

SCIENTIFIC AWARD SESSION 1-1

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:15-13:27 Room E(5F)

OP-Scientific 1-1

BCI action observation game superiorly facilitates the mirror neuron system in stroke patients

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Introduction

The action observation (AO) training based on mirror neuron theory is a promising strategy to promote motor cortical activation and motor function in stroke rehabilitation. However, because patients get bored easily during AO, its use has been limited and it could not sufficiently induce the recovery after stroke. The aim of this study was to investigate the effects of combined brain computer interface (BCI)-AO game on the facilitation of mirror neuron system in stroke patients.

Methods

We made a BCI-AO game that provides real-time BCI feedback. The degree of user's watching was provided by flickering action video game using Entity Relationship Diagram and Steady state visual evoked potential. Fifteen hemiplegic stroke patients were recruited in this study. All participants watched a video of repetitive grasping actions under two different conditions: 1) BCI -AO game and 2) conventional AO (without flickering and BCI feedback). The study was performed in following order: rest, training, BCI-AO game, and conventional AO, the last two in a random order. EEG was collected from 19 electrodes, using a DSI-24 (wearable sensing, San Diego, USA). Data were sampled at a rate of 128 Hz. To assess the activation of mirror neuron system, mu suppression in 8-13Hz was computed primarily at central sites (sensorimotor) C3 and C4 during each condition. Mu suppression indices were calculated as the log ratio of the power during action observation relative to the power during rest. Scalp distributions of suppression in the mu rhythm were conducted for each condition. Because the lesions of the brain showed inconsistencies among patients, suppression indices were also computed at additional sites across the scalp, separately for affected and unaffected hemispheres in each condition. Paired t-test was used to compare the mu suppression indices between BCI-AO game and the conventional AO condition, and between affected and unaffected hemisphere.

Results

The mean age of the participants was 67.87 ± 12.74 years and the mean time interval between stroke onset and the experiment was 20.86 days (Table 1). The overall mu suppression was stronger in the BCI-AO game than in the conventional AO. This effect was significant at C3, P3, P4, O1, and O2 (Figure 1). The magnitude of mu suppression at central sites was higher in the BCI-AO game compared to the conventional AO, and this difference was significant at the C3, but not at the C4. The magnitude of mu suppression was significantly higher in BCI-AO game compared with conventional AO at C3/C4, T3/T4, T5/T6, P3/P4, and O1/O2 in the affected hemisphere, and at C3/C4, T5/T6, P3/P4, and O1/O2 in the unaffected hemisphere (Figure 2).

Conclusion

These s support that the BCI-AO game has superiority in facilitating the activity of mirror neuron system compared with conventional AO. The BCI-AO game could be applicable and effective compared with conventional AO and it could promote the recovery after stroke.

Table 1. Demographic and baseline characteristics of subjects

Patient no.	Sex	Age	Days since onset	Etiology	Site of lesion	mRS	FMA upper	MMSE	MBI
1	M	48	42	Hemorrhage	Lt. thalamus (subcortical)	3	54	28	57
2	M	61	27	Infarction	Lt. med. medullary	2	63	29	76
3	F	74	75	Infarction	Lt. pontine	2	61	27	89
4	M	72	8	Infarction	Lt. MCA, PCA (cortical)	4	58	28	50
5	M	56	8	Infarction	Lt. thalamus (subcortical)	2	62	27	86
6	F	47	8	Infarction	Rt. Cerebellar	2	62	30	95
7	F	88	9	Hemorrhage	Rt. MCA (subcortical)	2	62	26	91
8	F	88	16	Infarction	Lt. pontine	4	59	25	8
9	M	69	26	Hemorrhage	Rt. MCA (subcortical)	4	28	30	53
10	M	82	30	Infarction	Rt. Cerebellar	2	61	28	78
11	M	61	24	Hemorrhage	Rt. MCA (subcortical)	3	64	25	54
12	M	78	14	Hemorrhage	Rt. MCA (cortical)	5	4	25	2
13	M	64	9	Hemorrhage	Rt. MCA (subcortical)	1	63	26	98
14	M	67	8	Infarction	Rt. lat medullary	4	64	30	57
15	F	63	9	Hemorrhage	Rt. Pontine	4	62	29	76

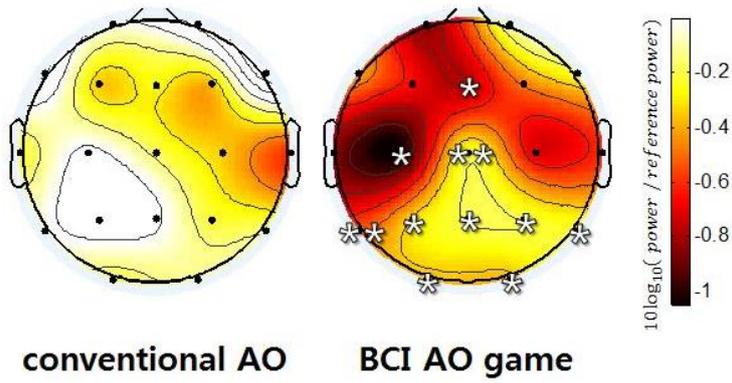


Fig1. Topographical representation of mu suppression in BCI-AO game and conventional AO conditions

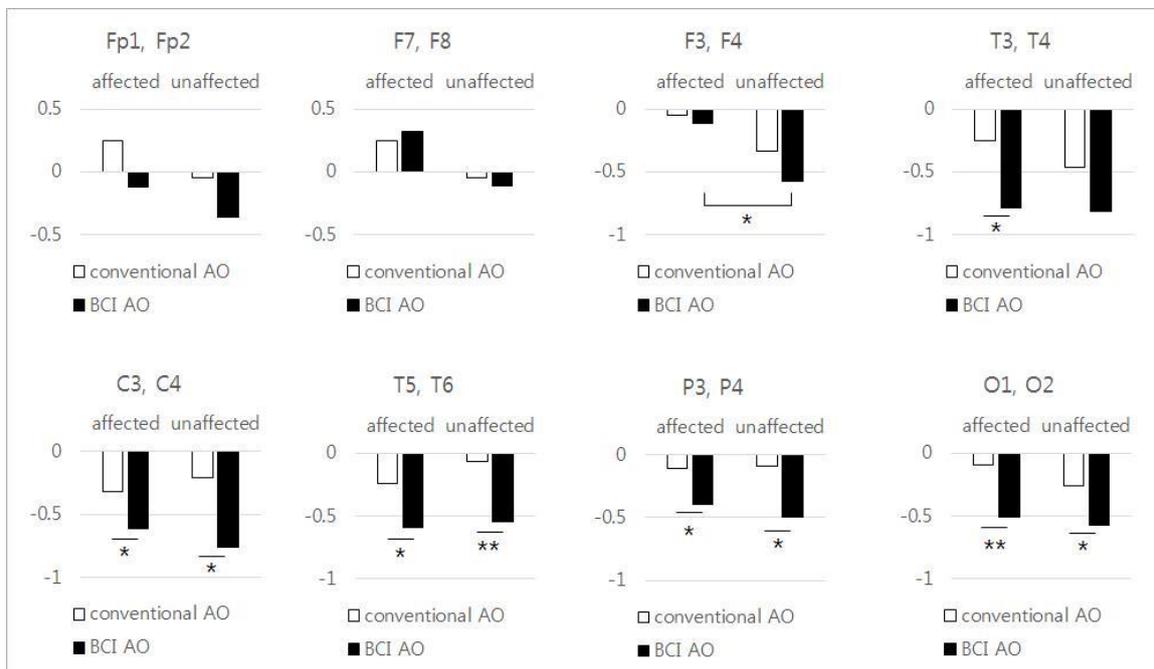


Fig2. Mu suppression expressed as log of the ratio of the power in BCI-AO game and conventional AO conditions, separately for affected and unaffected hemispheres

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:27-13:39 Room E(5F)

OP- Scientific 1-2

Which brain lesions produce spasticity?

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Objective

Spasticity is an important barrier that can hinder the restoration of function in stroke patients. Although several studies have attempted to elucidate the relationship between brain lesions and spasticity, the effects of specific brain lesions on the development of spasticity remain unclear. Thus, the present study investigated the effects of stroke lesions on spasticity in stroke patients.

Materials and Methods

The present retrospective longitudinal observational study assessed 45 stroke patients using the modified Ashworth Scale to measure muscle spasticity. Each patient was assessed four times: initially (within 2 weeks of stroke) and at 1, 3, and 6 months after the onset of stroke. Brain lesions were analyzed using voxel-based lesion symptom mapping (VLSM) with magnetic resonance imaging images.

Results

The present study analyzed 45 patients (mean age: 57.2 ± 12.6 years; 22 women and 23 men). Of these patients, 19 had left hemiplegia and 26 right hemiplegia, and the mean lesion volume was 60587.13 ± 72617.56 voxels. Spasticity scores significantly increased between the initial assessment and 3 months but did not differ between 3 and 6 months after onset ($p < 0.05$). The interaction between spasticity of the upper and lower limbs with time was not significant ($p = 0.373$). An overlay of the lesions of all subjects is presented in Figure 1. The VLSM method with NPM revealed that lesions of the superior corona radiata, internal capsule posterior limb, posterior corona radiata, thalamus, putamen, premotor cortex, and insula were associated with spasticity in the upper limbs (Fig. 2), whereas lesions of the superior corona radiata, internal capsule posterior limb, caudate nucleus, posterior corona radiate, thalamus, putamen, and external capsule were associated with spasticity in the lower limbs (Fig. 3).

Conclusion

The involvement of white matter tracts and the striatum influences the development of spasticity in the upper and lower limbs of patients with stroke. These Results may be

useful for planning rehabilitation strategies and understanding the pathophysiology of spasticity in stroke patients.

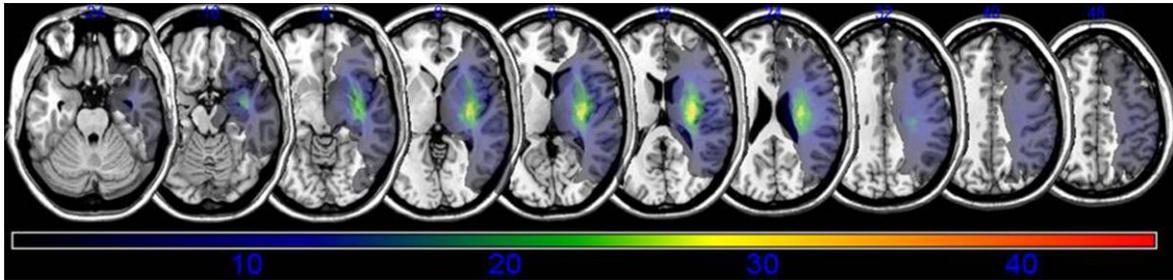


Figure 1. Overlay of lesions in all the subjects with stroke ($n = 45$). The color indicates the frequency of overlap.

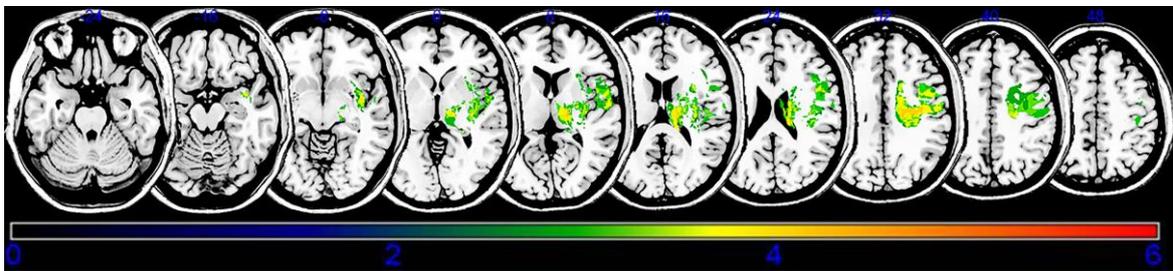


Figure 2. Statistical voxel-based lesion-symptom mapping for upper limb spasticity. The nonparametric Brunner–Munzel statistical analysis was used for the continuous severe poststroke upper limb spasticity. Color scale indicates Brunner–Munzel rank order z-statistics. Only voxels significant at $P < 0.05$ are shown. Colored bar represents the z statistics. The statistical map is displaying voxels with a minimum Z score of 2.4083. This matches the false discovery rate threshold. We set the maximum range of the Z score as 6, which be shown as being the maximum brightness.

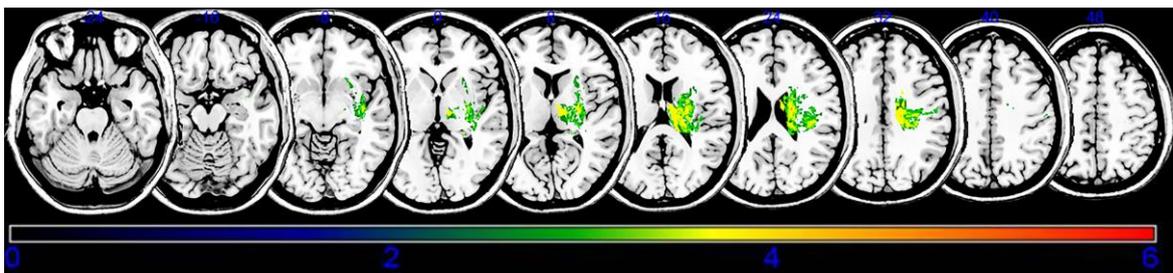


Figure 3. Statistical voxel-based lesion-symptom mapping for lower limb spasticity. The nonparametric Brunner–Munzel statistical analysis was used for the continuous severe poststroke lower limb spasticity. Color scale indicates Brunner–Munzel rank order z-statistics. Only voxels significant at $P < 0.05$ are shown. Colored bar represents the z statistics. The statistical map is displaying voxels with a minimum Z score of 2.5742. This matches the false discovery rate threshold. We set the maximum range of the Z score as 6, which be shown as being the maximum brightness.

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 13:39-13:51 Room E(5F)

OP- Scientific 1-3

Significance of regular follow-up before noninvasive ventilation in Duchenne muscular dystrophy

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Objective

Duchenne muscular dystrophy (DMD), an X-linked recessive and progressive muscular disorder, is the most common type of genetic muscular dystrophy. The development of mechanical ventilation and medical management of dilated cardiomyopathy have prolonged their lives. For determining the necessity of initiating noninvasive ventilation (NIV), various factors such as hypoventilatory symptoms, forced vital capacity (FVC), maximal inspiratory pressure (MIP), and end-tidal carbon dioxide (EtCO₂), are considered. We aim to reveal the clinical importance of regular follow-up before initiation of NIV by comparing patients with and without regular medical surveillance in DMD.

Materials and Methods

This retrospective research analyzed successful applications of NIV in the pulmonary rehabilitation center in a single tertiary university hospital from March 2000 to April 2018. The patients were categorized into three groups according to follow-up status before NIV initiation. Group 1 patients had been followed regularly in the outpatient clinic before the initiation of NIV. The patients in group 2 were lost during follow-up or were never followed before NIV. And in group 3 patients were transferred from another hospital or another department with inadequate ventilatory support. We analyzed various parameters such as partial pressure of CO₂ (PCO₂) in arterial blood gas analysis (ABGA) and nocturnal non-invasive continuous monitoring, ventilatory support time for each day after completion of NIV setting, and various respiratory function including FVC, maximum insufflation capacity (MIC), peak cough flow (PCF), assisted peak cough flow (APCF), MIP and maximal expiratory pressure (MEP).

Results

Total 239 cases of DMD patients with NIV were included in this study. The mean age of the patients was 19.7 ± 4.6 years (Table 1). The number of the patients in group 1, 2, and 3 are 119, 82, and 38 respectively. All parameters except for the duration of ventilator use, differed significantly. Age was lowest at group 1. Initial pCO₂ of ABGA was highest in

group 2. Nocturnal maximum CO₂ and mean CO₂ were highest in group 2 and lowest in group 3. This trend was due to the inclusion of some patients undergoing NIV in group 3. All respiratory functions were highest in group 1 and lowest in group 3. Although age did not differ between group 1 and 3, respiratory function decreased remarkably in group 3 compared with group 1 and group 2, indicating that appropriate NIV setting exert a positive effect on preservation of respiratory function.

Conclusion

Regular follow-up before the onset of ventilatory failure is crucial for timely application of NIV. Because NIV itself does not guarantee correction of abnormal ventilation, accurate correction of hypoventilation should be confirmed using monitoring system. Appropriate NIV exert preventive effect on the deterioration of respiratory function.

Table 1. Demographic characteristics of the patients

	Total (N = 239)
Age	19.7 ± 4.6
ABGA pH	7.395 ± 0.046
ABGA PCO ₂ (mmHg)	44.6 ± 12.6
Initial maximum CO ₂ *	52.5 ± 8.5
Initial mean CO ₂ *	45.4 ± 7.5
Final maximum CO ₂ *†	39.9 ± 5.7
Final mean CO ₂ *†	33.0 ± 5.3
FVCsit (%)‡	22.6 ± 16.2
FVCsup (%)‡	21.4 ± 15.2
MIC (mL)	1391 ± 579
PCF (L/min)	132 ± 80
APCF (L/min)	260 ± 91
MIPsit (%)‡	22.3 ± 15.9
MIPsup (%)‡	22.0 ± 14.9
MEPsit (%)‡	14.9 ± 9.3
MEPsup (%)‡	14.8 ± 9.1

ABGA: arterial blood gas analysis, PCO₂: partial pressure of carbon dioxide, FVC: forced vital capacity, MIC: maximum insufflation capacity, PCF: peak cough flow, APCF: assisted peak cough flow, MIP: maximal inspiratory pressure, MEP: maximal expiratory pressure, sit: at sitting position, sup: at supine position

* In the nocturnal noninvasive and continuous CO₂ monitoring

† After completion of noninvasive ventilator setting

‡ These values calculated to percentage of normal predictive values.

Table 2. Comparison of pulmonary function among the groups

	Group 1	Group 2	Group 3	Group 1 vs 2	Group 2 vs 3	Group 1 vs 3	Among groups
Age (years)	18.2 ± 3.8	21.7 ± 5.1	19.9 ± 5.1	<0.001	0.206	0.066	<0.001
ABGA pH	7.401 ± 0.341	7.370 ± 0.054	7.423 ± 0.054	0.078	0.048	0.719	0.004
ABGA PCO ₂ (mmHg)	41.6 ± 10.3	49.5 ± 13.9	43.4 ± 13.5	<0.001	0.089	>0.999	<0.001
Initial maximum CO ₂ (mmHg)*	51.3 ± 6.2	55.7 ± 9.9	49.6 ± 9.7	0.002	0.007	0.978	<0.001
Initial mean CO ₂ (mmHg)*	44.8 ± 4.7	48.9 ± 9.3	40.6 ± 10.7	0.040	0.016	0.406	<0.001
Ventilator time (hours/day)	8.8 ± 2.4	9.8 ± 3.7	9.2 ± 4.4	0.137	>0.999	>0.999	0.138
FVCsit (%) [†]	27.8 ± 17.7	17.8 ± 11.7	16.0 ± 14.1	<0.001	>0.999	0.002	<0.001
FVCsup (%) [†]	26.5 ± 16.8	16.9 ± 11.6	14.7 ± 10.5	<0.001	>0.999	<0.001	<0.001
MIC (mL)	1565 ± 598	1280 ± 511	1050 ± 448	0.004	0.088	<0.001	<0.001
PCF (L/min)	161 ± 73	110 ± 78	83 ± 73	<0.001	0.291	<0.001	<0.001
APCF (L/min)	283 ± 86	237 ± 84	227 ± 105	0.003	>0.999	0.012	0.001
MIPsit (%) [†]	28.6 ± 17.7	16.7 ± 10.9	13.1 ± 8.1	<0.001	0.339	<0.001	<0.001
MIPsup (%) [†]	28.2 ± 16.0	16.6 ± 11.1	13.2 ± 7.8	<0.001	0.394	<0.001	<0.001
MEPsit (%) [†]	18.0 ± 9.5	12.0 ± 8.3	10.8 ± 7.0	<0.001	>0.999	<0.001	<0.001
MEPsup (%) [†]	17.6 ± 8.9	12.6 ± 9.4	10.5 ± 6.4	0.002	0.765	<0.001	<0.001

ABGA: arterial blood gas analysis, PCO₂: partial pressure of carbon dioxide, FVC: forced vital capacity, MIC: maximum insufflation capacity, PCF: peak cough flow, APCF: assisted peak cough flow, MIP: maximal inspiratory pressure, MEP: maximal expiratory pressure, sit: at sitting position, sup: at supine position

* In the nocturnal noninvasive and continuous CO₂ monitoring

[†] These values calculated to percentage of normal predictive values.

신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 26 일(금) 13:51-14:03 Room E(5F)

OP- Scientific 1-4

Usefulness of comprehensive next-generation sequencing panel for neuromuscular diseases in Korean

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Purpose

Neuromuscular disorder (NMD) is a very broad term that encompasses many diseases that affect the neuromuscular system. The genetic and clinical heterogeneity, unspecific clinical features, unidentified genes and the implication of large genes give challenges in routine molecular diagnosis, increasing turnaround time and effort to make molecular validation of the diagnosis. Recently, the targeted multi-gene panel sequencing (GPS) has been emerging as a molecular diagnostic tool, which is a part of next generation sequencing (NGS) technique. The multi-GPS generally ensures that all coding exons of the gene of interest are targeted, and all exons exhibit sufficiently high coverage, which is the most appropriate in diagnosing diseases like NMDs that are genetically heterogeneous but similar in clinical aspect. There have been several multi-GPS studies of a specific NMD such like congenital myopathy, muscular dystrophy, motor neuron disease and polyneuropathy. However, few researches on the comprehensive NMDs gene panel have been conducted. Therefore, the purpose of the present study was to assess the usefulness of a comprehensive NMDs gene panel.

Methods

We designed two comprehensive NGS panels targeting 293 genes (version 1) and 410 genes (version 2) associated with NMDs. All patients were analyzed by a NGS panel (Version 1 was used from June 2016 to September 2017, and version 2 was used from October 2017 to May 2018), chromosomal microarray and karyotyping tests.

Results

Total 91 patients were enrolled and a genetic diagnosis was possible in 36 of 91 patients (39.5%). Thirty-four patients were diagnosed through the comprehensive NMDs gene panel, and two were confirmed by chromosome microarray test (Fig. 1). Approximately 38.5% (35/91) of the subjects using this panel version 1 and 2 were tested for myopathy as the initial impression, and 18 of 35 patients were diagnosed as myopathy and the

diagnosis rate was as high as 50%. Neuropathy was suspected in 15 patients, of which 7 (46.7%) were diagnosed. In the case of ataxia, four of 12 patients (33.3%) were diagnosed. Spastic paraplegia was suspected in 20 patients, and 5 of them (25.0%) were diagnosed. A diagnostic yield of version 2 was higher than version 1 (14/39; 35.9% vs 20/52; 38.5%, Fig. 2). Total 37 definitive causative and 10 possible causative variants were identified, of which 17 were novel (Table 1).

Conclusions

Comprehensive NMDs gene panel can improve the genetic diagnosis efficiency. Due to the rapid discovery of disease causing genes, an update of gene panel is required.

Table 1. Summary of 34 patients diagnosed with causative/possible causative variants using NGS panel.

Patient ID	Sex	Current age, y	Onset age, y	Gene	Panel	Variant	ACMG score	Final diagnosis	Causative/Possible causative	References
26	F	33	NB	<i>MYH7</i>	1	NM_000257.3: c.1498_1500del (p.Glu500del)	Likely pathogenic	Laing Distal Myopathy	Possible causative	This study
27	M	58	25	<i>REEP1</i>	1	NM_022912.2: c.603delC (p.*202Argfs*21)	VUS	SPG31/HMN5B	Possible causative	This study
28	M	53	31	<i>SPG4</i>	1	NM_014946.3: c.1307C>T (p.Ser436Phe)	pathogenic	Spastic paraplegia 4	Causative	Neurology. 2000;55:1388-90
29	F	10	NB	<i>RYR1</i>	1	NM_000540.2: c.4496_4497delTT (p.Phe1499Cysfs*47) NM_000540.2: c.9716T>A (p.Met3239Lys)	Pathogenic Likely pathogenic	Minicore myopathy with external ophthalmoplegia	Causative Causative	This study This study
30	M	1.3	NB	<i>LMNA</i>	1	NM_005572.3: c.745C>T (p.Arg249Trp)	Pathogenic	LMNA related congenital muscular dystrophy	Causative	Ann Neurol. 2008;64:177-86 This study
31	M	24	17	<i>CACNA1A</i>	1	NM_000068.3: c.3855C>G (p.Tyr1285*)	Pathogenic	Episodic ataxia type 2	Causative	Eur J Neurol. 2017 Jul;24(7):e43-e44 J Lipid Res. 1994;35:1031-9
32	M	42	42	<i>CYP27A1</i>	1	NM_000784.3: c.1420C>T (p.Arg474Trp)	Pathogenic	Cerebrotendinous xanthomatosis	Causative	This study
33	F	46	20	<i>LMNA</i>	1	NM_170707.3: c.1412G>C (p.Arg471Pro)	VUS	LMNA related limb girdle muscular dystrophy	Possible causative	This study
34	M	32	20	<i>GNE</i>	1	NM_001128227.2: c.131G>C (p.Cys44Ser) NM_001128227.2: c.258-8G>A	Pathogenic VUS	GNE myopathy	Causative Possible causative	Hum Mutat. 2014;35:915-26 This study
35	M	53	40	<i>GJB1</i>	1	NM_000166.5: c.590C>T (p.Ala197Val)	Pathogenic	Charcot-Marie-Tooth Neuropathy X Type 1	Causative	Clin Genet 2012;81:142-9
36	M	55	20	<i>EMD</i>	1	NM_000117.2: c.101dupA (p.Tyr34*)	Pathogenic	Emery-Dreifuss muscular dystrophy 1	Causative	Neuromuscul Disord 1999;9:159-65
37	F	10	NB	<i>CACNA1A</i>	1	NM_001127221.1: c.4991G>A (p.Arg1664Gln)	Pathogenic	non-progressive congenital cerebellar ataxia	Causative	J Neurol Sci. 2006;241(1-2):13-7
38	F	23	15	<i>CACNA1A</i>	1	NM_001127221.1: c.5035C>T (p.Arg1679Cys)	Pathogenic	Episodic ataxia, type 2	Causative	J Neurol Sci 2010;291(1-2):30-6
39	F	45	25	<i>CAPN3</i>	1	NM_000070.2: c.1118G>A (p.Trp373*) NM_000070.2: c.1795dupA (p.Thr599Asnfs*33)	Pathogenic Pathogenic	Muscular dystrophy, limb-girdle, type 2A	Causative Causative	This study Muscle Nerve 1998;21:1493-501
72	M	35	35	<i>DYSF</i>	2	NM_003494.3: c.1284+2T>C NM_003494.3: c.5303G>A (p.Arg1768Gln)	Pathogenic likely Pathogenic	Muscular dystrophy, limb-girdle, type 2B	Causative Causative	J Neurol Sci 2003;211(1-2):23-8 This study
73	F	7	2	<i>SACS</i>	2	NM_014363.5: c.12973C>T (p.Arg4325*) NM_014363.5: c.11101T>C (p.Trp3701Arg)	Likely pathogenic VUS	Autosomal recessive spastic ataxia of Charlevoix-Saguenay	Causative Possible causative	J Neurol 2006;253:1372-3 This study
74	M	50	4	<i>MFN2</i>	2	NM_014874.3: c.1090C>T (p.Arg364Trp)	Pathogenic	Charcot-Marie-Tooth disease, axonal, type 2A	Causative	Neurology 2011;76:1690-6
75	M	14	8	<i>BSCL2</i>	2	NM_032667.6: c.269C>T (p.Ser90Leu)	Pathogenic	HMNSA (Neuropathy, distal hereditary motor, type VA), SPG17 (spastic paraplegia-17)	Causative	Muscle Nerve 2007;36:384-6
76	F	8	NB	<i>INF2</i>	2	NM_022489.3: c.311G>A (p.Cys104Tyr)	Likely pathogenic	Charcot-Marie-Tooth disease, dominant intermediate E	Causative	NEJM 2011;365:2377-88
77	M	9	NB	<i>SPG4</i>	2	NM_014946.3: c.1253_1255del(p.Glu418del)	Pathogenic	Spastic paraplegia 4	Causative	J Neurol 2013;260: 906-909
78	F	17	NB	<i>PMP22</i>	2	NM_000304.3: c.281delG (p.Gly94Alafs*17)	Pathogenic	Charcot-Marie-Tooth disease type 1E	Causative	Muscle Nerve 1997;20:1308-10
79	F	37	7	<i>GNE</i>	2	NM_005476.5: c.2135T>C (p.Met1712Thr)	Pathogenic	GNE myopathy	Causative	Nat Genet 2001;29:83-7
80	M	23	20	<i>ANO</i>	2	NM_213599.2: c.1158delT (p.Phe386Leufs*41) NM_213599.2: c.1640G>A (p.Arg547Gln)	Pathogenic VUS	Miyoshi muscular dystrophy 3 or Muscular dystrophy, limb-girdle, type 2L	Causative Possible causative	This study Neuromuscul Disord 2013;23:456-60
81	F	10	7	<i>TTN</i>	2	NM_133378.4: c.26231-1G>C NM_133378.4: c.85108dup (p.Arg28370Lysfs*15)	Pathogenic Pathogenic	Muscular dystrophy, limb-girdle, type 2J	Causative Causative	This study This study
82	M	33	7	<i>DMD</i>	2	NM_004006.2: c.1652G>A (p.Trp551*)	Pathogenic	Duchenne muscular dystrophy	Causative	This study
83	M	58	40	<i>DES</i>	2	NM_001927.3: c.1255C>T (p.Pro419Ser)	Pathogenic	Myofibrillar myopathy	Causative	Neuromuscul Disord. 2007;17:443-50
84	M	31	20	<i>SPG11</i>	2	NM_025137.3: c.3291+1G>T NM_025137.3: c.5410_5411del (p.Cys1804Profs*25)	Pathogenic Pathogenic	Spastic paraplegia 11	Causative Causative	J Neurol 2009;256:1714-8 J Neurol 2009;256:1714-8
85	M	22	20	<i>DES</i>	2	NM_001927.3: c.1043A>C (p.Gln348Pro)	Pathogenic	Myofibrillar myopathy	Causative	PLoS One 2014;9:e115470
86	F	1.8	NB	<i>ALDH3A</i>	2	NM_000382.2: c.1291_1292del (p.Lys431Glufs*5) NM_000382.2: c.1309A>T (p.Lys437*)	Pathogenic Pathogenic	Sjogren-Larsson syndrom	Causative Causative	Am J Hum Genet 1999;65:1547-60 J Child Neurol. 2013 Oct;28(10):1259-65
87	F	55	25	<i>DYSF</i>	2	NM_003494.3: c.779C>G (p.Pro260Arg) NM_003494.3: c.2997G>T (p.Trp999Cys)	Likely pathogenic Pathogenic	Muscular dystrophy, limb-girdle, type 2B	Causative Causative	This study Proc Jpn Acad 1999;75B:207-212
88	M	3	2	<i>DMD</i>	2	NM_004006.2: c.9563+1G>A	Pathogenic	Duchenne muscular dystrophy	Causative	This study
89	F	17	NB	<i>ACTA1</i>	2	NM_001100.3: c.739G>C (p.Gly247Arg)	Likely pathogenic	ACTA1 gene related myopathy	Causative	This study
90	M	27	10	<i>LAMA2</i>	2	NM_000426.3: c.4640C>T (p.Thr1547Met) NM_000426.3: c.7928_7929del (p.Arg2643Lysfs*9)	VUS Likely pathogenic	LAMA2-Related Muscular Dystrophy	Possible causative Possible causative	Sci Rep 2016;6:29088 This study
91	M	44	41	<i>GJB1</i>	2	NM_000166.5: c.394T>C (p.Trp132Arg)	Pathogenic	Charcot-Marie-Tooth Neuropathy X Type 1	Causative	Clin Genet 2012: 81:142-149

NB, new born; VUS, variant of uncertain significance

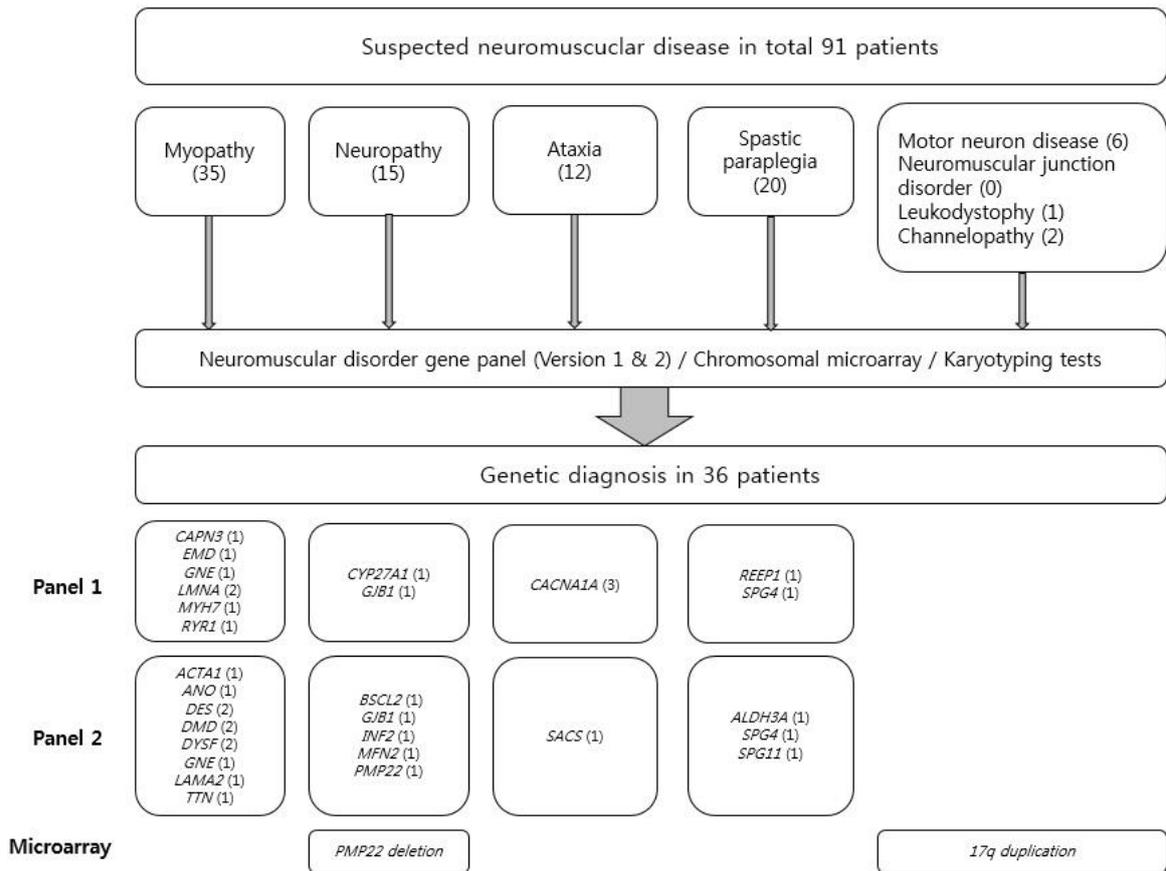


Figure 1. Flow chart of patients enrolled in this study

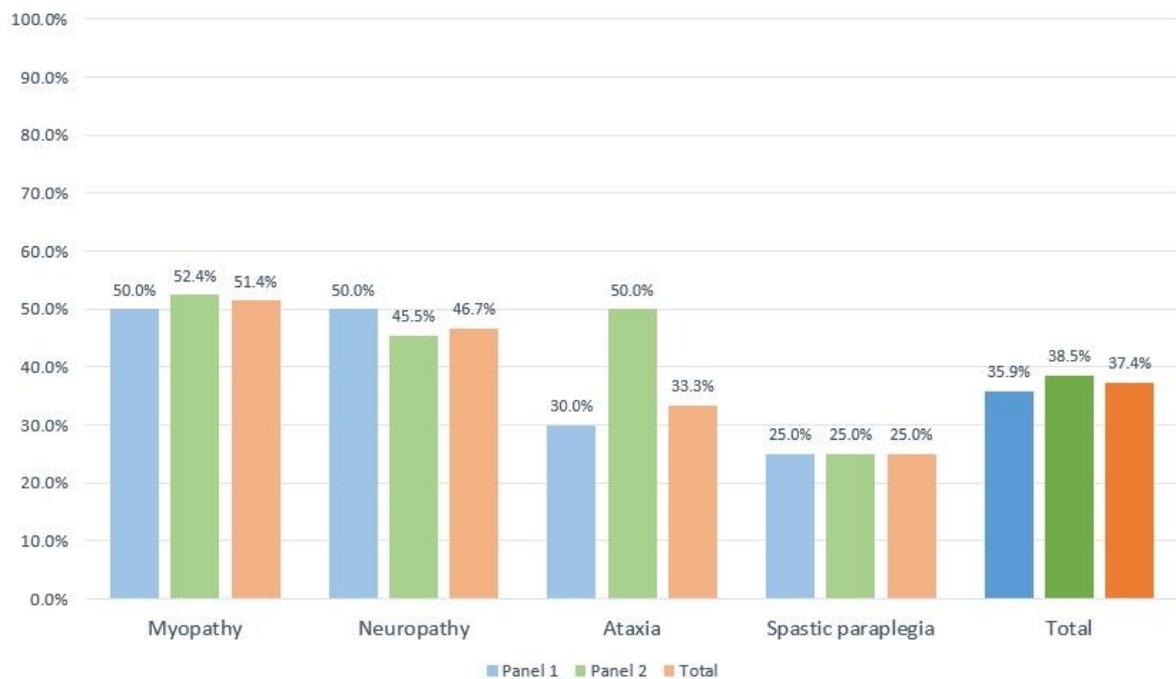


Figure 2. Diagnostic rate for each disease category using NGS panel version 1 and 2.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 14:03-14:15 Room E(5F)

OP- Scientific 1-5

Down-Regulation of Long-Term Potentiation-Related Proteins in Mouse Brain After Mild Brain Injury

Byung-Mo Oh^{1*†}, Han Gil Seo¹, Seung Hak Lee¹, Eun Young Heo¹, Junho Park², Youngsoo Kim²

Seoul National University Hospital, Department of Rehabilitation Medicine¹, Seoul National University College of Medicine, Department of Biomedical Engineering²

Background and Purpose

Over sixty million people worldwide are estimated to sustain a traumatic brain injury (TBI) each year. Mild TBI (mTBI) accounts for over 80% of all individuals with TBI. In spite of the generally good prognosis, symptoms following mTBI can persist for more than a year, including an inability to concentrate, memory deficits, reduced problem-solving capacity, and impaired balance. There are no well-validated diagnostic tools to predict which patients are likely to experience sustaining problems, which is called post-concussion syndrome (PCS). Furthermore, TBI increases a risk for degenerative neurological diseases in the later life. However, the mechanisms contributing to the development of PCS or neurodegeneration after TBI still remain to be elucidated. The present study aimed to investigate the TBI-induced molecular dysfunctions in the mouse brain using the proteomics approach.

Materials and Methods

In this study, quantitative proteomic approach, a high-resolution Q-exactive mass spectrometer, was employed to measure proteome changes of mouse brain tissue after mTBI. A total of six 2-month-old male C57BL6 mice were randomly assigned to either the control (n=3) or the weight-drop mTBI group (n=3). The mouse in mTBI group was mounted on a thin foil and was impacted on the mid-point between the bregma and lambda by a single metallic weight. The whole brain tissues were harvested 72 hours after the injury and were pooled for the subsequent proteomic analysis.

Results

A total of 3 047 proteins were identified in >90% of the samples, of which, 432 proteins were significantly changed (differentially expressed proteins, DEPs) between control and mTBI groups. When the cut-off value 1.5 for the fold change was applied, 250 proteins were yielded (65 up- and 185 down-regulated proteins, Figure 1). Functional bioinformatics analysis and protein to protein interaction (PPI) network mapping showed biological processes such as the oxidative reduction, protein translation and RNA processing, protein transport, and glial cell differentiation were over-represented.

Ingenuity pathway analysis (IPA) revealed that the most affected biological function by the DEPs was the long-term potentiation (Figure 2).

Conclusion

These Results demonstrated that mTBI evokes distinct proteome changes after the injury, and the long-term potentiation become a most vulnerable biological function to the following pathophysiologic cascade.

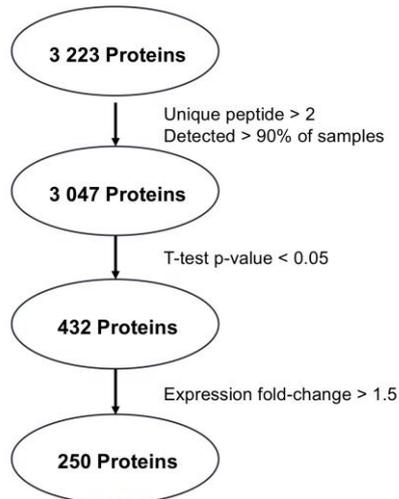


Fig 1. Included, detected, and differentially-expressed proteins

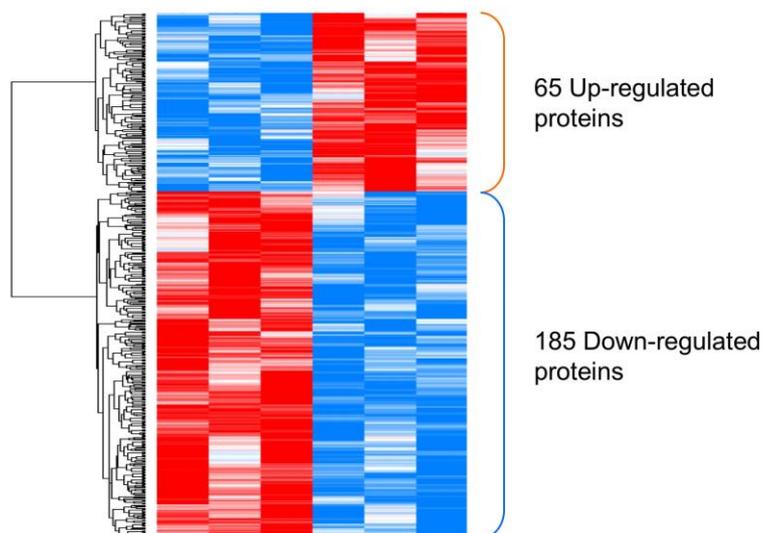


Fig 2. A cluster analysis for the differentially expressed proteins with the fold change >1.5

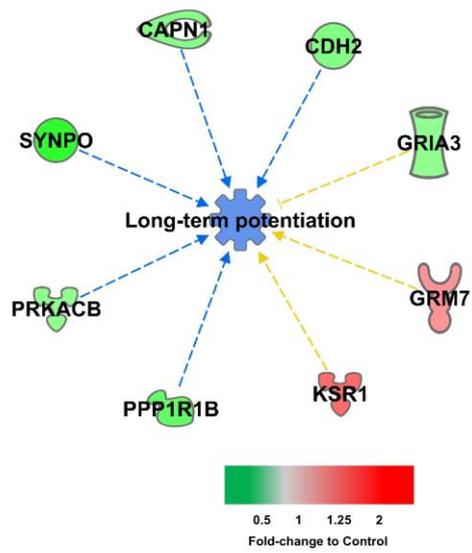


Fig 3. Protein network analysis using Ingenuity Pathway Analysis. Long-term potentiation was shown to be the most affected function by the proteome changes after mTBI.

SCIENTIFIC AWARD SESSION 2-1

소아재활

발표일시 및 장소 : 10 월 26 일(금) 14:15-14:27 Room E(5F)

OP- Scientific 2-1

The Mechanism of Hip Dislocation in Patients with Spastic Cerebral Palsy

Sangyoung Kim¹, Dajeong Lee¹, Jin Young Ko², Yulhyun Park², Yong Hoon Yoon³, Jee Hyun Suh⁴, Min Young Lee², Ju Seok Ryu^{1,2**+}

Seoul National University College of Medicine, Department of Medicine¹, Seoul National University Bundang Hospital, Department of Rehabilitation Medicine², SRC Rehabilitation Hospital, Department of Rehabilitation Medicine³, Bobath children`s clinic, Department of Rehabilitation Medicine⁴

Introduction

The purpose of this study was to identify the changes of forces in the hip adductor between with or without the abduction bar (AB) and evaluate the effect of pelvic supporter compressing the proximal femur on the spasticity of the adduction muscles.

Methods

Prospective experimental study. Thirty-three patients with cerebral palsy (FMFCS IV and V) were included. Surface electromyography (S-EMG) were taken by attaching EMG on the bilateral adductor longus, adductor magnus, Gluteus medius, and tensor faciae latae muscles. Clinical photography and S-EMG were taken when spasticity developed with and without AB, as well as with both AB and pelvic supporter by theraband. Neck Shaft Angle and Migration Index were also obtained.

Results

The angle between bilateral femur was changed from 9.4 ± 4.5 to -2.73 ± 5.1 after applying AB (P-value < 0.001). RMS values were significantly increased with AB in the adductor longus, adductor magnus, and tensor fascia lata muscles ($p < 0.05$). Adductor Sum and Net Adduction Index showed significant increases after the use of AB ($p < 0.05$). After applying pelvic supporter, the NET Adduction Index was significantly decreased ($p < 0.05$).

Conclusion

Our Results showed significant changes in the adductor muscles' amplitude, Adduction Sum, and Net Adduction Index. These Results indicate that force may be inflicted to worsen hip dislocation. Therefore, abduction bars should either be removed or replaced by softer material. Hip compression bandages significantly decreased adductor spasticity. Hence, it has the potential to be considered as a non-invasive method for preventing hip dislocations.

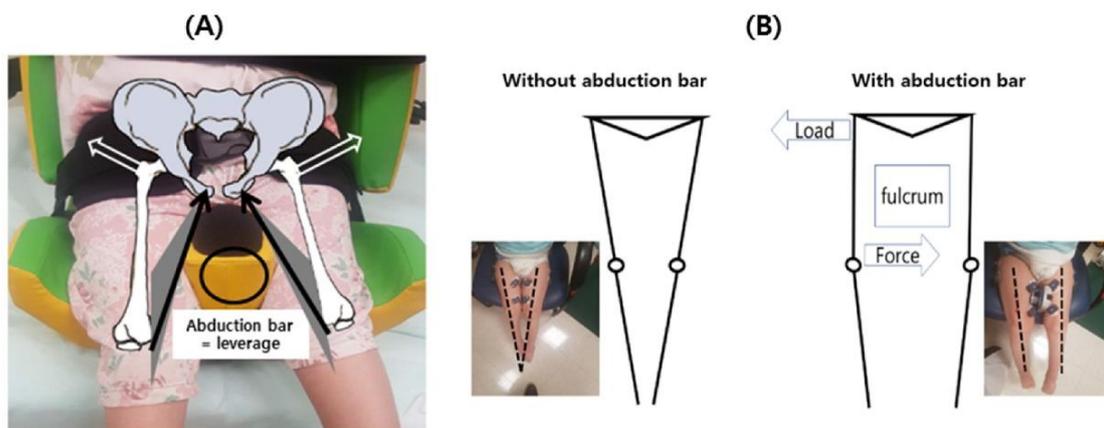
	Without abduction bar(μV)*	With abduction bar(μV)	With abduction bar and theraband (μV)
Adductor Longus m.	22.2 \pm 20.78	32.5 \pm 21.0**	29.6 \pm 22.2
Adductor Magnus m.	17.4 \pm 18.0	22.3 \pm 26.3**	19.2 \pm 16.1
Tensor Fascia Lata m.	18.9 \pm 27.4	22.1 \pm 18.8**	26.7 \pm 31.2
Gluteus Medius m.	13.4 \pm 13.9	13.8 \pm 18.2	13.9 \pm 21.5
Adductor Sum	75.7 \pm 53.8	112.6 \pm 68.2**	95.5 \pm 57.6
Abductor Sum	64.6 \pm 68.6	90.8 \pm 64.6	90.8 \pm 64.6
Net Adduction Index	291.9 \pm 488.9	414.2 \pm 548.8*	202.3 \pm 287.0#

Values are presented as mean \pm SD.

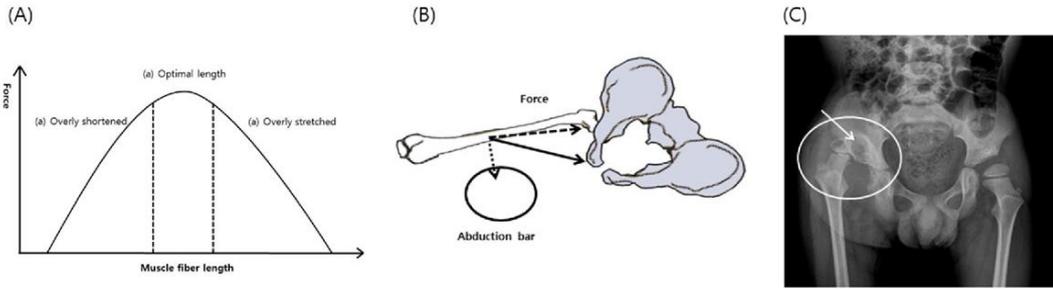
Comparison between without abduction bar and with abduction bar, * $p < 0.05$, ** < 0.01

Comparison between with abduction bar and with abduction bar and theraband, # $p < 0.05$

This table shows the Results of S-EMG at three positions when spasticity developed: (1) without either AB or bilateral hip compression bandage, (2) with AB only, and (3) with both AB and bilateral hip compression bandage. When comparing between with and without the use of AB, RMS values in the adductor longus, adductor magnus, and tensor fascia lata muscles were significantly increased in the former ($p < 0.05$). Although the abductor sum was not statistically significant, the adductor sum showed a significant increase after the use of AB ($p < 0.05$). The calculated net adduction index showed a significant increase after the use of AB ($p < 0.05$).



These figures show the leverage fulcrum as a mechanism of aggravated hip dislocation in the presence of abduction bar (first class lever, (A)). In the presence of spasticity, tone of adductor muscles becomes greater than the tone of abductor muscles and, thus, scissoring occurs ((B), Left figure). After the use of abduction bar, decrease of angle between femur shafts indicates that an abduction bar helps resist the force inflicted inward on the thighs, implying its function as a leverage fulcrum during spasticity ((B), Right figure).



This figure (A) shows the length-tension relationship of muscles. At the optimal length, the muscular tone is greater than shortened or lengthened muscles. Abduction bar prevents shortening of hip adductor muscles and preserves the adductor muscle at optimal length. Figure (B) shows the vectors of adductor muscles. The vector of hip adductor muscles can be divided into two vertical planes – medial vector and upward vector. In the presence of abduction bar, the upward direction, which destructs the superior (supine position) or postero-superior acetabulum (sitting position), is increased by the length-tension relationship, thereby, resulting in aggravated acetabular destruction and hip dislocation. The white arrow (C) indicates the destructed acetabulum.

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 14:27-14:39 Room E(5F)

OP- Scientific 2-2

The Effect of Early Outpatient Rehabilitation Program Among Heart and Lung Transplant Recipients

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Daegu Catholic University Medical Center, Department of Rehabilitation Medicine¹, National Taiwan University Hospital and National Taiwan University College of Medicine, Department of Physical Medicine and Rehabilitation², Fu Jen Catholic University Hospital and Fu Jen Catholic University School of Medicine, Department of Physical Medicine and Rehabilitation³, National Taiwan University Hospital and National Taiwan University College of Medicine, Department of Surgery⁴, Fu Jen Catholic University Hospital and Fu Jen Catholic University School of Medicine, Department of Surgery⁵

Objective

The purpose of this study is to investigate the effect of an early postoperative outpatient rehabilitation program to physical capacity and health-related quality of life among patients with bilateral sequential lung transplantation (BLTx) or orthotopic heart transplantation (OHT).

Method

The study included 19 clinically stable BLTx patients (age: 41.5 ± 13.3 years; 8 men, 11 women) and 29 OHT patients (age: 42.4 ± 12.1 years; 19 men, 10 women). The patients started outpatient rehabilitation at 78 ± 47 days after transplantation and participated in a 3-6 months supervised exercise training program. The physical capacity of study subjects was evaluated by the cardiopulmonary exercise testing (CPET) and health-related quality of life by the Medical Outcomes Trust 36-item health survey (SF-36) at baseline and upon the completion of rehabilitation.

Results

After outpatient rehabilitation, the BLTx patients exhibited a significant increase of peak oxygen uptake (16.9 ± 3.4 to 19.6 ± 4.9 mL/kg/min, $p=.002$) as well as OHT patients (15.4 ± 3.4 to 20.4 ± 3.7 mL/kg/min, $p<.001$). Both groups showed improvement of physical component in health-related quality of life. The OHT group showed a significant improvement of SF-36 scores in physical functioning (64.7 ± 22.4 to 80.2 ± 13.8), bodily pain (62.2 ± 24.3 to 76.1 ± 23.0), vitality (56.2 ± 22.6 to 67.2 ± 17.7), social functioning (65.1 ± 25.1 to 76.7 ± 16.9), mental health (66.5 ± 17.6 to 72.6 ± 16.1), and PCS (38.8 ± 10.8 to 44.3 ± 10.5). The BLTx group showed a significant improvement of SF-36 scores in

physical functioning (72.6 ± 16.4 to 85.8 ± 17.9), physical role (42.1 ± 44.1 to 86.8 ± 32.7), general health (62.5 ± 18.1 to 69.9 ± 17.1), vitality (63.9 ± 21.4 to 74.7 ± 15.1), social functioning (69.1 ± 27.4 to 86.8 ± 15.9), emotional role (66.7 ± 44.4 to 91.2 ± 24.4), mental health (69.3 ± 20.8 to 77.7 ± 12.4), and PCS (42.5 ± 10.1 to 51.7 ± 8.1).

Conclusions

Early postoperative exercise training significantly improved physical capacity and health-related quality of life among BLTx and OHT patients. Early postoperative outpatient rehabilitation program should be recommended to heart and lung transplantation recipients.

Table 1. Baseline Demographic and Clinical Characteristics

	BLTx (n=19)	OHT (n=29)
Age (y)	41.5 ± 13.3	42.4 ± 12.1
Gender (M/F)	8/11	19/10
Body height (cm)	160.0 ± 6.9	164.8 ± 7.9
Body weight (kg)	49.2 ± 8.1	58.0 ± 9.7
BMI	19.2 ± 3.1	21.3 ± 3.0
Resting heart rate (bpm)	97.7 ± 15.1	101.8 ± 11.9
Resting BP (mm Hg)	124.1 ± 13.8	124.8 ± 16.9
Time from surgery (days)	77.4 ± 12.1	68.2 ± 33.2

Data are listed as median(lower quartile-upper quartile). BP, blood pressure; BLTx, bilateral sequential lung transplantation; OHT, orthotopic heart transplantation

Table 2. Functional Capacity and Quality of Life Before and After Training

Variables	OHT (n=29)			BLTx (n=19)		
	Pretraining	Posttraining	P Value	Pretraining	Posttraining	P Value
VO _{2peak} (mL · kg ⁻¹ · min ⁻¹)	15.4 ± 3.4	20.4 ± 3.7	<.001*	16.9 ± 3.4	19.6 ± 4.9	0.002*
Short Form 36						
Physical functioning	64.7 ± 22.4	80.2 ± 13.8	<.001*	72.6 ± 16.4	85.8 ± 17.9	0.004*
Role-physical	33.6 ± 44.4	43.1 ± 40.6	0.362	42.1 ± 44.1	86.8 ± 32.7	<0.001*
Bodily pain	62.2 ± 24.3	76.1 ± 23.0	0.006*	75.7 ± 21.0	81.2 ± 21.1	0.165
General health	63.0 ± 17.2	66.1 ± 19.7	0.115	62.5 ± 18.1	69.9 ± 17.1	0.012*
Vitality	56.2 ± 22.6	67.2 ± 17.7	0.017*	63.9 ± 21.4	74.7 ± 15.1	0.003*
Social functioning	65.1 ± 25.1	76.7 ± 16.9	0.005*	69.1 ± 27.4	86.8 ± 15.9	0.003*
Role-emotional	70.1 ± 42.1	70.1 ± 39.2	0.982	66.7 ± 44.4	91.2 ± 24.4	0.031*
Mental health	66.5 ± 17.6	72.6 ± 16.1	0.035*	69.3 ± 20.8	77.7 ± 12.4	0.035*
PCS	38.8 ± 10.8	44.3 ± 10.5	0.003*	42.5 ± 10.1	51.7 ± 8.1	<0.001*
MCS	47.9 ± 10.8	49.6 ± 9.1	0.505	47.8 ± 13.2	53.5 ± 7.1	0.113

Data are listed as mean ± standard deviation. BLTx, bilateral sequential lung transplantation; OHT, orthotopic heart transplantation; VO_{2peak}, peak oxygen uptake; PCS, standardized physical component scale; MCS, standardized mental component scale.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:39-14:51 Room E(5F)

OP- Scientific 2-3

Eletromyographic analysis of paraspinal muscles in adolescents with idiopathic scoliosis

Yul Hyun Park^{1*}, Ju Seok Ryu^{1†}, Yae Lim Lee¹

Seoul National University Bundang Hospital, Department of Rehabilitation Medicine¹

Background and aim(s)

Many studies have been done to reveal the etiology of adolescent idiopathic scoliosis(AIS), but its pathogenesis is still poorly understood. As it possible to measure activity of paraspinal muscles using surface electromyography(S-EMG), several studies found out that the S-EMG activity increased on the convex side of the scoliotic curve and suggested paraspinal muscle asymmetry as a cause of IS. Therefore, we assumed that curve patterns of scoliosis is relate with concave side muscle weakness. The first purpose of this study was to find out the association between paraspinal muscle imbalance and scoliosis curve type. The second, based on the Results of the S-EMG mentioned above, we tried to develop an exercise protocol for IS using asymmetric spinal stabilization exercise, depending on the type of spinal curvature and paraspinal muscles asymmetry.

Method

The study design was prospective clinical trials. S-EMG was used to evaluate the muscular activation at bilateral erector spinae (ES) on three vertebral levels(7th, 12th thoracic, 3rd lumbar). The curve type was measured in simple radiograph. Curve types were defined on the basis of the Scoliosis Research Society Classification Definitions.

Result(s)

Between February 2017 to June 2018, 29 patients included in the primary analysis(Fig. 1). Table 1 shows the result of th mean RMS S-EMG values(S.D.) of the paraspinal muscles of the concave and convex side . In thoracolumbar type, the activity of EST12 muscles was significantly different between the convex and concave sides(convex/concave : $126.66 \pm 28.38/97.66 \pm 25.28$, p value = 0.043). There was increased mean RMS in the convex side. At the levels of EST7 and ESL3, there were no significant differences. There was significant difference in ESL3 in lumbar type(convex/concave side: $59.40 \pm 11.41/50.60 \pm 17.90$, p value = 0.043) and no differences in other level. In double major type, the muscle activity also displayed a significant difference in EST7 and ESL3, where the apex of curve present(EST7 convex/concave : $261.20 \pm 121.20/161.33 \pm 58.33$, p value = 0.001, ESL3 convex/concave : $134.12 \pm 61.68/85.42 \pm 37.06$, p value = 0.002). Besides, there were no significant differences between the convex and concave sides in single thoracic and double thoracic types. Considering the difficulty of obtaining statistical significance due to few cases, we combined types and analyzed them as groups based on the level with

apex located. Table 2 shows the S-EMG data on thoracic, thoracolumbar and lumbar curve groups. EST7 showed most significant differences in thoracic group and other findings showed same Results in thoracolumbar and lumbar groups.

Conclusion(s)

The paraspinal muscle asymmetry well reflected the curve type on this study. Based on these findings, we propose a new exercise protocol to carry out the asymmetrical stabilization exercise of the scoliosis according to the asymmetrical paraspinal muscle weakness.

Table 1 show the result of th mean RMS S-EMG values(S.D.) of the paraspinal muscles of the concave and convex side according to the type of scoliosis

SRS type	N	Muscle lesion	Mean RMS		P-value
			Concave side[μ V]	Convex side[μ V]	
Single Thoracic	5	ES, T7	161,48 \pm 180,28	197,04 \pm 158,96	0,080
		ES, T12	92,46 \pm 39,59	80,50 \pm 41,16	0,686
		ES, L3	85,42 \pm 48,46	94,50 \pm 35,85	0,686
Thoracolumbar	5	ES, T7	238,92 \pm 115,08	184,52 \pm 80,68	0,686
		ES, T12	97,66 \pm 25,28	126,66 \pm 28,38	0,043*
		ES, L3	111,48 \pm 40,42	101,94 \pm 43,46	0,500
Lumbar	5	ES, T7	196,02 \pm 51,41	159,32 \pm 39,12	0,080
		ES, T12	83,18 \pm 25,26	102,88 \pm 14,82	0,225
		ES, L3	50,60 \pm 17,90	59,40 \pm 11,41	0,043*
Double Major	11	ES, T7	161,33 \pm 58,33	261,20 \pm 121,20	0,001*
		ES, T12	124,47 \pm 67,91	136,16 \pm 52,64	0,532
		ES, L3	85,42 \pm 37,06	134,12 \pm 61,68	0,002*
Double Thoracic	2	ES, T7	215,15 \pm 90,58	267,10 \pm 148,35	0,180
		ES, T12	147,10 \pm 28,71	196,55 \pm 47,59	0,180
		ES, L3	143,25 \pm 21,43	129,65 \pm 28,71	0,180

Data are expressed as mean \pm SD, * p < 0,05

Table 2 show the result of th mean RMS S-EMG values(S.D.) of the paraspinal muscles of the concave and convex side according to the group of scoliosis

Curve group	N	Muscle lesion	Mean RMS		P-value
			Concave side[μ V]	Convex side[μ V]	
Thoracic curve (ST, DM, DT)	18	ES, T7	167,35 \pm 102,15	244,03 \pm 129,55	0,000*
		ES, T12	118,09 \pm 58,73	127,41 \pm 58,49	0,471
		ES, L3	91,84 \pm 41,68	122,62 \pm 53,84	0,002*
Thoracolumbar curve (TL, DT)	7	ES, T7	232,13 \pm 101,64	208,11 \pm 98,14	0,866
		ES, T12	111,79 \pm 33,85	146,63 \pm 45,58	0,018*
		ES, L3	120,56 \pm 37,50	109,86 \pm 39,24	0,310
Lumbar curve (L,DM)	16	ES, T7	172,17 \pm 57,00	229,36 \pm 112,16	0,030*
		ES, T12	111,57 \pm 60,30	125,76 \pm 46,47	0,288
		ES, L3	76,32 \pm 35,29	122,72 \pm 69,62	0,001*

Data are expressed as mean \pm SD, * p < 0,05

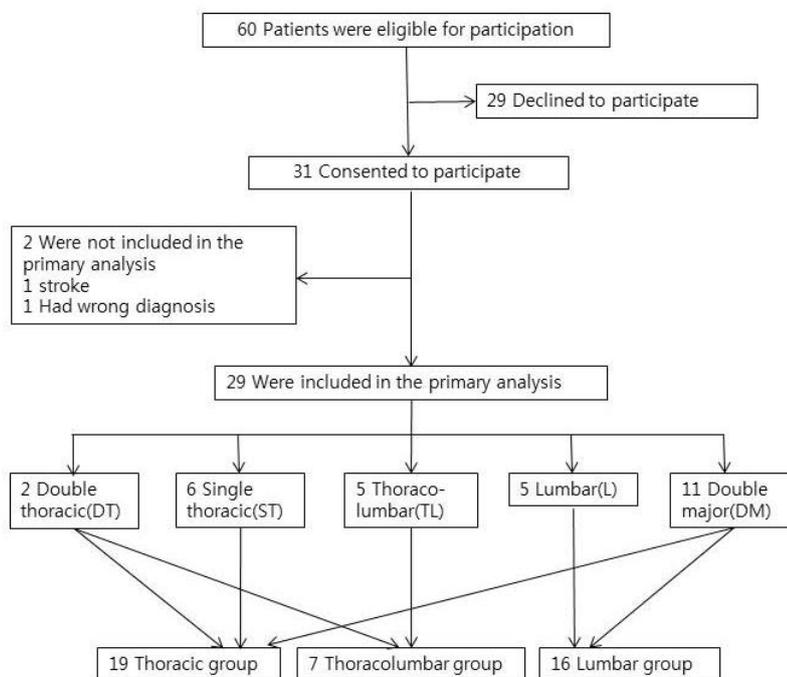


Figure 1. Study Enrollment and classification of the Patients. Between February 2017 to June 2018, a total of 60 patients underwent screening. Of those, 29 patients declined to participate and 2 were excluded in the primary analysis. A total of 29 patients included in the primary analysis.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:51-15:03 Room E(5F)

OP- Scientific 2-4

Effects of prolotherapy using platelet-rich plasma for chronic non-specific low back pain

Da-ye Kim¹, Jae Min Kim^{1*†}

Incheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, ,
Department of Rehabilitation Medicine¹

INTRODUCTION

Chronic low back pain is a common problem for which there is currently no effective intervention. Patient with chronic non-specific low back pain is weakened ligament, and prolotherapy is the effective treatment but their use remains controversial. These ligaments can be strengthened by platelet-rich plasma prolotherapy. We hypothesized that the effectiveness of prolotherapy using platelet-rich plasma may decrease pain and improved disability of patient with chronic low back pain Introduction This study was a prospective, double-blind, randomized controlled trial. Thirty-four patients with chronic non-specific low back pain were randomized to platelet-rich plasma injection and lidocaine injection. Patients were treated with weekly platelet-rich plasma or lidocaine injections at the lumbopelvic ligaments for 2 weeks and then weekly prolotherapy with 15% glucose for 2 weeks and followed up 6 months. Visual analog scale, Oswestry Disability Index and Roland-Morris Disability Questionnaire were evaluated at initial, 4weeks, 3 months, and 6 months. Four patients did not complete this trial. Three were in the platelet-rich plasma injection and one was in the lidocaine injection.

RESULTS

The intensity of pain was significantly decreased in platelet-rich plasma injections at 6 months as compared lidocaine injections. (Figure 1) All participants were significantly decreased pain and disability index (Figure 2) at 4 weeks, 3 months, and 6 months but there were no significant differences between groups except for visual analog scale at 6 months. The baseline parameters were no significant differences in both groups. (Table 1)

CONCLUSION

The platelet-rich plasma prolotherapy is an effective intervention in chronic non-specific low back pain. And injection at the lumbopelvic ligaments is also an effective treatment.

Table 1. Baseline Parameters

Variables	Lidocaine injection (n=16)	Platelet-rich plasma injection (n=14)
Male	6 (37.5%)	6 (42.9%)
Female	10 (62.%)	8 (57.1%)
Age (years)	50.5 ± 17.0	51.0 ± 18.1
Body mass index	25.1 ± 4.1	22.9 ± 2.7
Duration of Pain (months)	12.7 ± 13.5	16.2 ± 16.7

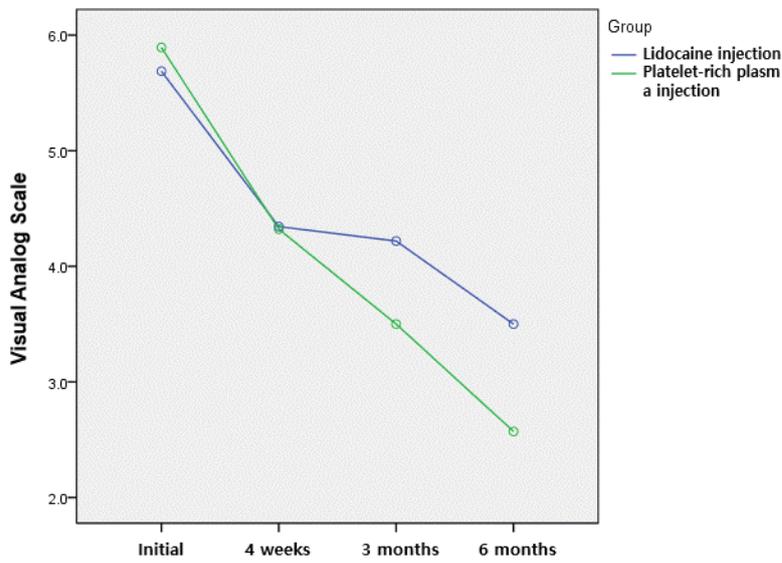


Figure 1. Visual analog scale scores of both groups at initial and subsequent follow-ups.

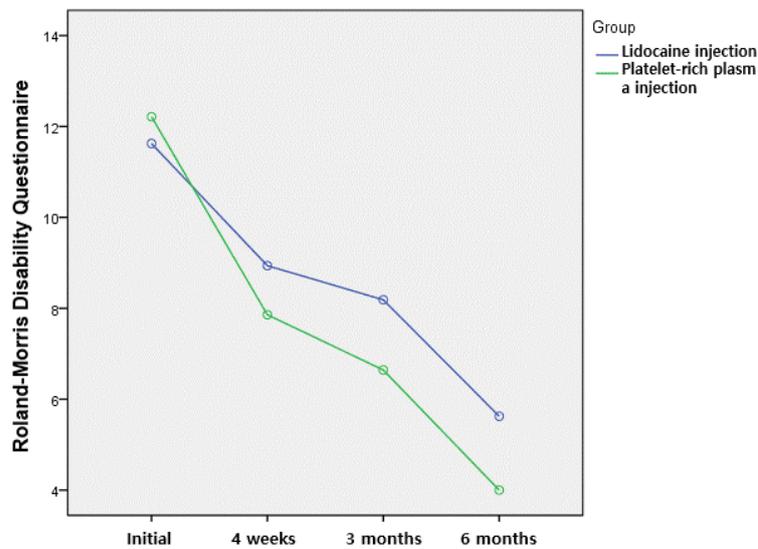


Figure 2 Roland-Morris Disability Questionnaire of both groups at initial and subsequent follow-ups.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:03-15:15 Room E(5F)

OP- Scientific 2-5

Optimal seatback reclining angle for preservation of lumbar lordosis at driving posture

Hyung Seok Nam^{1,2*}, Seonggyu Kang³, Matthew W. Smuck⁴, Shi-Uk Lee^{5,6†}

Seoul National University College of Medicine, Department of Biomedical Engineering¹, Seoul National University Hospital, Department of Rehabilitation Medicine², Hyundai Motors, Namyang R&D Division³, Stanford University, Department of Orthopaedic Surgery⁴, Seoul National University Boramae Medical Center, Department of Rehabilitation Medicine⁵, Seoul National University College of Medicine, Department of Rehabilitation Medicine⁶

Objective

Optimal seatback angles for automobile drivers' seats have been investigated based on comfort and back muscle activities; however, radiology supported evidences are scarce. The aim of this study was to evaluate optimal range of the seatback reclining regarding torso angles for an automobile driver's seat to preserve lumbar lordosis.

Materials and Method

A total of 60 healthy volunteers were recruited among various body type categories across 4 ethnicity groups. A mock-up carseat was created with the carseat that is used in a commercial vehicle, with a steering wheel to resemble real driving posture. Lateral lumbar spine X-rays were obtained for the neutral sitting posture without seatback as a reference, and for the sitting posture in the carseat leaning against the seatback with the hands on the handle (Fig. 1), at torso reclining angles of 25 to 31 degrees by 2 degree intervals. The Cobb angles for the L1-L4, L4-S1, and L1-S1 segments were measured.

Results

The Cobb angle for L4-S1 was nearest to the reference ($20.23 \pm 1.05^\circ$, mean \pm standard error mean) at torso reclining angles of 29 and 31 degrees ($19.86 \pm 1.10^\circ$ and $20.25 \pm 2.18^\circ$, respectively, Fig. 2). The Cobb angle at L4-S1 between reclining angles of 27 deg ($18.67 \pm 1.08^\circ$) and 29 deg ($19.86 \pm 1.10^\circ$) were significantly different ($p < 0.001$, paired t test). The reclining angle of 29 deg was determined the most optimal reclining angle for most subgroups for the factors including height, BMI, and ethnicity; however, the subgroup with short height demonstrated that the torso reclining angle of 25° is most optimal posture. Morbidly obese people (body mass index > 31.0) showed higher L4-S1 angle in neutral sitting posture, but the range of the Cobb's angle was predominantly decreased when seating in a carseat while the optimal torso reclining angle was still 29 deg.

Conclusion

Torso reclining angles of 29 to 31 degrees revealed to be optimal for preserving lordosis at the L4-S1 segment. The Results of this study may serve as an individualized healthcare-related guideline for driver's seat adjustment settings.



Fig1. The mock-up carseat with a steering wheel is set up in the x-ray room for lateral x-ray acquisition.

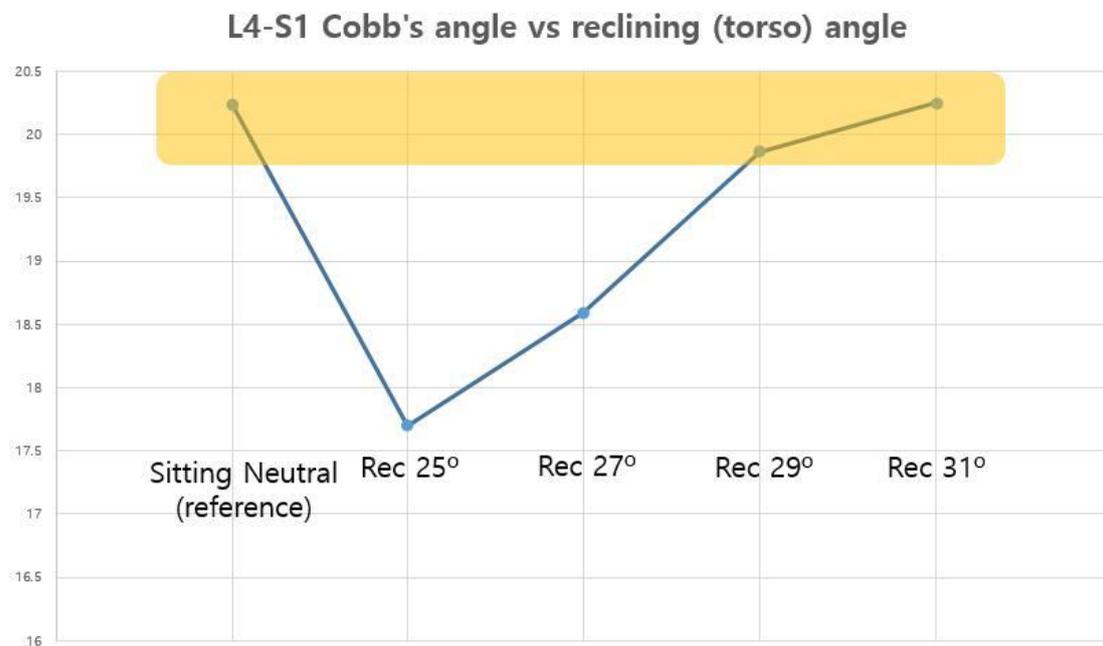


Fig2. The Cobb's angle for L4-S1 segment is nearest to the reference posture at torso reclining angles of 29 and 31 degrees, suggestive of optimal reclining angles.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:15-15:27 Room E(5F)

OP- Scientific 2-6

Stem cell injection for supraspinatus partial thickness tear: randomized controlled study

Se-Woong Chun^{5*}, Won Kim³, Sang Yoon Lee², Jeong-Gil Kim⁴, Chul-Hyun Park¹, Chai-Young Lim¹, Keewon Kim¹, Sung Hwan Hong⁶, Hye Jin Yoo⁶, Sun G. Chung^{1†}

Seoul National University Hospital, Department of Rehabilitation Medicine¹, Seoul National University Boramae Medical Center, Department of Rehabilitation Medicine², Asan Medical Center, Department of Rehabilitation Medicine³, The Armed Forces Daejeon Hospital, Department of Rehabilitation Medicine⁴, Changwon Gyeongsang National University Hospital, Department of Rehabilitation Medicine⁵, Seoul National University Hospital, Department of Radiology⁶

Background

The supraspinatus is prone to wear and tear injury and the degenerative process of this tendon is a well-noticed cause of chronic shoulder pain. However, there is no unquestionable treatment for this condition. Recently, attempts to promote tissue regeneration have proved some efficacy in various tendinopathies. The aim of this study is to investigate the effect of mesenchymal stem cell injection in treating partial tear of the supraspinatus.

Methods

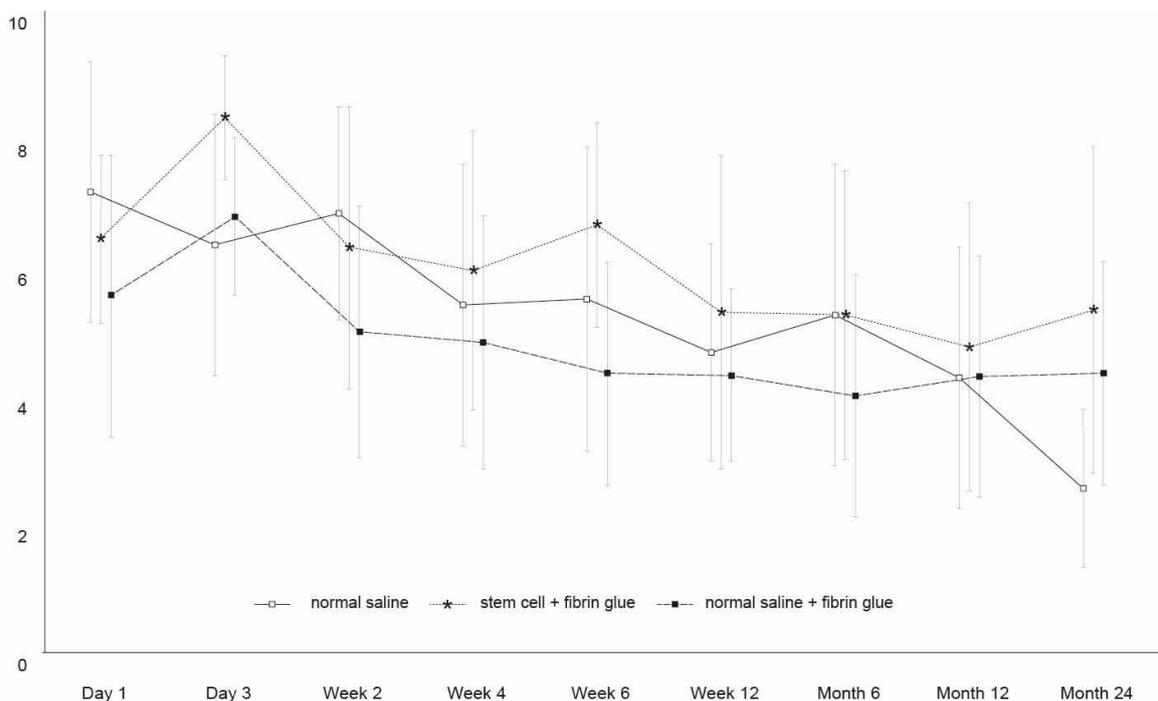
We enrolled 24 patients with shoulder pain lasting more than three months and partial tear of the supraspinatus tendon shown in the MRI. Participants were randomly assigned to three groups according to the injectate; stem cells suspended in fibrin glue, normal saline and fibrin glue mixture, and normal saline. Intra-lesional injection was performed under ultrasonographic guidance. Pain at activity and rest were assessed by visual analogue scale (VAS) and shoulder function was assessed by questionnaire and physical examination (ASES, UCLA, DASH score). Radiologic evaluation was done with MRI and ultrasonography. The follow up images were graded by 5-point Likert scale compared to the baseline image. All assessment was completed at baseline, 3 days, 2, 4, 6, 12 weeks, 6, 12 months and 2 years after injection except the MRI which was performed at baseline, 3 and 12 months after injection. Participants, the author who delivered the injection, those assessing the outcomes were all blinded to group assignment. Primary outcome measure was the improvement in pain at activity at 3months after injection. Additionally, we investigated whether there was difference in pain, shoulder function, and image by group and time. Kruskal-Wallis test was used to compare the primary outcome between groups and mixed effect model was adopted to test whether there was difference in the rate of change in each assessment tool.

Results

One participant who was assigned to the stem cell group dropped out before the injection and total 23 patients were included in the analyses. There was no statistically significant difference in the baseline characteristics between groups. The improvement of pain at activity did not differ by group at 3 months after intervention ($p = .352$). Mixed effect model with baseline values as covariate and time and group as factors revealed no statistically significant interaction. Only time significantly predicted the outcome measure when identical modeling without interactions were performed except for MRI gradings which showed no significant factor. All participants reported pain at the injection site most frequently lasting for 2 to 3 weeks. There was no significant difference in the post-injection pain duration between groups.

Conclusions

Stem cell injection to supraspinatus partial tear in patients with shoulder pain lasting more than three months is not more effective than normal saline injection. Pain and shoulder function improves after injection by time regardless of the injectate.



통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:27-15:39 Room E(5F)

OP- Scientific 2-7

The restoration of proliferative capacity and characteristics of human tenocyte by Vitamin D

Yong-Soo Choi¹, Ji Min Lee¹, Mi Jin Kim¹, Hee Ho Cho¹, Sang Youn Jung², Soonchul Lee³,
Kyunghoon Min^{4,5*†}

CHA University, Department of Biotechnology¹, CHA Bundang Medical Center, CHA University School of Medicine, Department of Internal Medicine², CHA Bundang Medical Center, CHA University School of Medicine, Department of Orthopaedic Surgery³, CHA Bundang Medical Center, CHA University School of Medicine, Department of Rehabilitation Medicine⁴, CHA University, Rehabilitation and Regeneration Research Center⁵

Background

Tendinopathies are prevalent and result in pain and activity limitations. To relieve pain in tendinopathies, glucocorticoid (GC) injection can be used. However, GC injection has harmful effects on the mechanical properties of tendon. Recent studies have shown that tenocytes exposed to GC in vitro lose their viability and properties. Vitamin D (Vit D), on the other hand, is known to improve muscle strength other than bone health and could be a candidate drug for tendon recovery. Therefore, we investigated whether Vit D could counterbalance the negative effect of GC on tenocytes.

Methods

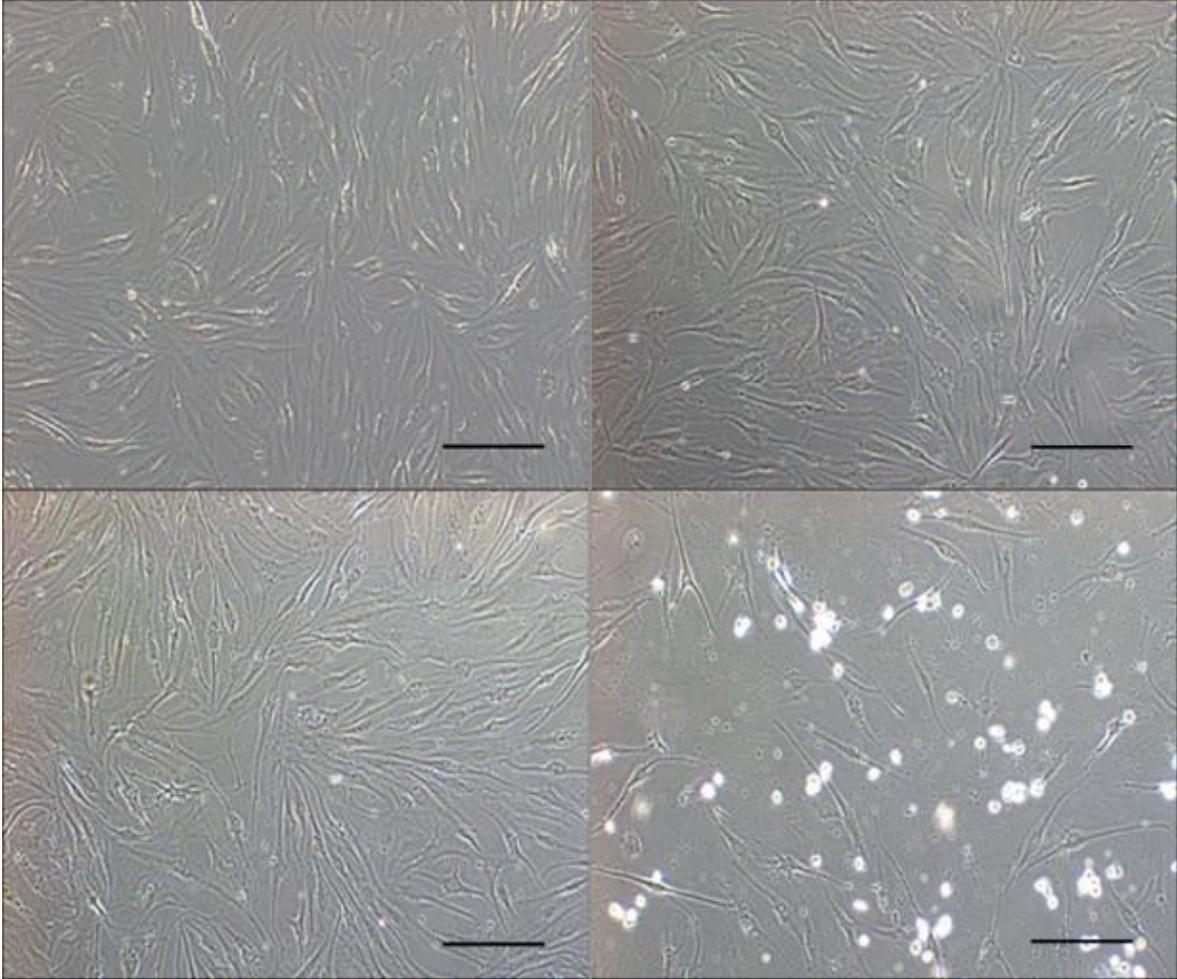
Human tenocytes were exposed to dexamethasone (Dex) in concentrations from 1 to 100 μ M. Cell morphology was observed using microscope and proliferation was measured by WST-1. The changes of tenocyte-specific mRNA expression such as tenomodulin (Tnmd), tenascin C (Tnc), scleraxis (Scx), mohawk (Mkx), collagen (Col) 1 and 3 were measured by qPCR. After exposure to Dex, tenocytes were treated with Vit D at concentrations of 10, 20 and 40 μ M for 48 h. Tenocyte-specific protein expressions such as tenomodulin (TNMD) and tenascin-C (TNC) were confirmed by Western blotting. Reactive oxygen species (ROS) were analyzed by 2',7'-dichlorofluorescein diacetate probe.

Results

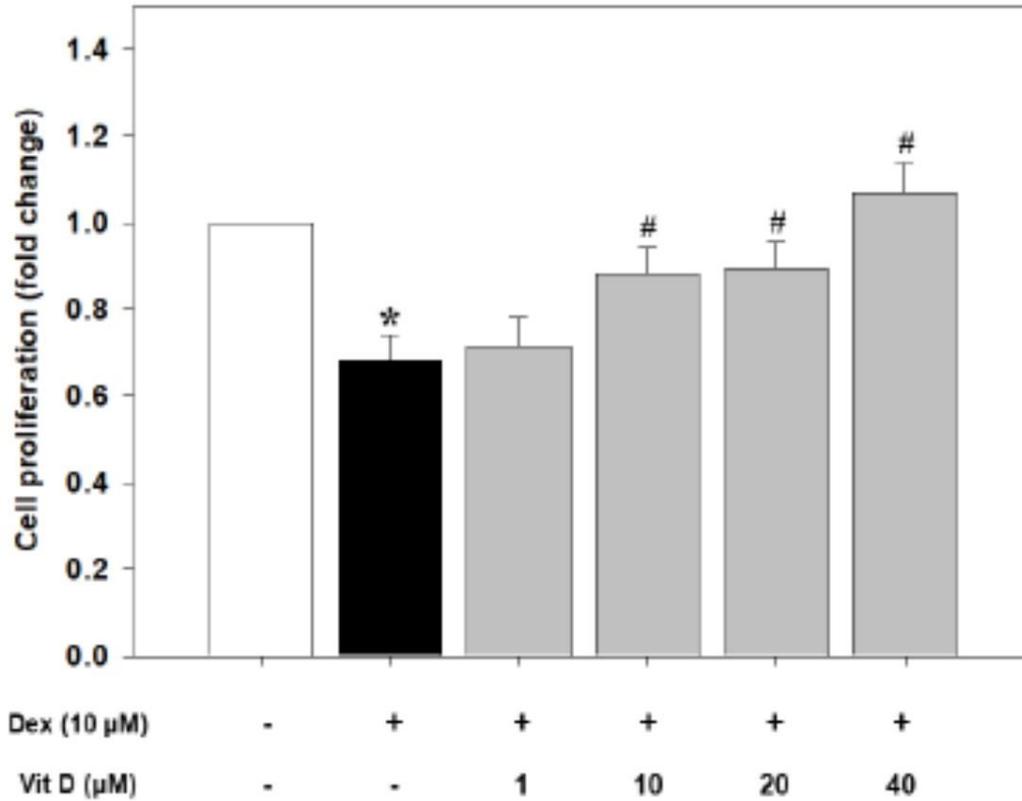
After exposure to 10 μ M Dex, the growth of tenocytes was significantly inhibited and gene expression of Tnmd, Tnc, Scx, Mkx, Col 1 and 3 also decreased. However, when co-treated with Vit D, cell proliferation increased dose-dependently and the expressions of TNMD and TNC were recovered to normal level. Furthermore, the ROS produced by Dex decreased. Finally, in relation to the cell signaling pathway, we found that the ratio of phosphorylated forms of ERK and p38 increased after Vit D co-treatment.

Conclusions

Vit D could play a protective role in tenocytes exposed to Dex. Therefore, our Results may provide a scientific basis for clinical use of Vit D in patients with tendinopathy.

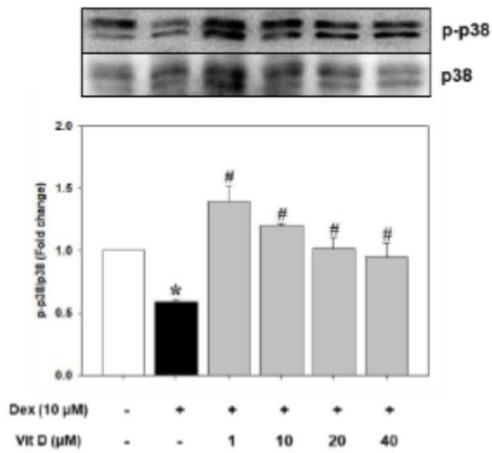


Effect of dexamethasone in tenocyte

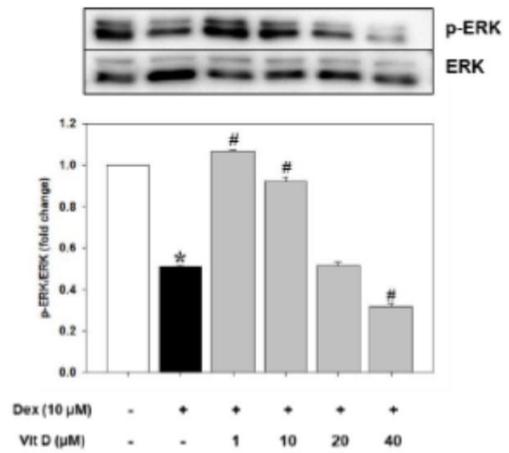


Cell proliferation by vitamin D in dexamethasone-treated tenocytes

a.



b.



Changes of p38 and ERK pathways by vitamin D in dexamethasone-treated human tenocytes

ORAL PRESENTATION 1-1

물리학

발표일시 및 장소 : 10 월 26 일(금) 13:15-13:25 Room B(5F)

OP1-1-1

Does microcurrent intensity affect regenerative effects on muscle atrophy in an immobilised rabbit?

Dong Rak Kwon^{1*†}, Gi Young Park¹, Yong Suk Moon²

Catholic University of Daegu School of Medicine, Department of Rehabilitation Medicine¹,
Catholic University of Daegu School of Medicine, Department of Anatomy²

Objective

To investigate the intensity-specific regenerative effects of microcurrent therapy (MT) on gastrocnemius (GCM) muscle atrophy induced by cast-immobilization in rabbits.

Methods

Fifteen rabbits were randomly allocated to 3 groups. The right GCM muscle was immobilized by cast (IC) for 2 weeks. Fifteen rabbits were randomly allocated to 3 groups after cast removal (CR): IC and sham MT for 2 weeks (group 1); IC and MT (25 uA) for 2 weeks (group 2); IC and MT (5000 uA) for 2 weeks (group 3). Atrophic change in calf circumference, compound muscle action potential (CMAP) of the tibial nerve, thickness of the GCM muscle, Cross sectional area (CSA) of GCM muscle fibres was measured in right side. Proliferating cell nuclear antigen (PCNA) or bromodeoxyuridine (BrdU)-positive cell ratio was estimated as the number of PCNA or BrdU-positive cells per muscle fibre.

Results

Mean atrophic changes in calf circumference, amplitude of CMAP of the tibial nerve, and GCM muscle thickness in group 2 and 3 were significantly lower than those in group 1, respectively ($p < 0.05$, Table 1). Those parameters in group 2 were significantly lower than those in groups 3 ($p < 0.05$, Table 1). Mean CSA of GCM type 1 muscle fibres and PCNA or BrdU ratio in group 2 and 3 were significantly greater than those in group 1, respectively ($p < 0.05$, Table 2, Figure 1). Those parameters in group 2 were significantly greater than those in groups 3 ($p < 0.05$, Table 2, Figure 1).

Conclusion

The Results showed that low-intensity MT promotes regeneration in atrophied GCM muscle more effectively than high-intensity MT.

Table 1. Comparison of Clinical Parameters among Three Groups

	Atrophic change (%)		
	Rt. calf muscle circumference	CMAP on Rt. tibial nerve	Rt. GCM muscle thickness on US
Group 1 (n=5) (2W IC + 2W sham MT)	33.68 ± 1.09 ^{a)}	30.90 ± 1.01 ^{a)}	32.98 ± 1.44 ^{a)}
Group 2 (n=5) (2W IC + 2W MT 25µA)	15.28 ± 1.55 ^{b)}	13.40 ± 0.45 ^{b)}	13.30 ± 0.43 ^{b)}
Group 3 (n=5) (2W IC + 2W MT 5000µA)	18.16 ± 0.40 ^{c)}	14.10 ± 0.27 ^{c)}	14.10 ± 0.59 ^{c)}

Values are presented mean ± standard error

Group 1: IC for 2 weeks and sham MT for 2 weeks after CR; Group 2: IC for 2 weeks and MT (25 µA) for 2 weeks after CR; Group 3: IC for 2 weeks and MT (5000 µA) for 2 weeks after CR; IC, immobilization by cast; MT, microcurrent therapy; CR, cast removal, CMAP, compound muscle action potential, GCM, gastrocnemius muscle; US, ultrasound

Any two means in the same row with different letters represent a significant difference at $p < 0.05$, One Way ANOVA, post-hoc Tukey test.

Table 2. Comparison of Cross Sectional Area among Three Groups

	Cross Sectional Area (µm ²)	
	Rt. GCM type 1	
	Medial	Lateral
Group 1 (n=5) (2W IC + 2W sham MT)	260.46 ± 17.86 ^{a)}	262.51 ± 14.31 ^{a)}
Group 2 (n=5) (2W IC + 2W MT 25µA)	822.37 ± 19.76 ^{b)}	870.43 ± 21.57 ^{b)}
Group 3 (n=5) (2W IC + 2W MT 5000µA)	675.11 ± 16.91 ^{c)}	684.06 ± 32.80 ^{c)}

Values are presented mean ± standard error

Group 1: IC for 2 weeks and sham MT for 2 weeks after CR; Group 2: IC for 2 weeks and MT (25 µA) for 2 weeks after CR; Group 3: IC for 2 weeks and MT (5000 µA) for 2 weeks after CR; IC, immobilization by cast; MT, microcurrent therapy; CR, cast removal, CMAP, compound muscle action potential, GCM, gastrocnemius muscle; US, ultrasound

Any two means in the same row with different letters represent a significant difference at $p < 0.05$, One Way ANOVA, post-hoc Tukey test.

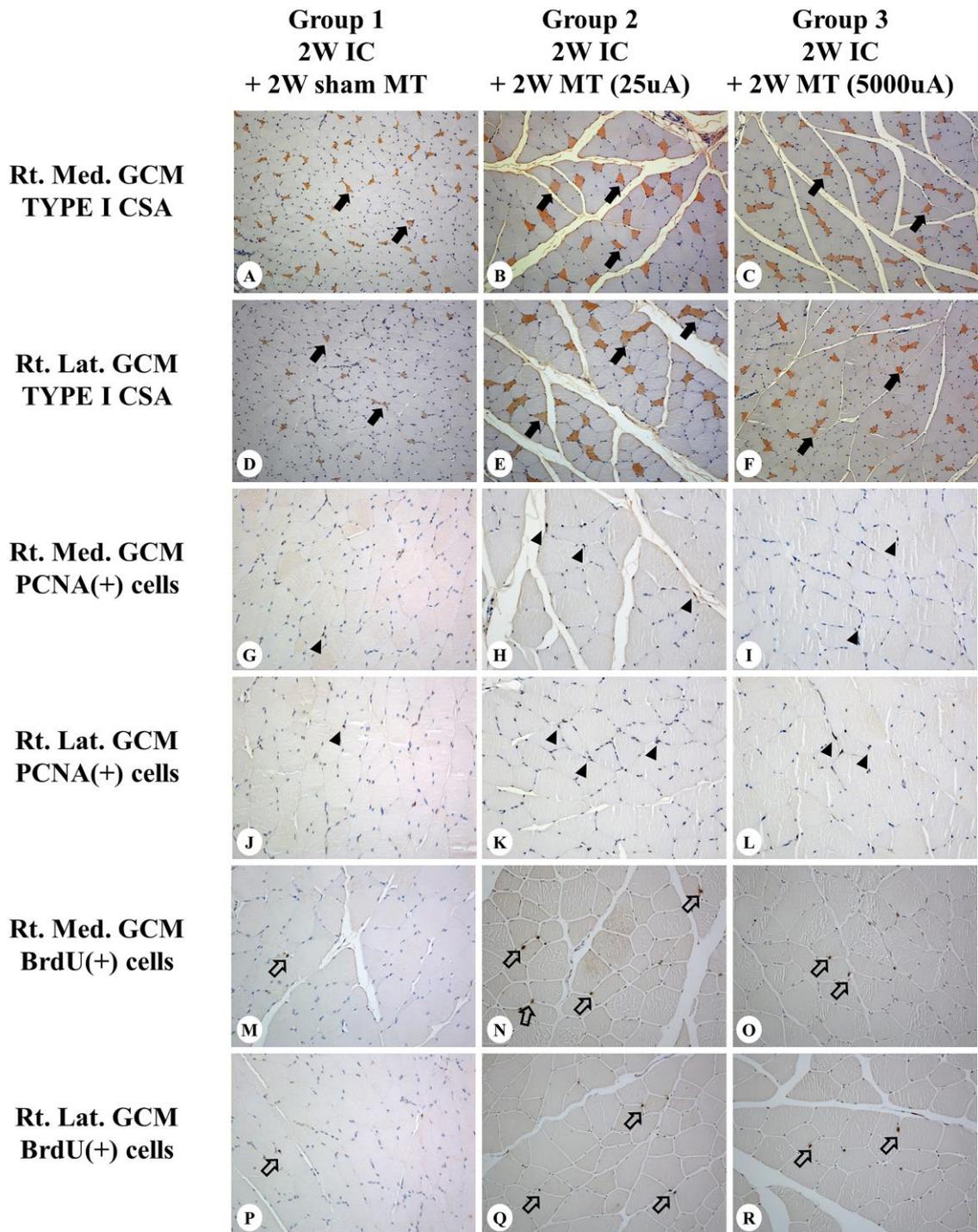


Figure 1. Immunohistochemical findings of the right medial and lateral gastrocnemius muscles in groups 1 - 3. (A, B, C, D, E, F) Cross sectional areas of right medial and lateral gastrocnemius type I muscle fibres [Monoclonal anti-myosin (skeletal, slow) antibody stain; x 100, arrows] were increased after microcurrent therapy. (G, H, I, J, K, L) PCNA positive cells were seen in right medial and lateral gastrocnemius muscle fibres (arrow heads). PCNA positive cells or nuclei were more increased in group 2 than group 1 and 3. (M, N, O, P, Q, R) BrdU positive cells were seen in right medial and lateral gastrocnemius muscle fibres (open arrows). The number of BrdU labelled cells or nuclei were increased after microcurrent therapy.

물리학

발표일시 및 장소 : 10 월 26 일(금) 13:25-13:35 Room B(5F)

OP1-1-2

Transabdominal functional magnetic stimulation for constipation in brain-injured patients

Kwang Jae Lee^{1,2*†}, Yong-Soon Yoon^{1,2†}, Jin-Gyung Lee¹, Young-Cheol Yun¹, Won-Jae Jo¹

Presbyterian Medical Center, Department of Rehabilitation Medicine¹, Presbyterian Medical Center, Medical Device Clinical Trial Center²

Objective

To investigate effects of the transabdominal functional magnetic stimulation (A-FMS) for constipation in stroke or brain-injured patients.

Methods

Twenty-four brain-injured patients (11 male, 13 female, median age 65 years, 22 stroke and 2 TBI) with constipation, who were admitted to the rehabilitation department, were enrolled and divided them into magnetic stimulation group (MS) and sham-treated control group (Sham) randomly and several parameters about constipation were evaluated such as total and segmental colon transit time (CTT), defecation frequency, and Bristol stool scale (BSS) before and after 2 weeks of A-FMS (5 times per week, total 10 times of A-FMS). Korean version of the modified Barthel index (K-MBI) was also evaluated.

Results

The change of segmental CTT in the left colon was significantly decreased (-8.2 ± 3.85 vs 4.1 ± 2.5 hours, $P < 0.05$ by paired sample T test) and frequency of defecation was significantly increased (1.5 ± 0.15 vs 0.67 ± 0.26 , $P < 0.05$ by paired sample T test) in the MS compared to in the Sham. Stool hardness, evaluated by BSS, became softer in the MS than in the Sham significantly (from 2.3 to 3.5 in the MSG, and from 2.6 to 3.1 in the Sham, $P < 0.05$ by Chi-squared test). The change of K-MBI had no difference between two groups.

Conclusion

The present study suggests that A-FMS can be an additional therapeutic tool for managing constipation in brain-injured patients affecting bowel movement, defecation frequency, and stool hardness.

스포츠재활

발표일시 및 장소 : 10 월 26 일(금) 13:35-13:45 Room B(5F)

OP1-1-3

Effects of Climbing Stairs in Daily Living on Physical Fitness and Lipid Profiles

Hong Jae Lee^{1†}, Kil Byung Lim¹, Jee Hyun Yoo¹, Ji Yong Kim¹, Yeong Sook Yoon¹, Kyoung Hwan Koh¹, Tae Ho Jeong¹, Young Hye Hwan¹, Jung Wha Moon¹, Ha Seong Kim^{1*}

Inje University Ilsan Paik Hospital, Department of Rehabilitation Medicine¹

Purpose

The purpose of this study is to identify the effects of climbing upstairs of office workers on blood pressure, lipid profiles, and general health properties.

Methods

Total of 130 adults, 13 male and 117 female office workers aged 20 to 60 were recruited in this study. 72 of them were allocated into stair climbing group(SG), and the other 58 were allocated into control group(CG). SG was asked to climb upstairs in workplace for 12 weeks of period, at least 3 times a week and 3 floors in a time. To investigate the effects of stair climbing on participants' health, blood pressure, heart rate, lipid profiles, the maximum intake of oxygen(VO₂max), isokinetic strength of knee joint and other physical performances like strength, balance and flexibility were assessed at the time of start and at the end of this study.

Results

As a result of 12 weeks of stair climbing in daily living, SG showed significant decrease in resting systolic blood pressure($p<.001$), resting diastolic blood pressure($p<.001$), resting heart rate($p<.001$), total cholesterol($p<.01$) and LDL-cholesterol($p<.01$) between two times of assessment, in contrast to CG which showed no significant changes. Also just SG showed significant improvements in strength of both knee extensor($p<.001$), back muscle($p<.001$), VO₂max($p<.001$) and maximal HR($p<.001$) while CG showed no significant changes after 12 weeks. In sit and reach test, which was a measurement tool for flexibility, there was no significant differences after 12 weeks in both SG and CG. In each one leg standing test with eyes-closed, which was a measurement tool for static balance, and forward and backward velocity test, which was a measurement tool for dynamic balance, only SG showed significant improvements ($p=.004$, $p=.015$, $p=.041$)

Conclusions

For workers aged 20 to 60, the 12-week stair climbing program lowered resting systolic blood pressure and heart rate and improved lipid profiles and several health properties. It also had significant effects on improving the static and dynamic balance and increasing

the cardiovascular capacity and strengthening the muscles of the lower limbs. Based on the Results of this study, it is strongly recommended for office workers to climb upstairs in office hours to improve their own health.

Table 1. Results of blood glucose, blood pressure, heart rate, and Lipid profiles (M±SD)

Variables	Stair Group		Control Group	
	pre	post	pre	post
glucose	94.7±10.2	96.3±8.1	94.6±12.2	94.2±10.2
total cholesterol	183.7±33.3	176.7±26.6**	180.0±29.4	182.9±29.6
HDL-C	66.3±16.5	65.9±13.9	63.8±16.1	66.0±16.3
LDL-C	99.9±32.0	94.1±26.5**	99.4±28.3	100.5±28.7
triglyceride	97.1±60.7	87.7±42.6	96.4±62.2	122.0±166.3
SBP	122.7±11.4	115.5±12.1***	119.9±10.5	118.1±12.3
DBP	74.8±7.9	71.5±8.8***	73.1±6.7	71.6±7.3
resting heart Rate	82.4±10.8	76.7±8.5***	80.5±10.6	80.7±11.5

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2. Results of knee joint strength, back muscle strength, flexibility, VO₂max, maximal HR(M±SD)

Variables		Stair Group		Control Group	
		pre	post	pre	post
knee flexor (60degree/sec)	Lt	48.7±18.3	51.8±18.5*	44.5±13.3	44.7±14.1
	Rt	51.0±18.7	51.7±21.4	47.1±15.5	44.8±17.0
knee extensor (60degree/sec)	Lt	99.8±34.3	113.2±38.3***	90.0±25.1	94.1±34.3
	Rt	101.7±35.9	112.3±41.1***	90.0±27.2	89.6±32.9
Back muscle strength		60.8±23.2	71.8±24.4***	57.8±17.2	60.2±20.3
sit and reach		7.7±11.7	8.7±9.9	8.1±9.5	8.3±10.0
VO ₂ max		35.9±9.8	41.9±9.6***	39.0±9.8	39.3±9.6
maximal HR		140.1±16.1	126.5±15.6***	134.3±14.7	134.3±14.8

* $p < .05$, ** $p < .01$, *** $p < .001$

스포츠재활

발표일시 및 장소 : 10 월 26 일(금) 13:45-13:55 Room B(5F)

OP1-1-4

The effects of electrical muscle stimulation on trunk muscle strengthening : double blinded RCT

Yu-Sun Min^{1**†}, Sujin Lee¹, Tae-Woo Nam¹, Hyun-Min Oh¹

School of Medicine, Kyungpook National University, Department of Rehabilitation Medicine¹, Kyungpook National University Hospital, Department of Rehabilitation Medicine²

Background

Electrical Muscle Stimulation (EMS) has been introduced and globally gained increasing attention on its usefulness. Continuous application of EMS may lead to the increment of muscle mass and indirectly will increase the strength. Objective to investigate the effects of self-administered EMS on changes on trunk muscle strengthening, skeletal muscle mass and anthropometric measures. Design: double blind randomized controlled trial.

Methods

Thirty-eight adults (21 males, age : 34.7±7.0) were randomized and allocated into one of three groups. Fourteen adults (real EMS group) stimulated their abdominals, lateral trunk (left and right) and back 5 days per week (20-40 minutes per session) for 8 weeks. A Sham EMS group (N=12) were received electrical stimulation with lower power output at the minimal sensory threshold intensity. A Control group (N=12) did not receive any electrical stimulation. Their consumption of food and physical activity were continuously monitored with watch-type activity monitoring (fitbit). Subjects were tested at the pre, 4wks, and 8wks after trunk-EMS. Isometric strength of the trunk muscles was measured using the McGill's endurance test. Abdominal skeletal muscle mass, visceral and subcutaneous fat was measured with CT. Anthropometric parameter such as BMI, waist hip ratio was measured by bioelectrical impedance analysis. Laboratory data such as pulmonary function test, exercise tolerance test(VO₂max) and blood test were also collected. Two-way repeated measure ANOVA was used for statistical analysis.

Results

The muscle strength of flexor was improved after 4wks (47.7%, 20.3%, 15.9%) and 8wks (67.7%, 117.2%, 83.4%) compared with that of pre-evaluation in real-EMS, Sham-EMS and control group (p<0.001). Time and group interaction is not significant. There was no difference among group at each time point. Other muscle such as extensor, left SB, right SB showed a similar pattern. There were no significant differences in skeletal muscle thickness, visceral and subcutaneous fat in trunk over the course of the study in either group. Waist hip ratio was decreased after 4weeks, and 8 weeks compared with that of

pre-evaluation in real-EMS, Sham-EMS and control group ($p < 0.001$). VO2 max was increased after 8 weeks stimulation only in real-EMS group ($p < 0.001$)

Conclusions

EMS as used in the current study, resulted in significant improvements in the muscular strength in the trunk and waist hip ratio. However further study will be needed to explore real-effects of EMS.

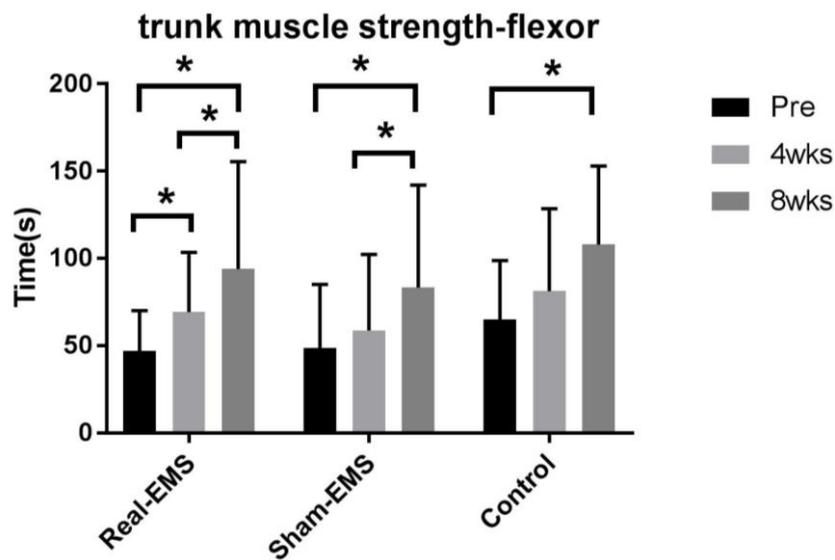


fig 1. The change of trunk muscle strength in real-EMS, sham-EMS, control group.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 13:55-14:05 Room B(5F)

OP1-1-5

Comparison of clinical parameters between adhesive capsulitis with and without SASD bursitis

Gi-Young Park^{1†}, Dong Rak Kwon¹, Dae Gil Kwon¹, In Ho Woo^{1*}

Daegu Catholic University Medical Center, Department of Rehabilitation Medicine¹

Objective

The purpose of this study was to investigate clinical findings based on the presence of subacromial-subdeltoid (SASD) bursitis in patients with adhesive capsulitis (AC).

Methods

One hundred-five patients (36 men, 69 women; mean age, 55.1 + 9.8 years; range, 41-83 years) with a clinical diagnosis of unilateral idiopathic AC with freezing or frozen stage were recruited from June 1st 2014 to January 31th 2018. Contrast-enhanced MRI and ultrasound were performed in all patients. The MRI diagnostic criteria for SASD bursitis were the presence of a fluid collection and enhancement in the subacromial bursa on oblique coronal T2-weighted images and oblique coronal fat-suppressed enhanced T1-weighted images (figure A). The SASD bursitis on ultrasound was defined as fluid or hypertrophic synovium filling the bursa with a thickness of > 2mm (figure B). Clinical parameters including a visual analogue scale (VAS), the Constant-Murley Score (CMS), shoulder passive range of motion (PROM), and Cyriax stage for AC were assessed. Shoulder PROM, including forward flexion, abduction, and external and internal rotation, was measured. The patients were allocated into two groups, forty-six patients with AC (group 1; 21 men, 25 women; mean age, 54.8+9.4 years; range, 41-83 years) and fifty-nine patients with AC and SASD bursitis (group 2; 15 men, 44 women; mean age, 55.3+10.1 years; range, 41-83 years). Clinical parameters were compared between two groups. Calculations were performed to determine the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of ultrasound for making a MRI diagnosis of SASD bursitis.

Results

Patients in group 2 showed more limited shoulder PROM of forward flexion, abduction, and internal rotation (110.9 ± 15.9 , 95.4 ± 20.9 , and 17.2 ± 10.7 , respectively) than did patients in group 1 (121.8 ± 13.4 , 106.1 ± 18.5 , and 22.4 ± 11.5 , respectively) ($p < .05$) (table). However, there was no significant difference in other clinical parameters between the two groups. There was a significant difference of AC stage between two groups (39 freezing/7 frozen stage in group 1, 40 freezing/ 19 frozen stage in group 2). Ultrasound

showed a sensitivity of 63.3%, specificity of 44.2%, accuracy of 55.3%, positive and negative predictive values of 61.3% and 46.3% for SASD bursitis.

Conclusions

Our Results indicated that the shoulder PROMs except external rotation in patients with AC and SASD bursitis were more limited than those in patients with AC alone. In addition, the patients with AC in the frozen stage had more SASD bursitis than those in the freezing stage. Therefore, accurate imaging diagnosis and treatment of SASD bursitis is necessary to achieve better outcomes in the patients with AC and SASD bursitis.

Table 1. Demographic data and clinical assessment scale in adhesive capsulitis with/without subacromial-subdeltoid bursitis / Group 1, adhesive capsulitis alone; Group 2, adhesive capsulitis with subacromial-subdeltoid bursitis / * P-values calculated by chi-squared test † P-values calculated by independent t-test Values are mean \pm SD.

	Group 1 (n=46)	Group 2 (n=59)	P value
Age (year)	54.8 \pm 9.4	55.3 \pm 10.1	0.765
Sex, n (%)			
Male	21 (58.3)	15 (41.7)	0.030*
Female	25 (36.2)	44 (63.8)	
Symptom duration (month)	5.2 \pm 3.0	5.5 \pm 2.9	0.613
Stage			
Freezing, n (%)	39 (49.4)	40 (50.6)	0.045*
Frozen, n (%)	7 (26.9)	19 (73.1)	
VAS			
Motion	7.3 \pm 1.4	7.7 \pm 1.4	0.177
Resting	2.2 \pm 1.9	2.7 \pm 2.3	0.236
Sleep	6.1 \pm 2.5	5.8 \pm 2.9	0.552
Range of motion (degree)			
Forward flexion	121.8 \pm 13.4	110.9 \pm 15.9	<0.001†
Abduction	106.1 \pm 18.5	95.4 \pm 20.9	0.008†
External rotation	32.9 \pm 13.2	30.8 \pm 10.9	0.370
Internal rotation	22.4 \pm 11.5	17.2 \pm 10.7	0.018†
Cyriax stage	3.3 \pm 0.5	3.1 \pm 0.6	0.117
Constant score	47.8 \pm 8.7	43.9 \pm 10.0	0.099

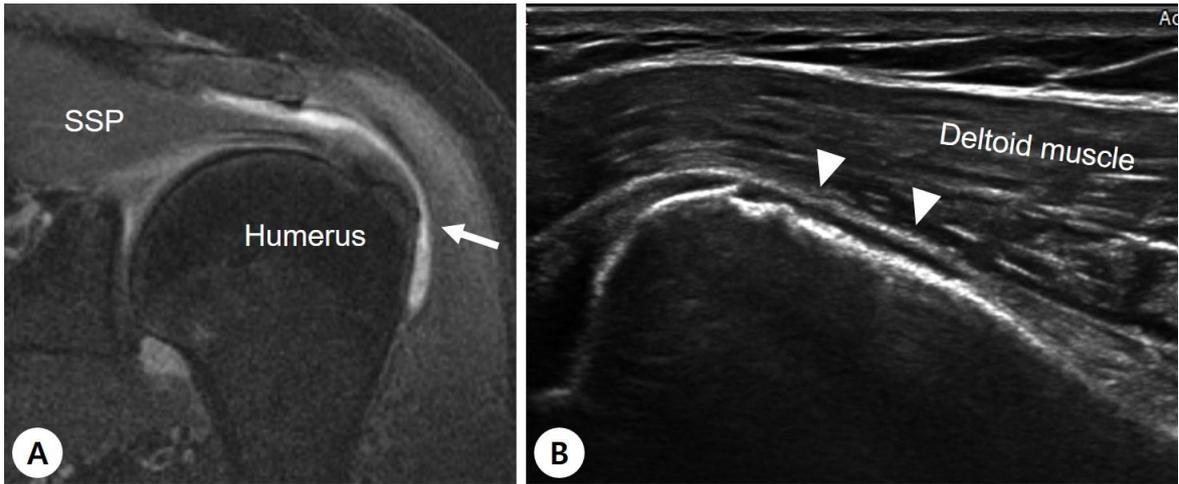


Figure. (A) A contrast enhanced oblique coronal fat-suppressed enhanced T1-weighted MRI showed contrast enhancement of subacromial-subdeltoid (SASD) bursa (white arrow). (B) A corresponding ultrasound image revealed some fluid collection in SASD bursa (arrowhead). Abbreviation: SSP, supraspinatus muscle; GT, greater tuberosity.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:05-14:15 Room B(5F)

OP1-1-6

Comparison of High versus Low-Energy Extracorporeal Shock Wave Therapy for Knee Osteoarthritis

Jong Hwa Lee^{1†}, Sang Beom Kim¹, Kyeong Woo Lee¹, Jin Gee Park¹, Joung Bok Lee^{1*}

Dong-A University Hospital, Department of Rehabilitation Medicine¹

Background

Osteoarthritis (OA) is the most prevalent progressive degenerative joint disease and is a leading cause of pain and disability in most countries. The treatment Methods for knee OA are diverse. Recently, many researchers have demonstrated the effects of focused extracorporeal shock wave therapy (fESWT) for knee OA which has previously been resistant to conservative treatment. However, despite the many reports on the efficacy of fESWT for knee OA, the exact treatment protocol is not established. Particularly, many controversies exist regarding the proper amount of energy to be applied to the affected tissue. Therefore the purpose of this study is to investigate the dose-related effects of fESWT in patients with knee OA.

Method

Patients who suffered from knee OA at least 3 months and radiologically diagnosed as Kellgren-Lawrence (KL) grade II or III were recruited. All patients were randomly divided into high-energy (HE) group and low-energy (LE) group. HE group received high-energy fESWT(1,000 shocks/session, energy flux density (EFD) per shock 0.1 mj/mm²) and LE group received low-energy fESWT(1,000 shocks/session, EFD per shock 0.03 mj/mm²). All patients received fESWT 1 session per week for 3 weeks. At each session, all subjects were positioned in a supine manner, with the affected knee flexed at 90°. The shockwave probe was held stationary on a tender area around the medial tibial plateau. During the course of the experiment, all subjects were prevented from receiving any additional treatment, such as physical therapy, steroid injection, or anti-inflammatory drugs. Before and 1 months after the treatment, Western Ontario and McMaster Universities Osteoarthritis index (WOMAC), Lequesne index, 9-Stair climb test (9-SCT) and Visual Analogue Scale (VAS) of pain perception were evaluated.

Results

Seven patients were recruited in each group. There were no significant differences in baseline characteristics and initial values between two groups (Table1). One month after the treatment, all groups showed significant improvement in WOMAC, Lequesne index, 9-SCT and VAS (Table 2). But the changes in all measurements showed no significant difference between two groups (Table 3).

Conclusion

In this study, there were no significant differences between HE and LE fESWT treatment for knee OA. Further well-designed studies in a larger population might be needed to elucidate the effect of energy differences of fESWT on knee OA.

Table 1. Baseline characteristics of two groups

	HE group (n=7)	LE group (n=7)	p-value
Age (year)	68.0±7.9	66.4±6.0	0.548
BMI (kg/m ²)	26.0±4.7	26.2±4.7	0.916
KL grade			
II	4	3	
III	1	2	
WOMAC (0-96)	37.2±17.7	50.8±7.0	0.151
Lequesne index (0-24)	7.2±2.1	7.4±2.5	0.841
9-SCT (sec)	72.2±12.1	68.0±9.7	0.855
VAS (0-10)	3.6±0.9	4.4±0.9	0.222

Values are presented as mean±standard deviation.

BMI, Body Mass Index; KL, Kellgren-Lawrence; WOMAC, Western Ontario and McMaster Universities Osteoarthritis index; 9-SCT, 9-Stair climb test; VAS, Visual Analogue Scale.

Table 2. Change of measurements after treatment

	HE group(n=7)		p-value	LE group (n=7)		p-value
	Pre	Post		Pre	Post	
WOMAC (0-96)	37.2±17.7	25.8±13.9	0.043*	50.8±7.0	37.4±5.3	0.042*
Lequesne index (0-24)	7.2±2.1	4.6±2.5	0.042*	7.4±2.5	5.0±1.2	0.047*
9-SCT (sec)	72.2±12.1	68.6±11.7	0.043*	68.0±9.7	63.6±10.4	0.042*
VAS (0-10)	3.6±0.9	2.0±0.7	0.038*	4.4±0.9	2.0±0.8	0.039*

Values are presented as mean±standard deviation.

WOMAC, Western Ontario and McMaster Universities Osteoarthritis index; 9-SCT, 9-Stair climb test; VAS, Visual Analogue Scale.

*p<0.05 by Wilcoxon signed rank test.

Table 3. Changes of measurements between two groups

	HE group (n=7)	LE group (n=7)	p-value
Δ WOMAC	-11.4±5.6	-12.8±3.0	0.421
Δ Lequesne index	-2.6±1.5	-2.6±1.6	0.841
Δ 9-SCT	-3.6±2.7	-3.8±2.6	0.918
Δ VAS	-1.6±0.55	-2.2±0.83	0.310

Values are presented as mean±standard deviation.

WOMAC, Western Ontario and McMaster Universities Osteoarthritis index; 9-SCT, 9-Stair climb test; VAS, Visual Analogue Scale.

ORAL PRESENTATION 1-2

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:15-14:25 Room B(5F)

OP1-2-1

Optimal Elbow Positions for Identifying the Radial Collateral Ligament

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Introduction

Ultrasonographic localization of the radial collateral ligament (RCL) is important to determine the presence of RCL tears in the setting of lateral epicondylitis. At present, the standard position of examining the lateral elbow under ultrasound is a “slightly flexed” position. However, since the RCL is more deeply attached on the lateral epicondyle than the common extensor tendons, an anisotropic artifact of the RCL could be observed by the ultrasonography in the conventional slightly flexed position, making it difficult to fully visualize the RCL to determine the presence of RCL tears. The purposes of this study are to determine optimal elbow positions for identifying the RCL, and further to illustrate the ultrasonographic landmarks of the RCL using ultrasonography.

Methods

Healthy individuals without history of elbow pain were recruited. The RCL was evaluated using ultrasonography with six different elbow flexion positions (0°, 30°, 60°, 90°, 120°, and 140°). Depth interval was defined as the depth of the humeral capitellum subtracted by the depth of the radial head in ultrasonographic images, and was measured in each flexion angle of elbow (Figure 1). The presence of ultrasonographic landmarks (eg. superior and anterior tubercles and hyperechogenic line) for the RCL were assessed, and the frequency rate of the landmarks were calculated. Statistical comparisons were performed by one-way analysis of variance (ANOVA) with Bonferroni post-hoc analysis. P values <0.05 were considered significant.

Results

A total of 40 healthy elbows of 10 men and 10 women were evaluated by ultrasonography. The average of age and a maximal angle of elbow flexion were 30.1 (SD, 2.9) years, and 142.4° (3.2), respectively. The depth interval between the capitellum and the radial head was significantly decreased according to increased flexion angle of elbow (p for trend<0.001; Figure 2). The subjects with flexion angle of 140° showed the lowest depth interval among six flexion angles (Bonferroni post hoc test, all p<0.05). The groups with the depth interval near to zero were shown in the groups with flexion angle of 90°

and 120° as 0.4 (0.3) mm and 0.3 (0.4) mm, respectively. The frequency rate of superior tubercle and anterior tubercle were 100% and 70%, respectively. Furthermore, the frequency rate of the hyperechogenic line was 100%.

Conclusion

The present study demonstrates that the optimal elbow positions to visualize the RCL with the least possibility of anisotropism are 90° and 120° of flexion of elbow under ultrasound, implicating that the elbow should be flexed far more than the conventional “slightly flexed” position. In the optimal elbow positions, the ultrasonographic landmarks to identify the RCL such as the hyperechogenic line and tubercles are distinctively observed.

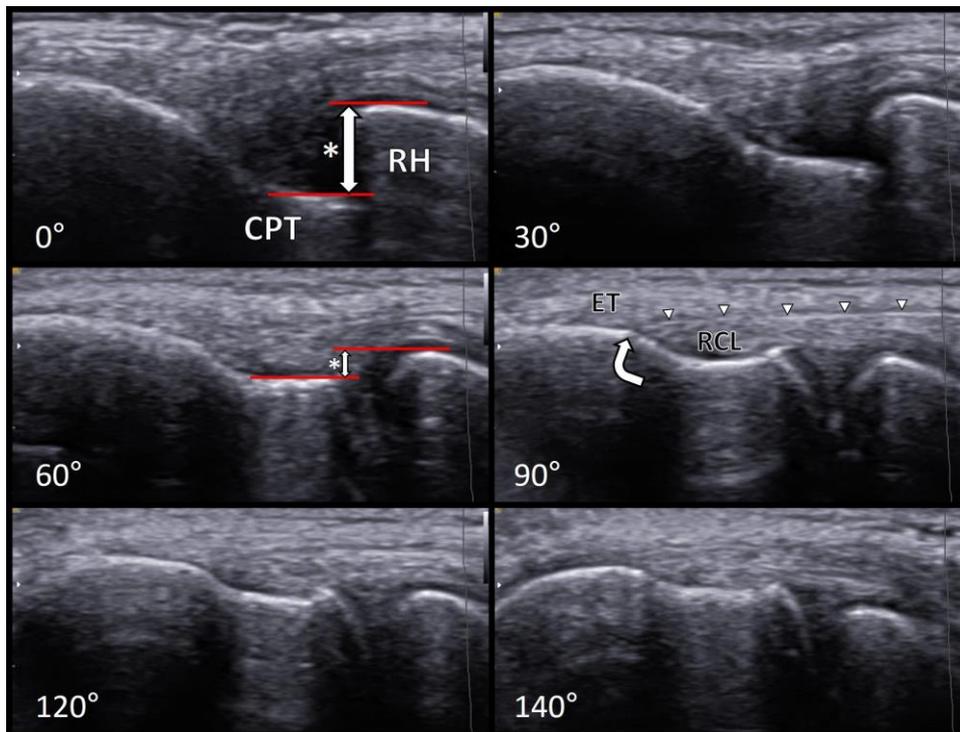


Figure 1. Ultrasonographic images of the radial collateral ligament (RCL) at 6 elbow flexion angles. Depth interval (asterisk) was defined as the depth of the capitellum (CPT) subtracted by the depth of radial head (RH) on the ultrasonography (US). Hyperechogenic line (arrow head) and a superior tubercle (curved arrow) are shown on the US image of a 90° flexed elbow, separating RCL from extensor tendon (ET).

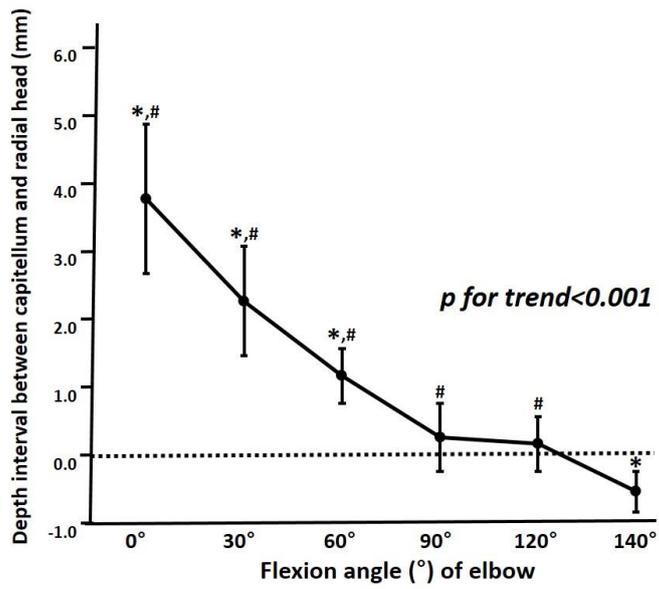


Figure 2. Means of depth interval (mm) between the capitellum and the radial head using an ultrasonography according to elbow flexion angle. * <0.05 : vs group with elbow flexion of 120° on Bonferroni method. # <0.05 : vs group with elbow flexion of 140° on Bonferroni method.

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 14:25-14:35 Room B(5F)

OP1-2-2

The association of sarcopenia with low back pain and lumbar spine degeneration

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Asan Medical Center, University of Ulsan College of Medicine, Department of Rehabilitation Medicine¹, University of Waterloo, Faculty of Applied Health Sciences-Kinesiology²

OBJECTIVE

There were few studies about on the association between low back pain (LBP) and lumbar spine degeneration (LSD) with sarcopenia. In particular, there were few published descriptions of the effects of sarcopenia on LBP and LSD simultaneously. The aim of this study is to investigate the association of low back pain and lumbar spine degeneration with sarcopenia using nationwide survey in men over 60 years old.

METHODS

We conducted a cross-sectional study using the 5th Korea National Health and Nutrition Examination Survey (2010-2011). Men \geq 60 years of age were included. Skeletal muscle mass index (SMI) and body composition were evaluated using Dual-energy X-ray absorptiometry. We defined sarcopenia as a modified SMI (ASM/ht²) value less than 20% of the participants. LSD was evaluated using a modified version of the Kellgren–Lawrence (KL) grade and was defined if the modified KL grade was 2. The risk of LBP and LSD with sarcopenia were investigated with multivariate logistic regression analyses. Model 1 was adjusted by age group. Model 2 was adjusted by age group, obesity, occupation, and physical activity. We also adjusted for LSD.

RESULTS

Of 1032 participants, 849 participants had no LBP and 183 participants had LBP. Sarcopenia was associated with increased risk of LBP (OR=2.08; 95% CI 1.39-3.11) (OR=2.03; 95% CI 1.36-3.02 and OR=2.23; 95% CI 1.38-3.59, respectively for model 1 and 2). This increased odds ratio was maintained after adjusting for LSD (OR=2.16; 95% CI 1.43-3.25 and OR=2.37; 95% CI 01.45-3.86, respectively for model 1 and 2). However, sarcopenia was associated with decreased risk of LSD in multivariate analysis (OR=0.62; 95% CI 0.42-0.93 and OR=0.61; 95% CI 0.40-0.92, respectively for model 1 and 2). (Table 2, Table 3)

CONCLUSION

Our Results suggest that sarcopenia was associated with increased risk of LBP in men ≥ 60 years old. It was also maintained after adjusting for LSD. However, sarcopenia was associated with decreased risk of LSD.

Table 1. Demographics of the study participants

	No LBP (n=849), no. (%)	LBP (n=183), no. (%)	p-value
Mean age, yrs ^a	68.22 ± 0.24	69.22 ± 0.56	0.107
Height, cm ^a	165.83 ± 0.24	165.46 ± 0.43	0.451
Weight, kg ^a	65.04 ± 0.43	62.18 ± 0.70	0.005
BMI, kg/m ^{2a}	23.59 ± 0.14	22.96 ± 0.23	0.007
ASM	20.14 ± 0.13	19.62 ± 0.26	0.041
ASM/ht ²	7.31 ± 0.04	7.15 ± 0.08	0.066
ASM/wt	31.15 ± 0.15	31.40 ± 0.28	0.334
ASM/bmi	0.86 ± 0.00	0.86 ± 0.01	0.721
Obesity			0.161
Absent	577 (66.47)	134 (72.50)	
Present	272 (33.53)	49 (27.50)	
LSD			0.020
Absent	555 (67.73)	93 (56.16)	
Present	294 (32.27)	90 (43.84)	
Occupation			0.001
WC workers	212 (20.98)	44 (24.54)	
PC workers	127 (13.46)	18 (9.65)	
BC workers	244 (32.53)	34 (17.27)	
AL workers	266 (33.02)	87 (48.54)	
Vigorous PA ^b			0.166
Absent	739 (87.01)	154 (82.48)	
Present	110 (12.99)	29 (17.52)	
Moderate PA ^c			0.017
Absent	762 (90.09)	155 (82.84)	
Present	87 (9.91)	28 (17.16)	
Walking ^d			0.743
Absent	445 (54.85)	105 (56.44)	
Present	404 (45.15)	74 (43.56)	

Values are expressed as the mean ± standard deviation or as numbers (%).

$p < 0.05$ was considered statistically significant

PA physical activity, LBP low back pain, LSD lumbar spine degeneration, ASM appendicular skeletal mass, WC white-collar, PC pink-collar, BC blue-collar, AL agribusiness, fisheries, and low-level labor

^aThe data are presented as mean ± standard deviation

^bVigorous PA, =20 mins of vigorous exercise on =3 days per week.

^cModerate PA, =30 mins of moderate intensity exercise on =5 days per week.

^dWalking, =30 mins of walking on =5 days per week.

Table 2. Odds ratios of sarcopenia on low back pain and lumbar spine degeneration

	OR	95% CI	<i>p</i> -value
LBP			
Univariate analysis	2.08	1.39-3.11	.000
Model 1 ^a	2.03	1.36-3.02	.000
Model 2 ^b	2.23	1.38-3.59	.001
LSD			
Univariate analysis	0.82	0.56-1.19	.296
Model 1 ^a	0.62	0.42-0.93	.019
Model 2 ^b	0.61	0.40-0.92	.018

p < 0.05 was considered statistically significant

LBP low back pain, LSD lumbar spine degeneration

^aModel 1 was adjusted by age group.

^bModel 2 was adjusted by age group, obesity, occupation, and physical activity.

Table 3. Odds ratios of sarcopenia on low back pain adjusted by lumbar spine degeneration

	OR	95% CI	<i>p</i> -value
LBP			
Univariate analysis			
Sarcopenia	2.08	1.39-3.11	.000
Model 1 ^a			
Sarcopenia	2.03	1.36-3.02	.000
Plus, adjusted by LSD	2.16	1.43-3.25	.000
Model 2 ^b			
Sarcopenia	2.23	1.38-3.59	.001
Plus, adjusted by LSD	2.37	1.45-3.86	.000

p < 0.05 was considered statistically significant

LBP low back pain, LSD lumbar spine degeneration

^aModel 1 was adjusted by age group

^bModel 2 was adjusted by age group, obesity, occupation, and physical activity.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:35-14:45 Room B(5F)

OP1-2-3

Effects of assisted sit-up exercise compared to core stabilization exercise on patients with NSLBP

Cho Rong Bae^{1*}, Sang-Heon Lee^{1†}, Nack-Hwan Kim¹

Korea University Anam Hospital, Department of Physical Medicine & Rehabilitation¹

BACKGROUND

Traditional sit-up exercise is a simple method to strengthen core muscles. However, it can increase the potential of lumbar spine injury during the bending process.

OBJECTIVE

To evaluate the effect of assisted sit-up exercise (SUE) using new training device, HubEX-LEX[®], on strengthening core muscles and improving non-specific low back pain (NSLBP) compared to conventional core stabilization exercise (CSE).

METHODS

Subjects with chronic NSLBP were randomly divided into two groups: SUE (n=18) or CSE (n=18). They participated in 12 sessions of exercise program. Before and after the training, thickness and activity of core muscles were measured using ultrasonogram and surface electromyography, respectively. Pain and disability were assessed using two questionnaires.

RESULTS

Thickness ratios (contracted/rest) of rectus abdominis and external oblique in the SUE group and those of transversus abdominis in the CSE group showed statistically significant difference between before and after exercise ($p < 0.05$). The ratio of activation of internal oblique relative to rectus abdominis and all measurements for pain and disability showed statistically significant improvement in both groups ($p < 0.05$).

CONCLUSIONS

Assisted SUE using new training device can be an effective therapeutic exercise to strengthen dynamic abdominal muscles and improve core muscle activation pattern in NSLBP patients.

Table 1. Pain and disability data at T0 and T1

	SUE group			CSE group			<i>p</i> -value for difference between groups
	T0	T1	<i>p</i> -value	T0	T1	<i>p</i> -value	
VAS	3.0±1.3	1.5±1.3	<0.001*	2.9±0.8	2.1±0.9	<0.001*	0.114
RMDQ	2.4±1.5	1.1±1.6	<0.001*	3.1±2.9	2.4±2.6	0.014*	0.063
ODI	12.8±8.2	8.0±7.7	<0.001*	14.2±11.6	12.0±10.1	0.040*	0.190

CSE: conventional core stabilization exercise; ODI: Oswestry disability index; RMDQ: Roland-Morris disability questionnaire; SUE: assisted sit-up exercise; VAS: visual analogue scale; T0: pre-training; T1: within one week after the end of exercise program; *: statistically significant difference ($p < 0.05$).

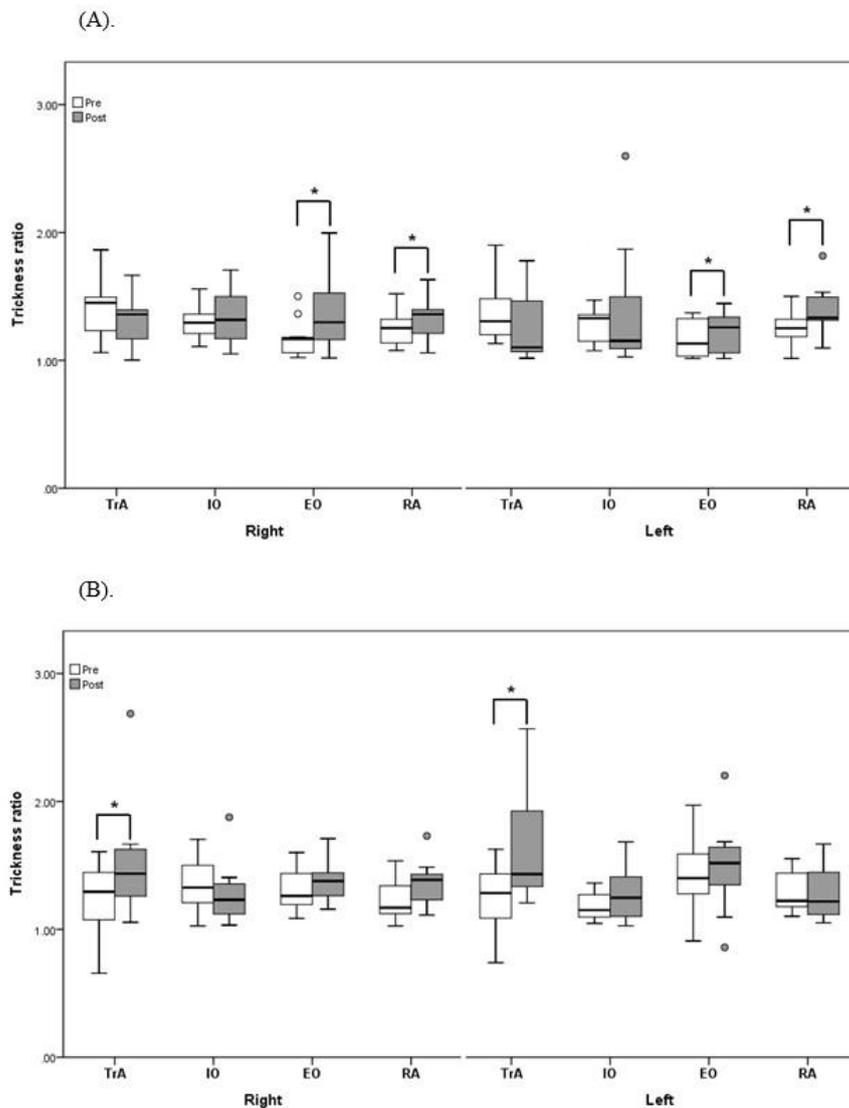


Figure 1. Thickness ratios (contracted/rest) of transversus abdominis (TrA), internal oblique (IO), external oblique (EO), and rectus abdominis (RA) for subjects. (A) Assisted sit-up exercise (SUE) group, (B) Conventional core stabilization exercise (CSE) group.

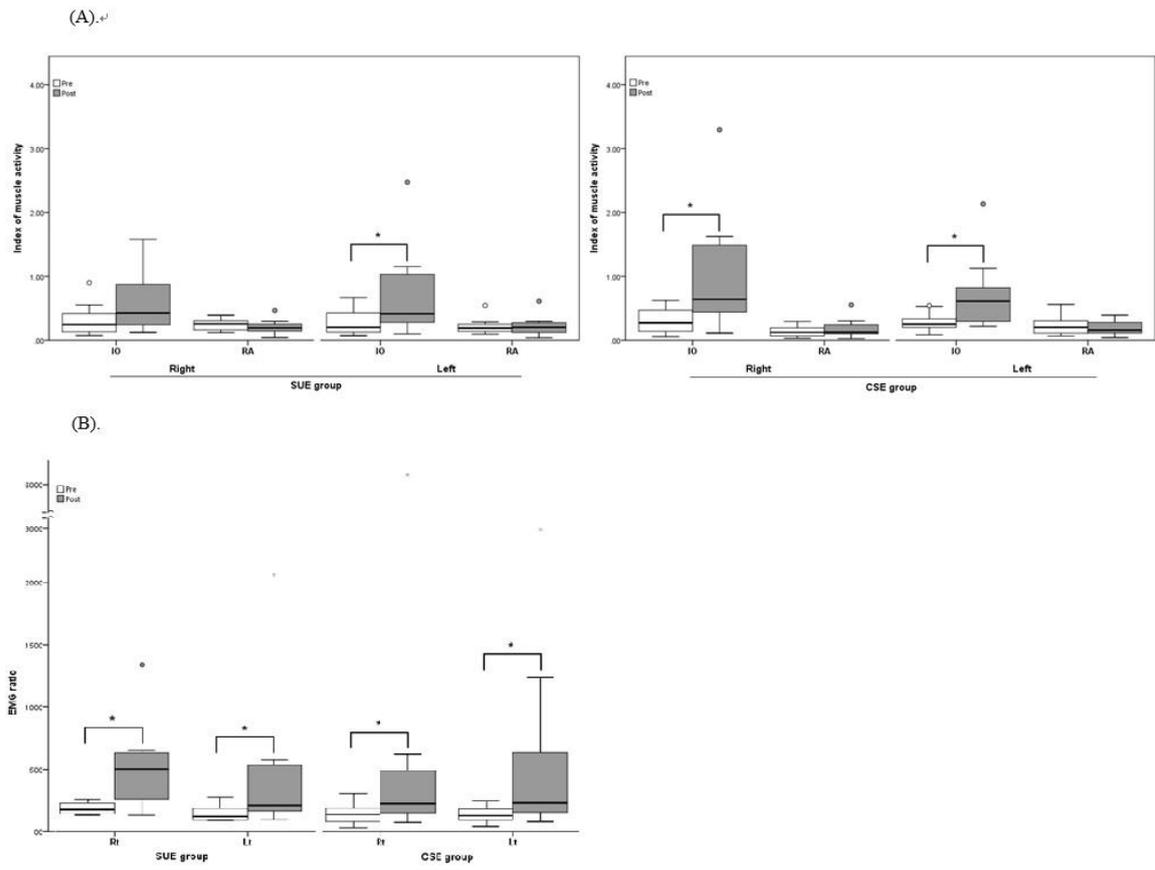


Figure 2. (A) Normalized surface electromyography (sEMG) of rectus abdominis (RA) and internal oblique (IO) muscles in CSE and SUE groups, (B) Ratios of activation (IO/RA) for CSE and SUE groups.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:45-14:55 Room B(5F)

OP1-2-4

Efficacy of Stimulator Using Low-intensity US Combined with TENS on Patients with Painful Knee OA

Eu-Deum Kim^{1*}, Yu Hui Won^{1,2}, Sung-Hee Park^{1,2}, Myoung-Hwan Ko^{1,2}, Jeon-Hwan Seo^{1,2}, Gi-Wook Kim^{1,2†}

Chonbuk National University Medical School, Department of Physical Medicine and Rehabilitation¹, Chonbuk National University Hospital, Research Institute of Clinical Medicine of Chonbuk National University ? Biomedical Research Institute ²

Introduction

Knee osteoarthritis (OA) is a major public health issue causing chronic pain and disability. Many patients with knee OA are treated with a combination of pharmacologic and non-pharmacologic modalities. Trans-Cutaneous Electrical Nerve Stimulation (TENS) is widely used for management pain in knee OA and there are several reports about the effects of cartilage regeneration of low intensity ultrasound (US). To the best of our knowledge there is no report about the stimulator using low intensity US combined with TENS for patients with painful knee OA. In this study we aim to evaluate the efficacy and safety of the stimulator using low intensity US combined with TENS.

Methods

This prospective randomized controlled trial is designed to compare the treatment effect of stimulator using low intensity US combined with TENS (US/TENS group) with TENS only (TENS group). Both group were undergone a session of 20 minute-self therapy which was done 3 or less than 3 sessions for a day and more than 10 sessions for a week during 8 weeks. Thus, total treatment session was more than 80 sessions. We evaluated knee pain and disability with Visual Analogue Scale (VAS) score, Western nulltario and McMaster (WOMAC) score and the MOS 36-item Short-Form Health Survey (SF-36). We also measured the cartilage thickness of the knee for assessment of cartilage regeneration with a diagnostic US in both groups, before and after the treatment (visit 1 = baseline, visit 2 = right after sessions of treatment, visit 3= 3 weeks after session of treatment). Statistics were executed for comparing the effects of treatment within and between the groups.

Results

Total 34 patients were enrolled and completed a series of evaluations in a timely manner (US/TENS group = 17, TENS group = 16). In both groups, we found the significant improvements for VAS, WOMAC and SF-36 score when comparing pre-treatment (V1) values with post-treatment (V2 and V3) Results. However, the thickness of knee cartilage

did not show difference after treatment. When comparing VAS and WOMAC score of V1 with V2, the score of US/TENS group show more significant improvement than those of TENS group. On the other hand, TENS group had better VAS and WOMAC score when comparing V2 values with V3 Results. There was no statically significant difference of VAS and WOMAC score between two groups when comparing V1 values with V3 Results.

Conclusions

The stimulator using low intensity US combined with TENS for patients with painful knee OA showed significant efficacy for relieving pain and improving physical performance. However, further study is needed to confirm the difference of therapeutic effect in comparison to other modalities.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 14:55-15:05 Room B(5F)

OP1-2-5

Anti-Inflammatory Effect of Low dose Triamcinolone-Nanoparticle Complex

Jun-Young Park ^{1,2}, Dongwoo Khang ^{2,3†}, Youn Joo Kang ^{4*†}

Gachon University, Department of Gachon Advanced Institute for Health Science & Technology (GAIHST)¹, Gachon University, Lee Gil Ya Cancer and Diabetes Institute², College of Medicine, Gachon University, Department of Physiology³, Eulji Hospital, Eulji University School of Medicine, Department of Rehabilitation Medicine⁴

Objectives

Triamcinolone (TA) is a synthetic glucocorticoid that has been widely used for symptomatic arthritis and repetitive injections are necessary for treating the synovial inflammation of advanced arthritis. Unfortunately, use of high-dose repetitive corticosteroid injections is sometimes accompanied by severe and/or irreversible side effects (i.e., adrenal insufficiency, hyperglycemia, Cushing syndrome, Charcot arthropathy, etc.). For this reason, we assessed the efficacy of low dose triamcinolone-nanoparticle complex (TA-NP) for suppressing the inflammation of fibroblast-like synovial cells (FLS cells) and in vivo arthritis animal models.

Materials and Methods

The TA-NP complex was fabricated by non-covalently conjugating TA with PEG-coated NPs. We investigated the anti-inflammatory efficacy of TA-NP by observing the suppression of inflammatory-inducing genes from FLS cells of osteoarthritis patient (in vitro study). For vivo study, we investigated the collagen induced arthritis animal model, which tail of mice were injected with the mixture of Freund's complete adjuvant and Bovine Type II collagen. Mice were divided into 6 group: Control, NP, TA-NP (low dose & high dose), TA alone (low dose & high dose). We investigated inflammation score of feet and histologic examination and analysis of suppression of inflammatory cytokine such as TNF- α , IL-1 β , IL-6, and IF- γ using immunohistochemistry.

Result

Suppression of TNF- α , IL-1 β , IL-6, MMP-1, and MMP-3 gene expression were observed from FLS cells, when treated with a low dosage of TA-NP (Figure 1, in vitro study). Score of inflammation from collagen induced arthritis animal model demonstrated inhibited inflammatory score of TA-NP using low doses (2 mg/kg) compared with conventional and low dose of TA (both 2 and 5 mg/kg). Suppressed expressions of TNF- α , IL-1 β , IL-6, and IF- γ using low dose TA-NP complex in histological examination, we confirmed the anti-inflammatory effect of a low dose TA-NP complex in vivo model

Conclusion

Our in vitro and in vivo study demonstrated that our low dose TA-NP complex can suppress inflammatory-related genes expression and decrease the inflammation score in animal model, suggested the possibility of low dosage TA-NP injection therapy for arthritis treatment.

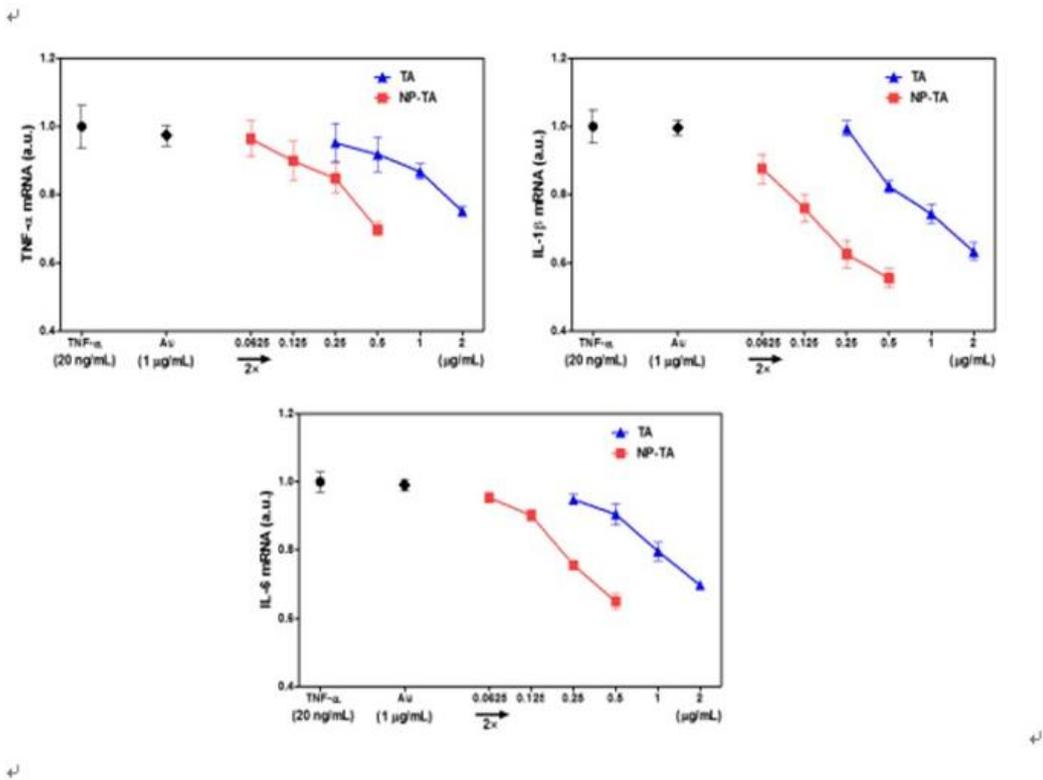


Fig1. Inhibitions of TNF- α , IL-1 β , IL-6, MMP-1, and MMP-3 from fibroblast-like synovial cells (FLS cells), isolated from a patient suffering osteoarthritis when treated with a low dosage of TA-NP(in vitro study).

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:05-15:15 Room B(5F)

OP1-2-6

The Clinical Efficacy of a Lordotic Curve Controlled Spinal Traction Device

Ju Hyun Son^{1*}, Ji Hong Min¹, Eun-Ho Yu¹, Sung Jin Heo², So Hyun Park³, Chang-Hyung Lee^{1†}

Pusan National University Yangsan Hospital, Department of Rehabilitation Medicine¹, Pusan National University Yangsan Hospital, Research Institute for Convergence of Biomedical Science and Technology², Pusan National University Yangsan Hospital, Department of Physical Therapy³

Background

A standard spinal traction (ST) device was designed to straighten the spine and improve spinal alignment to relieve pain in patients with disk disease. Although it was theoretically expected to have an effect on spinal decompression, its clinical effects have been disappointing. Because previous ST devices decompress the whole spinal structure equally without maintaining the lordotic curve, unnecessary pain could develop. Thus, our study was aimed at evaluating geometrical changes using radiography when spinal traction was applied by Lordotic Curve Controlled Traction device (LCCT), a device developed by the authors.

Methods

Herein, 40 patients with or mild non-radicular low back pain (LBP) were included. The participants were scheduled to receive LCCT or ST in random order. Anterior and posterior intervertebral distance and the ratio of anterior-to-posterior intervertebral distance (A/P ratio) during traction were calculated. Lordotic angles of intervertebral bodies (L2~L5) were measured by radiography.

Results

Mean intervertebral distances were greater during LCCT than those measured before applying traction ($p < 0.05$). Mean A/P ratio was also significantly greater during LCCT than during ST or before applying traction ($p < 0.05$). In particular, for the L4/5 intervertebral segment, which is responsible for most of the lordotic curve, the mean LCCT angle was similar to mean lordotic angle in the standing position (10.9°).

Conclusion

Based on the measurements of radiologic geometrical changes, the newly developed LCCT appears to be a useful traction device for evenly increasing the intervertebral disk space while maintaining the lordotic curve in the clinical setting.

Table 1. The demographic data of the participants General characteristics of the participants (N=40)

Variables	Male(n=13)	Female(n=27)
Age (years)	38.38±10.53	41.22±16.79
Height (cm)	171.84±3.99	161.44±3.28
Weight (kg)	75.30±7.15	52.62±4.86
BMI	23.66±4.02	20.26±2.29

All values are mean±standard deviation

Abbreviation: BMI: Body mass index

* $p < 0.05$

Table 2. Multicomparison in A/P ratio in L4/5 among initial, LCCT and ST.

(I)group	Difference of mean	Standard Deviation	p-value
Initial-ST	0.11300	0.04119	0.026*
Initial-LCCT	-0.00777	0.04119	0.982
LCCT-ST	0.12077	0.04119	0.016*

* $p < 0.05$

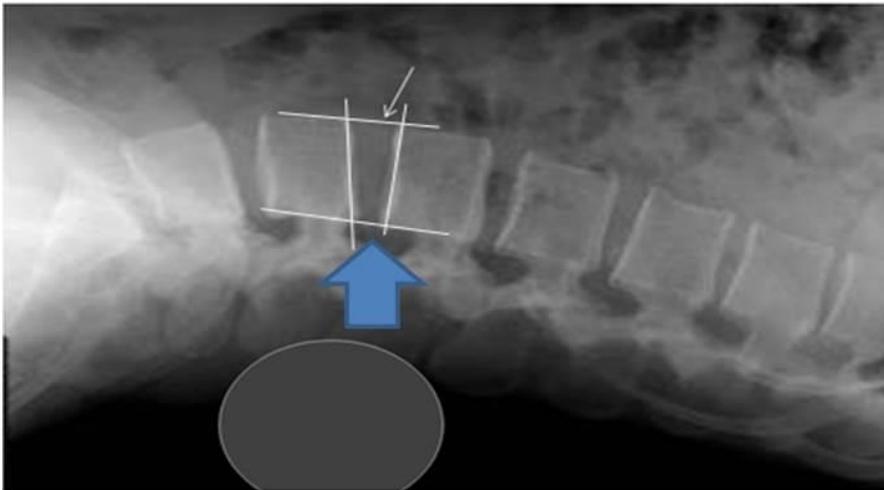


Figure 1. Lordotic curve controlled spinal traction device (LCCT)

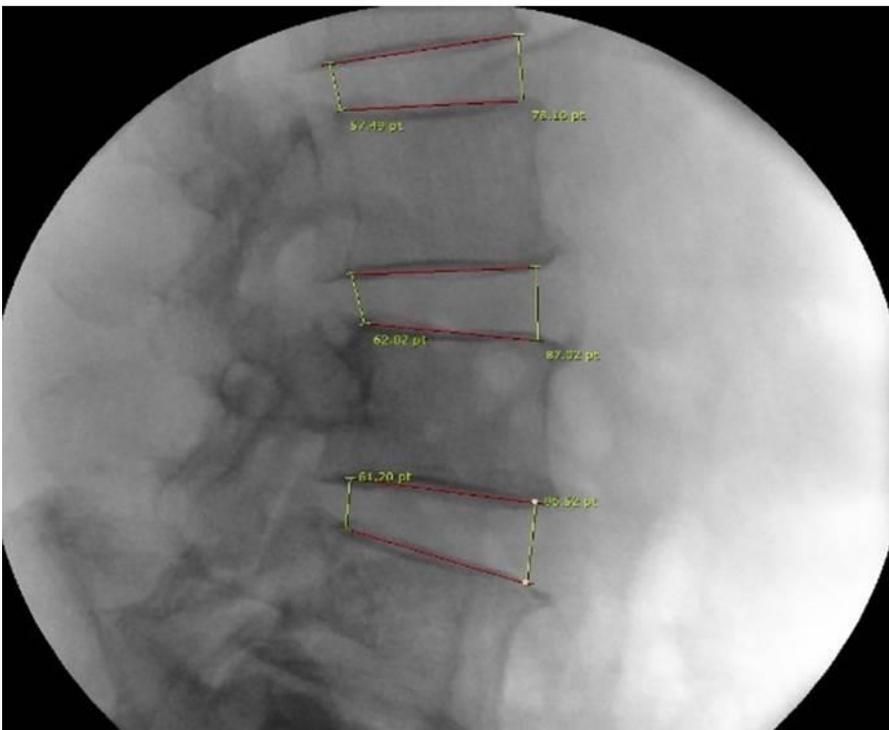


Figure 2. Measurement of intervertebral distance, distance ratio and in lateral view

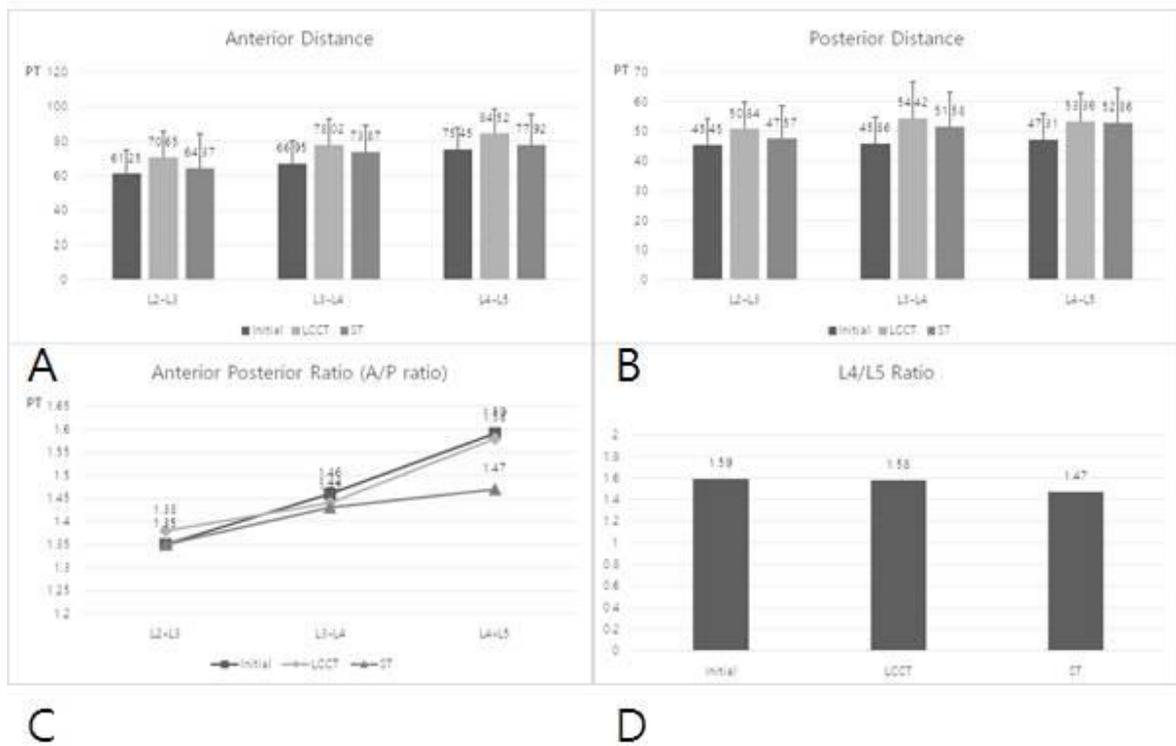


Figure 3. The intervertebral disk distances (A) in anterior and (B) posterior side in each vertebra. (C) The ratios of anterior and posterior distance in each vertebra and (D) The ratios of anterior and posterior distance in L4/5 level.

Abbreviation: initial indicated pre operative position; LCCT, lordotic curve controlled traction device ; ST , standard traction

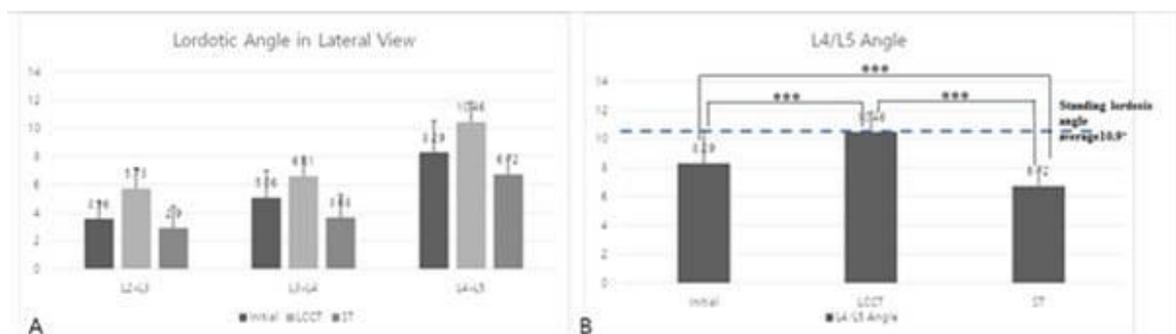


Figure 4. (A) The lordotic angle and intervertebral disk angle in each vertebral. (B) in L4/5 level in three condition. Standing lordosis angle average is 10.9. Our patient who is initial group has the lowest L4/L5 angle and LCCT group has the highest L4/L5 angle. It has statistic significant among initial, LCCT and ST. ($p=0.000***$)

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:15-15:25 Room B(5F)

OP1-2-7

Machine Learning Approach of Classifying of Minimal Joint Disease Phenotype in Knee Osteoarthritis

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Introduction

Knee osteoarthritis(OA) has a heterogeneous pathology and is caused by various causes. Also, prognosis of the disease is also known to be different. Therefore, there have been several attempts to distinguish different phenotypes of OA of the knee such as minimal joint disease (MJD), chronic pain, inflammatory, metabolic syndrome, bone and cartilage and malaligned biomechanical phenotype. Among these phenotypes, MJD represent a subgroup with low to mild symptomatology with intact stability over time and is associated with minor health care needs. Clinical classification of MJD has recently been proposed. However qualitative method to classify MJD phenotype is not well established. Now we investigate the possibility of classifying MJD by gait analysis through hip-knee cyclogram(H-K cyclogram) and which factors would contribute the classification of MJD. Finally, we expect to understand walking characteristics of MJD.

Methods

100 knee patients were recruited for this study. Among these patients, patients with $VAS \leq 3$, both $KL \leq 2$ or $VAS \geq 3$, both $KL \leq 2$ or $VAS \leq 3$, both $KL \geq 2$ were selected. Selected patients were classified into three classes(class 1, 2, 3). Class 1 corresponds to MJD patients who have $VAS \leq 3$ with both KL grades ≤ 2 , class 2 corresponds to less degenerative change with more painful patients who have $VAS \geq 3$, both KL grades ≤ 2 , class 3 corresponds to degenerative change with less painful patients who have $VAS \leq 3$, both KL grades ≥ 2 . Each classes were 13, 21, and 13 patients each. Total 688 gait patterns were acquired. Inertial Measurement Unit (IMU) based gait analysis were used to measure gait patterns. These patterns were classified using H-K cyclogram. H-K cyclogram is, unlike conventional gait analysis, is a cyclo-kinematic graph that can simultaneously observe the angles of two joints as an angle-angle diagram consisting of hip range of motion as X axis and knee range of motion as Y axis. We used 61 mathematically meaningful feature of cyclograms and selected 33 features with relieff algorithm. The training consisted of 80% of training set and 20% of validation with cross-validation 5 fold. We organized the data set with k-Nearest Neighbor method and decided which feature is most influential.

Results

When classified with k-Nearest Neighbor, it showed 96% of accuracy in predicting class 1, 98% of accuracy in predicting class 2, 97% of accuracy in predicting class 3, and overall 96.8% of accuracy in classifying MJD patients. Additionally, one of the most contributing features were the long-axis slope of the knee-knee cyclogram and the width of the hip-hip cyclogram.

Conclusion

A gait analysis using machine learning, especially with H-K algorithm is a new valid method to distinguish phenotype of knee OA. With the wider arrange of sample size study, the parameter ranking by the patient's severity classification is expected to make it possible to understand the walking characteristics of MJD.

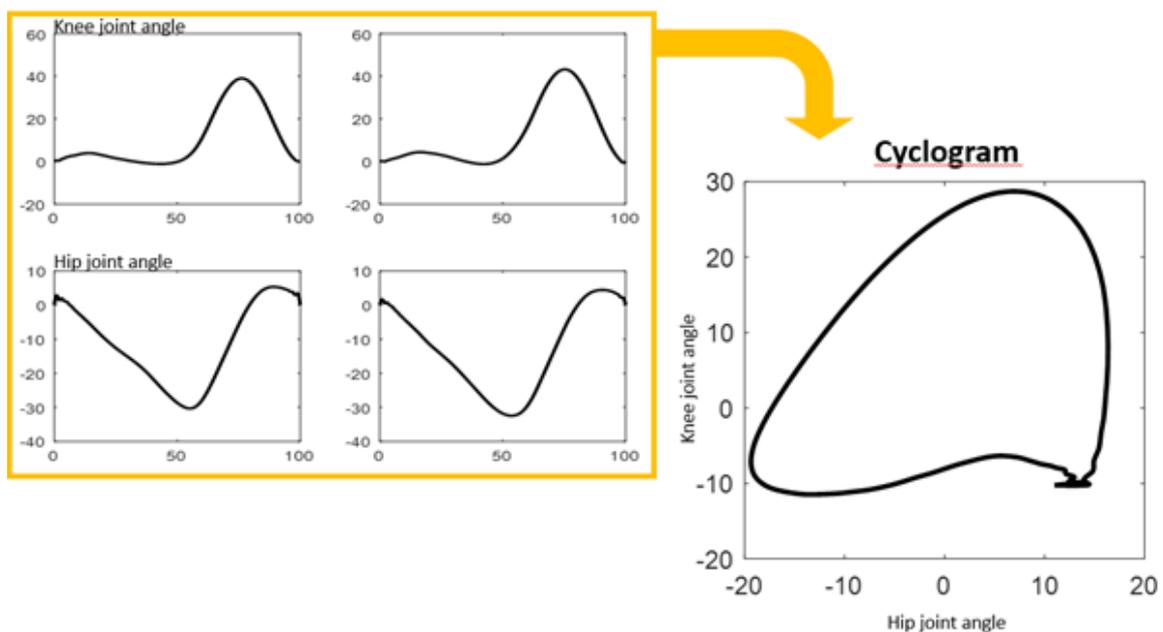
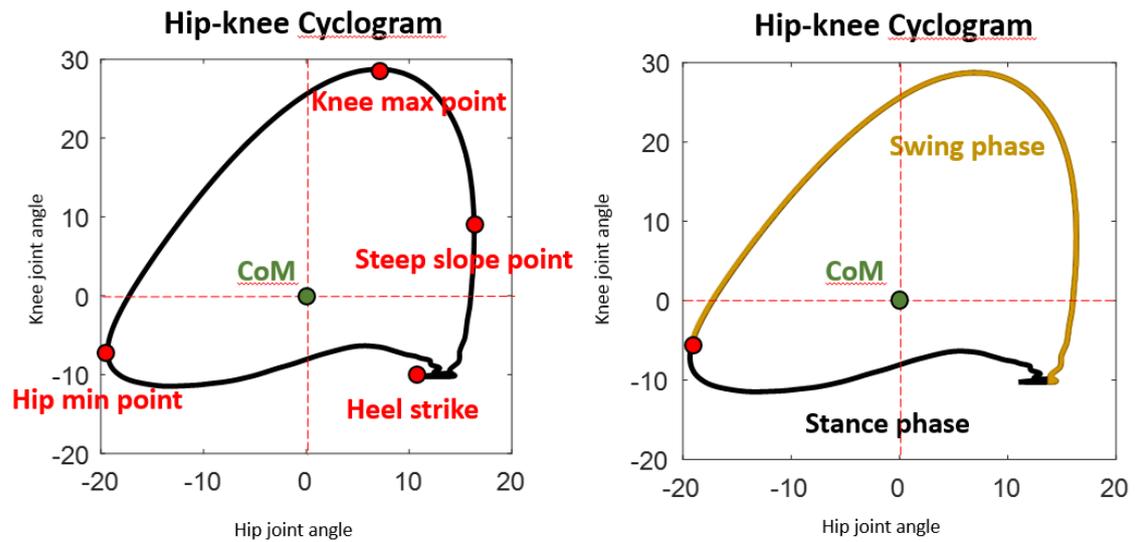


Fig 1. Graph of angle change per gait cycle of hip and knee in sagittal plane(left), cyclo-kinematic graph simultaneously observing the angles of two joints as an angle-angle diagram consisting of hip joint angle as X axis and knee joint angle as Y axis(right).



Graph showing the relationship between gait cycle and H-K cyclogram. (CoM: Center of Mass)

Confusion Matrix

Actual class	1	96% (n=170)	1% (n=2)	3% (n=6)
	2	1% (n=4)	98% (n=272)	1% (n=2)
	3	2% (n=5)	1% (n=3)	97% (n=224)
		1	2	3
		Predicted class		

Confusion matrix of predicted class and actual class.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:25-15:35 Room B(5F)

OP1-2-8

MRI-based Morphological Parameters to Quantify Lumbar Disc Degeneration

Beom Suk Kim^{1*}, Sang Jun Park³, Hye Young Sun², Hyun Bang⁴, Sun G. Chung^{1†}

Seoul National University Hospital, Department of Rehabilitation Medicine¹, Seoul National University Hospital, Department of Radiology², Dobong Hospital, Department of Rehabilitation Medicine³, Seoul Hyun Rehabilitation Clinic, Department of Rehabilitation Medicine⁴

Background and aims

When an intervertebral disc degenerates, structural deterioration occurs in a wide range of anatomical components within and adjacent to the disc, being clearly represented in cross-sectional imaging. To suggest reliable and valid MRI-based morphologic parameters to quantify lumbar disc degeneration, the reliabilities of 6 MRI parameters and one radiographic parameter were analyzed to choose those with high reliability. The selected parameters were further tested to determine validity by correlating with Pfirrmann and modified Pfirrmann grading, as reference standards.

Methods

85 patients over 60 years old who underwent MRI of the lumbar spine for mild low back pain were included. Two reviewers independently assessed the degree of degeneration and assigned one of the 4 ordinal scores from 0 to 3 in the following 7 parameters at 6 spinal segments: T2-signal intensity (T2-SI), disc extension beyond interspace (DEBIT), annular fissure, Modic changes, endplate integrity, osteophytes and disc height. Inter-observer and intra-observer agreements were assessed using Cohen's kappa statistic. For those parameters with high reliability, relationships with Pfirrmann and modified Pfirrmann grading were examined by calculating Spearman's correlation coefficients.

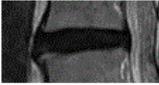
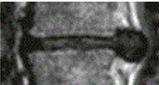
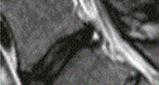
Results

While intra-observer agreements were substantial to excellent for all parameters (weighted kappa range 0.762-0.923), the inter-observer agreements were substantial to excellent for T2-SI, DEBIT, Modic changes, endplate integrity, and disc height loss (weighted kappa range 0.629-0.890), moderate for osteophytes (weighted kappa 0.573), and only fair for annular fissure (weighted kappa 0.29). T2-SI ($r=0.772$, $p<0.01$) showed high positive correlation with Pfirrmann and modified Pfirrmann grading, while DEBIT ($r=0.565$, $p<0.01$), endplate integrity ($r=0.597$, $p<0.01$), and osteophytes ($r=0.537$, $p<0.01$) showed moderate positive correlations. Only low positive correlations were observed in Modic changes ($r=0.397$, $p<0.01$) and disc height loss ($r=0.391$, $p<0.01$).

Conclusions

To quantify lumbar disc degeneration using MRI, T2-SI, DEBIT, Modic changes, endplate integrity, and osteophytes could be used as reliable parameters. Disc height loss on radiographic study also could be a reliable parameter. However, different weights might be applied to each parameter because validities to represent degeneration varied.

Table 1. Imaging parameters of disc degeneration.

	0	1	2	3
T2-SI loss 	Normal	Intermediate loss	Marked loss	Absent signal
DEBIT 	Intact	Bulge	Protrusion	Extrusion/ <u>Sequestration</u>
Annular fissure 	Intact	Concentric fissures	Radial fissures	Transverse fissures
Modic changes 	Normal	Type I	Type II	Type III
Endplate integrity 	Intact	Isolated defects	<u>Schmorl's node</u> <5mm	<u>Schmorl's node</u> >5mm
Osteophytes 	Absent	Marginal	Dis-continuous	Continuous
Disc height loss 	0-10%	10-20%	20-30%	>30%

	0	1	2	3
T2SI				
DEBIT				
Annular fissure				
Modic changes				
Endplate integrity				
Osteophytes				
Disc height loss				

Figure 1. Grading assessment of imaging parameters.

L4/5	Total score: 4	7	9	12	14	16
L5/S1	3	6	8	12	15	18

Figure 2. Stratification of disc degeneration process.

통증 및 근골격재활

발표일시 및 장소 : 10 월 26 일(금) 15:35-15:45 Room B(5F)

OP1-2-9

Comparison of imaging findings between calcific tendinitis with bursitis and adhesive capsulitis

Gi Young Park^{1†}, Dong Rak Kwon¹, Dae Gil Kwon^{1*}, Dong Han Kim¹

Daegu Catholic University Medical Center, Department of Rehabilitation Medicine¹

Objective

To evaluate radiographic and ultrasound (US) findings in the patients with calcific tendinitis of shoulder and compare these imaging findings between the patients with subacromial-subdeltoid (SASD) bursitis and adhesive capsulitis (AC) alone.

Methods

One hundred-thirty-four shoulders (129 patients, 36 men, 93 women; mean age, 56.9+9.3 years; range, 33-84 years) that were diagnosed as calcific tendinitis of shoulder on US were recruited from January 1st 2013 to June 31th 2018. Radiographic morphology of calcification was classified by Gartner and Simons method including type 1 (dense with well-defined borders), type 2 (dense with indistinct borders or transparent with well-defined border), and type 3 (transparent with indistinct borders). US morphology of calcification was classified as arc-shaped, fragmented, nodular, cystic, and linear type (Figure 1). Shadow of calcification on US was classified as type 1 (well-defined shadow), type 2 (faint shadow), and type 3 (no shadow). Size of calcification was measured as the maximal diameter on radiograph and US. Power Doppler signal intensity in calcification was graded as no signal, mild, moderate, and severe. Location of calcification in tendon was classified as bursal side, articular side, and full-thickness involvement. The patients were allocated into two groups according to response to US guided injection; group 1 (responder to SASD bursa injection, 75 patients, 21 men, 54 women; mean age, 56.3 ± 9.1 years; range, 33-77 years) and group 2 (responder to glenohumeral joint injection, 54 patients, 15 men, 39 women; mean age, 57.7 ± 9.5 years; range, 43-84 years). Visual analogue scale was reduced more than half at two weeks after injection in both groups.

Results

There was no significant difference of demographic data between two groups (Table 1). There was a significant difference of US morphology, power Doppler signal intensity, and location of calcification between two groups (Table 2). Fragmented type was 55 calcifications (75.3%) in group 1 and 18 (24.7%) in group 2, and arc-shaped type was 20 (69.0%) in group 2 and 9 (31.0%) in group 1 ($p<.001$). Power Doppler signal intensity in group 1 (0.7 ± 0.8) was stronger than that in group 2 (0.4 ± 0.6) ($p=.008$). Articular side location was 39 calcifications (61.9%) in group 2 and 24 (38.1%) in in group 1, and bursal

side/full-thickness were 24 (85.7%) / 30 (69.8%) in group 1 and 4 (14.3%) / 13 (30.2%) in group 2 ($p < .001$). There was no significant difference of radiographic morphology, size, and US shadow between two groups.

Conclusions

Our Results indicated that the morphology, power Doppler signal intensity, and location of calcification on US is associated with the pain of shoulder calcific tendinitis. Therefore, the US assessment of morphology, power Doppler signal intensity, and location of calcification can help to decide the target of treatment in the patients with shoulder calcific tendinitis.

Table 1. Demographic data in shoulder calcific tendinitis with subacromial-subdeltoid bursitis and adhesive capsulitis

	Group 1 (n=78)	Group 2 (n=56)	P value
Age (year)	56.3 ± 9.1	57.7 ± 9.5	0.387
Sex, n (%)			
Male	21 (26.9)	15 (26.8)	0.986
Female	57 (73.1)	41 (73.2)	
Weight (kg)	59.1 ± 9.3	60.2 ± 9.7	0.530
Height (cm)	161.1 ± 7.9	161.8 ± 7.7	0.619
Body mass index	22.7 ± 2.3	23.0 ± 2.7	0.548
Symptom duration (months)	3.5 ± 4.0	4.2 ± 3.9	0.375
Associated disease, n (%)			
DM	8 (10.3)	12 (21.4)	0.073
Stroke	0 (0.0)	1 (1.8)	0.236
Thyroid disease	2 (2.6)	2 (3.6)	0.735
Heart disease	4 (5.1)	1 (1.8)	0.314

Group 1, calcific tendinitis with subacromial-subdeltoid bursitis; group 2, calcific tendinitis with adhesive capsulitis

Values are mean ± SD.

Table 2. Radiographic and ultrasound findings in shoulder calcific tendinitis with subacromial-subdeltoid bursitis and adhesive capsulitis

	Group 1 (n=78)	Group 2 (n=56)	P value
Radiographic classification, n (%)			
No calcification	12 (15.5)	2 (3.6)	0.093
Type 1	9 (11.5)	12 (21.4)	
Type 2	48 (61.5)	35 (62.5)	
Type 3	9 (11.5)	7 (12.5)	
Radiographic diameter (mm)	10.1 ±	9.3 ± 4.7	0.613
Ultrasound morphology, n (%)			
Arc-shaped	9 (11.5)	20 (35.7)	<0.001*
Fragmented	55 (70.5)	18 (32.1)	
Nodular	14 (17.9)	14 (25.0)	
Linear	0 (0.0)	4 (7.1)	
US longitudinal diameter (mm)	9.5 ± 4.1	8.4 ± 3.2	0.097
US transverse diameter (mm)	7.0 ± 3.0	6.6 ± 3.0	0.497
Power Doppler signal intensity	0.7 ± 0.8	0.4 ± 0.6	0.008†
Location, n (%)			
Articular	24 (30.8)	39 (69.6)	<0.001*
Bursal	24 (30.8)	4 (7.1)	
Full-thickness	30 (38.5)	13 (23.2)	

Group 1, calcific tendinitis with subacromial-subdeltoid bursitis; group 2, calcific tendinitis with adhesive capsulitis

* P-values calculated by chi-squared test

† P-values calculated by Mann-Whitney U test

Values are mean ± SD.

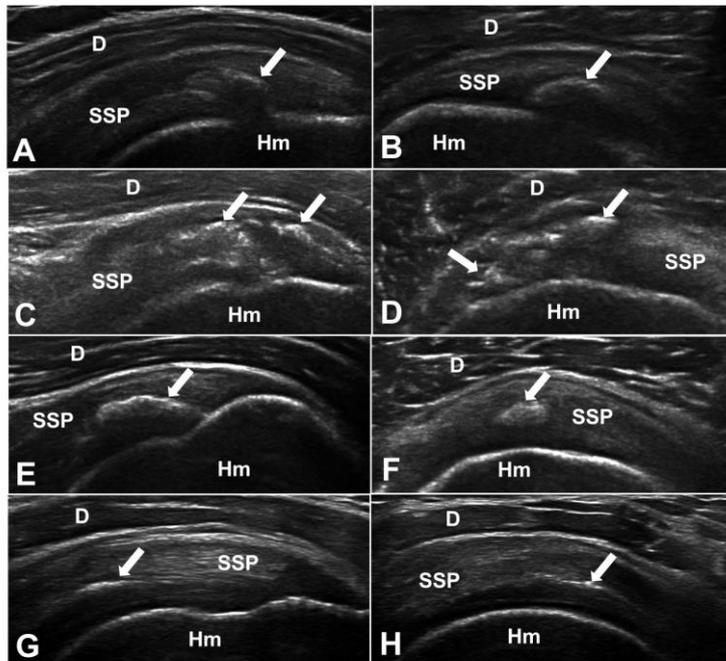


Figure 1. Morphology of calcification on longitudinal and transverse ultrasound imaging. (A, B) arc-shaped type (C, D) fragmented type, (E, F) nodular type, (G,H) linear type; D, deltoid muscle; SSP, supraspinatus muscle; Hm, humeral head; arrow, calcification

ORAL PRESENTATION 1-3

통증 및 근골격재활

발표일시 및 장소 : 10 월 27 일(토) 14:00-14:10 Room B(5F)

OP1-3-1

Painful arc test: predictor for short term pain relief after subacromial-subdeltoid bursa injection.

Dong Yoon Park^{1*}, Sang Rok Woo¹, Joon shik Yoon^{1†}

Korea University Guro Hospital, Department of Rehabilitation Medicine¹

Introduction

Subacromial-subdeltoid (SASD) bursa injection has been widely used to treat a range of shoulder conditions such as impingement syndrome, rotator cuff tendinosis, calcific tendinitis or bursitis. However, these conditions are sometimes difficult to distinguish clinically and sometimes exist at the same time. The purpose of this study was to identify predictor of short-term pain relief after SASD bursa injection

Methods

The medical records of 150 patients who were visited our outpatient clinic from January 1st 2017 to June 1st 2018 and treated with SASD bursa injection were reviewed in this retrospective study. The inclusion criteria were as follows: i) shoulder pain without recent trauma(<1 months), ii) at least one of the following findings is positive; pain arc test (60-120 degrees), empty can test, end range pain at passive flex or abduction, Hawkin test. The exclusion criteria were as follows; i) limited range motion of shoulder in capsular pattern, ii) pain from AC joint, iii) pain from cervical origin, iv) follow up loss. All the injections were conducted by an experienced physiatrist under ultrasound guidance on an outpatient basis. A mixture of 10 mg (0.25cc) of triamcinolone acetonide suspension and 5 cc of 0.5% lidocaine was injected to the SASD bursa. Oral analgesics were prescribed to all the patients. Ultrasound findings of the shoulder was recorded on the chart. All the patients were instructed to visit the clinic after 2 weeks. The short term pain relief were defined as the group with a reduction greater than 50% on NRS compared with initial visit. We conducted independent t-test, Fisher's exact test and chi-squared test to demonstrate the statistical difference. And univariate logistic regression analysis was used to identify the predictor. P-value<0.05 was considered statistically significant.

Results

Based on the inclusion and exclusion criteria, 83 out of 150 patients were included in this study. Demographics, medications prescribed, physical examination, and ultrasound findings were compared between the good and poor response groups (Table 1,2,3). A

statistically significant difference was observed only in the proportion of painful arc test. An univariate logistic regression analysis demonstrated that positive painful arc test increased the odds of significant improvement 2 weeks after SASD bursa injection.($p=0.04$, $OR=3.98$).

Conclusions

The positive painful arc test is likely to predict a short term good response 2 weeks after SASD bursa injection. Other physical and ultrasonographic findings were not associated with the short term response prediction. The Results should be validated via randomized prospective studies in the future.

Table 1. Summary of demographics and medications.

Variables	Values			
	Poor response(n=29)	Good response(n=54)	P-value	
Demographic				
Sex	Male	13	28	0.54
	Female	16	26	
Age	56.7±9.2	55.7± 14.1	0.70	
Medication				
NSAIDs	27	46	0.33	
NSAIDs/ AAP	0	1		
NSAIDs/AAP/Tramadol	1	4		
AAP	1	0		
AAP/Tramadol	0	3		

Data are expressed as mean ± standard deviation or absolute number.

NSAIDs :non-steroidal anti-inflammatory drugs, AAP : acetaminophen, SST : supraspinatus

Table 2. Summary of physical exam findings

Variables		Values		
		Poor response(n=29)	Good response(n=54)	P-value
Physical exam				
ROM	Flexion	164.8±20.0	171.4±16.7	0.11
ROM	Abduction	160.7±26.0	170.2±20.0	0.07
Empty can	Positive	21	41	0.73
	Negative	8	13	
Hawkin test	Positive	14	17	0.13
	Negative	15	37	
Pain arc test	Positive	3	17	0.03*
	Negative	26	37	

Data are expressed as mean ± standard deviation or absolute number.

Table 3. Summary of ultrasound findings

Variables		Values		
		Poor response(n=29)	Good response(n=54)	P-value
Ultrasound				
Bicipital groove	Normal	20	43	0.28
	Fluid	9	11	
SST tear	No	3	15	0.12
	Partial	17	21	
	Full	9	18	
SST swelling	No	20	42	0.38
	Swelling	9	12	
Calcification	No	22	40	0.60
	Type 1	2	4	
	Type 2	5	7	
	Type 3	0	3	

Data are expressed as mean ± standard deviation or absolute number.

통증 및 근골격재활

발표일시 및 장소 : 10 월 27 일(토) 14:10-14:20 Room B(5F)

OP1-3-2

Principal component analysis of variables from insole pressure measurement for post stroke hemiplegia

Woo Sub Kim^{1†}, Hanboram Choi¹, Ju Hyong Jeoung^{1*}

Korea University Guro Hospital, Department of Rehabilitation Medicine¹

Objective

To investigate structure of variance dependencies among gait variables from insole pressure measurement system in post-stroke hemiplegia, we measured gait variables during level walking and conducted principal component analysis.

Method

58 participants with acute post-stroke hemiparesis were included in this study. They performed 10 meter level walking without cane or walker. Insole foot pressure measurement was applied. Temporo-spatial parameters included walking speed, stride length, cadence, double support phase, stance phase for more and less affected limbs, stride time and its standard deviation, stance phases and their standard deviations. Effective foot length (EFL) was a normalized anterior-posterior displacement of center of pressure for individual foot length, respectively. Principal component analysis was conducted for the variables from insole pressure measurement system. Principal components which could explain more than 80% of variability were selected. After selection of components, each component was interpreted by variables with more than absolute value 0.3 loadings.

Results

Cumulative proportions of variations explained by first 3 components are 73.9% (Figure 1). Each components and variables with their loading on components are reported in table 1. We interpreted 1st components as representing impairments in more affected lower limb function (Figure 3). We interpreted 2nd components as representing compensations in less affected lower limb function (Figure 2). We interpreted 3rd components as representing variability and stability.

Conclusions

For gait variables from insole type pressure measurement system, there are three independent components explaining total variance. The largest proportion of variance is from impairment of more affected side.

Table 1. 1st 4 components and each variable's loading on each components. DS: double stance phase, SS: single stance phase, MA: more affected side, LA: less affected side, EFL: effective foot length, DSDI: double stance phase duration, sd: standard deviation, Sym: symmetrical index.

	Component1	Component2	Component3	Component4
Stride length	-0.350			
Cadence	-0.231	-0.243	0.149	
Initial DS	0.339			-0.239
Terminal DS	0.337		-0.210	
SS_MA	-0.354	-0.260	0.119	-0.185
SS_LA	-0.272	0.394	0.145	0.335
EFL_MA	-0.330	-0.172	-0.158	0.203
EFL_LA	-0.219	0.250	0.388	-0.390
DSD sd	0.176	-0.303	0.562	0.288
Stance sd MA	0.243	-0.246	0.474	0.312
Stance sd LA	0.298	-0.182	-0.111	-0.201
Sym_EF	0.194	0.366	0.404	-0.429
Sym_SS	0.151	0.547		0.425

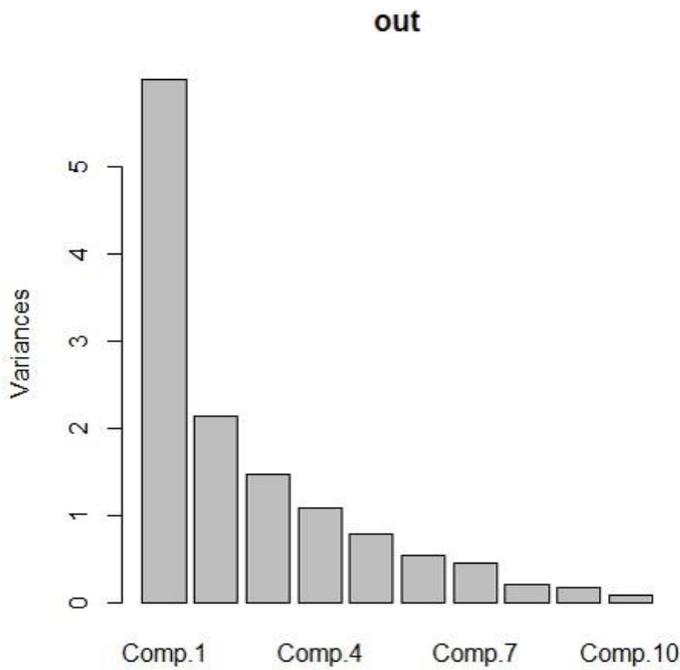


Figure 1. Variances explained by each component. 1st component explains 46.10% of total variance. 2nd component explains 16.48%, and 3rd components explains 11.37%.

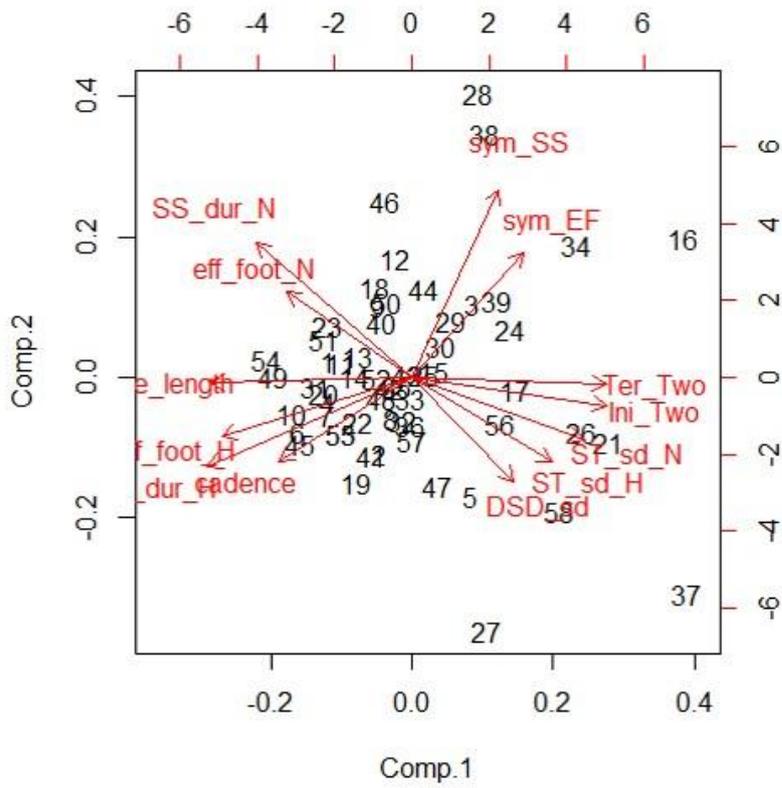


Figure 2. Each variables loadings on 1st and 2nd components which are independent each other.

통증 및 근골격재활

발표일시 및 장소 : 10 월 27 일(토) 14:20-14:30 Room B(5F)

OP1-3-3

C δ G Attenuates Allodynia in Chronic CRPS by Inhibiting Spinal Astrocyte-Mediated Neuroinflammation

Donghwi Park^{1*†}, Dae Hee Lee¹, Kwang Jae Yu¹

Daegu Fatima Hospital, Department of Rehabilitation Medicine¹

Complex regional pain syndrome (CRPS) is a painful, disabling, and often chronic condition with an estimated incidence rate of 26.2 per 100,000 per person-years. Although CRPS is described as a single disease, it is usually categorized into two distinct phases: an acute stage of CRPS and a chronic stage of CRPS. Although the mechanisms supporting the chronic phases of CRPS are still very poorly understood, reactive astrocyte-mediated neuroinflammatory responses in the spinal dorsal horn have been identified as one of the major causes of central sensitization, and has been regarded as one of the causes of the chronic stage of CRPS in previous studies. C δ G, which belongs to the lipocalin family, seems to act as an inhibitor of sphingosine-1 phosphatase (S1p) receptor. Here, we explored the anti-allodynia effects of C δ G on a model of chronic CRPS induced and investigated the levels of the GFAP protein and the mRNA and protein levels of pro-inflammatory cytokines in the spinal cord, including interleukin-6 (IL-6) and tumor necrosis factor- α (TNF- α), C-C motif chemokine ligand 2 (CCL2). Chronic CRPS model using limb fracture and cast immobilization significantly induced mechanical allodynia. Intrathecal administration of C δ G remarkably reversed the mechanical allodynia and reduced the mRNA levels of IL-6, TNF- α , and CCL2 in the spinal cord. And in immunohistochemistry (IHC) of the lumbar spinal cord, intrathecal administration of C δ G remarkably reduced the level of GFAP protein compared with the control group. (Figure 1) Additionally, according to the in vitro data, the C δ G treatment inhibited S1p-induced increases in the mRNA and protein levels of IL-6, TNF- α , and CCL2 and suppressed the NF- κ B pathway by inhibiting the phosphorylation of NF- κ B/p65 and the degradation of inhibitor of NF- κ B (I κ B) in astrocytes without toxicity to astrocytes. (Figure 2) Overall, the analgesic effect of C δ G correlated with the inhibition of spinal reactive astrocyte-mediated neuroinflammation through the NF- κ B pathway in a mouse model of chronic CRPS.

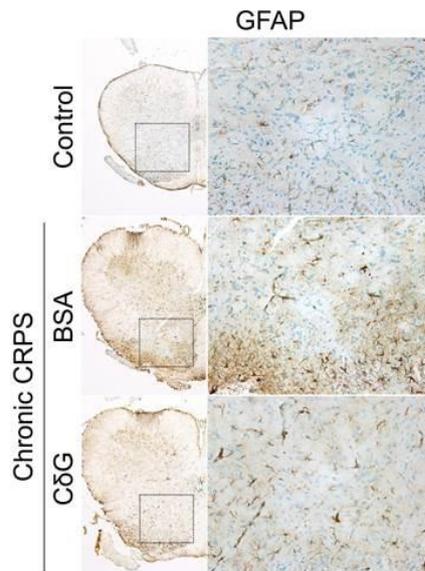


fig 1. Immunohistochemistry (IHC) of the lumbar spinal cord. Astrocyte activation is decreased by intrathecal administration of CδG

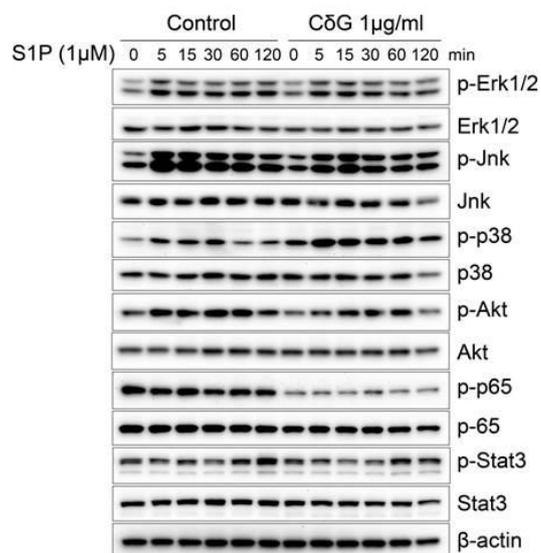


fig 2. In vitro data, the CδG treatment inhibited S1p-induced increases in the mRNA and protein levels of IL-6, TNF- α , and CCL2 and suppressed the NF- κ B pathway by inhibiting the phosphorylation of NF- κ B/p65

통증 및 근골격재활

발표일시 및 장소 : 10 월 27 일(토) 14:30-14:40 Room B(5F)

OP1-3-4

Hybrid regenerative effects of 3D bioprinting with stem cell in rotator cuff tear in rabbit model

Sang Chul Lee², Dong Rak Kwon^{1*†}, Gi Young Park¹, Yong Suk Moon³, Jinah Jang⁴, In Ho Woo¹

Daegu Catholic University Medical Center, Department of Rehabilitation Medicine¹, Severance Hospital, Department of Rehabilitation Medicine², Daegu Catholic University Medical Center, Department of Anatomy³, Others, POSTECH, Department of Creative IT Engineering and IBIO⁴

Objective

The aim of this study was to compare the regenerative effects of implantation with three-dimensional bioprinting of multilayered construct containing umbilical cord blood (UCB)-derived mesenchymal stem cell (MSC) and ultrasound (US)-guided injection with human umbilical cord blood-derived mesenchymal stem cells (UCB-MSCs).

Methods

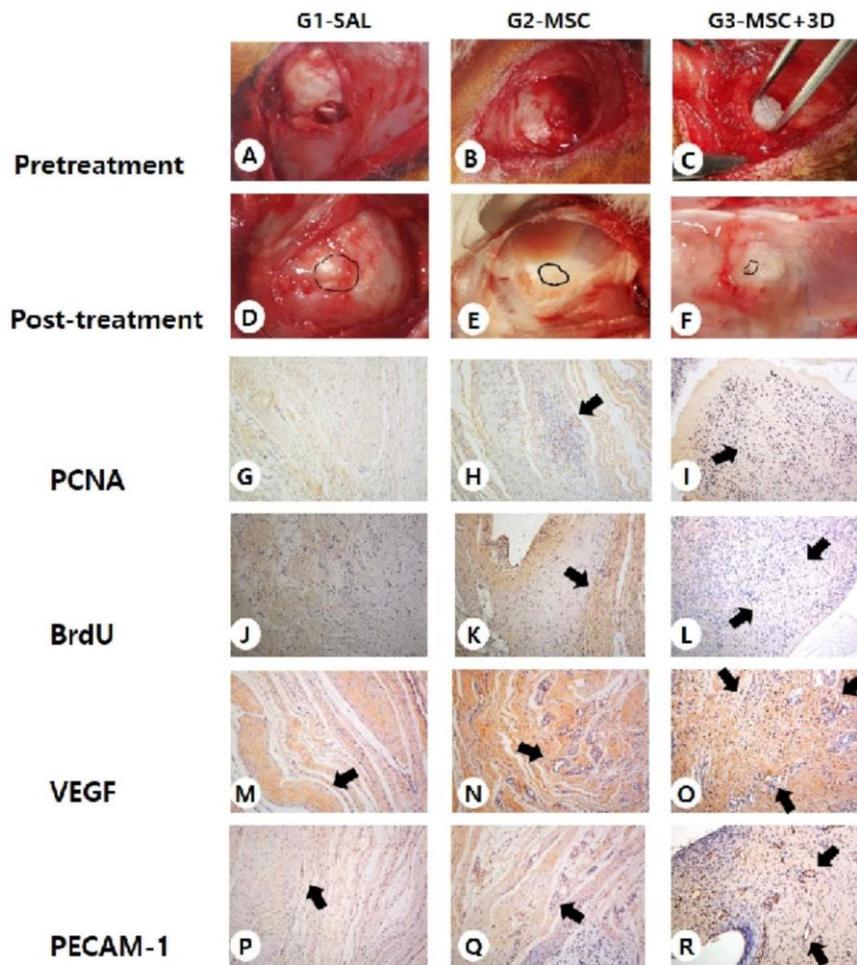
Rabbits (n=18) were allocated into 3 groups. After a 5-mm sized full-thickness rotator cuff tendon tear (FTRCTT) just proximal to the insertion site on the supraspinatus tendon was created by excision, the wound was immediately closed by subcutaneous and skin sutures. Two injections (0.2 mL normal saline, G1-SAL; 0.2 mL UCB-MSCs, G2-MSC) were performed into FTRCTT under US guidance. 3D construct containing UCB-derived MSC was implanted into the FTRCTT (0.2mL UCB-MSCs+3D construct, G3-MSC+3D). Gross morphologic changes and histologic examination were performed on all rabbits after sacrifice. Motion analysis was also performed.

Results

The gross morphologic mean tendon tear size in G3-MSC+3D and G2-MSC was significant smaller than that of G1-SAL ($p<.05$). There was no significant difference in tendon tear size between G2-MSC and G3-MSC+3D. However there were differences in the degree of tendon recovery among three groups ($p<.05$). Complete healing(CH) was observed in two rabbits (33%) and partial thickness tear(PTT) was observed in four rabbits (67%) in G3-MSC+3D, CH was observed in one rabbit (16.7%), PTT was observed in three rabbits (50%) in G2-MSC. In G1-SAL, FTT was observed in every rabbits. In G3-MSC+3D, regenerative activity, angiogenesis, walking distance, fast walking time, mean walking speed were greater than in the other two groups on histological examination and motion analysis.

Conclusions

Three dimensional bioprinting of multilayered construct implantation with mesenchymal stem cell treatment was more effective than ultrasound guided injection in gross morphological, histological and motion analysis in a rabbit model of traumatic FTRCTT.



Gross morphological (A-F) findings of the supraspinatus tendons in G1-SAL, G2-MSC, and G3-MSC+3D. (A-C) Pre-treatment images; (D-F) Post-treatment images. Immunohistochemical (G-R) findings of the supraspinatus tendons in G1-SAL, G2-MSC, and G3-MSC+3D. (G-L) Numerous PCNA and BrdU stained cells (black arrow, X200) were observed in regenerated tendon fibers in G2-MSC, and G3-MSC+3D. Few PCNA stained cells were observed in G1-SAL. (M-R) Numerous VEGF-positive cells and PECAM-1 positive microvascular densities (black arrows, X200) were observed in G2-MSC, and G3-MSC+3D. Few VEGF-positive cells and PECAM-1 positive microvascular densities were observed in group G1-SAL.

Abbreviations are MSC : Mesenchymal stem cell; PCNA: proliferating cell nuclear antigen; BrdU : 5-bromo-2'-deoxyuridine; VEGF : vascular endothelial growth factor; and PECAM : platelet endothelial cell adhesion molecule.

Gross morphological and immunohistochemical findings

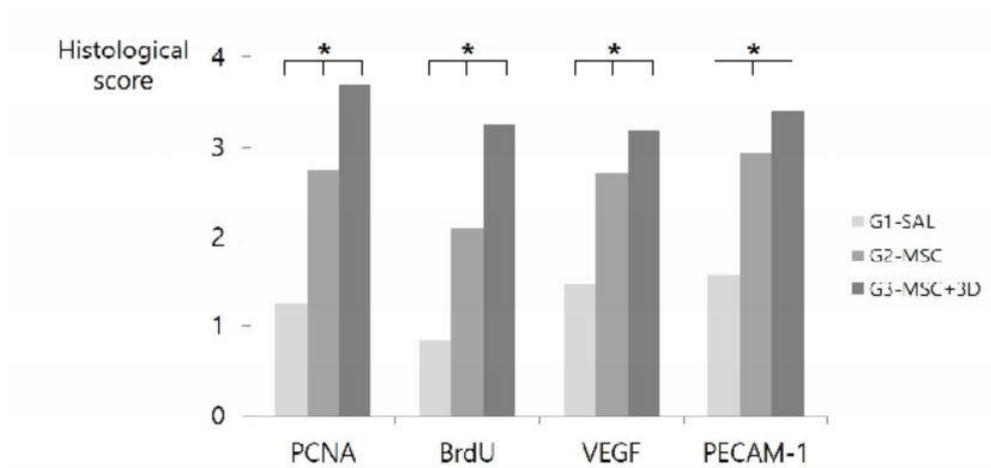


Fig. 2. Semiquantitative score of histological findings, immunoreactivity of stain.

The proportion of PCNA-, BrdU-, VEGF-, and PECAM-1-positive cells were scored as detailed in Materials and Methods.

*P < .05 one-way ANOVA, Turkey's post hoc test among group.

Abbreviations are MSC : Mesenchymal stem cell; PCNA: proliferating cell nuclear antigen; VEGF : vascular endothelial growth factor; and PECAM : platelet endothelial cell adhesion molecule.

Groups (Injection regimens)			
	G1-SAL (n=6)	G2-MSC (n=6)	G3-MSC+3D (n=6)
Gross			
Tear size	14.75±3.13	4.98±4.1 [*]	2.88±1.75 [†]
Histological score			
PCNA	1.25±1.05	2.74±0.97 [*]	3.69±0.76 ^{†‡}
BrdU	0.84±0.89	2.1±1.02 [*]	3.25±1.06 ^{†‡}
VEGF	1.47±0.18	2.72±0.79 [*]	3.19±0.75 ^{†‡}
PECAM-1	1.56±0.95	2.94±0.9 [*]	3.4±0.87 ^{†‡}
Motion analysis			
Walking distance(cm)	4852.75±137.27	6343.63±213.57 [*]	7291.83±433.74 ^{†‡}
Fast walking time(%)	5.62±1.42	10.04±2.35 [*]	14.06±1.79 ^{†‡}
Mean walking speed(cm/sec)	6.3±0.57	9.63±1.79 [*]	13.68±2.47 ^{†‡}

Values are mean±SD.

The proportion of positive cells of PCNA, VEGF, PECAM-1 was scored as 0 = no cells stained positive, 1 = between 1% and 10%, 2 = between 11% and 33%, 3 = between 34% and 66%, and 4 = between 67% and 100%.

PCNA, proliferating cell nuclear antigen; BrdU : 5-bromo-2'-deoxyuridine; VEGF, Vascular endothelial growth factor; PECAM-1, Platelet endothelial cell adhesion molecule.

^{*}) p < .05 one-way ANOVA, Tukey's post hoc test between group 1 and 2

[†]) p < .05 one-way ANOVA, Tukey's post hoc test between group 1 and 3.

[‡]) p < .05 one-way ANOVA, Tukey's post hoc test between group 2 and 3.

Semiquantitative score of gross morphologic, histological findings, immunoreactivity of stain and motion analysis according to treatment groups at 4 weeks after injection.

통증 및 근골격재활

발표일시 및 장소 : 10 월 27 일(토) 14:40-14:50 Room B(5F)

OP1-3-5

The effectiveness of intraarticular pulsed radiofrequency in a rabbit model of rheumatoid arthritis

Hee Kyung Cho^{1*†}, Gi Young Park¹, Woo Jung Sung², Won Bin Jung¹, In Ho Woo¹

Catholic University of Daegu School of Medicine, Department of Rehabilitation Medicine¹,
Catholic University of Daegu School of Medicine, Department of Pathology²

Purpose

Rheumatoid arthritis (RA) is a chronic autoimmune pathology characterized by the proliferation and inflammation of the synovium and this process leads to the joint erosion. When arthritis worsen in one or two joints, the most often therapy is known as intraarticular corticosteroid injection. Although fast in reducing arthrogenic pain, corticosteroid injection may lead severe adverse events such as septic arthritis with repeated usage. Pulsed radiofrequency (PRF) was initially introduced for the relief of chronic neurogenic pain. Recently, some clinical studies have shown that intraarticular PRF administration reduced chronic peripheral joint pain. However, to our knowledge, there is no research that has investigated about the effectiveness of PRF in an animal model of RA. We aimed to compare the effectiveness of intraarticular PRF administration and corticosteroid injection using histopathologic and motion analysis Methods in ovalbumin (OVA)-induced arthritis rabbit model.

Methods

Eighteen rabbits were included in this study. RA was induced in right knee joint by intraarticular OVA injection. Rabbits were randomly allocated into three groups to receive either ultrasound guided intraarticular PRF administration with a 45 V, 5 Hz, and 4 minute or intraarticular corticosteroid injection with 0.1 ml of triamcinolone acetonide (10 mg/ml). For rabbits in the sham stimulation group, electrode placement was conducted in precisely the same manner, but the machine was turned off and radiofrequency stimulation was not applied in the joint. Rabbits were tested motion analysis at 2 weeks, 4 weeks, and 8 weeks after PRF administration. Histopathologic evaluation of distal femur and synovium was performed at 2 weeks, 4 weeks, and 8 weeks after PRF administration.

Results

After intraarticular PRF administration and intraarticular corticosteroid injection, walking distance, fast walking time, and mean walking speed was statistically increased as time goes by ($p < 0.05$) (Figure 1). Histopathologic image analysis showed significantly decreased damage of medial and lateral femoral condyle at 2 weeks and 4 weeks after both intraarticular PRF administration and corticosteroid injection groups than sham

stimulation group ($p < 0.05$). However, at 8 weeks, histopathologic score of femoral condyle in intraarticular PRF administration group did not showed significant difference from sham stimulation group (Table 1). The mean grade of synovitis score of intraarticular PRF administration and corticosteroid injection groups had a tendency to be lower than that of sham stimulation group, but statistically no significant (Table 2).

Conclusion

The study demonstrated that intraarticular PRF administration in rheumatoid arthritis could improve cartilage protection capability as well as the functional motion of the rabbits. This study could provide a new therapeutic strategy for RA-induced arthrogenic pain through the local administration of PRF current.

Table1. Semiquantitative score of histopathological findings of distal femurs at 2, 4, 8 weeks after intraarticular pulsed radiofrequency administration, corticosteroid injection, and sham stimulation

Group	Time, mean(SE)			p-value†		
	2 weeks	4 weeks	8 weeks	G	T	G x T
Control ¹⁾	4.000(0.623)	4.625(0.623)	4.458(0.623)			
Sham PRF ²⁾	15.875(1.079)	16.250(1.079)	16.750(1.079)	<0.001*	0.320	0.218
PRF ³⁾	12.000(1.079)	13.250(1.079)	14.250(1.079)			
Steroid ⁴⁾	10.375(1.079)	12.250(1.079)	8.125(1.079)			
p-value‡	< 0.001* (1<3,4<2§)	< 0.001* (1<3,4<2§)	< 0.001* (1<4<2,3§)			

(Abbreviation) SE: Standard Error, G: Group, T: Time effect, GxT; Group x Time Interaction

* : Statistically significant with $p < 0.05$

† : Result by Generalized Linear Model

‡ : Result by Kruskal-Wallis Test

§ : Multiple comparison(post-hoc) result by Dunn's procedure method

Table2. Semiquantitative score of histopathological findings of synovium at 2, 4, 8 weeks after intraarticular pulsed radiofrequency administration, corticosteroid injection, and sham stimulation

Group	Time, mean(SE)			p-value†		
	2weeks	4weeks	8weeks	G	T	G x T
Control ¹⁾	1.917(0.419)	1.333(0.419)	1.917(0.419)			
Sham PRF ²⁾	5.750(0.725)	6.500(0.725)	6.250(0.725)	<0.001*	0.722	0.428
PRF ³⁾	4.500(0.725)	5.250(0.725)	5.250(0.725)			
Steroid ⁴⁾	4.500(0.725)	4.750(0.725)	3.000(0.725)			
p-value‡	0.040* (1<2,3,4§)	0.025* (1<2,3,4§)	0.070			

(Abbreviation) SE: Standard Error, G: Group, T: Time effect, GxT; Group x Time Interaction

* : Statistically significant with $p < 0.05$

† : Result by Generalized Linear Model

‡ : Result by Kruskal-Wallis Test

§ : Multiple comparison(post-hoc) result by Dunn's procedure method

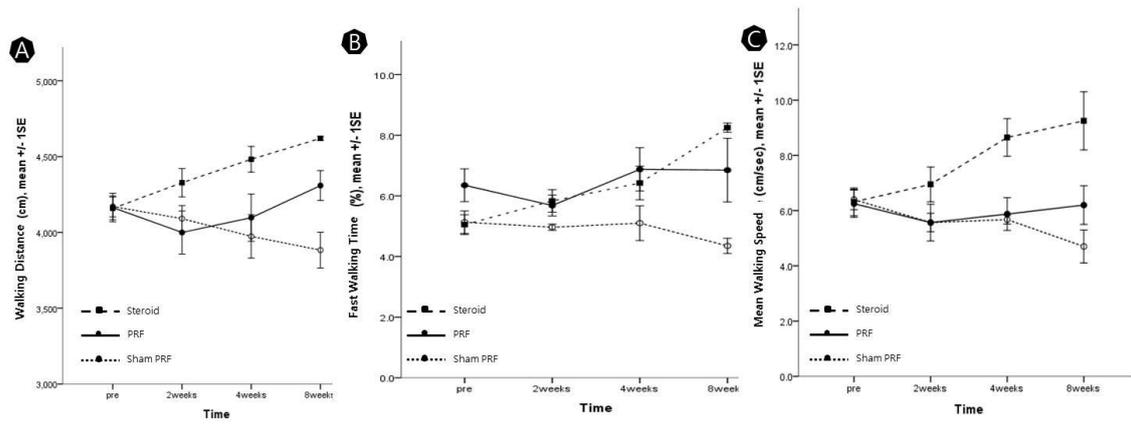


Figure 1. Semiquantitative score of motion analysis of ovalbumin-induced arthritis rabbits at 2, 4, 8 weeks after intraarticular pulsed radiofrequency administration (PRF), corticosteroid injection (Steroid), and sham stimulation (Sham PRF). (A): walking distance (cm), (B): fast walking time (%), and (C): mean walking speed (cm/sec)

통증 및 근골격재활

발표일시 및 장소 : 10 월 27 일(토) 14:50-15:00 Room B(5F)

OP1-3-6

The safety zone of procedure in the sternocleidomastoid muscle

Chung Ho Lee ^{1*}, Hyuk Sung Choi ¹, Seok Kang ¹, Joon Shik Yoon ^{1†}

Korea University College of Medicine, Department of Physical Medicine and Rehabilitation¹

Introduction

In clinical practice, dysfunction of the sternocleidomastoid (SCM) muscle causes myofascial syndrome, torticollis and cervical dystonia. The treatments have used for the dysfunction of the SCM muscle include steroid plus lidocaine and alcohol and botulinum toxin injections. The greater auricular nerve (GAN) provides sensory information on the superficial area of the outer ear lobe. Spinal accessory nerve (SAN) innervates the sternocleidomastoid and trapezius muscles. Transverse cervical nerve (TCN) provides sensory information on the skin over the anterior cervical triangle. Common feature of the greater auricular nerve (GAN), spinal accessory nerve (SAN) and transverse cervical nerve (TCN) can be injured occur during procedure in the SCM because they are superficial or penetrate to the SCM muscle. The aim of this study was to demonstrate that course of GAN, SAN, TCN mapped in healthy volunteers and relation of surface landmark using ultrasound. If this is achievable, it might be possible to reduce the risk during procedure in SCM muscle.

Material and Methods

The of the neck was scanned in 20 healthy volunteers (6 females, mean age 31 [25–36] y) by a qualified sonographer using the HD15 Ultrasound System (Philips, Bothell, WA, USA) and a 7-12 MHz linear array transducer. After recording characteristics, participants were scanned bilaterally in a standardized supine position with head turned 45° to the contralateral side. The following features of the GAN, SAN and TCN were recorded bilaterally (1) The distance between mastoid process and sternoclavicular notch (= reference line) (2) The cross sectional area and depth of the GAN, SAN and TCN at the reference line (3) The cross sectional area and depth of the GAN, SAN and TCN at the anterior, posterior border of SCM

Results

Characteristics of participants were shown in Table 1. The ultrasonographic findings of GAN, SAN and TCN were shown in Table 2. The GAN mean proportion was 21% [range, 10-31] at the level of reference line and 29% [range, 19-36] at the level of the posterior border of the SCM. The SAN mean proportion was 28% [range, 25-34] at the level of reference line and 36% [34-39]. The TCN mean proportion was 47% [range, 46-52] at the anterior border of the SCM, 51% [range, 46-53] at the level of reference line and

52[range, 49-55] at the posterior border of the SCM. The anatomical correlation of the three nerves is shown in the figure. (Figure 1).

Conclusion

The cervical nerves (GAN, SAN, TCN) around the SCM muscle are clearly observed at point of posterior border of SCM and reference line, but are not visible on the anterior border of SCM. The knowledge of the nerve's precise location and relation of surface landmark around the SCM muscle may have useful clinical applications considering invasive procedure. According to our study, it is recommended to perform the procedure in lower half portion of SCM muscle.

Table 1 Baseline characteristics of the study participants

Variables	Mean ± standard deviation [range]
<i>n</i>	20
Mean age (years)	31.3±2.5 [25-36]
Mean height (m)	1.72±0.07 [1.58-1.83]
Mean weight (kg)	69.7±8.8 [54-83]
Mean BMI (kg/m ²)	23.3±1.9 [18-26]
Reference line (cm)	15.6±2.3 [13-18]

* Reference line means the distance between mastoid process and sternoclavicular notch

Table 2 Ultrasonographic characteristics of the study participants

Nerves	Anterior border of SCM	Reference line	Posterior border of SCM
Greater auricular nerve			
CSA (mm ²)	Non visible	0.5±0.02	0.6±0.05
Depth (cm)	Non visible	0.28±0.12	0.26±0.04
Proportion (%; Mean[range])	Non visible	21[10-31]	29 [19-36]
Spinal accessory nerve			
CSA (mm ²)	Non visible	0.3±0.02	0.7±0.07
Depth (cm)	Non visible	0.78±0.35	0.57±0.05
Proportion (%; Mean[range])	Non visible	28[25-34]	36 [34-39]
Transverse cervical nerve			
CSA (mm ²)	0.4±0.21	0.3±0.15	0.3±0.07
Depth (cm)	0.29±0.12	0.29±0.08	0.31±0.02
Proportion (%; Mean[range])	47[43-52]	51[46-53]	52[49-55]

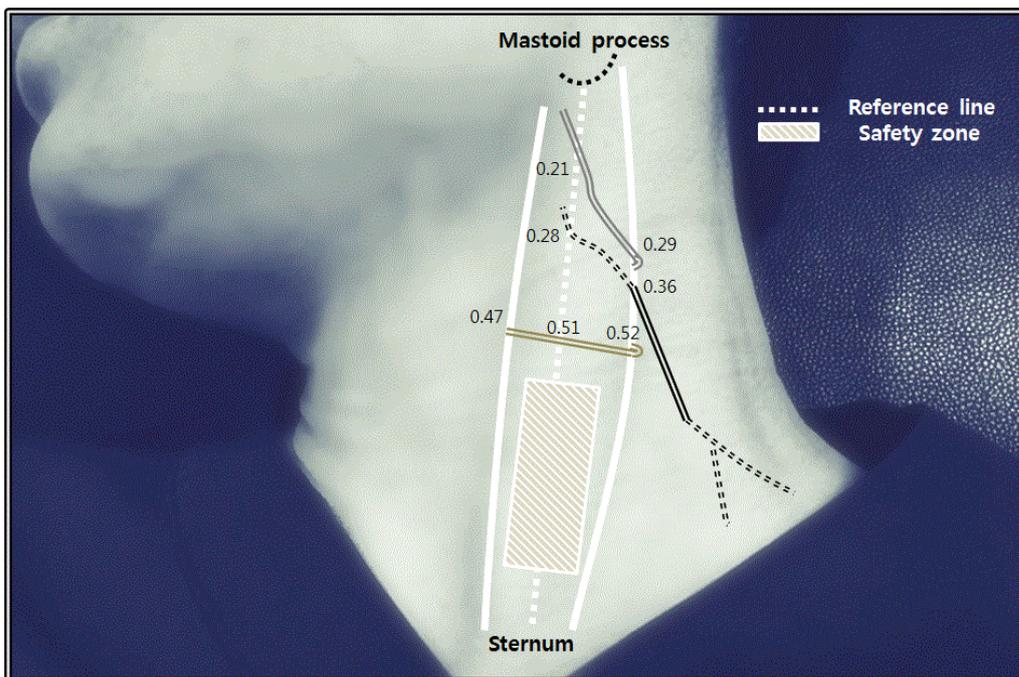


Figure 1 The anatomical correlation of the greater auricular nerve, spinal accessory nerve and transverse cervical nerve

ORAL PRESENTATION 2-1

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:15-13:25 Room C(5F)

OP2-1-1

A Comparative fMRI study of Brain Activity for Visual and Kinesthetic Motor Imagery

Woo Hyung Lee^{1*}, Eunkyung Kim², Han Gil Seo², Byung-Mo Oh², Hyung Seok Nam¹, Hyun Haeng Lee², Min-Gu Kang², Seo Jung Yun², Sungwan Kim^{1,3†}, Moon Suk Bang^{2†}

Seoul National University College of Medicine, Department of Biomedical Engineering¹, Seoul National University Hospital, Department of Rehabilitation Medicine², Seoul National University, Interdisciplinary Program for Bioengineering³

Background

The technology of Brain-Computer Interfaces (BCIs) has evolved with remarkable breakthroughs during the last decade. However, the study to explore appropriate type of motor imagery for developing optimal training protocols has been rarely published. The aim of this study was to investigate functional brain activity comparing visual and kinesthetic (KI) motor imagery in healthy adults.

Methods

Twenty right handed, healthy adults over 20 years of age were enrolled in this study. The Kinesthetic and Visual Imagery Questionnaire (KVIQ), sympathetic skin response, electromyography, and mental chronometry were conducted to evaluate the ability of visual and kinesthetic motor imagery. Pre-scan training was conducted for motor execution (ME) and three types of motor imagery which were comprised of first- (VI-1) and third-perspective visual motor imagery (VI-3), and KI for sequential grasp and release of a right hand. In fMRI scanning sessions (by a 3T Siemens scanner), perceptual control was added in these four conditions as a baseline. Experimental procedure of fMRI scanning was visualized on Fig. 1. Data was preprocessed and analyzed through SPM 12 software.

Results

Fig. 2 A-D showed distinctive patterns of brain activity during the three motor imagery tasks and motor execution. The common areas of increased brain activity in three types of MI were the left inferior parietal lobule, supramarginal, and middle frontal area corresponding to the premotor cortex (Fig. 2 E). In addition, there were increased areas including left rolandic operculum occupying lower part of the motor strip in KI, and right inferior parietal lobule in VI-3. During ME, increased brain activity was observed in the brain areas including the right cerebellum, left postcentral, supplementary motor,

precentral, and rolandic operculum areas. There was no common area showing increased brain activity during both ME and three types of MI (uncorrected $P < 0.001$, cluster-level $FDR < 0.05$). There was no increased BOLD signal in VI-1 and VI-3 compared to KI condition. Conjunction analysis showed the increased brain activity in KI compared to VI-1 and VI-3 for the bilateral supramarginal, bilateral supplementary motor area, and left rolandic operculum areas (Fig. 3).

Conclusion

The present study showed that the activated brain regions during the motor imagery was significantly different with ME, even though the regions were still associated with motor planning and generation of mental images, particularly for KI. This findings can be applied in optimal setting of BCI training protocols for disabled patients.

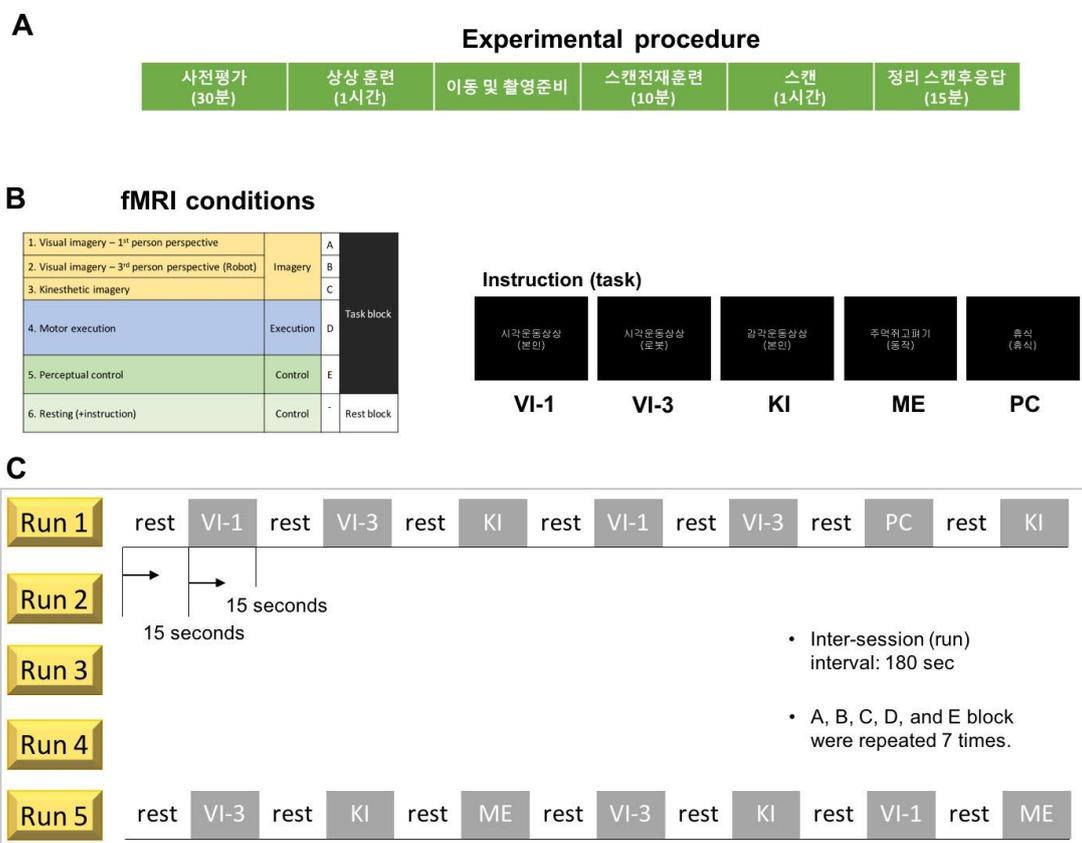
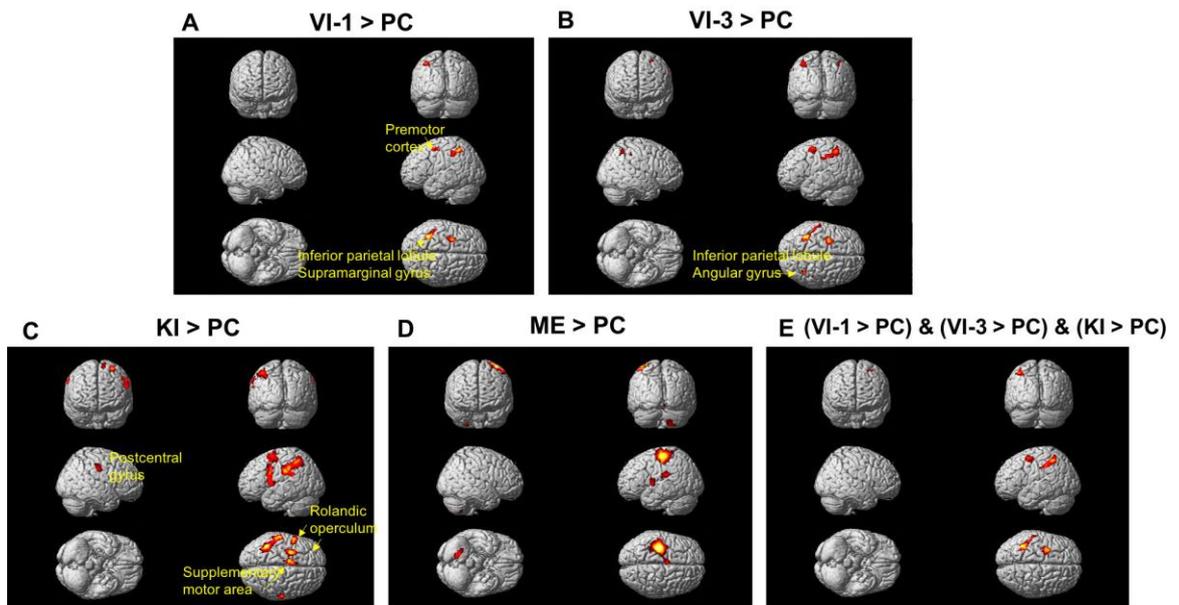


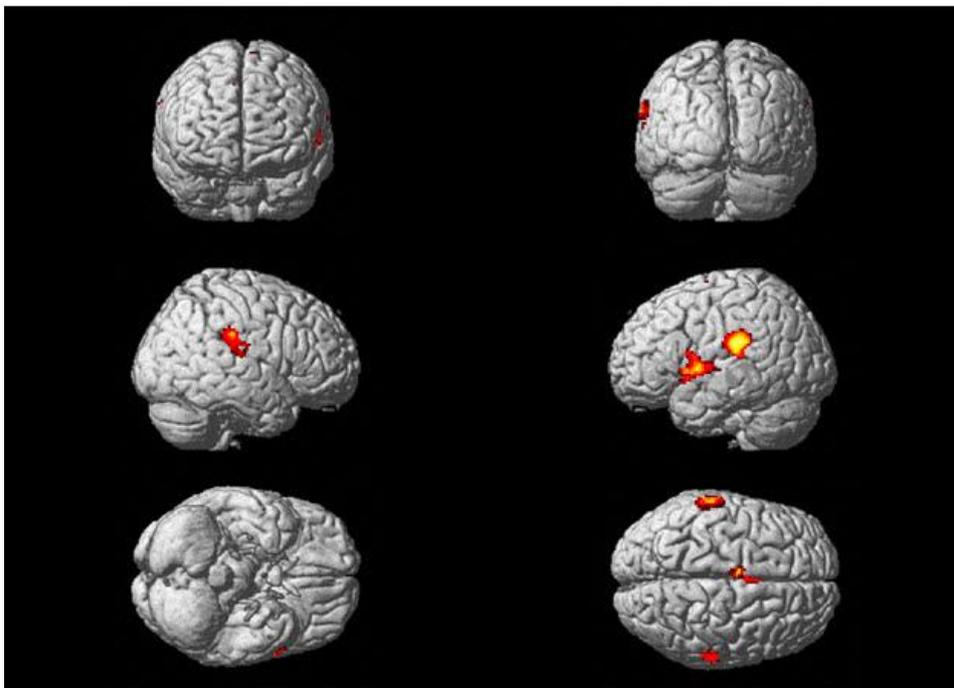
Fig 1. Experimental procedure of this study. (A) The overall process included pre-scanning test, training, preparation, scanning, and post-scanning questionnaires. (B) fMRI scanning conditions were comprised of 5 task and rest. Task instruction was visualized on the screen as counterbalanced order. (C) The task and rest conditions was alternated 15 seconds, and 5 runs were presented to the participants. Inter-session interval was 3 minutes.



$P < 0.001$, cluster-level FDR < 0.05

Fig 2. The distinctive patterns of brain activity during the motor imagery and motor execution (A-D). The common areas of increased brain activity observed in three types of motor imagery (E).

(KI > VI-1) & (KI > VI-3)



$P < 0.001$, cluster-level FDR < 0.05

Fig 3. The brain areas with increased activity for kinesthetic motor imagery compared to first- and third-perspective visual motor imagery.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:25-13:35 Room C(5F)

OP2-1-2

A pilot study to evaluate the safety and efficacy of cord blood therapy in stroke patients

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Minyoung Kim^{1,2†}

CHA Bundang Medical Center, CHA University School of Medicine, Department of Rehabilitation Medicine¹, CHA University, Rehabilitation and Regeneration Research Center²

Introduction

Stroke causes significant neurological sequelae, however, perfect treatment is not available yet. In previous researches, stem cells therapy decreased infarction volume and ameliorated inflammation-related mechanisms. Although it cannot explain all therapeutic mechanisms, the Results provide a positive perspective on the effects of stem cell therapy and directions of subsequent studies. In this pilot study, we aimed to confirm the safety and efficacy of allogeneic umbilical cord blood (UCB) therapy for patients with stroke.

Methods

Five patients with stroke within 1 to 6 months after the onset were included. A single intravenous infusion of UCB selected by criteria of immune compatibility and cell number was performed. All patients received oral immunosuppressant for 2 weeks. Adverse events were monitored closely for safety. To measure the efficacy, functional outcomes were assessed at baseline, 4, 12 and 20 weeks after UCB therapy. To assess therapeutic mechanism, functional magnetic resonance imaging (fMRI) was performed in 20 weeks post-infusion. And gene expression related to inflammation was conducted using peripheral blood samples.

Results

The demographic characteristics of subjects are summarized in Table. As a safety issue, there was no serious adverse event and only mild symptoms were reported which were associated with immunosuppressant. As for the efficacy, muscle strength, Berg Balance Scale, Trunk Impairment Scale, Fugl-Meyer Assessment, Functional Independence Measure, Modified Barthel Index and Motor-free Visual Perception Test-3 scores showed improvement after UCB treatment (Figure 1). Patients who had good function showed near normal status from the baseline. Follow up fMRI of patient 1 showed localized activation of ipsilateral M1 cortex. And in patient 3 and 4, follow up fMRI showed cortical reorganization with deactivation of contralateral M1 cortex (Figure 2). In serologic study,

gene expression levels of tumor necrosis factor- α and interleukin-1 β were down-regulated after UCB treatment except patient 4 who had common cold (Figure 3).

Conclusions

We could observe improvement in motor function after UCB treatment in the subjects without significant side effect. In cases of very good initial function, the ceiling effect of each score may have concealed therapeutic effect. Early bilateral activation of the motor network and later localized ipsilateral activation of the motor cortex were found. These findings were similar to previous study Results that showed neuroplasticity and it could be interpreted that ipsilateral motor pathways may play a role in motor recovery. And after the intervention, inflammatory markers were suppressed significantly, that could be supported by various studies demonstrating anti-inflammatory effects of UCB. We believe that this pilot study could be a useful reference for future development of stem cell therapy protocols.

Table. Patients characteristics

	Age	Sex	Brain lesion	Type of stroke	From onset to treatment (months)	UCB cell count
Patient 1	43	M	Right thalamus	Hemorrhage	1	2.0X10 ⁷ /kg
Patient 2	49	M	Right basal ganglia	Hemorrhage	1	2.5X10 ⁷ /kg
Patient 3	53	M	Left frontal lobe	Hemorrhage	2	2.5X10 ⁷ /kg
Patient 4	52	M	Right pons	Hemorrhage	2	2.7X10 ⁷ /kg
Patient 5	41	M	Left fronto-parietal lobe	Hemorrhage	4	2.3X10 ⁷ /kg

UCB, Umbilical Cord Blood

Figure 1. Changes in functional evaluation after UCB administration

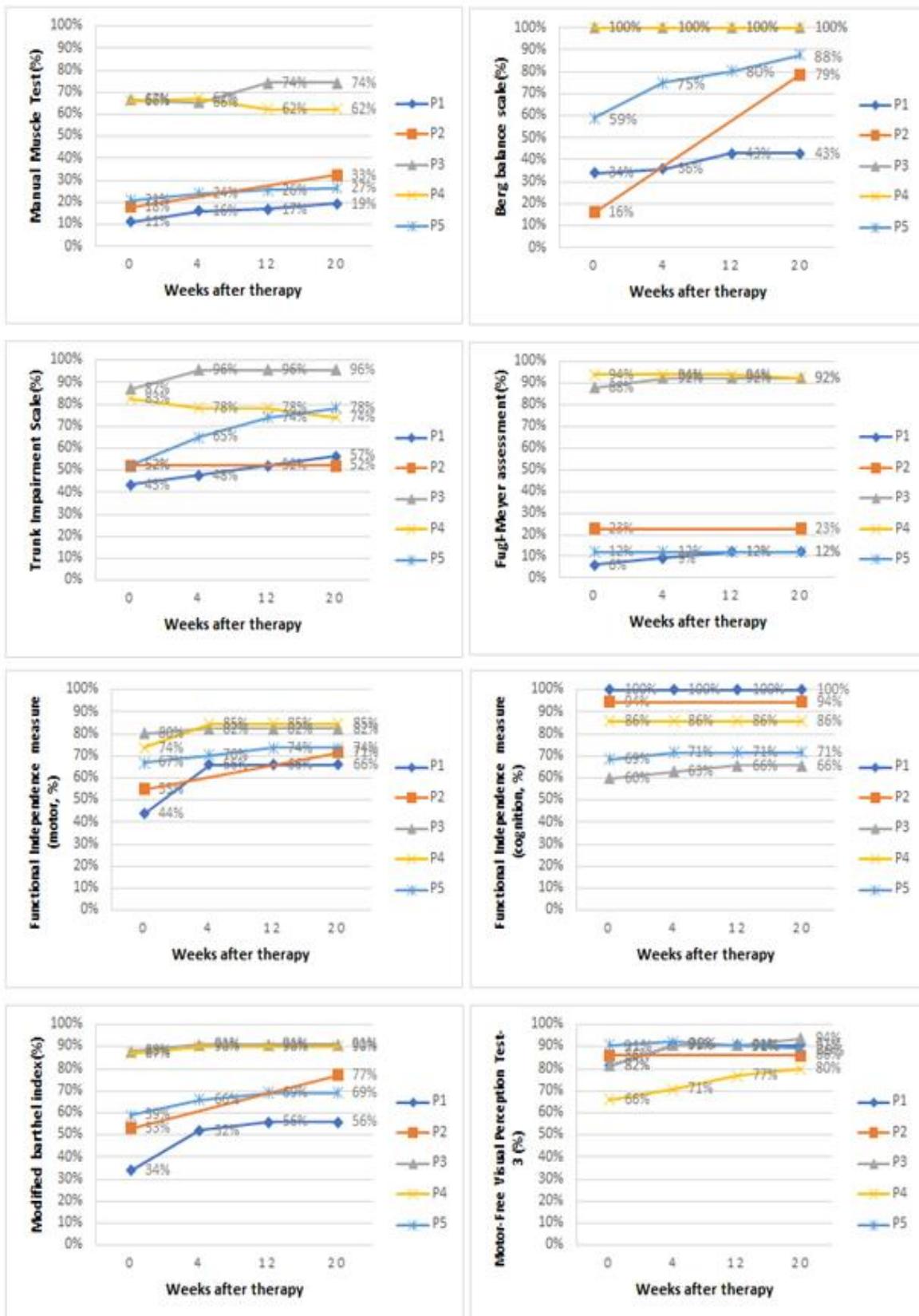


Figure 2. Changes in fMRI by UCB administration while hand movement of affected side

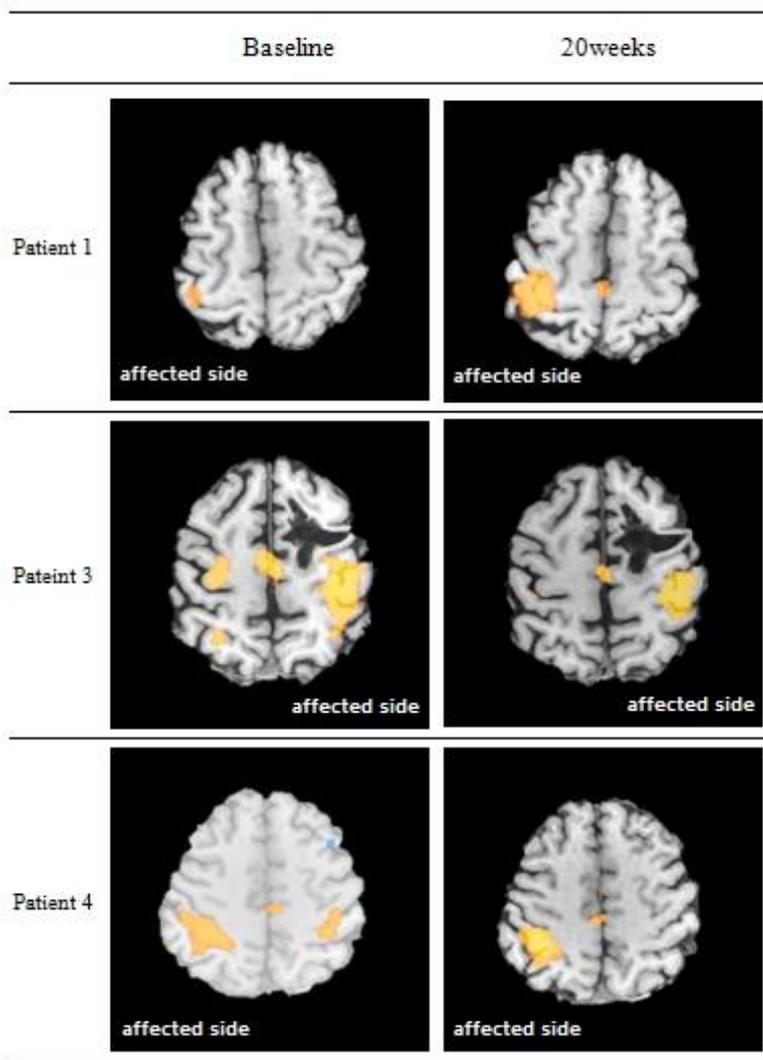
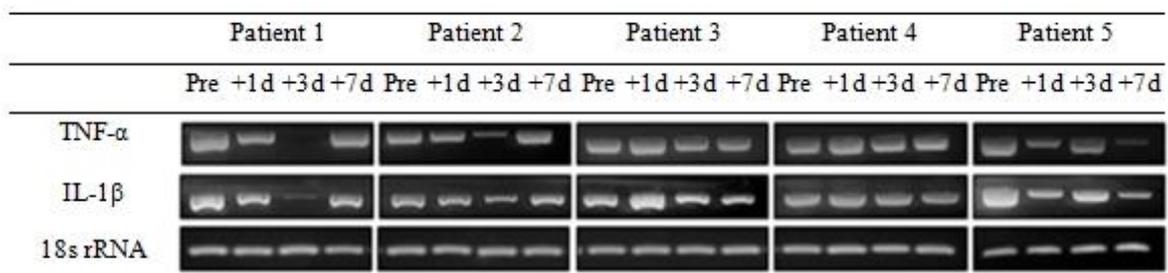


Figure 3. Changes of TNF- α , IL-1 β by UCB administration



TNF- α ; tumor necrosis factor alpha, IL-1 β ; interleukin 1 beta, rRNA; ribosomal ribonucleic acid

Gene expression levels related to inflammation in peripheral blood samplings within 10 days before UCB administration and at 1 day, 3 days and 7 days after UCB administration by RT-PCR.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:35-13:45 Room C(5F)

OP2-1-3

A randomized controlled trial to determine dose-response relationship for BTX in finger spasticity

Sang Yoon Lee¹, Min Hyung Lee¹, Sohee Oh², Shi-Uk Lee^{1*†}

Seoul National University Boramae Medical Center, Department of Rehabilitation Medicine¹, Seoul National University Boramae Medical Center, Department of Biostatistics²

Objectives

Long finger flexor is one of the most commonly injected muscles with botulinum toxin A (BTX-A) in the management of spasticity. However, how much units of toxin should be injected for appropriate decrease in spasticity has not been reported. To our knowledge no randomized placebo-controlled trial has been reported. This study aimed to investigate dose-dependent efficacy and safety of BTX-A for post-stroke finger flexor spasticity. Study design: A double-blind randomized placebo-controlled design

Methods

Participants with post-stroke finger flexor spasticity (modified Ashworth scale [MAS] 2 and higher) were enrolled in this randomized, placebo-controlled study. After randomization, subjects were injected with placebo (0), 30, 60, 100, or 150 units of BTX-A (halves into flexor digitorum profundus and flexor digitorum sublimis) by ultrasound guided technique. The BTX-A used in this study was Nabota® (Daewoong Pharm. Inc). The primary efficacy endpoint was MAS, and the secondary outcomes were Fugl-Myer upper extremity assessment, Wolf motor assessment, and hand grip strength of the affected hand at 2, 4, 8, and 12 weeks after the initial treatment visit. Adverse events were also recorded.

Results

Eighty-five participants were recruited and 78 were randomized (21 women, age 60.6 ± 9.5 years) to one of the 5 groups. After six participants were dropped during follow-up, 72 subjects were analyzed as per protocol. Finger flexor spasticity decreased more with injections of BTX-A than with placebo at weeks 2 (100 units) and 4 (150 units) ($P = 0.031$). A dose-dependent response was generally observed in tone reduction but not in upper extremity functions and hand grip strength. There were no serious adverse events of BTX-A injections.

Conclusion

BTX-A reduced post-stroke spasticity in a dose-dependent manner in finger flexor but did not appear to affect upper extremity functional outcomes and hand grip strength.

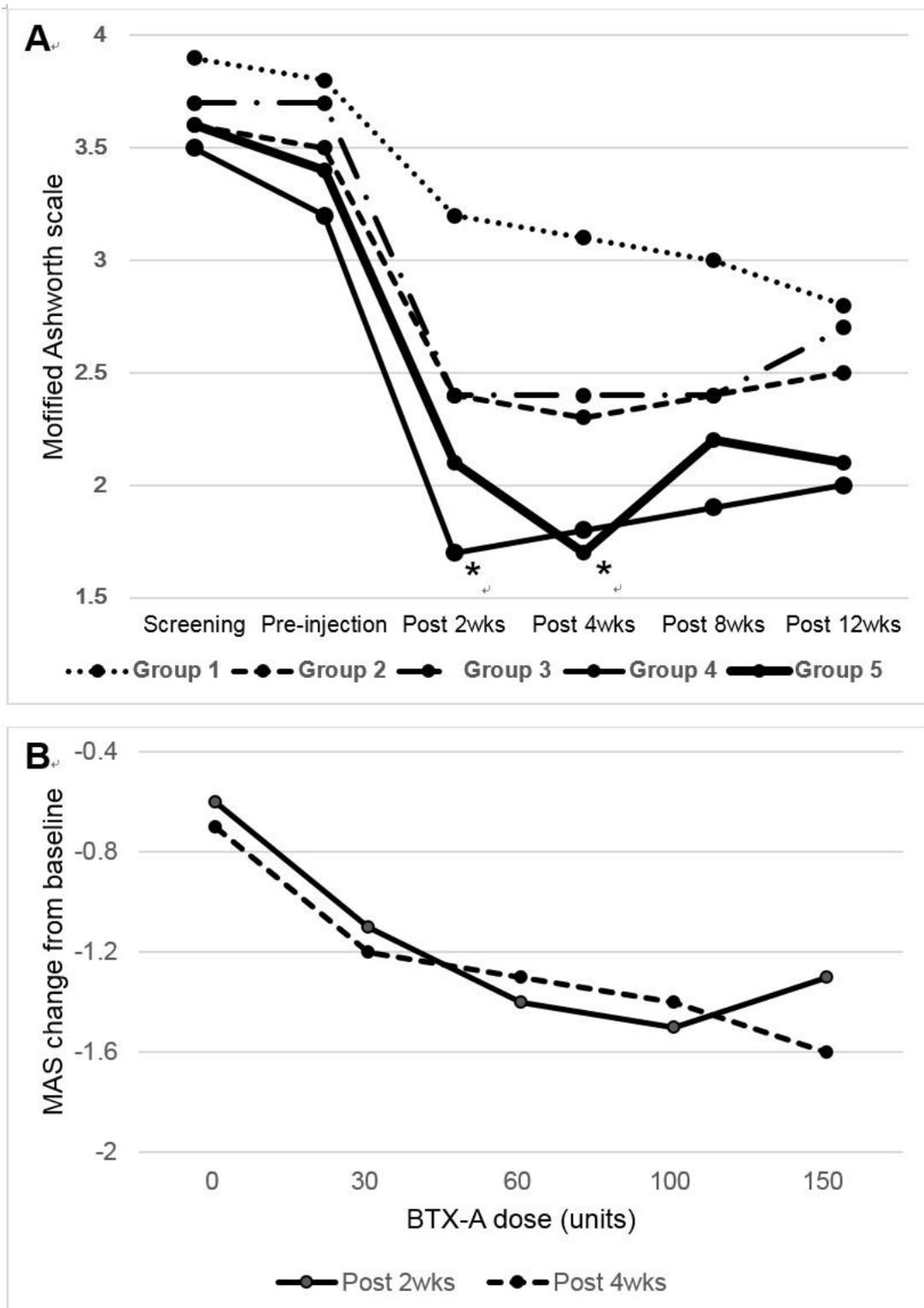


Figure 1. Dose-response analysis of finger flexor spasticity measured by modified Ashworth Scale (MAS): (A) MAS measured at each point, (B) MAS changes from baseline depending on BTX-A dose at 2 and 4 weeks after BTX-A injection. * $P < 0.05$ compared with group 1 at each measure point (by ANOVA test with post-hoc analysis of Tukey HSD)

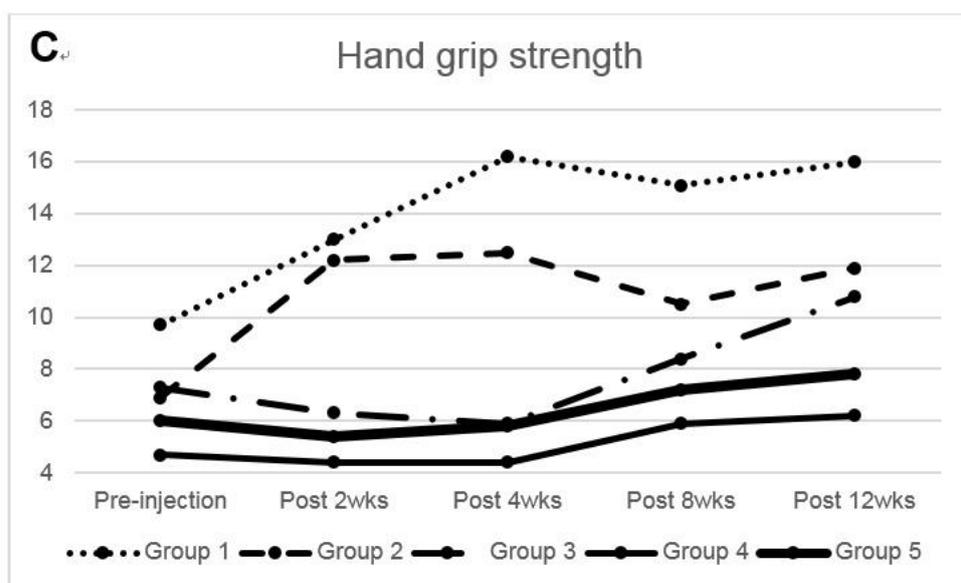
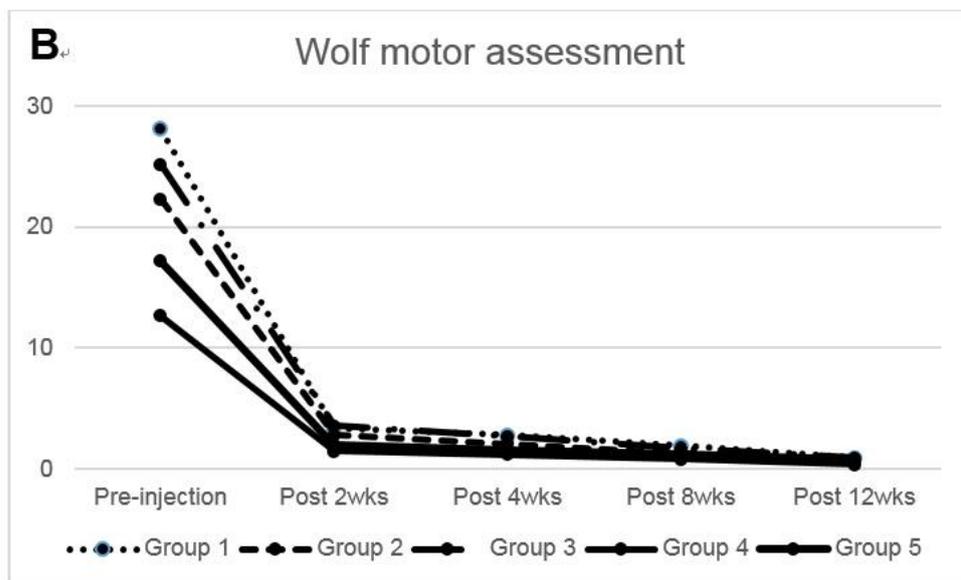
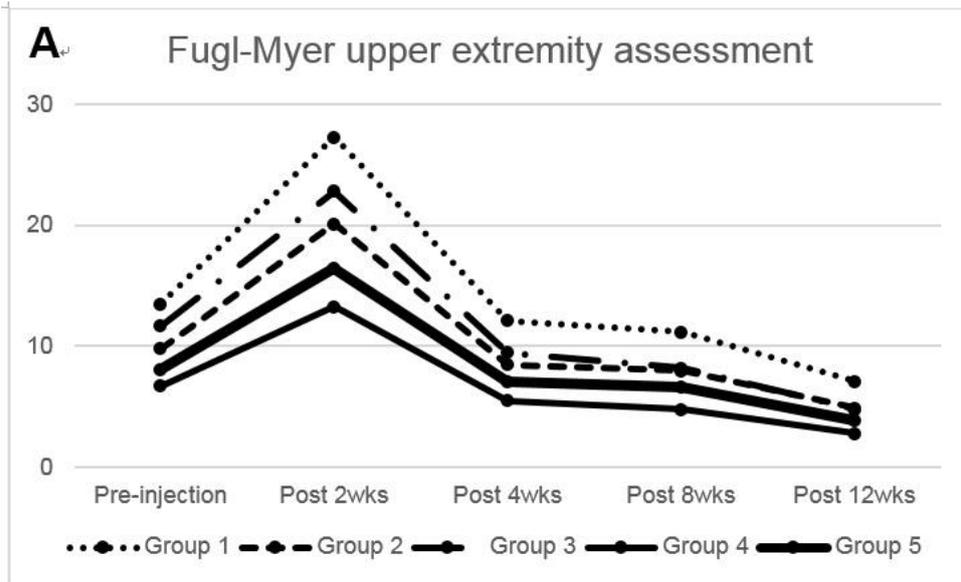


Figure 2. Dose–response analysis of upper extremity functional assessments measured by (A) Fugl-Myer upper extremity assessment, (B) Wolf motor assessment, and (C) Hand grip strength.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:45-13:55 Room C(5F)

OP2-1-4

Clinical characteristics of the patients with delayed poststroke recovery

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Introduction

It is generally known that after the stroke, early rapid neurological recovery slows down during chronic poststroke period. In some patients, however, a prominent recovery pattern is observed in the chronic phase after stroke. The purpose of this study was to investigate the clinical characteristics of the patients with delayed poststroke recovery compared with patients with early neurological recovery.

Methods

In the present study, we used Korean Stroke Cohort for functioning and rehabilitation (KOSCO) data. KOSCO is a large, multi-centre, prospective cohort study for all acute first-ever stroke patients admitted to the participating hospitals in nine distinct areas of Korea. We excluded patients whose Fugl-Meyer Assessment (FMA) of upper extremity decreased by more than 3 points, whose FMA of lower extremity decreased by more than 2 points, and whose total score of FMA decreased by more than 5 points to exclude patients with poststroke neurologic deterioration. In the present study, the patient with delayed recovery was defined as one with change of FMA score (total, upper limb, and lower limb, respectively) from poststroke 3 months to 12 months over 13, 8, 5 points, and that from onset of stroke onset to 3 months.

Results

We enrolled 722 first-ever stroke patients (430 men; 62.97 ± 12.93 [20 - 98] years). Of the enrolled patients, 137 (18.98%) had delayed recovery. The initial score of FMA in patients with poststroke delayed recovery was significantly lower than that of patients with early recovery (35.28 ± 26.31 [0 - 89] vs 43.62 ± 27.46 [0 - 90], $p < 0.001$). In addition, patients with delayed recovery had more risk factors for stroke than patients with early recovery, with statistical significance (2.28 ± 1.24 [0 - 6] vs 2.02 ± 1.19 [0 - 7], $p = 0.020$). There were significant differences in the number of complications and the incidence of pneumonia during hospitalization for poststroke care and rehabilitation (8.11% vs 3.19%, $p = 0.014$).

Conclusion

In the present study, we found out that the incidence of poststroke complications including pneumonia and the number of risk factors for stroke were higher in patients with poststroke delayed recovery than them with early recovery.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 13:55-14:05 Room C(5F)

OP2-1-5

Development of Predictive Model for Moderately Disabled Stroke Patients with Difficult to Discharge

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Wonkwang University School of Medicine and Institute of Wonkwang Medical Science, Department of Rehabilitation Medicine¹, Chungnam National University, Department of Rehabilitation Medicine, School of Medicine², Department of Rehabilitation Medicine, Konkuk University School of Medicine³, Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine⁴, Chonnam National University Medical School, Department of Physical and Rehabilitation Medicine⁵, Pusan National University School of Medicine, Department of Rehabilitation Medicine⁶, Wonkwang University, Department of Preventive Medicine⁷, Kyungpook National University Hospital, Department of Rehabilitation Medicine⁸, Jeju National University Hospital, Department of Rehabilitation Medicine⁹, Hallym University, Department of Statistics¹⁰, Ewha Womans University, Department of Health Convergence¹¹, Sungkyunkwan University School of Medicine, Department of Physical and Rehabilitation Medicine¹²

Background and Purpose

To develop an assessment tool that predicts the possibility of returning home after acute stroke rehabilitation, specifically for moderately disabled stroke patients whom difficult to predict discharge destination.

Methods

Stroke patients with modified Rankin scale score of 3 or 4 were included for this prospective cohort study. Various demographic, clinical, and functional factors were analyzed as potential predictive factors. A Weighted scoring model was developed through a three-step process: 1) selection of the factors by logistic regression analyses, 2) weighted scoring model development, and 3) validate the generalizability.

Results

Of the 732 patients, 372 patients (51%) return home at discharge and the mean length of stay of all participants was 32.5 days. 1) Cognitive Functional Independence Measure (FIM), 2) Functional Ambulation Categories (FAC), 3) Charlson comorbidity index (CCI), and 4) marital status were independent predictors for home discharge. The cognitive FIM was categorized into 3 groups based on the severity and awarded a score of 0, 3, and 6.

The FAC, CCI, and marital status were categorized into 2 groups, and given a score of 4, 2, 1 or 0, respectively. The total score ranged from 0 to 13 in this model, with a higher score indicating a higher probability of home discharge. In the cutoff point 7, this model showed a sensitivity of 83.5% and specificity of 82.3% (area under the curve=0.87).

Conclusions

A novel assessment model for the patients with moderate disability can help to make more reliable discharge plan after acute stroke rehabilitation.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 14:05-14:15 Room C(5F)

OP2-1-6

Different Functional Recovery Pattern According to Sex in the First-ever Strokes in Korea

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Samsung Medical Center, Sungkyunkwan University School of Medicine, Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular Stroke Institute¹, Pusan National University School of Medicine, Pusan National University Yangsan Hospital, Department of Rehabilitation Medicine², Chungnam National University School of Medicine, Department of Rehabilitation Medicine³, Konkuk University School of Medicine, Department of Rehabilitation Medicine⁴, Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine⁵, Chonnam National University Medical School, Department of Physical and Rehabilitation Medicine⁶, Wonkwang University, School of Medicine, Department of Preventive Medicine⁷, Kyungpook National University School of Medicine, Kyungpook National University Hospital, Department of Rehabilitation Medicine⁸, Wonkwang University School of Medicine, Department of Rehabilitation Medicine⁹, Jeju National University Hospital, Jeju National University School of Medicine, Department of Rehabilitation Medicine¹⁰, Hallym University, Department of Statistics¹¹, Ewha Womans University, Department of Health Convergence¹², Korea Centers for Disease Control and Prevention, Division of Chronic Disease Prevention, Center for Disease¹³, Korea Centers for Disease Control and Prevention, Division of Chronic Disease Control, Center for Disease Prevention¹⁴, Sungkyunkwan University, School of Mechanical Engineering¹⁵, Sungkyunkwan University, Department of Health Science and Technology, Department of Medical Device Management and Research, SAIHST¹⁶

Objective

The objective of this study was to investigate differences of functional recovery pattern between men and women and identify the factors associated with functional recovery pattern according to sex in stroke patients.

Materials and Methods

This study was an interim analysis of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) designed as 10 years long-term follow-up study of stroke patients. In this study, we analyzed 10,636 stroke patients to investigate differences in demographics and clinical features between male and female stroke patients. Serial data

up to 24 months of multi-facet functional assessments such as Korean-Modified Barthel Index (K-MBI), Fugl-Meyer Assessment (FMA), Functional ambulation classification (FAC), American Speech-Language-Hearing Association-National Outcomes Measurement System (ASHA-NOMS), Korean version of Frenchay Aphasia Screening Test (K-FAST) were analyzed to identify differences in recovery patterns and factors associated with these recovery patterns according to sex in the first-ever stroke patients after adjustments for difference with age, educational level, initial stroke severity, premorbid functional level, degree of comorbidity, and multi-facet functional levels at 7 day after stroke.

Results

Out of total 10,636 stroke patients (6,043 male and 4,593 female), female patients showed significantly older age, lower education level, lower body mass index, worse premorbid functional level, higher co-morbidity and more severe initial severity assessed by NIHSS compared with male stroke patients ($p < 0.05$, Table 1). Even after multiple adjustments for differences, multi-facet functional outcomes were more severe in female stroke patients such as lower FMA, K-FAST, and FAC at 7 day; lower K-MBI, K-FAST, and FAC at 3, 12, and 24 months; lower ASHA-NOMS at 24 months ($p < 0.05$, Table 2).

Conclusion

These Results revealed that there are sex-specific differences in multi-facet functional recoveries in stroke patients. The Results of this study could provide more specific information for establishing the stroke rehabilitation strategy according to sex.

Table 1. Demographics and clinical features in male and female stroke patients.

	Sex (Mean±SD)		P value
	Male (6,043)	Female (4,593)	
Age	62.9±13.2	68.1±13.3	<0.001*
Education level	6.2±2.4	4.3±2.5	<0.001*
Body Mass Index	23.7±3.2	23.2±3.5	<0.001*
Initial NIHSS	4.9±5.4	6.1±6.3	<0.001*
Initial GCS	12.1±4.0	12.1±3.1	0.917
Premorbid mRS	0.7±1.3	0.8±1.4	<0.001*
CCAS	3.1±1.5	3.4±1.5	<0.001*

* $p < 0.05$

NIHSS, National Institutes of Health Stroke Scale; GCS, Glasgow Coma Scale; mRS, modified Rankin Scale; CCAS, Combined condition and age-related score

Table 2. Differences in functional assessment score between male and female stroke patients after multiple adjustments using analysis of covariance.

	7 days			3 months			12 months			24 months		
	Sex (Mean±SD)		P value	Sex (Mean±SD)		P value	Sex (Mean±SD)		P value	Sex (Mean±SD)		P value
	Male	Female		Male	Female		Male	Female		Male	Female	
K-MBI				87.4±0.3	86.2±0.4	0.015*	91.0±0.3	89.1±0.4	<0.001*	92.0±0.3	90.1±0.4	0.001*
FMA	76.1±0.5	73.2±0.6	<0.001*	87.9±0.3	87.6±0.4	0.465	90.1±0.3	89.4±0.4	0.164	90.7±0.3	89.8±0.4	0.110
ASHA-NOMS	5.7±0.03	5.6±0.03	0.379	6.7±0.02	6.8±0.019	0.567	6.8±0.01	6.7±0.017	0.099	6.8±0.01	6.7±0.02	0.049*
K-FAST	19.9±0.1	17.2±0.2	<0.001*	22.9±0.1	21.2±0.1	<0.001*	24.4±0.1	22.4±0.1	<0.001*	24.8±0.1	22.4±0.1	<0.001*
FAC	2.8±0.03	2.5±0.03	<0.001*	4.2±0.019	4.0±0.023	<0.001*	4.4±0.02	4.3±0.02	<0.001*	4.5±0.02	4.3±0.02	<0.001*

*p<0.05

K-MBI, Modified Barthel Index; FMA, Fugl-Meyer Assessment; ASHA-NOMS, American Speech-Language-Hearing Association-National Outcomes Measurement System; K-FAST, Korean version of Frenchay Aphasia Screening Test; FAC, Functional ambulation classification.

ORAL PRESENTATION 2-2

노인재활

발표일시 및 장소 : 10 월 26 일(금) 14:15-14:25 Room C(5F)

OP2-2-1

Association between Asymmetry in Lean Mass of Lower Extremities and Balance in Elderly People

Eun Jeong Lee^{1*}, Jinmann Chon^{1†}, Hee-Sang Kim¹, Jong Ha Lee¹, Seung Don Yoo¹, Dong Hwan Yun¹, Dong Hwan Kim¹, Seung Ah Lee¹, Yun Soo Soh¹, Yong Kim¹, Young Rok Han¹, Chang Won Won²

Kyung Hee University Medical Center, Department of Rehabilitation Medicine¹, Kyung Hee University Medical Center, Department of Family Medicine²

Objective

Physical abilities, including balance function, are impaired with increasing age. Previous study reported that asymmetry in strength of lower extremities diminish the balance function in elderly people. Asymmetry in strength of lower extremities was reported to be related to asymmetry in lean mass of lower extremities. The aim of this study is to examine whether asymmetry of lower extremity lean mass would affect the balance function in elderly people.

Method

This study utilized a cross sectional analysis of a pre-existing database from the Korean frailty and aging cohort study. The lower extremity lean mass was measured in 951 community-dwelling elderly subjects (age, 75.86±0.13 years) using dual-energy x-ray absorptionmetry (DEXA). Asymmetry was established using a limb symmetry index (LSI) calculated using the following standard equation : $LSI = 2 \times 100 \times (\text{Right limb} - \text{Left limb}) / (\text{Right limb} + \text{Left limb})$. The clinical balance tests were carried out using the timed up and go (TUG) test, and short physical performance battery (SPPB). Also, The Results of the Korean frailty and aging cohort study questionnaire were used to evaluate the daily life in relation to balance. We assessed the relationship between the LSI and balancing indexes (TUG time, SPPB time, sitdown time). Also, We evaluated whether LSI affect the daily life including falling.

Results

The LSI was significantly associated with SPPB time ($p < 0.001$). Using the cutoff value 5 of LSI, 287 people had values more than cutoff value. Their SPPB time was significantly longer than those found in the 664 people whose LSI was below the cutoff value ($p < 0.001$). However, The LSI had no significant relationship with TUG time ($p = 0.109$) and sitdown time ($p = 0.493$). Also, The experience of falling was not significantly associated

with the LSI ($p=0.347$). But, in a questionnaire asking for confidence in the balance, the higher the LSI, the harder it was to walk on a slippery road with ice ($p=0.007$). In addition, the question of whether it is difficult to climb 10 stairs, the LSI value was significantly higher in the group that answered "yes" ($p=0.0016$).

Conclusion

Our Results reveal that the asymmetry of lower extremity lean mass affect balance function. As the asymmetry get worse, it became more difficult for the elderly to walk, to sit on the chair, to get up, to walk on slippery roads, and to climb the stairs.

노인재활

발표일시 및 장소 : 10 월 26 일(금) 14:25-14:35 Room C(5F)

OP2-2-2

Association between Sarcopenia and Falls in Community-Dwelling Elderly Population

Miryeong Yang^{1*}, Jinmann Chon^{1†}, Chang Won Won², Hee-Sang Kim¹, Jong Ha Lee¹, Dong Hwan Yun¹, Seung Don Yoo³, Dong Hwan Kim³, Seung Ah Lee³, Yun Soo Soh¹, Yong Kim¹, Young Rok Han³

Kyung Hee University Medical Center, Department of Rehabilitation Medicine¹, Kyung Hee University Medical Center, Department of Family Medicine², Kyung Hee University Hospital at Gangdong, Department of Rehabilitation Medicine³

Objective

Korea is classified as one of the most rapidly aging nations around the world. Falling is a well-known geriatric syndrome and is the leading cause of injury and accidental death in older adults. This study aimed to assess the associations of falls with sarcopenia in a community-dwelling elderly population, based on an assessment of both history of falls and physical performance tests.

Method

Using data from the first year baseline data of Korean Frailty and Aging Cohort study, a total of 1551 elderly individuals (70 years and old) were included. According to the diagnostic criteria of the Asian Working Group for Sarcopenia (AWGS), Sarcopenia was defined as low muscle function accompanying low muscle mass. The participants were asked about their history of falls in the preceding year. The Activities-Specific Balance Confidence (ABC) Scale, Short Physical Performance Battery (SPPB) and Timed up and go (TUG) test were used to assess risk of falling. For continuous variables, an independent t test was performed, and for categorical variables, a chi square test was performed. Multivariate analysis was performed using logistic regression to identify independent risk factors for falls.

Results

The mean age of the participants was 76.2 ± 3.9 years, and 52.9% were women. From a total of 1551 participants, 156 (10.0%) were classified to sarcopenia according to the diagnostic criteria of the AWGS. There was a statistically significant difference in the history of falls between sarcopenia group and no sarcopenia group (26.9% versus 19.6 %, $p < 0.05$). Compared to no sarcopenia group, sarcopenia group had a lower ABC score (73.4 ± 52.7 versus 84.0 ± 37.9 , $p < 0.05$) and SPPB score (9.7 ± 2.0 versus 10.8 ± 1.5 , $p < 0.001$) and higher TUG (12.6 ± 3.4 versus 10.6 ± 2.8 , $p < 0.001$). After adjusting for age, obesity in the logistic regression model, sarcopenia (Odds ratio 1.57, 95% Confidence

interval 1.07-2.29, $p < 0.05$) and female sex (Odds ratio 1.63, 95% Confidence interval 1.26-2.10, $p < 0.001$) were independent risk factors for falls in the community-dwelling older adults.

Conclusion

Our study showed that sarcopenia had an association with falls in community-dwelling older adults. Moreover, Sarcopenia worsened balance and increased fall risk assessed by ABC, SPPB and TUG. In conclusion, Sarcopenia is risk factor for falls in community-dwelling elderly population.

노인재활

발표일시 및 장소 : 10 월 26 일(금) 14:35-14:45 Room C(5F)

OP2-2-3

Comorbidities in patients with end-stage knee OA : prevalence and impact on physical function

Won Bin Kim^{1*}, Bo Ryun Kim^{1†}, Sang Rim Kim², Eun Young Han¹, Kwang Woo Nam², So Young Lee¹, Young Geun Park², Yun Ji Lee³

Jeju National University, Department of Rehabilitation Medicine¹, Jeju National University, Department of Orthopedic Surgery², Jeju National University, School of Medicine³

Objective

This study was undertaken to investigate the prevalence of comorbidities and its association with physical function, quality of life and pain in patients with end-stage knee osteoarthritis.

Methods

In this cross-sectional study, we assessed a total of 557 patients (74 males and 503 females; average age 71.4±5.8 years) who were diagnosed with end-stage knee osteoarthritis (OA). Comorbidities were classified into osteoporosis, presarcopenia (defined as a loss of skeletal muscle mass by Bioelectrical Impedance Analysis), degenerative spine disease, diabetes, and hypertension. All patients completed performance-based physical function tests including stair climbing test (SCT), 6-minute walk test (6MWT), timed up and go test (TUG), instrumental gait analysis for spatio-temporal parameters. Self-reported physical function and pain were measured using the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and Visual Analog Scale (VAS), and self-reported quality of life was measured using the EuroQOL five dimensions (EQ-5D) questionnaire.

Results

The prevalence of osteoporosis was 35.4 % (204 of 577) of patients, presarcopenia in 6.1 % (35 of 577), degenerative spine disease in 14.9 % (86 of 577), diabetes in 17.7 % (102 of 577), and hypertension in 65.5 % (378 of 577). In the univariate analyses, patients with osteoporosis exhibited significantly higher scores in SCT-ascent, SCT-descent, TUG, WOMAC-pain and lower scores in 6MWT, gait speed, cadence. Patients with presarcopenia showed significantly higher scores in SCT-ascent, TUG, and lower scores in 6MWT, EQ-5D, gait speed. Patients with degenerative spine disease exhibited significantly higher scores in WOMAC-pain and lower scores in gait speed. Patients with diabetes showed significantly higher scores in SCT-ascent, and patients with hypertension showed significantly lower scores in 6MWT. After adjusting for age, sex, BMI by the

logistic regression, SCT-descent remained significantly associated with patients with osteoporosis (OR=1.040, 95% CI 1.010-1.071, p=0.010) and SCT-ascent score was independently associated with patients with presarcopenia (OR=1.120, 95% CI 1.053-1.191, p<0.001) and diabetes (OR=1.042, 95% CI 1.002-1.084, p=0.040). In patients with degenerative spine disease, WOMAC-pain showed a significant association (OR=1.081, 95% CI 1.002-1.166, p=0.043).

Conclusions

This study confirmed the prevalence of several important comorbidities, which could be associated with the performance-based and self-reported physical function, and quality of life in patients with end-stage knee OA. In addition, these Results may be an importance consideration in determining various preoperative and/or rehabilitation strategies.

Table 1. Demographic and Disease-Related Characteristics of the Subjects (N=577)

Variables	Values
Age (years)	71.4±5.8
Sex, males/females	74 (12.8) / 503 (87.2)
BMI (kg/m ²)	26.6± 3.4
K-L grades	
Grade 3	127 (22.0)
Grade 4	450 (78.0)
Comorbidities	
Osteoporosis	204 (35.4)
Presarcopenia	35 (6.1)
Degenerative spine disease	86 (14.9)
Diabetes mellitus	102 (17.7)
Hypertension	378 (65.5)

Values represent mean ± standard deviation or number (%) of cases

Abbreviations: BMI, Body Mass Index, K-L, Kellgren-Lawrence

Table 2. The Comparison of Performance-based Physical Function, Self-reported Physical Function, Quality of Life and Pain according to Comorbidities in Patients with End-stage Knee Osteoarthritis[Ⓢ]

Variable	Osteoporosis (+)	Osteoporosis (-)	Sarcopenia (+)	Sarcopenia (-)	Degenerative spine disease (+)	Degenerative spine disease (-)	Diabetes (+)	Diabetes (-)	Hypertension (+)	Hypertension (-)
SCT-ascent (sec)	14.45±5.64 [Ⓢ]	13.40±5.41 [Ⓢ]	16.43±7.34 [Ⓢ]	13.51±5.32 [Ⓢ]	14.43±5.77 [Ⓢ]	13.66±5.47 [Ⓢ]	15.14±7.10 [Ⓢ]	13.47±5.06 [Ⓢ]	14.06±5.81 [Ⓢ]	13.18±4.83 [Ⓢ]
SCT-descent (sec)	17.59±6.68 [Ⓢ]	15.84±6.05 [Ⓢ]	18.91±8.84 [Ⓢ]	16.18±6.10 [Ⓢ]	17.50±7.15 [Ⓢ]	16.29±6.18 [Ⓢ]	17.60±6.76 [Ⓢ]	16.20±6.21 [Ⓢ]	16.82±6.71 [Ⓢ]	15.72±5.44 [Ⓢ]
6MWT (m)	302.24±101.41 [Ⓢ]	320.59±104.07 [Ⓢ]	259.80±106.66 [Ⓢ]	318.57±102.23 [Ⓢ]	299.59±115.37 [Ⓢ]	316.68±101.07 [Ⓢ]	298.66±104.81 [Ⓢ]	317.43±102.93 [Ⓢ]	307.57±103.39 [Ⓢ]	326.56±102.60 [Ⓢ]
TUG (sec)	12.74±5.66 [Ⓢ]	11.66±3.27 [Ⓢ]	13.63±6.11 [Ⓢ]	11.92±4.17 [Ⓢ]	12.72±4.88 [Ⓢ]	11.93±4.18 [Ⓢ]	12.69±6.36 [Ⓢ]	11.91±3.70 [Ⓢ]	12.24±4.51 [Ⓢ]	11.67±3.84 [Ⓢ]
VAS	7.06±1.56 [Ⓢ]	6.92±1.74 [Ⓢ]	7.29±1.30 [Ⓢ]	6.94±1.70 [Ⓢ]	7.16±1.73 [Ⓢ]	6.94±1.67 [Ⓢ]	6.95±1.72 [Ⓢ]	6.98±1.67 [Ⓢ]	7.00±1.72 [Ⓢ]	6.92±1.61 [Ⓢ]
Gait Speed (m/sec)	0.86±0.17 [Ⓢ]	0.91±0.17 [Ⓢ]	0.82±0.19 [Ⓢ]	0.90±0.17 [Ⓢ]	0.86±0.19 [Ⓢ]	0.90±0.17 [Ⓢ]	0.91±0.19 [Ⓢ]	0.89±0.17 [Ⓢ]	0.89±0.17 [Ⓢ]	0.90±0.18 [Ⓢ]
Cadence (steps/min)	101.92±16.34 [Ⓢ]	105.22±14.02 [Ⓢ]	97.37±20.24 [Ⓢ]	104.44±14.54 [Ⓢ]	101.36±21.42 [Ⓢ]	104.53±13.46 [Ⓢ]	103.39±15.32 [Ⓢ]	104.20±14.88 [Ⓢ]	103.64±15.14 [Ⓢ]	104.85±14.58 [Ⓢ]
Stride length (cm)	102.46±14.88 [Ⓢ]	102.93±14.81 [Ⓢ]	100.21±18.93 [Ⓢ]	103.09±14.46 [Ⓢ]	100.01±17.94 [Ⓢ]	103.25±14.17 [Ⓢ]	105.39±16.26 [Ⓢ]	102.20±14.45 [Ⓢ]	102.82±14.11 [Ⓢ]	102.65±16.11 [Ⓢ]
Gait cycle duration (sec)	1.15±0.31 [Ⓢ]	1.14±0.50 [Ⓢ]	1.12±0.39 [Ⓢ]	1.15±0.45 [Ⓢ]	1.19±1.02 [Ⓢ]	1.14±0.22 [Ⓢ]	1.16±0.31 [Ⓢ]	1.14±0.47 [Ⓢ]	1.17±0.51 [Ⓢ]	1.10±0.27 [Ⓢ]
Stance phase duration (% of gait cycle)	65.26±2.73 [Ⓢ]	65.08±2.45 [Ⓢ]	64.31±4.12 [Ⓢ]	65.18±2.40 [Ⓢ]	65.37±3.92 [Ⓢ]	65.10±2.23 [Ⓢ]	64.91±2.23 [Ⓢ]	65.19±2.61 [Ⓢ]	65.15±2.57 [Ⓢ]	65.14±2.53 [Ⓢ]
Swing phase duration (% of gait cycle)	34.94±3.68 [Ⓢ]	34.88±2.58 [Ⓢ]	35.69±4.12 [Ⓢ]	34.82±2.40 [Ⓢ]	34.64±3.92 [Ⓢ]	34.95±2.83 [Ⓢ]	35.10±2.23 [Ⓢ]	34.86±3.16 [Ⓢ]	34.89±3.23 [Ⓢ]	34.93±2.56 [Ⓢ]
Double support duration (% of gait cycle)	30.12±5.55 [Ⓢ]	29.89±5.43 [Ⓢ]	28.96±7.22 [Ⓢ]	34.87±2.93 [Ⓢ]	30.85±7.19 [Ⓢ]	29.82±5.10 [Ⓢ]	29.45±4.53 [Ⓢ]	30.09±5.65 [Ⓢ]	30.09±5.26 [Ⓢ]	29.76±5.86 [Ⓢ]
Single support duration (% of gait cycle)	34.77±3.33 [Ⓢ]	34.91±3.35 [Ⓢ]	35.62±3.43 [Ⓢ]	34.85±3.34 [Ⓢ]	35.09±5.84 [Ⓢ]	34.82±2.68 [Ⓢ]	35.35±3.67 [Ⓢ]	34.75±3.26 [Ⓢ]	34.77±2.96 [Ⓢ]	35.02±3.96 [Ⓢ]
EQ-5D	0.57±0.17 [Ⓢ]	0.59±0.17 [Ⓢ]	0.59±0.16 [Ⓢ]	0.50±0.21 [Ⓢ]	0.55±0.20 [Ⓢ]	0.58±0.16 [Ⓢ]	0.58±0.16 [Ⓢ]	0.57±0.17 [Ⓢ]	0.57±0.17 [Ⓢ]	0.59±0.17 [Ⓢ]
WOMAC-pain	9.79±3.15 [Ⓢ]	9.22±3.05 [Ⓢ]	9.80±2.97 [Ⓢ]	9.38±3.10 [Ⓢ]	10.15±3.41 [Ⓢ]	9.29±3.02 [Ⓢ]	9.51±3.10 [Ⓢ]	9.40±3.10 [Ⓢ]	9.42±3.20 [Ⓢ]	9.41±2.90 [Ⓢ]
WOMAC-Stiffness	2.85±1.27 [Ⓢ]	2.81±1.37 [Ⓢ]	2.69±1.57 [Ⓢ]	2.83±1.33 [Ⓢ]	2.92±1.54 [Ⓢ]	2.81±1.30 [Ⓢ]	2.62±1.26 [Ⓢ]	2.87±1.36 [Ⓢ]	2.78±1.33 [Ⓢ]	2.91±1.36 [Ⓢ]
WOMAC-Function	29.51±9.22 [Ⓢ]	28.72±8.99 [Ⓢ]	31.80±10.09 [Ⓢ]	28.82±8.91 [Ⓢ]	30.06±10.46 [Ⓢ]	28.81±8.80 [Ⓢ]	29.11±8.88 [Ⓢ]	28.98±9.12 [Ⓢ]	28.93±9.19 [Ⓢ]	29.13±8.87 [Ⓢ]

Values represent mean ± standard deviation.

Table 3. Factors of Performance-based Physical Function, Self-reported Physical Function, Quality of Life and Pain associated with Comorbidities in Patients with End-stage Knee Osteoarthritis[Ⓢ]

Outcome/Independent predictor [Ⓢ]	Standardized (B) [Ⓢ]	p-value [Ⓢ]	Adjusted R ² [Ⓢ]
Osteoporosis [Ⓢ]			
SCT – descent [Ⓢ]	1.040 [Ⓢ]	0.010 [Ⓢ]	0.090 [Ⓢ]
Sarcopenia [Ⓢ]			
SCT – ascent [Ⓢ]	1.120 [Ⓢ]	<0.001 [Ⓢ]	0.330 [Ⓢ]
Degenerative spine disease [Ⓢ]			
WOMAC pain [Ⓢ]	1.082 [Ⓢ]	0.043 [Ⓢ]	0.027 [Ⓢ]
Diabetes [Ⓢ]			
SCT – ascent [Ⓢ]	1.042 [Ⓢ]	0.044 [Ⓢ]	0.029 [Ⓢ]

The Logistic Regression Analyses adjusting for age, sex, BMI[Ⓢ]

노인재활

발표일시 및 장소 : 10 월 26 일(금) 14:45-14:55 Room C(5F)

OP2-2-4

Correlation between mechanography and clinical parameters 6 months after hip fracture surgery

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Objective

To demonstrate the correlation between mechanography and clinical parameters in the elderly after hip fracture surgery.

Methods

A longitudinal follow-up study was conducted in university hospitals for 33 patients in 3 months and 22 patients in 6 months after hip fracture surgery. Subjects aged 65 years and more completed measurements on Berg balance scale (BBS), K-FRAIL scale, Functional Ambulation Category (FAC), KOVAL stage, and hand grip strength (HGS). Romberg test with center of foot pressure (COP) and chair rise test (CRT) maximal power (W/kg) were also conducted using the Leonardo mechanography[®].

Results

BBS revealed significant correlations with COP area ($r=-0.521$, $p=0.002$) and COP pathway length ($r=-0.456$, $p=0.008$) 3 months after hip fracture surgery. Also, the BBS showed significant correlations with COP area ($r=-0.694$, $p<0.001$) and COP pathway length ($r=-0.692$, $p<0.001$) 6 months after surgery. The maximal power during CRT did not show significant correlation with the BBS, KOVAL, FAC, K-FRAIL and HGS in 3 and 6 months after hip fracture surgery.

Conclusion

The study revealed significant correlation between mechanography and the BBS for balance evaluation in the elderly after hip fracture surgery. Not only the clinical assessment with the BBS but the objective test with mechanography may be required for quantitative follow-up functional measurement.

노인재활

발표일시 및 장소 : 10 월 26 일(금) 14:55-15:05 Room C(5F)

OP2-2-5

Dehydration as an Etiologic Factor of Halitosis : a case control study

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Background :

Salivation is considered to be an important factor in the control of halitosis, and the amount of salivation has been shown to be closely related to the level of hydration. The purpose of our study was to evaluate the relationship between dehydration and halitosis.

Methods

Twenty healthy young women with no dental problem were recruited. All participants were asked to dehydrate and then over-hydrated. After inducing each hydration, the severity of hydration and halitosis factor(organoleptic scores, amounts of resting and functional saliva, gas examinations, tongue coatings) were measured. Hydration statuses were graded as dehydration, normal, or over-hydration according to urine osmolality. Cross sectional study with a cross over design was used.

Results

A dehydrated status was associated with the higher organoleptic scores than a normal or over-hydrated status(1.75 ± 0.75 vs. 0.87 ± 0.63 and 0.65 ± 0.53 , respectively, $P < 0.05$). Mean values of CH₃SH, (CH₃)₂S in gas chromatography for a dehydrated, normal, and over-hydrated status were 11.70 ± 37.00 , 6.75 ± 13.50 , 2.80 ± 5.87 and 10.50 ± 15.59 , 7.25 ± 10.87 , 1.50 ± 2.55 ppbv respectively, $p > 0.05$). (CH₃)₂S($r = 0.382$, $p = 0.066$) showed moderate correlations with dehydration status. The resting salivation rates were relatively lower for a dehydrated status than for a normal or over-hydrated status($p > 0.05$), and tongue coating Results were also higher for a dehydrated status($p > 0.05$).

Conclusions

Dehydration status appears to be positively correlated with a low resting salivation rate, high gas chromatography Results. This shows that dehydration might be an etiologic factor of halitosis.

Table 1. Demographic data of the participants

	Dehydration*	Normal hydration _†	Over-hydration _‡	P value
Number	17	6	17	
Age	29.30±3.30	33.00±6.06	31.10±4.46	0.883
Body weight	50.50±1.72	51.50±2.38	51.10±1.73	0.867
Hydration status : urine osmolality	913.94±64.98	749.50±40.00	148.12±85.43	0.000

Table 2. Halitosis severity according to hydration status

Hydration status			Dehydrated	Normal	Over-hydrated
Halitosis severity (Organoleptic score)			1.71±0.79*	0.75±0.61*	0.61±0.55*
Halitosis factor	Salivation rate	Resting	0.39±0.27	0.31±0.24	0.50±0.34
		Functional	1.37±0.69	0.87±0.35	1.50±0.95
Gas chromatography	Tongue coating	H ₂ S	8.53±6.16	7.83±4.45	8.65±8.57
		CH ₃ SH	13.65±38.53	4.50±11.02	1.94±4.58
		(CH ₃) ₂ S	10.24±15.24	8.50±11.10	1.12±2.17
BB checker	Tongue coating		2.00±0.94	2.00±0.82	1.70±0.48
		Oral Gas	24.0±18.59	14.00±3.74	25.70±16.64
		Exhalation Gas	52.30±35.57	50.25±27.47	55.50±21.73

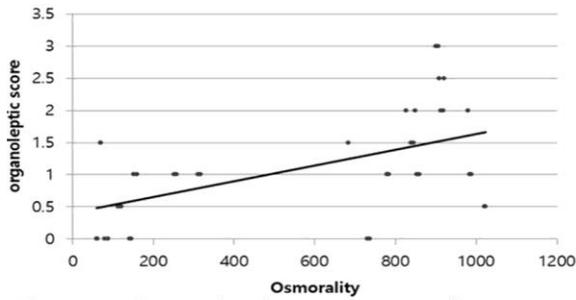
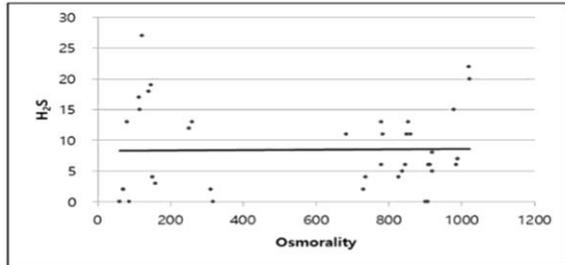
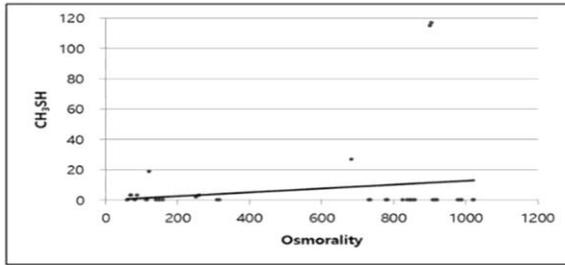


Figure 1. Organoleptic scores according to the hydration status ($r = 0.540$, $p = 0.000$)

(a)



(b)



(c)

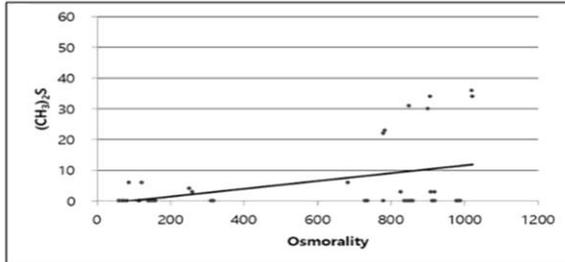


Figure 2. The gas chromatography analysis of the participants according to the dehydration status. CH₃SH ($r = 0.181$, $p = 0.264$) and (CH₃)₂S ($r = 0.410$, $p = 0.009$) showed the positive correlation according to the dehydration status of the participants

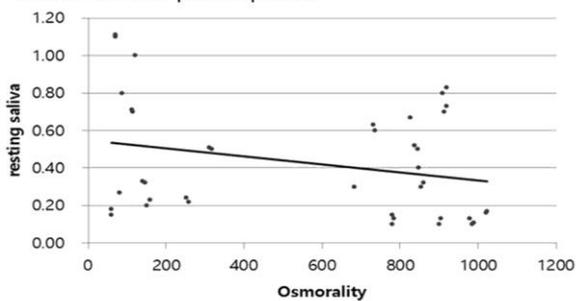


Figure 3. Resting salivation measurements according to the dehydration status. There was a weak negative correlation between dehydration and resting salivation rate ($r = -0.267$, $p = 0.096$)

노인재활

발표일시 및 장소 : 10 월 26 일(금) 15:05-15:15 Room C(5F)

OP2-2-6

Functional outcomes after clinical pathway for inpatient rehabilitation of total knee arthroplasty

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Objective

This study was undertaken to investigate short-term functional outcomes after clinical pathway for inpatient rehabilitation of total knee arthroplasty (TKA) and to examine group effects of unilateral and bilateral TKA patients.

Methods

In this retrospective cohort study, A total of 184 patients (57 males and 127 females; average age 71.5±5.9 years) who had received unilateral and bilateral TKA were followed up from preoperative to postoperative 3 months. Clinical pathways for inpatient rehabilitation included early, intensive individualized rehabilitation (progressive resistance exercise using air resistance machines at 30% of their one-repetition maximum, for three sets of 15 repetitions, progressive gait training using anti-gravity treadmill starting from a workload of 50% bodyweight (BW) and a speed of 2.0 km/hr, and aerobic exercise using ergometer) twice a day, five times a week for 2-week period. Patients completed performance-based physical function tests including stair climbing test (SCT), 6-minute walk test (6MWT), timed up and go test (TUG), isometric knee flexor and extensor strength of the surgical knee, gait speed, range of motion of knee flexion and extension. Self-reported physical function and pain were measured using the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) and Visual Analog Scale (VAS), and self-reported quality of life was measured using the EuroQOL five dimensions (EQ-5D) questionnaire. These evaluations were performed preoperatively, 1 month and 3 months postoperatively, respectively.

Results

The various performance-based and self-reported physical function and quality of life measures improved nonlinearly over time. Specifically, 6MWT, TUG, gait speed, WOMAC-pain, WOMAC-function, VAS, EQ-5D scores showed significant improvements in the first 1 month post-TKA, and SCT, peak torque (PT) of the extensor and flexor of the surgical knee, WOMAC-stiffness scores showed gradual, but, substantial improvements over the

3-month observational period. Group difference (unilateral and bilateral TKA groups) influenced the time course of various functional measures including SCT, 6MWT, TUG, VAS, WOAMC-stiffness, and WOMAC-function. Unilateral TKA group showed steeper improvements in TUG, WOMAC-function, and VAS scores during the first 1 month post-TKA, and in 6MWT and WOMAC-function scores during the 3-month post-TKA than bilateral TKA group. In addition, SCT scores exhibited significantly slower values in the bilateral TKA group than in the unilateral TKA group at 1 month postoperatively, and preoperative WOMAC-stiffness values were significantly higher in the bilateral TKA patients than in the unilateral TKA.

Conclusions

This study confirmed that patients underwent clinical pathway for early intensive inpatient rehabilitation showed significant improvements in various functional measurements during the first 3 months after TKA, with group difference observed in the several functional measures

Table 1. Demographic and Disease-Related Characteristics of the Subjects (N=184)[Ⓢ]

Variables [Ⓢ]	Values [Ⓢ]
Age (years) [Ⓢ]	71.5 ± 5.9 [Ⓢ]
Sex, males/females [Ⓢ]	26 (14.1) / 158 (85.9) [Ⓢ]
BMI (kg/m ²) [Ⓢ]	26.1 ± 3.1 [Ⓢ]
Unilateral / Bilateral [Ⓢ]	127 (69.0) / 57 (31.0) [Ⓢ]
K-L grades [Ⓢ]	[Ⓢ]
Grade 3 [Ⓢ]	34 (14.1) [Ⓢ]
Grade 4 [Ⓢ]	207 (85.9) [Ⓢ]
Lesion side [Ⓢ]	[Ⓢ]
Right [Ⓢ]	135 (56.0) [Ⓢ]
Left [Ⓢ]	106 (44.0) [Ⓢ]
Comorbidities [Ⓢ]	[Ⓢ]
Hypertension [Ⓢ]	125 (67.9) [Ⓢ]
Diabetes mellitus [Ⓢ]	35 (19.0) [Ⓢ]
Degenerative spine disease [Ⓢ]	24 (13.0) [Ⓢ]
Osteoporosis [Ⓢ]	93 (50.5) [Ⓢ]
Presarcopenia [Ⓢ]	10 (5.8) [Ⓢ]

Values represent mean ± standard deviation or number (%) of cases[Ⓢ]

Abbreviations: BMI, Body Mass Index, K-L, Kellgren-Lawrence[Ⓢ]

Table 2. Postoperative Outcomes of Performance-based and Self-reported Physical Function, and Quality of Life by Repeated Measure of ANOVA[†]

Variables [‡]	Values [‡]		
	Preop. [‡]	Postop. 1M [‡]	Postop. 3M [‡]
SCT-ascent(sec) [‡]	14.14±5.71 [‡]	16.41±5.26 ^{a‡}	10.82±3.86 ^{ab‡}
SCT descent(sec) [‡]	16.90±5.81 [‡]	17.67±6.35 [‡]	12.13±4.03 ^{ab‡}
6MWT(m) [‡]	314.48±100.60 [‡]	366.65±81.40 ^{a‡}	444.04±95.36 ^{ab‡}
TUG(sec) [‡]	12.00±3.45 [‡]	11.28±2.94 ^{a‡}	9.31±1.75 ^{ab‡}
PT Ex of surgical knee (N·m·kg ⁻¹ BW) [‡]	[‡]	[‡]	[‡]
PT Flx of surgical knee (N·m·kg ⁻¹ BW) [‡]	[‡]	[‡]	[‡]
Gait speed (m/sec) [‡]	0.89±0.17 [‡]	1.02±0.15 ^{a‡}	1.22±0.76 ^{ab‡}
ROM-knee flexion [‡]	127.72±13.32 [‡]	114.36±15.16 ^{a‡}	121.49±12.65 ^{ab‡}
ROM-knee extension [‡]	-7.1±5.88 [‡]	-2.45±4.40 ^{a‡}	-6.76±5.37 ^{b‡}
WOMAC-pain [‡]	9.58±3.16 [‡]	6.57±2.5 ^{a‡}	4.7±2.15 ^{ab‡}
WOMAC-stiffness [‡]	2.92±1.36 [‡]	2.68±1.09 [‡]	1.95±0.91 ^{ab‡}
WOMAC-function [‡]	29.58±8.83 [‡]	26.29±8.54 ^{a‡}	18.72±8.16 ^{ab‡}
VAS [‡]	6.98±1.70 [‡]	3.67±1.21 ^{a†}	2.50±2.21 ^{ab†}
EQ5D [‡]	0.58±0.15 [‡]	0.73±0.06 ^{a‡}	0.81±0.08 ^{ab‡}

Values represent mean ± standard deviation [‡]

Abbreviations: WOMAC, Western Ontario McMaster Universities Osteoarthritis Index, SCT, stair climbing test, 6MWT, 6-minute walk test, TUG, timed up and go, EQ-5D, EuroQOL five dimensions, PT, peak torque, BW, body weight, Ex, extensor, Flx, flexor[‡]

^aSignificant difference between preoperatively and 1month postoperatively, between preoperatively and 3 months postoperatively (p<0.05) [‡]

^bSignificant difference between 1 month postoperatively and 3 months postoperatively (p<0.05)[‡]

Table 3. Postoperative Outcomes of Physical Performance, Physical Function, and Quality of Life. Subgroup analysis between unilateral and bilateral TKA groups.

Variables	Preop.	Values	
		Postop. 1M.	Postop. 3M.
WOMAC-pain			
Unilateral	9.53±3.07	6.33±2.53*	4.40±2.19 ^{ab}
Bilateral	9.75±3.36	7.02±2.37*	5.20±2.01 ^{ab}
WOMAC-stiffness			
Unilateral	3.10±1.53	2.69±1.10*	1.82±0.92 ^{ab}
Bilateral	2.65±0.95*	2.68±1.07	2.19±0.81 ^{ab}
WOMAC-function			
Unilateral	29.35±8.72	25.22±8.66*	17.65±8.39 ^{ab}
Bilateral	30.26±9.10	28.39±7.98*	20.82±7.39 ^{ab}
SCT-ascent(sec)			
Unilateral	14.33±5.90	15.52±4.79	11.12±4.16 ^{ab}
Bilateral	13.78±5.38	18.34±5.76*	10.27±3.17 ^{ab}
SCT-descent(sec)			
Unilateral	16.66±5.71	16.37±5.09	12.29±3.97 ^{ab}
Bilateral	17.50±6.06	17.50±6.06*	11.90±4.21 ^{ab}
6MWT(m)			
Unilateral	311.63±99.77	367.56±86.54 ^{ab}	428.82±97.54 ^{ab}
Bilateral	318.60±103.68	363.25±70.90*	474.91±84.10 ^{ab}
TUG(sec)			
Unilateral	12.00±3.38	10.91±2.55*	9.38±1.86 ^{ab}
Bilateral	12.05±3.67	12.12±3.58*	9.17±1.50 ^{ab}
EQ5D			
Unilateral	0.59±0.15	0.74±0.64*	0.81±0.08 ^{ab}
Bilateral	0.56±0.16	0.72±0.04*	0.80±0.08 ^{ab}
ROM-knee flexion			
Unilateral	127.56±11.04	114.10±17.71*	122.35±11.69 ^{ab}
Bilateral	129.69±9.92	115.12±11.90*	122.35±12.88 ^{ab}

ROM-knee extension	-7.63±5.80	-3.75±5.25*	-7.91±5.52 ^b
Unilateral	-7.58±6.23	-1.23±3.02*	-6.63±5.42 ^b
Bilateral			
VAS			
Unilateral	7.03±1.60	3.52±1.28*	2.55±1.34 ^{ab}
Bilateral	6.93±1.85	4.04±0.97*	2.41±0.93 ^{ab}
Gait speed			
Unilateral	0.88±0.17	1.02±0.15 ^{ab}	1.23±0.91 ^{ab}
Bilateral	0.90±0.18	1.02±0.15*	1.19±0.21 ^{ab}
PT Ex of surgical knee (N·m·kg ⁻¹ ·BW)			
Unilateral	72.50±27.80	53.00±21.70*	80.71±25.24 ^{ab}
Bilateral	78.44±33.26	57.69±22.42*	89.55±27.03 ^{ab}
PT Flex of surgical knee (N·m·kg ⁻¹ ·BW)			
Unilateral	49.07±14.84	48.52±13.30	53.07±13.89 ^{ab}
Bilateral	45.87±14.58	46.48±15.08	50.53±13.71 ^{ab}

Values represent mean ± standard deviation.

Abbreviations: WOMAC, Western Ontario McMaster Universities Osteoarthritis Index, SCT, stair climbing test, 6MWT, 6-minute walk test, TUG, timed up and go, EQ-5D, EuroQOL five dimensions, PT, peak torque, BW, body weight, Ex, extensor, Flex, flexor.

*Significant difference between preoperatively and 1 month postoperatively, between preoperatively and 3 months postoperatively (p < 0.05).

^aSignificant difference between 1 month postoperatively and 3 months postoperatively (p < 0.05).

^bSignificant difference between unilateral and bilateral TKA groups (p < 0.05).

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 15:15-15:25 Room C(5F)

OP2-2-7

Enriched Environment Ameliorates Oxidative Stress and Olfactory Dysfunction in a Parkinson's Model

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Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine¹, Yonsei University College of Medicine, Brain Korea 21 PLUS Project for Medical Science², National Health Insurance Service Ilsan Hospital, Department of Physical Medicine and Rehabilitation³

Introduction

Parkinson's disease (PD) features nonmotor symptoms such as olfactory dysfunction referred to as hyposmia, an initial sign of disease progression. Metabolic dysfunction can contribute to neurodegenerative diseases, and various xenobiotics and endogenous compounds are also involved in the pathogenesis of PD. Although aerobic exercise was found to induce preservation or improvement in olfactory function in PD patients in a recent study, the exact underlying mechanism for this effect is not clear. We aimed to investigate the influence of an enriched environment (EE) on olfactory dysfunction especially via metabolic pathways related to detoxification enzymes.

Method

Eight-month-old PD transgenic (Tg) mice overexpressing human A53T α -synuclein (α -syn) were randomly allocated to an EE or standard conditions for 2 mo. Buried food test was performed twice on mice at 8 and 10 mo of age. Reverse transcription polymerase chain reaction (PCR) and real-time quantitative PCR were done to evaluate expression of the detoxification enzymes at 10 and 13 mo in the olfactory bulb of PD. We performed immunohistochemical staining of iNOS to evaluate the level of oxidative stress in olfactory bulb of 10-mo-old WT, PD control, and PD EE mice.

Results

The buried food test showed that EE group had significantly improved olfactory function compared to the control group. Reverse transcription polymerase chain reaction (PCR) and real-time quantitative PCR showed that expression of the detoxification enzymes—cytochrome P450 family 1 subfamily A member 2, paraoxonase 1, alcohol dehydrogenase 1, UDP glucuronosyltransferase family 2 member A1 complex locus, aldehyde oxidase homolog 2, and aldehyde glutathione peroxidase 6—was significantly increased in the olfactory bulb (OB) of the PD control group, but these enzymes were normalized in the EE

group. Immunohistochemical staining of the OB showed that oxidative stress and nitrated a-syn were significantly increased in the control group but decreased in the EE group.

Conclusion

In a Tg mouse model of PD that overexpressed human A53T a-syn, exposure to an EE reduced oxidative stress and nitrated a-syn, resulting in normalized detoxification enzymes and amelioration of olfactory dysfunction.

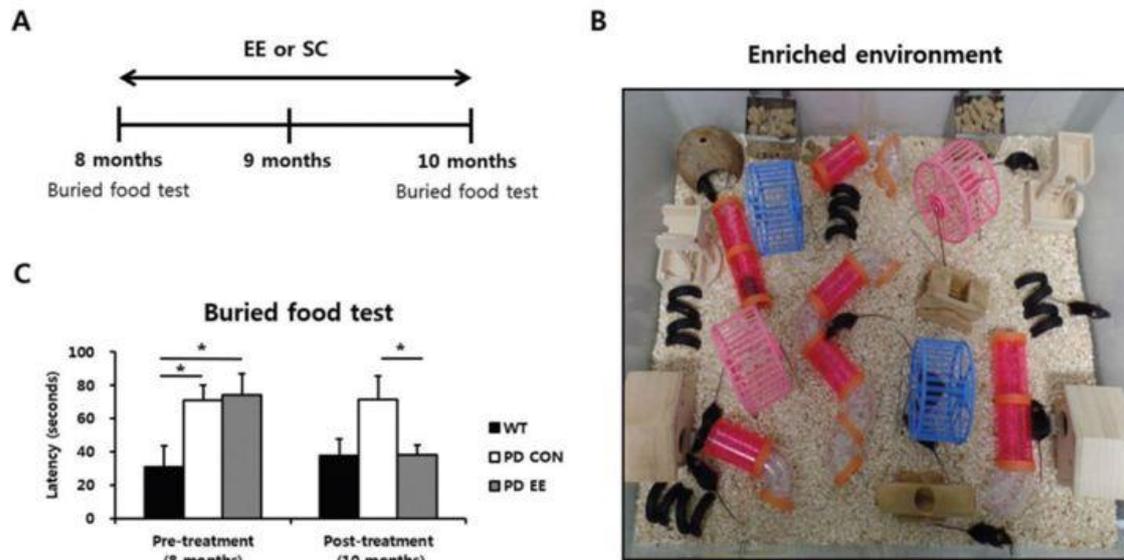


Figure 1. Experimental design and effect of an enriched environment on olfactory dysfunction in Parkinson's disease. (A) Schematic timeline of the experiment in a mouse model of PD. (B) An image of EE. (C) Buried food test result. The latency time of finding food in PD control group (N=14, 71.0±9.2 sec, $P < 0.05$) and PD EE group (N=11, 74.2±12.8 sec, $P < 0.05$) significantly increased compared to WT group (N=8, 30.7±4.6 sec) at 8 mo of age. The result of latency time of find food at 10 mo of age showed that the PD EE group (37.9±6.1 sec, $P < 0.05$) significantly decreased compared to PD control group (71.3±14.2 sec). Abbreviations: PD=Parkinson's disease; EE=enriched environment; WT=wild type. * $P < 0.05$ is based on a one-way ANOVA followed by a post hoc test.

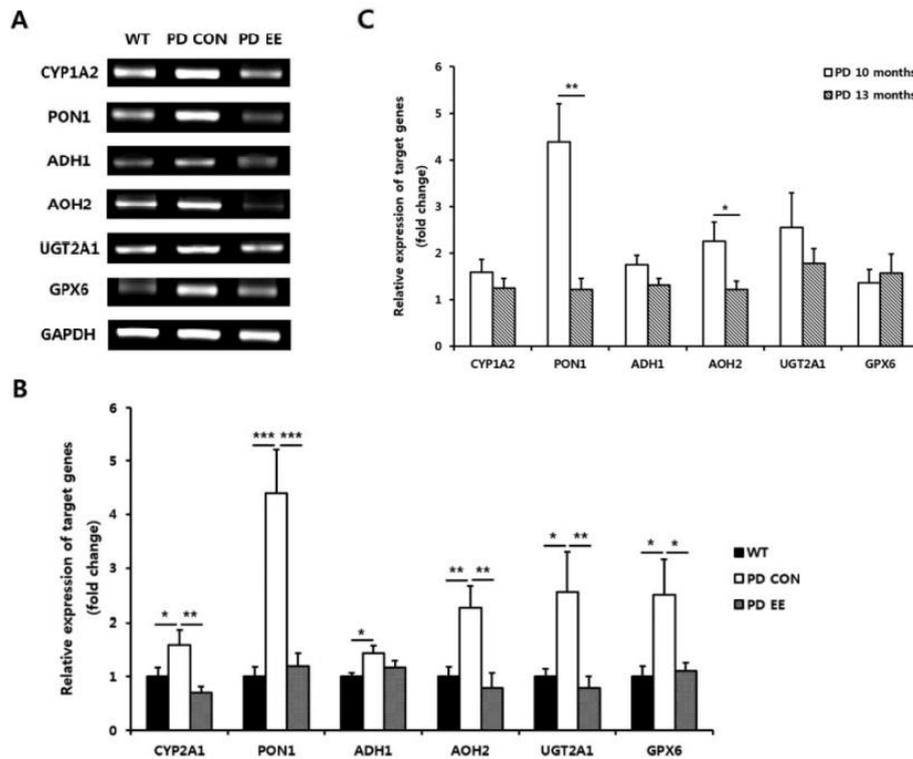


Figure 2. Expression of genes related to detoxification enzymes in the olfactory bulb. (A) RT-PCR analysis of 6 genes related to detoxification enzymes in the OB of PD mice at 10 mo of age. (B) Quantitative comparison of gene expression in the PD control (N=5) and PD EE group (N=5) relative to WT mice (N=5) at 10 mo determined by RT-qPCR. The expression of CYP1A2 (1.59-fold), PON1 (4.39-fold), ADH1 (1.43-fold), AOH2 (2.26-fold), UGT2A1 (2.55-fold), and GPX6 (2.50-fold) was significantly increased in the PD control group compared to the WT group. However, the expression of CYP1A2 (0.70-fold), PON1 (1.20-fold), ADH1 (1.17-fold), AOH2 (0.79-fold), UGT2A1 (0.79-fold), and GPX6 (1.10-fold) was decreased in the PD EE group compared to the PD control group. * $P < 0.05$ and ** $P < 0.01$ by an independent t test. (C) Gene expressions of early stage mice, 10 mo of age, of PD mice (N=5) relative to the same age of WT mice (N=5) and that of PD mice (N=7) in late stage, 13 mo of age, relative to the same age of WT mice (N=5) were compared. PD mice in late stage showed the decrease in CYP1A2 (0.78-fold), PON1 (0.28 fold), ADH1 (0.75-fold), AOH2 (0.54-fold), UGT2A1 (0.70-fold), and GPX6 (1.16-fold) compared to the PD mice in early stage. * $P < 0.05$, ** $P < 0.01$, and *** $P < 0.001$ by a one-way ANOVA followed by a post hoc test.

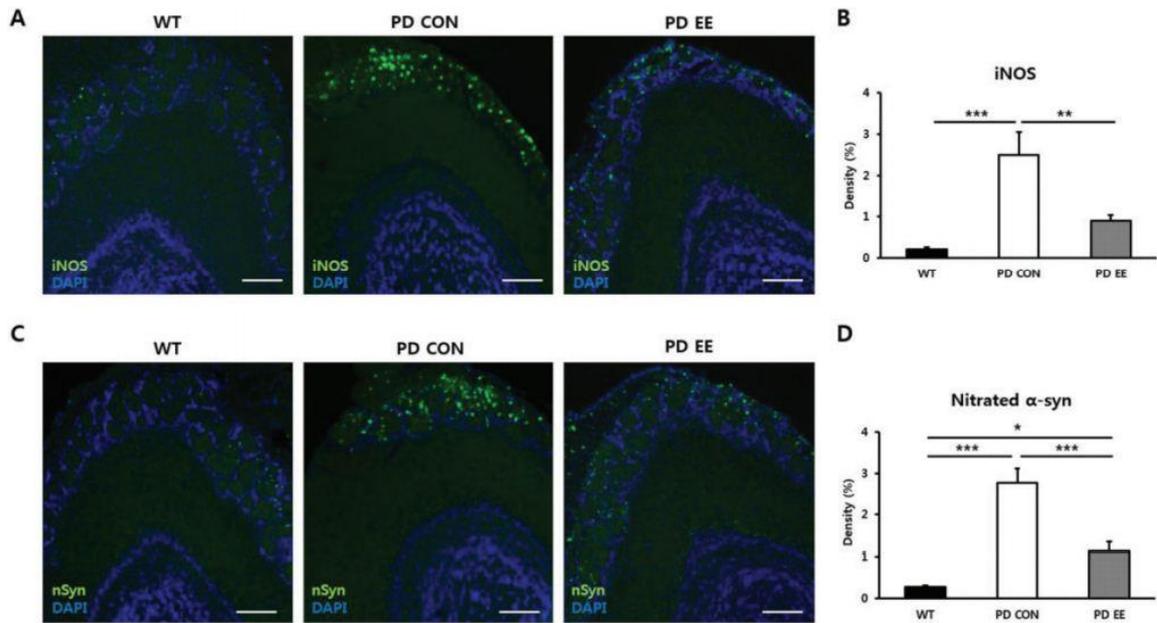


Figure 3. An enriched environment ameliorates oxidative stress and nitrated α -syn in PD. (A) Images of the iNOS immunohistochemistry staining in the glomerular layer of the olfactory bulb. (B) The density of iNOS was significantly higher in PD control group (2.5±0.53%, $P < 0.001$) than in WT group (0.2±0.06%). However, the density of nitrated α -syn was significantly lower in PD EE group than in both PD control group and WT group based on a one-way ANOVA (1.1±0.21%, $P < 0.001$, $P < 0.05$, respectively). Scale bars=200 μ m. Abbreviations: α -syn=human A53T α -synuclein; PD=Parkinson's disease; iNOS=inducible nitric oxide; WT=wild type; EE=enriched environment; ANOVA=analysis of variance. * $P < 0.05$, ** $P < 0.01$, and *** $P < 0.001$ by a one-way ANOVA followed by a post hoc test.

노인재활

발표일시 및 장소 : 10 월 26 일(금) 15:25-15:35 Room C(5F)

OP2-2-8

Predictive factors for independent ambulation after hip fracture surgery

Sang Ho Oh^{1*}, Yong-Chan Ha², Jaewon Beom^{1†}, Bo Ryun Kim³, Jae-Young Lim⁴, Si Hyun Kang¹, Don-Kyu Kim¹, Kyung Mook Seo¹

Chung-Ang University Hospital, Chung-Ang University College of Medicine, Department of Physical Medicine and Rehabilitation¹, Chung-Ang University Hospital, Chung-Ang University College of Medicine, Department of Orthopaedic Surgery², Jeju National University Hospital, Department of Rehabilitation Medicine³, Seoul National University Bundang Hospital, Department of Rehabilitation Medicine⁴

Objective

To investigate the predictive factors for independent ambulation in the elderly after hip fracture surgery.

Methods

Ninety-two patients aged 65 years and more who underwent fragility hip fracture surgery at three university hospitals from February 2017 to June 2018 were enrolled in the prospective clinical trial. Age, gender, KOVAL stage, Functional Ambulatory Category (FAC), modified Rivermead mobility index (MRMI), Berg balance scale (BBS), mini-mental state examination (MMSE-K), geriatric depression scale (GDS), EQ-5D, modified Barthel index (MBI), Korean instrumental activities of daily living (K-IADL), K-FRAIL, and hand grip strength (HGS) were evaluated. KOVAL 1 to 3 stage and FAC 4 to 5 score were classified as independent ambulation, whereas KOVAL 4 to 7 stage and FAC 0 to 3 score as dependent ambulation.

Results

Among 92 patients, 46 patients can walk independently 3 months after surgery. In univariate analysis, pre-fracture KOVAL stage or FAC score, MRMI, BBS, MBI, K-IADL, and HGS were significant parameters. In multivariate logistic regression analysis, low pre-fracture KOVAL stage (OR=2.228) and high pre-fracture FAC score (OR=3.351) revealed high probability for independent ambulation 3 months after surgery.

Conclusion

Ambulatory function assessed by KOVAL or FAC before fragility hip fracture may be the strongest predictive factor for independent ambulation after hip fracture surgery. A future study with larger sample size will be needed for definite conclusion.

뇌신경재활

발표일시 및 장소 : 10 월 26 일(금) 15:35-15:45 Room C(5F)

OP2-2-9

Would intravitreal bevacizumab injection increase risk of cerebral infarction?

Seong Hoon Lim^{1*†}, Jin-woo Kwon², Donghyun Jee², Won Jin Sung¹

St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Republic of Korea, Department of Rehabilitation Medicine¹, St. Vincent's Hospital, College of Medicine, The Catholic University of Korea, Republic of Korea, Department of Ophthalmology and Visual Science²

Purpose

There has been controversy concerning the possible association between intravitreal bevacizumab injection(IVB) injection and thromboembolic accidents. Some studies reported no association between IVB injection and stroke or myocardial infarction (MI). Several other studies have reported the possible association between IVB injection and thromboembolic accidents. The use of IVB for AMD has been increased with time for aged community. Thus, the relation between IVB and thromboembolic accidents should be uncovered. Although previous studies have investigated the effects of IVB injection on cerebral infarction, the effects of IVB are still not fully understood. The aim of this study was to determine the effects of IVB on cerebral infarction. In a small-scale study, we identified possible new risk factors, providing a basis for future population-based studies.

Material and Methods

We retrospectively reviewed patients with AMD who received IVB injections for 1 year and determined the incidence of CI within 60 days after IVB injection to analyze the possible association between IVB and CI.

Results

Over a 12-month period, 263 patients were enrolled. Six patients (2.28%) were diagnosed with CI within 2 months after receiving an IVB injection. The average number of IVB injections over the 1-year period was 2.98 ± 1.58 and was not significantly different between the two groups. The total number of IVB injections per patient was 4.95 ± 3.31 and was not significantly different between the two groups (Table 1). The incidence of CI in patients 75–84 years of age was 6.38%. These Results showed a higher incidence of patients with IVB injections than the Results of previous epidemiological studies (0.13% for all age groups, 1.68% for patients 75–84 years of age). All CI occurred 21–53 days after the IVB injection (mean: 39.33 ± 14.65 days). Logistic regression analyses showed that age and a history of previous cerebral infarction were factors associated with cerebral infarction ($p = 0.042$ and $p = 0.008$, respectively; Table 2). However, the total number of

IVB injections and the number of IVB injections over 1 year were not associated with cerebral infarction (Table 2).

Conclusions

Treatment with IVB may be an independent risk factor for cerebral infarction. Careful consideration by clinicians is necessary before administering IVB injections, especially in older patients or in patients with a previous history of cerebral infarction. These Results are therefore useful for planning treatment strategies for patients with AMD, as well as for prevention of cerebral infarction.

Table 1. Demographic and baseline clinical characteristics of the patients

	Non-cerebral infarction (n = 257)	Cerebral infarction (n = 6)	p-value
Age (years)	70.02 ± 11.69	80.33 ± 2.42	< 0.001
Sex (male:female)	144:113	4:2	0.699
Average IVB in a year	2.98 ± 1.59	2.83 ± 0.75	0.998
Total IVB number	4.90 ± 3.29	7.00 ± 4.10	0.091
History of cerebral infarction	10 (3.89%)	2 (33.3%)	0.026

IVB, intravitreal bevacizumab

Table 2. Variables associated with cerebral infarction to IVB upon logistic regression analysis.

	Univariate analysis		Stepwise regression analysis	
	$\beta \pm SE$	p value	$\beta \pm SE$	p value
Age (years)	0.112 ± 0.055	0.041	0.116 ± 0.057	0.042
sex	0.451 ± 0.875	0.607		
IVB during a year	-0.065 ± 0.278	0.816		
Total number of IVB	0.130 ± 0.088	0.140		
DM	0.366 ± 0.344	0.287		
Hypertension	18.976 ± 2197.245	0.993		
History of CI	2.514 ± 0.924	0.007	2.594 ± 0.984	0.008

IVB, intravitreal bevacizumab; DM, diabetes mellitus; CI, cerebral infarction

ORAL PRESENTATION 2-3

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 10:00-10:10 Room C(5F)

OP2-3-1

Effect of Endoscopic Intervention for Dysphagia Patients with Lateral Medullary Infarction

Yeongwook Kim^{1*}, Sun Hyung Kang², Sungju Jee^{1†}

School of Medicine, Chungnam National University, Department of Rehabilitation Medicine¹, School of Medicine, Chungnam National University, Department of Internal Medicine²

Background and Purpose

Dysphagia is considered to be a significant barrier for recovery after lateral medullary infarction (LMI). However, there is still no gold standard treatment for dysphagia. The aim of this study was to compare early treatment options for swallowing dysfunction after acute LMI.

Methods

Medical records of acute LMI patients who had been admitted to the department of rehabilitation medicine from January 2014 to December 2017 were reviewed retrospectively. Treatment strategies included conventional dysphagia rehabilitation or early endoscopic intervention, using either botulinum toxin injection into the cricopharyngeus muscle or endoscopic balloon dilatation (EBD) of the muscle (Figure 1). Outcomes, such as duration of parental feeding, albumin level at diet transition to enteral feeding, and complications, were compared between treatment strategies.

Results

A total of 18 patients with LMI were enrolled. While eight patients (8/9, 88.89%) in the endoscopic group were capable of orally ingesting their diet after intervention, the conversion from tube feeding to an oral diet was possible in only five patients (5/9, 55.56%) of the conventional group during hospitalization. However, the difference between the two groups was not significant (p -value ≤ 0.147 , chi-square test). Only the final dietary level at the time of discharge was higher in endoscopic group, while there was no change in albumin levels, final hemoglobin levels, and follow-up video fluoroscopic swallowing study (VFSS) scores. The conversion interval from tube feeding to oral diet was also comparable between groups. There was no re-conversion from the oral diet to tube feeding in patients of either group during the median follow-up period of 20 months.

Conclusions

Early endoscopic intervention may be a better option for dysphagia with LMI, compared to conventional dysphagia rehabilitation. However, a larger and prospective trial may be needed to confirm our observations.

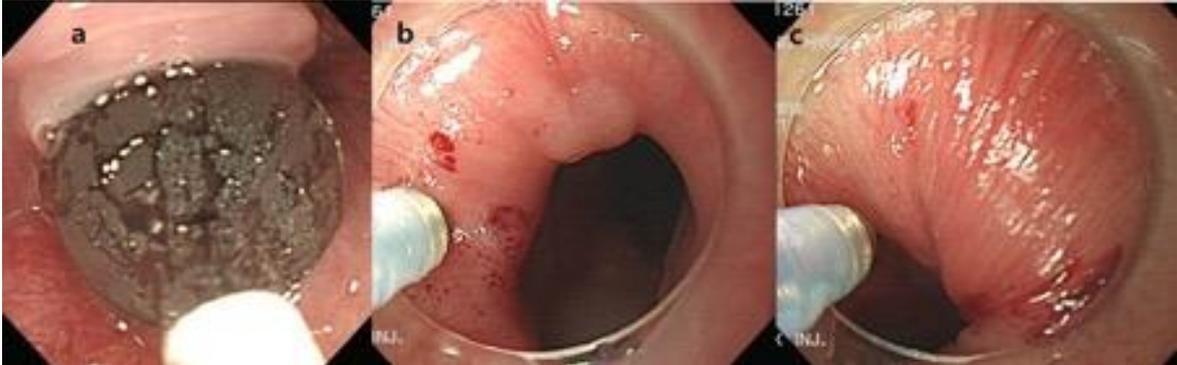


Figure 1. Endoscopic intervention. (a) Endoscopic balloon dilatation was performed by dilating a CRE balloon up to 20 mm with 6 atm pressure. (b, c) Botulinum toxin was injected into 4 UES quadrants with cap-assisted endoscopy.

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 10:10-10:20 Room C(5F)

OP2-3-2

Effectiveness of Chin Tuck Posture in Dysphagia Rehabilitation

Joo Young Ko^{1*}, Jung Keun Hyun^{1,2}, Tae Uk Kim¹, Seo Young Kim¹, Seong Jae Lee^{1†}

Dankook University Hospital, Department of Rehabilitation Medicine¹, Dankook University, Department of Nanobiomedical Science & BK21 PLUS NBM Research Center for Regenerative Medicine², Dankook University, Institute of Tissue Regeneration Engineering (ITREN)³

Objective

Dysphagia is a common disorder and It can occur as a result of significant primary illnesses. It causes various complications, which are relevant to morbidity and mortality. Treatment of dysphagia has traditionally been centered on behavioral interventions, with the intended purpose of facilitating safe and efficient oral feeding. Among them, chin tuck is one of the Methods most widely used to prevent aspiration. However, a few studies raised suspicion about its effectiveness. In previous studies, only about half of patients could avoid aspiration during this maneuver. It was demonstrated that chin tuck maneuver can be more effective in a few favorable conditions. They are female sex, absence of residue in pyriform sinus, delayed swallowing trigger, reduced laryngeal elevation and penetration in thin liquid. This study is designed to investigate if chin tuck maneuver is truly effective in patients who meet those conditions.

Methods

The subjects were one hundred eighteen patients who showed aspiration or penetration on videofluoroscopic swallowing study (VFSS). Sixty-nine patients were male and forty-nine were female. Mean age was 67.5 ± 14.5 years. VFSS was performed in two positions (neutral and chin tuck) and the findings were compared between positions. Parameters such as Penetration-aspiration scale (PAS), pharyngeal delay time (PDT), pharyngeal transit time (PTT), presence of excessive residue in vallecula and pyriform sinus and degree of laryngeal elevation were measured and analyzed.

Results

Aspiration was reduced or eliminated in only 22 patients with chin tuck maneuver. Even when the patients met all favorable conditions (female sex, absence of residue in pyriform sinus, delayed swallowing trigger, reduced laryngeal elevation and penetration in thin liquid) at the same time, chin tuck was effective only in 4 out of 18 patients. The patients with at least one favorable condition, chin tuck maneuver was effective in 20 out of 98 patients. In chi square analysis, chin tuck maneuver was more effective in patients with no residue in pyriform sinus ($p=0.00$). It was also more effective when aspiration or penetration was evident in thin liquid swallowing ($p=0.00$). However, only 34% (17/50)

and 54% (13/24) of patients with those conditions benefited from chin tuck. No other variables showed statistically significant difference.

Conclusion

The Results showed that chin tuck maneuver is less effective than expected. It can be more effective when residue in pyriform sinus is not evident or aspiration/penetration in thin liquid swallowing is observed on VFSS but efficacy is still questionable. clinical usefulness of chin tuck is doubtful although it has been almost routinely prescribed for treatment of dysphagia in clinical field.

노인재활

발표일시 및 장소 : 10 월 27 일(토) 10:20-10:30 Room C(5F)

OP2-3-3

Incidence of Aspiration Pneumonia in South Korea: A 12-Year Nationwide Population-Based Study

Gwang Pyo Jung^{1*}, Dan Huang², Aesun Shin², Byung-Mo Oh¹⁺, Han Gil Seo¹, Tai Ryoan Han¹

Seoul National University Hospital, Department of Rehabilitation Medicine¹, Seoul National University Hospital, Department of Preventive Medicine²

Introduction

Pneumonia is one of the leading causes of hospitalization and death in the elderly. Aspiration pneumonia is one of the common presentations of pneumonia. The incidence of aspiration pneumonia is important for understanding disease burden and helping public health plan. This study aims to investigate the incidence in South Korea between 2002 and 2013.

Method

This retrospective, longitudinal population-based study used National Health Insurance Service-National Sample Cohort Database which is a representative sample cohort of 1,025,340 participants by random selection, comprising 2.2% of the total eligible Korean population in 2002, and followed for 11 years until 2013 unless participants' eligibility was disqualified due to death or emigration. Pneumonia and aspiration pneumonia diagnosis was identified based on Korean Classification of Diseases code J10-J18 and J69 respectively. Participants with claim for hospitalization and chest radiography were included. Annual incidence and age-group incidence were calculated.

Results

The incidence of aspiration pneumonia per 100,000 of population was 13.0 in 2002 and 45.7 in 2013, and there was 11.0% yearly increase over the 12 years (Figure 1). On the other hand, the overall incidence of pneumonia did not show a dramatic increase. Incidence rates increased with advancing age, showing the highest rates among those who were 75 and older as 0.925 cases per 100 person-year.

Conclusions

Our data show that there was an increasing trend in the incidence of aspiration pneumonia from 2002 to 2013, particularly in 75 years and older. Continuing trends of increasing incidence of the aspiration pneumonia warrant full attention from the public health authorities.

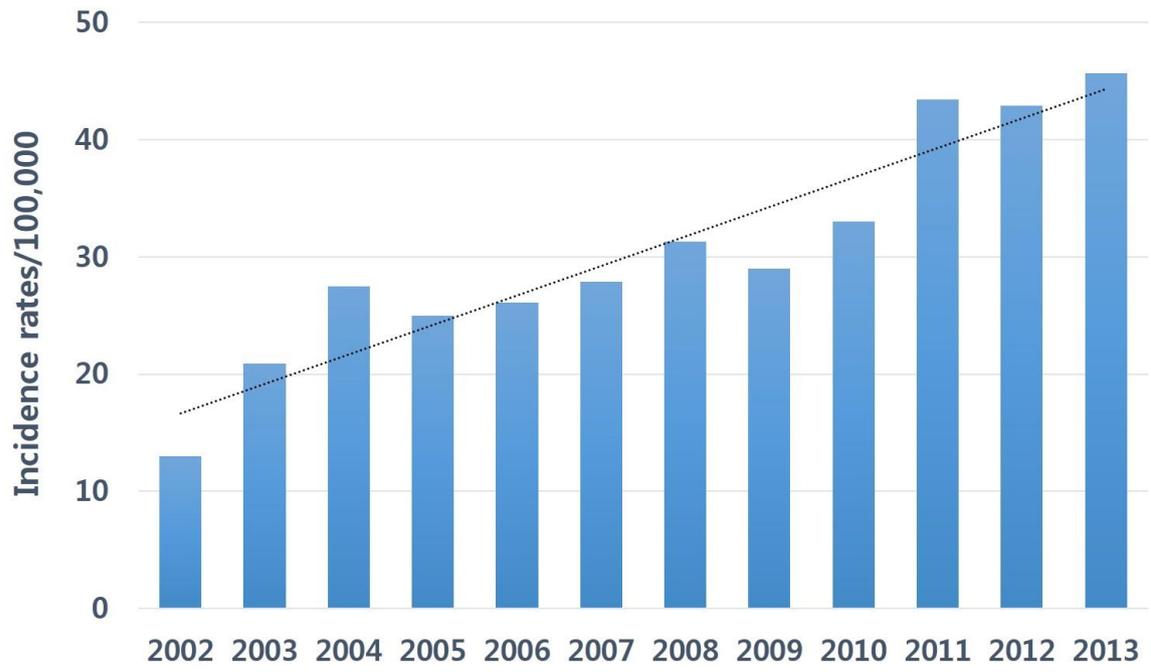


Fig1. Annual incidence rates of aspiration pneumonia

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 10:30-10:40 Room C(5F)

OP2-3-4

The Effect of Cerebellar rTMS on Post-stroke Dysphagia

Young Sam Kim^{1*}, Jin Gee Park^{1†}, Kyeong Woo Lee¹, Jong Hwa Lee¹, Sang Beom Kim¹

Dong-A University Hospital, Department of Rehabilitation Medicine¹

Objectives

There are well-known evidences that multiple regions within the central nervous system such as cerebral cortex, brain stem and cranial nerves play an important role in swallowing. However, the physiologic role of the cerebellum in control of swallowing is unknown. Neuro-imaging of the healthy human brain with positron emission tomography has demonstrated that increased regional blood flow in cerebellum during swallowing. Several studies using functional magnetic resonance imaging have also reported that cerebellum has some involvement in swallowing. Previous study have shown that cerebellar repetitive transcranial magnetic stimulation (rTMS) modulates pharyngeal corticobulbar excitability in healthy human. Thus, the aim of this study is to find out the effect of cerebellar rTMS on post-stroke dysphagia.

Methods

The subacute M1 territory stroke patient with dysphagia were recruited. All patients were randomly divided into the rTMS group and the control group. The rTMS group received rTMS for 10 minutes a day, 10 times. Each session included 900 stimulation over posterior fossa of the cerebellum at intensity of 110% pharyngeal motor threshold and frequency of 10 Hz. Both groups received conventional swallowing therapy for 20 minutes a day for 10 times. Both groups underwent a Video fluoroscopic swallowing study (VFSS) within 1 week before and after the treatment. While every VFSS, Functional Dysphagia Scale (FDS), Penetration Aspiration Scale (PAS) and American Speech Language Hearing Association National Outcome Measurement System Swallowing Scale (ASHA-NOMS) were evaluated.

Results

In each group, 15 patients were recruited. There were no significant differences in the baseline characteristics between the two groups (Table 1). After the treatment, in intra-group comparison, FDS showed significant improvement in both groups (Table 2). In inter-group comparison, a significant difference was found in FDS between rTMS and control group (Table 3). Neither group had complications during and after the treatment.

Conclusion

rTMS on cerebellum showed significant improvement in FDS. It is likely that rTMS may have augmented corticobulbar excitability so that have brought improvement in

oropharyngeal function. Therefore, rTMS on cerebellum could be an useful treatment option in M1-associated stroke patients with dysphagia.

table1. Baseline characteristics of the two groups

	rTMS group (n=15)	Control group (n=15)	p-value
Age	67.1±10.7	65.5±7.8	0.589
Sex			
Male	9 (60%)	6 (40%)	
Female	6 (40%)	9 (60%)	
Lesion			
Ischemic / Hemorrhagic	11 / 4	10 / 5	
Left / Right	12 / 3	8 / 7	
Initial NIHSS	17.7±9.5	13.7±8.6	0.203
OTTD			
- / +	5 / 10	9 / 6	0.143
FDS	43.6±12.2	36.7±11.9	0.108
PAS	7.2±1.6	7.1±1.4	0.798
ASHA-NOMS	2.7±1.1	3.2±1.1	0.645

Values are presented as mean±standard deviation.

rTMS; repetitive transcranial magnetic stimulation, OTTD; oral transition time delay, FDS; Functional Dysphagia Scale, PAS; Penetration Aspiration Scale, ASHA-NOMS; American Speech Language Hearing Association National Outcome Measurement System Swallowing Scale

table2. Change of measurements in each group after the therapy

	rTMS group (n=15)			Control group (n=15)		
	Pre	Post	p-value	Pre	Post	p-value
FDS	43.6±12.2	21.4±7.6	0.015*	36.7±11.9	25.5±9.2	0.043*
PAS	7.2±1.6	4.8±2.0	0.059	7.1±1.4	5.0±2.5	0.066
ASHA-NOMS	2.7±1.1	3.6±2.0	0.057	3.2±1.1	4.2±1.4	0.062

Values are presented as mean±standard deviation.

rTMS; repetitive transcranial magnetic stimulation, FDS; Functional Dysphagia Scale, PAS; Penetration Aspiration Scale, ASHA-NOMS; American Speech Language Hearing Association National Outcome Measurement System Swallowing Scale

*p<0.05 by Wilcoxon signed rank test.

table3. Comparison of changes between two groups after the therapy

	rTMS group (n=15)	Control group (n=15)	p-value
ΔFDS	-22.2±6.7	-11.2±3.7	0.032*
ΔPAS	-2.4±2.0	-2.1±2.3	0.069
Δ ASHA-NOMS	0.9±1.9	1.0±1.1	0.733

Values are presented as mean±standard deviation.

rTMS; repetitive transcranial magnetic stimulation, FDS; Functional Dysphagia Scale, PAS; Penetration Aspiration Scale, ASHA-NOMS; American Speech Language Hearing Association National Outcome Measurement System Swallowing Scale

*p<0.05 by Mann-Whitney U-test.

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 10:40-10:50 Room C(5F)

OP2-3-5

Ultrasound guided needle insertion technique into the cricopharyngeus muscle

Ju Hyong Jeong^{1*}, Young Ha Jeong¹, Seung Nam Yang^{1†}, Joon Shik Yoon¹

Korea University Guro Hospital, Department of Rehabilitation Medicine¹

BACKGROUND

Although cricopharyngeus muscle (CP) electromyography is used for diagnosis of swallowing disorder or botulinum toxin injection to treat CP muscle dysfunction, the risk of blind injection still remains. There are some important anatomic features around CP muscle, which are recurrent laryngeal nerve, thyroid gland, superior and inferior thyroid artery. Thus the aim of this study is to discuss the safe injection technique of CP muscle in the guidance of ultrasonography.

METHODS

This was a prospective study of 11 healthy volunteers (3 women and 8 men) aged 26 to 47 years. Neck ultrasonography was performed in supine position with neutral (targeting left CP muscle), right (targeting left CP muscle), and left neck rotation (targeting right CP muscle) each (figure 1). The safety injection angle was calculated which does not disrupt the important anatomic features around the CP muscle.

RESULTS

The optimal needle injection site was set up at the level of the superior border of the cricoid cartilage, vertically. The horizontal approach site one third point between just lateral to the cricoid cartilage and anterior border of the sternocleidomastoid muscle was superior to that of just lateral to the lateral margin of cricoid cartilage. The mean safety angle for injecting left CP muscle in right neck rotation position was between 68.6 ± 8.6 and 78.5 ± 6.7 degree, while range of mean approach angle was 9.8 ± 3.6 degree (Table 1). The number of unapproachable subject due to narrow injection angle was 5, 3 and 2 with neutral (Targeting left CP muscle), right (Targeting left CP muscle), and left neck rotation (Targeting right CP muscle) each. The optimal patient posture and approach technique were left CP muscle injection with right neck rotation.

CONCLUSION

Our Results show that this method can be useful for the practical application of ultrasound-guided bilateral CP muscle injection. Knowledge of the anatomical location of CP muscle and surrounding features can help clinicians to better access the target site bilaterally, thus prevent causing injury of important structures.

Table 1. Safety injection angle to CP muscle Abbreviations: Lt. CP_Neutral: Left cricopharyngeal muscle injection with neutral position, Lt. CP_Rt. neck rotation: Left cricopharyngeal muscle injection with right neck rotation position, Rt. CP_Lt. neck rotation: right cricopharyngeal muscle injection with left neck rotation position

	Lt. CP_Neutral	Lt. CP_Rt. neck rotation	Rt. CP_Lt. neck rotation
Angle (°)	72.4 ± 7.1 - 80.0 ± 3.9	68.6 ± 8.6 - 78.5 ± 6.7	65.9 ± 9.8 - 75.0 ± 7.4
Range (°)	7.6 ± 3.4	9.8 ± 3.6	9.1 ± 3.2

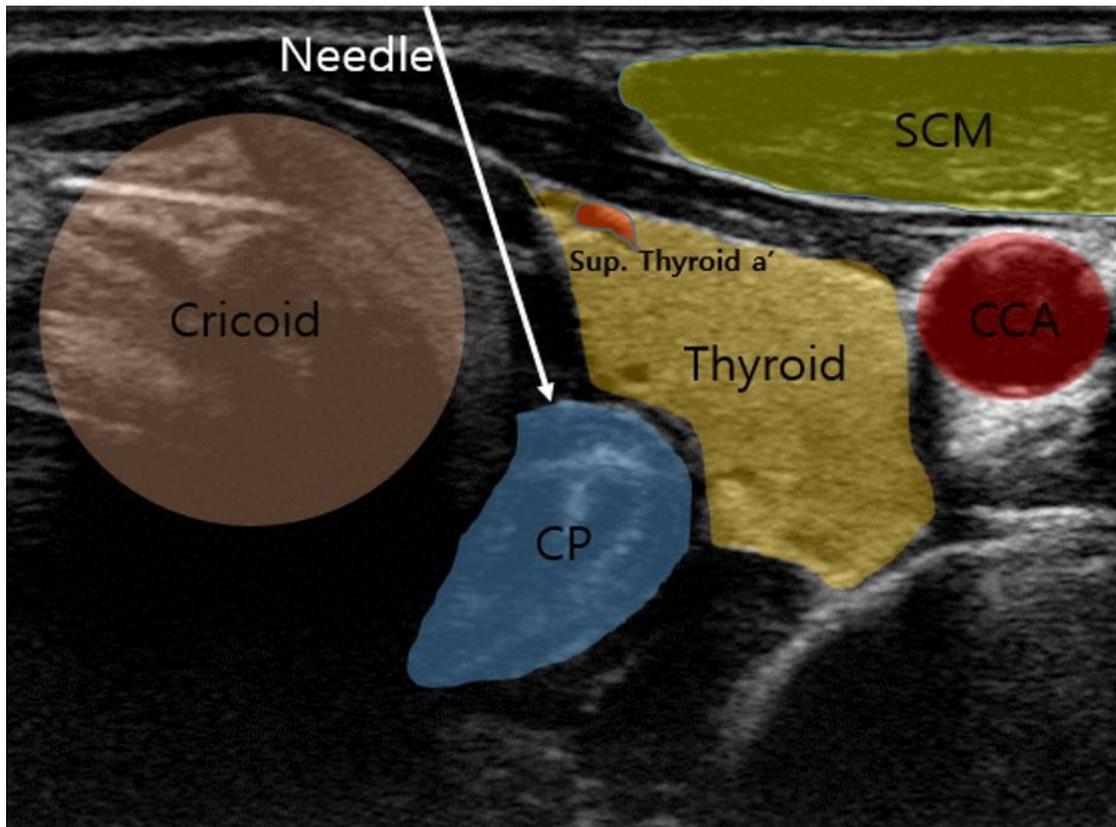


Figure 1. Ultrasound-guided injection to the cricopharyngeal muscle image. Axial view in right neck rotation position. The white arrow indicates the advancement course of the needle. SCM: sternocleidomastoid muscle, CCA: common carotid artery, CP: cricopharyngeal muscle.

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 10:50-11:00 Room C(5F)

OP2-3-6

Intensive Inpatient Rehabilitation Affects Functional Outcomes at 3 Months after Ischemic Stroke

Kyou Hyun Kim^{1*}, Min Kyun Sohn², Jongmin Lee³, Deog Young Kim⁴, Sam-Gyu Lee⁵, Yong-Il Shin⁶, Gyung-Jae Oh⁷, Yang-Soo Lee⁸, Min Cheol Joo⁹, Eun Young Han¹⁰, Junhee Han¹¹, Jeonghoon Ahn¹², Won Hyuk Chang¹, Min A Shin¹, Sung Hyun Kang¹³, Yong-Joo Choi¹³, Kang Hee Lee¹³, Young Taek Kim¹⁴, Yun-Hee Kim^{1,15†}

Samsung Medical Center, Department of Rehabilitation Medicine¹, Chungnam National University Hospital, Department of Rehabilitation Medicine², Konkuk University Medical Center, Department of Rehabilitation Medicine³, Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine⁴, Chonnam National University Medical School, Department of Physical and Rehabilitation Medicine⁵, Pusan National University Yangsan Hospital, Department of Rehabilitation Medicine⁶, Wonkwang University, School of Medicine, Department of Preventive Medicine⁷, Kyungpook National University School of Medicine, Department of Rehabilitation Medicine⁸, Wonkwang University School of Medicine & Hospital, Department of Rehabilitation Medicine⁹, Jeju National University Hospital, Department of Rehabilitation Medicine¹⁰, Hallym University, Department of Statistics¹¹, Ewha Womans University, Department of Health Convergence¹², Korea Centers for Disease Control and Prevention, Division of Chronic Disease Prevention, Center for Disease¹³, Korea Centers for Disease Control and Prevention, Division of Chronic Disease Control, Center for Disease Prevention¹⁴, Sungkyunkwan University, Department of Health Science and Technology, Department of Medical Device Management and Research, SAIHST¹⁵

Objective

Although it is highly recommended in most of stroke guidelines, early rehabilitation has limited evidence to guide practice. The aim of this study was to investigate the effect of intensive inpatient rehabilitation on functional outcome at 3 months in first-ever ischemic stroke patients.

Materials and Methods

This study was an interim analysis of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) designed as 10 years long-term follow-up study of stroke patients. All patients who admitted to the representative hospitals in 9 distinct areas of Korea with their acute first-ever stroke (from August 2012 to May 2015) were recruited. In this study, we analyzed data of 3,912 ischemic stroke patients who completed the 3 months follow-up. NIHSS at day 7 was used as stroke severity at acute phase. Multi-facet assessments at day 7 after onset included Korean Mini-Mental State Examination, Fugl-

Meyer Assessment, Functional Ambulatory Category, the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale, Short Korean Version of Frenchay Aphasia Screening Test. In addition, the course of the stroke during the hospitalization was reported, including information on neurologic aggravation, four common complications during hospitalization, and hospitalization duration. We assessed whether stroke patient received the intensive inpatient rehabilitation during the hospitalization defined as stroke patients who transferred to the rehabilitation department after acute stroke care. The univariate and the multivariate linear regression analyses with factors at 7 days and the course of the stroke during the hospitalization were performed to determine the significant relating factors of the Korean modified Barthel Index (K-MBI) at 3 months.

Results

Table 1 presents the demographic and clinical characteristics of patients. Table 2 shows Results of univariate regression analysis with factors at 7 days and the course of the stroke during the hospitalization for K-MBI at 3 months. The multivariate linear regression analysis with factors at 7 days and the course of the stroke during the hospitalization for K-MBI at 3 months was showed in Table 3. The multivariate regression analysis showed that the intensive inpatient rehabilitation was one of positive relating factors of K-MBI at 3 months in ischemic stroke patients ($p < 0.05$).

Conclusion

These Results demonstrate the significant effects of subacute intensive rehabilitation to improve functional outcome at 3 months in the first-ever ischemic stroke patients. Intensive rehabilitation should be provided to all stroke patients with functional impairment after acute stroke management.

Table 1. Distribution of general and clinical patient characteristics^a

Variables	Ischemic stroke patients (n=3,912)
	Mean±SD (range) or percentage
Age, years	64.8±12.3 (20-98)
Sex, male	61.8%
Body mass index	23.9±3.3 (14-44)
Smoking, current	28.4%
Alcohol, current	39.8%
Education, years	9.7±4.8 (0-21)
Medical history	
Hypertension, Yes	56.0%
Diabetes mellitus, Yes	24.2%
Coronary heart disease, Yes	6.7%
Atrial fibrillation, Yes	8.7%
Hyperlipidemia, Yes	11.2%
CCAS	5.2±1.7 (2-21)
Premorbid mRS, score	0.6±1.2 (0-5)
NIHSS at 7 day	3.3±5.1 (0-42)
Functional assessments at 7 day	
Fugl-Meyer Assessment	82.5±29.2 (0-100)
K-MMSE	23.2±7.5 (0-30)
Functional Ambulatory Category	3.2±1.8 (0-5)
AHSA-NOMS	6.2±1.7 (1-7)
Short K-FAST	14.3±5.5 (0-20)
Neurological aggravation, Yes	4.0%
Complication during hospitalization	
Thromboembolic disease, Yes	1.4%
Pneumonia, Yes	1.7%
Ventilatory insufficiency, Yes	0.4%
Urinary tract infection, Yes	1.8%
Duration of hospitalization, days	14.5±20.0 (1-328)
Intensive inpatient rehabilitation, Yes	17.8%

CCAS, combined condition- and age-related score; NIHSS, National Institutes of Health Stroke Scale; mRS, modified Rankin scale; K-MMSE, Korean Mini-Mental State Examination; AHSA-NOMS, the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; Short K-FAST, Short Korean Version of the Frenchay Aphasia Screening Test.

Table 2. Univariate regression analysis for functional outcome at 3 months in ischemic stroke patients.

	K-MBI at 3 months
	β (P-value)
Age (yr)	-0.271(<0.001) [*]
Sex, male	0.129(<0.001) [*]
Body mass index	0.066(<0.001) [*]
Smoking, current	0.069(<0.001) [*]
Alcohol, current	0.141(<0.001) [*]
Education years	0.192(<0.001) [*]
Medical history	
Hypertension	-0.062(0.001) [*]
Diabetes mellitus	-0.055(0.002) [*]
Coronary heart disease	-0.043(0.013) [*]
Atrial fibrillation	-0.076(<0.001) [*]
Hyperlipidemia	0.001(0.476)
CCAS	-0.061(0.001) [*]
Premorbid mRS	-0.133(<0.001) [*]
NIHSS at day 7	-0.679(<0.001) [*]
Functional levels at day 7	
FMA	0.637(<0.001) [*]
K-MMSE	0.496(<0.001) [*]
FAC	0.553(<0.001) [*]
AHSA-NOMS	0.441(<0.001) [*]
Short K-FAST	0.443(<0.001) [*]
Neurological aggravation	-0.090(<0.001) [*]
Complication during hospitalization	
Thromboembolic disease	-0.014(0.230)
Pneumonia	-0.164(<0.001) [*]
Ventilatory insufficiency	-0.033(0.045)
Urinary tract infection	-0.216(<0.001) [*]
Duration of hospitalization	-0.376(<0.001) [*]
Intensive inpatient rehabilitation	-0.277(<0.001) [*]

^{*}p<0.05.

K-MBI, Korean modified Barthel Index; K-MMSE, Korean Mini-Mental State Examination; FMA, Fugl-Meyer Assessment; FAC, Functional Ambulatory Category; AHSA-NOMS, the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; Short K-FAST, Short Korean Version of the Frenchay Aphasia Screening Test; CCAS, combined condition- and age-related score; mRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale.

Table 3. Multiple linear regression analysis for functional outcome at 3 months in ischemic stroke patients.

	K-MBI at 3 months
	β (P-value)
Age (yr)	-0.268 (<0.001)*
Sex, male	-
Body mass index	-
Smoking, current	-
Alcohol, current	1.308 (0.014)*
Education years	-
Medical history	-
Hypertension	-
Diabetes mellitus	-
Coronary heart disease	-
Atrial fibrillation	-
Hyperlipidemia	-
CCAS	0.761 (<0.001)*
Premorbid mRS	-
NIHSS at day 7	-1.706 (<0.001)*
Functional levels at day 7	-
FMA	0.173 (<0.001)*
K-MMSE	0.273 (<0.001)*
FAC	1.120 (<0.001)*
AHSA-NOMS	-
Short K-FAST	-
Neurological aggravation	-
Complication during hospitalization	-
Thromboembolic disease	-
Pneumonia	-7.226 (0.002)*
Ventilatory insufficiency	-
Urinary tract infection	-8.860 (<0.001)*
Duration of hospitalization	-0.127 (<0.001)*
Intensive inpatient rehabilitation	5.357 (<0.001)*

*p<0.05.

K-MBI, Korean modified Barthel Index; K-MMSE, Korean Mini-Mental State Examination; FMA, Fugl-Meyer Assessment; FAC, Functional Ambulatory Category; AHSA-NOMS, the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale; Short K-FAST, Short Korean Version of the Frenchay Aphasia Screening Test; CCAS, combined condition- and age-related score; mRS, modified Rankin scale; NIHSS, National Institutes of Health Stroke Scale.⁴¹

ORAL PRESENTATION 2-4

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 14:00-14:10 Room C(5F)

OP2-4-1

Exoskeletal overground robot-assisted gait training for individuals with Parkinson's disease

Da Young Lim^{1*}, So Young Ahn¹, Soo Kyung Bok^{1†}

Chungnam National University, School of Medicine, Department of Rehabilitation Medicine¹

Objective

The purpose of this study is to determine repetitive locomotor treatment using the robot-assisted gait training (RAGT) device (Exowalk®, HMM Co. Ltd, Korea) on the functional improvement of patients with Parkinson's disease.

Methods

This is a nonblinded prospective, randomized, controlled study from June to October 2018. Twenty cognitively intact Parkinson's disease (Hoehn-Yarh stage 2, 3) patients with history of freezing of gait (FOG) during "ON" phase of medication were included. Participants were randomized into 2 groups as follows. Ten patients were treated with RAGT, and 10 were treated with conventional gait training (CGT). RAGT group underwent a rehabilitation program of robot assisted gait training for 30 minutes, 5 times a week for 2 weeks, whereas the CGT group received a conventional gait training in same intensity. The outcome measure of efficacy was recorded by gait analysis, 10MWT (Meter Walk Test), TUG (Time Up and Go test), TT (Time to turn), N10m (Number of gait during 10 meter walk), NT (number of gait during turning), FOG-Questionnaire, and the motor score of MDS-UPDRS (Movement Disorder Society – Unified Parkinson's Disease) Part III. The assessments were performed at the beginning and at the end of the treatment.

Results

All patients participated in the experiment without fail. Both groups showed functional improvement, especially in TUG, NT, cadence, and FOG-Questionnaire. Compared with the CGT group, RAGT group showed a better result of 10MWT.

Conclusions

RAGT could be applied to individuals with Parkinson's disease to facilitate gait recovery. The subjects were well adapted to RAGT. However, larger sample size is needed to investigate the effectiveness and efficacy of RAGT as single gait training and combined with other gait training strategies.

Table 1.
Demographic and clinical features of patients.

	RAGT group (n = 10) mean	CGT group (n = 10) mean
Age (years)	73.6	72.8
Sex (Male/female)	4/6	5/5
Disease duration (years)	6.52	6.99
MDS -UPDRS part III score	27.30	28.10
Hoehn and Yahr stage	Number of patients	
2	5	7
3	5	3

Abbreviations: RAGT, Robotic Assist Gait Training; CGT, Conventional Gait Training; n, number of patients; MDS-UPDRS, Movement Disorder Society - Unified Parkinson's Disease Rating Scale.

Table 2.
Patients' performance in all outcome measures before (T0) and after (T1) 10 sessions of training.

	T0 Mean (SD)		T1 Mean (SD)	
	RAGT	CGT	RAGT	CGT
10MWT (s)	31 (0.08)	30 (0.10)	20 (0.12)*	22 (0.09)
TUG (s)	33 (0.20)	31 (0.15)	20 (0.25)*	21 (0.18)*
N10m (n)	42 (5.39)	44 (4.46)	36 (6.34)	38 (3.51)
NT (n)	10 (4.34)	10 (6.20)	7 (5.31)*	8 (6.12)
Stride length (cm)	66.3 (2.13)	67.4 (3.19)	79 (2.89)	75 (2.57)
Cadence (steps/min)	77.6 (4.70)	78.1 (5.11)	70.9 (4.98)*	72.3 (4.75)*
Total double support (%)	30.8 (9.18)	30.6 (8.12)	29.6 (8.89)	29.8 (8.17)
FOG – Questionnaire (0-24)	13 (6.30)	12 (5.91)	9 (5.76)*	9 (6.18)*
MDS-UPDR Part III Score	27.3(6.65)	28.1 (5.99)	25.5(6.53)	27.2 (6.23)

Abbreviations: SD, Standard Deviation; RAGT, Robotic Assist Gait Training; CGT, Conventional Gait Training; N10m, Number of gait during 10 meter walk; n: number; NT, Number of gait during Turning; s, seconds; cm, centimeters; steps/min, steps/minutes; MDS-UPDRS, Movement Disorder Society - Unified Parkinson's Disease Rating Scale.

* = statistically significant (p < 0.05).



Figure 1. A patient on a Exowalk

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 14:10-14:20 Room C(5F)

OP2-4-2

The effect of cerebrolysin on disorders of consciousness due to acquired brain injury

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Introduction

Acquired brain injury (ABI) can cause disorders of consciousness (DOC), which is clinically very difficult to treat. While a variety of studies including clinical trial of medication have been conducted to improve cognition of patients with DOC, the effect of cerebrolysin on DOC has not been studied systematically. Therefore, in the present study, we investigated the efficacy of cerebrolysin on DOC.

Methods

This study is a retrospective study. Patients were recruited from department of rehabilitation center of university hospital between January 1, 2013 to November 30, 2017. The patients were divided into two groups (single therapy group (Amantadine) and dual therapy group (Cerebrolysin and Amantadine). Amantadine was administered orally twice a day with 100 mg in single and dual therapy group. Cerebrolysin was administered via intravenous route twice a day (10 mL per administration) in dual therapy group. The Coma Recovery Scale - Revised (CRS-R) assessment was conducted twice to evaluate consciousness state; the first before drug administration and the second within 3 days before drug discontinuation.

Results

A total of 101 enrolled patients were recruited. The average age was 61.46 years. And we enrolled 43 females. The enrolled patients consisted of 42 with hemorrhagic stroke, 28 with ischemic stroke, 21 with traumatic brain injury (TBI), 6 with hypoxic brain injury, one with encephalitis, and 3 with unspecified injury. The initial total score of CRS-R was 11.20, and the interval between onset of disease and treatment was 6.45 months. According to the CRS-R assessment, 22 patients were diagnosed in coma or vegetative state and 79 in minimally conscious state (MCS). There was a significant difference in age (single therapy group: 66.64 ± 14.99 , dual therapy group: 56.37 ± 17.86 , $P=0.004$), category of disease ($P=0.016$), initial total scores of CRS-R (single therapy group: 13.56 ± 4.45 , dual therapy group: 8.88 ± 3.85 , $P<0.001$), and category of DOC ($P<0.001$) in both groups. After

treatment, the change of CRS-R score tended to be higher in dual therapy group than single therapy group without significance (single therapy group; 2.46 ± 3.29 , dual therapy group: 3.69 ± 3.30 , $P=0.056$). The change in the patient's DOC category occurred after treatment. There were significant differences in the change of the DOC category ($P=0.034$) in both groups. In the comparison of responsiveness, the proportion of patients who received the drug before 6 months from onset or patients with TBI was higher in the subgroup responding to dual therapies, although not statistically significant.

Conclusions

The ratio of patients with change of DOC in dual therapy group was higher than single therapy group, with a significant difference. In dual therapy group, change of CRS tends to be higher than single therapy group. And the patients who started treatment earlier or with TBI tended to have better responsiveness in dual therapy group.

Table1. Characteristics of patients

Characteristics	Total (n=101)	Amantadine (n=50)	Cerebrolysin + Amantadine (n=51)	p-value
Age (years) [range]	61.46 ± 17.21 [21 - 92]	66.64 ± 14.99 [23 - 92]	56.37 ± 17.86 [21 - 88]	0.004**
Sex (M / F) [n (%)]	58 / 43 (57.43% / 42.57%)	27 / 23 (54.00% / 46.00%)	31 / 20 (60.78% / 39.22%)	0.625
Category of disease [n] (Hemorrhagic stroke / Ischemic stroke) / Traumatic brain injury / Hypoxic brain injury / Encephalitis / Unspecified (including metabolic encephalopathy)	42 / 28 / 21 / 6 / 1 / 3	21 / 19 / 5 / 2 / 0 / 3	21 / 9 / 16 / 4 / 1 / 0	0.016*
Interval between onset of disease and treatment (months)	6.45 ± 5.72 [1 - 39]	6.18 ± 6.38 [1 - 39]	6.71 ± 5.03 [2 - 26]	0.227
Initial CRS [range]	11.20 ± 4.75 [3 - 21]	13.56 ± 4.45 [6 - 21]	8.88 ± 3.85 [3 - 20]	<0.001***
Category of initial DOC [n (%)] (coma or vegetative / MCS / emergence from MCS)	22 / 79 / 0	6 / 44 / 0	16 / 35 / 0	0.034*
Duration of treatment (days) [range]	32.52 ± 24.79 [6 - 211]	34.46 ± 32.25 [6 - 211]	30.63 ± 14.22 [8 - 109]	0.724
Cerebrolysin			27.04 ± 9.67 [8 - 64]	
Amantadine		34.46 ± 32.25 [6 - 211]	29.45 ± 15.03 [7 - 109]	
Concurrent (Cerebrolysin + Amantadine)			27.37 ± 13.98 [6 - 93]	
Follow-up CRS [range]	14.28 ± 4.87 [5 - 23]	16.02 ± 4.44 [5 - 23]	12.57 ± 4.70 [5 - 23]	<0.001***
Change of CRS [range]	3.08 ± 3.34 [-7 - 13]	2.46 ± 3.29 [-7 - 12]	3.69 ± 3.30 [-3 - 13]	0.056

Table2. Change of DOC

Characteristics	Total (n=101)	Amantadine (n=50)	Cerebrolysin + Amantadine (n=51)	p-value
Initial CRS [range]	11.20 ± 4.75 [3 - 21]	13.56 ± 4.45 [6 - 21]	8.88 ± 3.85 [3 - 20]	<0.001***
Category of DOC – initial [n (%)] (coma or vegetative / MCS / emergence from MCS)	22 / 79 / 0	6 / 44 / 0	16 / 35 / 0	0.034*
Follow-up CRS [range]	14.28 ± 4.87 [5 - 23]	16.02 ± 4.44 [5 - 23]	12.57 ± 4.70 [5 - 23]	<0.001***
Category of DOC – follow-up [n (%)] (coma or vegetative state / MCS / emergence from MCS)	7 / 94 / 0	3 / 47 / 0	4 / 47 / 0	1.000
Change of CRS [range]	3.08 ± 3.34 [-7 - 13]	2.46 ± 3.29 [-7 - 12]	3.69 ± 3.30 [-3 - 13]	0.056
Patients with change of DOC category – total [n (%)]	15 / 86 (14.85% / 85.15%)	3 / 47 (6.00% / 94.00%)	12 / 39 (23.53% / 76.47%)	0.028*
Patients with change of DOC category [n (%)] (from coma or vegetative state to MCS)	15 / 7 (68.18% / 31.82%)	3 / 3 (50.00% / 50.00%)	12 / 4 (75.00% / 25.00%)	0.544

Table 3. Comparison of responsiveness for patients of coma or vegetative state in dual therapy

Characteristics	Total (n=16)	Patients with no change of DOC category (n=4)	Patients with change of DOC category (n=12)	p-value
Age (years) [range]	61.50 ± 14.87 [24 - 82]	55.75 ± 23.89 [24 - 82]	63.42 ± 11.39 [46 - 79]	0.574
Sex (M / F) [n (%)]	9 / 7 (56.25% / 43.75%)	2 / 2 (50.00% / 50.00%)	7 / 5 (58.33% / 41.67%)	1.000
Category of disease [n] (Hemorrhagic stroke / Ischemic stroke) / Traumatic brain injury / Hypoxic brain injury / Encephalitis / Unspecified (including metabolic encephalopathy)	6 / 1 / 7 / 2 / 0 / 0	2 / 1 / 1 / 0 / 0 / 0	4 / 0 / 6 / 2 / 0 / 0	0.229
Interval between onset of disease and treatment (months)	6.94 ± 4.96 [2 - 19]	10.00 ± 2.83 [6 - 12]	5.92 ± 5.18 [2 - 19]	0.075
Initial CRS [range]	5.25 ± 1.13 [3 - 7]	5.25 ± 1.71 [3 - 7]	5.25 ± 0.97 [4 - 7]	0.845
Duration of treatment (days) [range]	28.50 ± 11.9 [8 - 64]	29.25 ± 5.44 [25 - 37]	28.25 ± 13.59 [8 - 64]	0.951
Cerebrolysin	27.62 ± 11.78 [8 - 64]	26.25 ± 4.11 [21 - 30]	28.08 ± 13.55 [8 - 64]	0.952
Amantadine	27.88 ± 12.07 [8 - 64]	29.25 ± 5.44 [25 - 37]	27.42 ± 13.77 [8 - 64]	0.584
Concurrent (Cerebrolysin + Amantadine)	27.00 ± 11.90 [8 - 64]	26.25 ± 4.11 [21 - 30]	27.25 ± 13.72 [8 - 64]	0.903
Follow-up CRS [range]	9.69 ± 3.32 [5 - 17]	6.25 ± 0.96 [5 - 7]	10.83 ± 3.01 [6 - 17]	<0.001***

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 14:20-14:30 Room C(5F)

OP2-4-3

The Effect of Sarcopenia on Functional Recovery in Subacute Stroke Patient

Kyeong Woo Lee^{1†}, Sang Beom Kim¹, Jong Hwa Lee¹, Jin Gee Park¹, Kyung Won Jang^{1*}

Dong-A University College of Medicine, Busan, Korea, Department of Physical Medicine and Rehabilitation¹

Objective

Stroke is a leading cause of disability which is usually caused by hemiplegia as a common neurologic complication. In hemiplegic patients, structural muscular changes followed by brain injury lead to rapid reduction of muscle mass. On the other hand, sarcopenia is characterized by muscle wasting and decline in strength and gait function. So initial presence of sarcopenia in stroke patients would have negative effect on functional recovery. Thus, the aim of this study is to investigate the effect of sarcopenia on functional recovery in subacute stroke patient.

Methods

Subacute stroke patients those who were referred to cardiocerebrovascular rehabilitation center were enrolled. At the day of referral, the patient diagnosed as sarcopenia were assigned to sarcopenia group. Sarcopenia was diagnosed according to the Asian Working Group on Sarcopenia and diagnostic criteria for sarcopenia consists of decreased Skeletal Muscle Index (SMI) (Men<7.00kg/m², Women<5.70kg/m²) and unaffected side grip strength (Men<26kg, Women<18kg). And those without sarcopenia were assigned to non-sarcopenia group. All patients were able to walk independently without a brace or assistive devices. Both group received conventional stroke rehabilitation treatment for 3 weeks. All patients were evaluated at the day of referral and after 3 weeks of treatment. SMI, Body Mass Index and Skeletal Muscle Mass were measured using the Bioelectrical Impedance Analysis. Unaffected upper extremity grip strength was measured by a hand dynamometer. Gait speed was measured by 4 Meter Walking Test (4MWT). Gait endurance was measured by 6 Minutes Walking Test (6MWT). Functional status was measured by Timed Up and Go test (TUG) and Modified Barthel Index (MBI).

Results

Twenty patients were enrolled, 8 patients were assigned to sarcopenia group and 12 patients were assigned to non-sarcopenia group. There were no significant differences in baseline characteristics (Table 1). After 3 weeks of treatment, all groups showed improvement in 4MWT, TUG and MBI. In addition, 6MWT significantly improved in non-sarcopenia group (Table 2). When changes between groups were compared, 6MWT and

TUG showed more improvement in non-sarcopenia group than sarcopenia group (Table 3).

Conclusion

In this study, we found that sarcopenia had negative effect on functional recovery in subacute stroke patients. As a result, it could be anticipated that stroke patients with preexisting sarcopenia would have more functional compromise than without sarcopenia.

Table 1. Baseline characteristics of subjects at the initial evaluation

	Sarcopenia [†]	Non-sarcopenia [†]	p-value [‡]
	(n=8) [‡]	(n=12) [‡]	
Sex (Male/Female) [‡]	4/4 [‡]	5/7 [‡]	
Stroke type (Infarction/Hemorrhage) [‡]	5/3 [‡]	6/6 [‡]	
Age (year) [‡]	68.24±12.92 [‡]	64.85±9.73 [‡]	0.628 [‡]
Stroke duration (day) [‡]	14.17±5.42 [‡]	16.73±5.53 [‡]	0.617 [‡]
BMI (kg/m ²) [‡]	21.75±2.42 [‡]	23.23±2.61 [‡]	0.335 [‡]
SMM (kg) [‡]	22.23±7.85 [‡]	24.35±8.98 [‡]	0.236 [‡]
SMI (kg/m ²) [‡]	6.45±2.24 [‡]	7.12±2.59 [‡]	0.181 [‡]
Grip strength (kg) [‡]	24.81±7.27 [‡]	27.46±6.55 [‡]	0.213 [‡]
4MWT (m/s) [‡]	0.65±0.24 [‡]	0.78±0.32 [‡]	0.338 [‡]
6MWT (m) [‡]	143.52±15.18 [‡]	155.64±17.85 [‡]	0.598 [‡]
TUG (sec) [‡]	10.15±3.28 [‡]	9.84±3.67 [‡]	0.354 [‡]
MBI [‡]	73.13±9.66 [‡]	75.25±10.57 [‡]	0.698 [‡]

Values are mean ± standard deviation. [†]

BMI; Body Mass Index, SMM; Skeletal Muscle Mass, SMI; Skeletal Muscle Index, 4MWT; 4Meter Walking Test, 6MWT; 6 Minute Walking Test, TUG; Timed up and Go Test, MBI; Modified Barthel Index.[‡]

Table 2.Changes of measurements after treatment

	Sarcopenia ^Δ			Non-sarcopenia ^Δ		
	pre ^Δ	post ^Δ	p-value ^Δ	pre ^Δ	post ^Δ	p-value ^Δ
Grip strength (kg) ^Δ	24.81±7.27 _Δ	26.24±7.46 _Δ	0.536 _Δ	27.46±6.55 _Δ	29.63±7.19 _Δ	0.648 _Δ
4MWT(m/s) ^Δ	0.65±0.24 _Δ	0.78±0.38 _Δ	0.047* _Δ	0.78±0.32 _Δ	0.98±0.48 _Δ	0.046* _Δ
6MWT(m) ^Δ	143.52±15.18 _Δ	172.52±21.18 _Δ	0.087 _Δ	155.64±17.85 _Δ	202.18±20.71 _Δ	0.028* _Δ
TUG (sec) ^Δ	10.15±3.28 _Δ	7.76±2.78 _Δ	0.036* _Δ	9.84±3.67 _Δ	6.12±3.48 _Δ	0.039* _Δ
MBI ^Δ	73.13±9.66 _Δ	82.63±7.16 _Δ	0.045* _Δ	75.25±10.57 _Δ	86.33±9.86 _Δ	0.041* _Δ

Values are mean ± standard deviation. ^Δ

4MWT; 4Meter Walking Test, 6MWT; 6 Minute Walking Test, TUG; Timed Up and Go Test, MBI; Modified Barthel Index.^Δ

*p<0.05, by Wilcoxon signed-rank test^Δ

Table 3.Comparison of changes between two groups

	Sarcopenia ^Δ	Non-sarcopenia ^Δ	p-value ^Δ
Δ Grip strength (kg) ^Δ	1.44±0.93 ^Δ	2.27±1.04 ^Δ	0.348 ^Δ
Δ 4MWT(m/s) ^Δ	0.13±0.08 ^Δ	0.20±0.12 ^Δ	0.137 ^Δ
Δ 6MWT(m) ^Δ	28.87±7.71 ^Δ	47.52±9.55 ^Δ	0.038* ^Δ
Δ TUG(sec) ^Δ	2.48±1.89 ^Δ	3.78±2.04 ^Δ	0.045* ^Δ
Δ MBI ^Δ	9.62±4.67 ^Δ	11.5±11.96 ^Δ	0.228 ^Δ

Values are mean ± standard deviation. ^Δ

4MWT; 4Meter Walking Test, 6MWT; 6 Minute Walking Test, TUG; Timed Up and Go Test, MBI; Modified Barthel Index.^Δ

*p<0.05, by Mann-Whitney U test^Δ

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 14:30-14:40 Room C(5F)

OP2-4-4

The Neuroprotective Effect of Macrophage Migration Inhibitory Factor (MIF) in Hypoxic Neuronal Cells

Su Hwan Bae^{1*}, In Kyung Hong¹, Dae Yul Kim^{1†}

Asan Medical Center, Department of Rehabilitation Medicine¹

Objective

Macrophage inhibitory factor (MIF) is a member of the inflammatory cytokine and is expressed in a variety of cells, including T cells, monocytes, and endothelial cells. Brain derived neurotrophic factor (BDNF) is known to be associated with neuroplasticity. Several previous studies have reported that MIF has a protective function during an ischemic event. However, little is known about the neuroprotective function of MIF in ischemic stroke. The purpose of this study is to demonstrate MIF is associated with neuroprotection in the human neuroblastoma cells with oxygen glucose deprivation model (OGD model)

Methods

The human neuroblastoma cell line SH-SY5Y (ATCC CRL-2266) were maintained in Dulbecco's Modified Eagle's Medium (DMEM, Gibco Life Technologies, Carlsbad, CA) supplemented with 10 % fetal bovine serum (FBS), 50U/ml penicillin, 50ug/ml streptomycin (Gibco), in a humidified incubator at 37°C and 5 % CO₂. Cultures were transferred to a multi-gas incubator containing a gas mixture of 1% O₂. The medium was replaced with a pre-warmed (37°C) glucose-free DMEM. The solution was bubbled with an anaerobic gas mix (95 % N₂, 5 % CO₂) for 1 hour. Cell cultures subjected to OGD were incubated in the solution at 37°C for a 4 h to produce oxygen deprivation (OGD) and then returned to the normal aerobic environment (OGD/R). At the same time, we administered 30ug/ml MIF recombinant or 50uM ISO-1 (MIF antagonist). Experimental parameters were assayed at 24 h following re-oxygenation solution. We assigned cell cultures to one of four groups: OGD 4h, OGD 4h/reoxygenation 24h, OGD 4h/reoxygenation 24hr with MIF, OGD 4h/reoxygenation 24hr with ISO-1. Then we analyzed the differences between 4 groups about BDNF, MIF by western blot. b-actin was used to match baseline in all groups. Then histological study was performed to observe expression levels of BDNF by immunocytochemistry.

Results

Figure 1 and Table 1 represent the MIF and BDNF expression levels of neuroblastoma cells from western blot. The expression levels of MIF in OGD 4h, OGD 4h/R24h group and the expression level of BDNF in MIF-OGD 4h/R24h group were significantly increased

than control group. On the other hand, the expression levels of MIF and BDNF in ISO-1-OGD 4h/R24h group were significantly decreased. Figure 2 represent the histological finding of neuroblastoma cells with BDNF staining from immunocytochemistry. There was no significant difference between all groups.

Conclusions

MIF administration induced increasing expression levels of BDNF in OGD/R model of neuroblastoma cells. Also, MIF expression level was increased in OGD and OGD/R model. These imply that MIF is an important factor for the neuroprotection in hypoxic neuronal cells. Thus, MIF could be the novel therapeutic modality for the neuroprotection of the cerebral ischemia. For this work, further in vivo study will be necessary.

Table 1. The MIF and BDNF expression levels of neuroblastoma cells in OGD 4h, OGD 4h/R24h model

	MIF	BDNF
	%	%
Control	55.7	128.89
^a OGD 4h	74.74	126.34
^b OGD 4h/R24h	79.37	88.07
^c MIF-OGD 4h/R24h	104.07	282.83
^d ISO-1-OGD 4h/R24h	28.81	98.91

^aOGD 4h: oxygen glucose deprivation 4hrs, ^bOGD 4h/R24h: oxygen glucose deprivation 4hrs and reoxygenation 24hrs, ^cMIF: macrophage migration inhibitory factor, ^dISO-1: MIF inhibitor
%: band of each group / band of b-actin

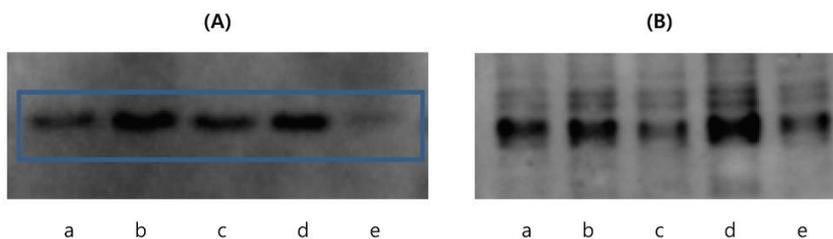


Figure 1. The band of MIF and BDNF expression levels of neuroblastoma cells in western blot. (A) The MIF expression level increased in OGD 4h, OGD 4h/R24h group and decreased ISO-1-OGD 4h/R24h group. (B) The BDNF expression level increased in MIF-OGD 4h/R24h group and decreased in ISO-1-OGD 4h/R24h group. a: Control, b: OGD 4h, c: OGD 4h/R24h, d: MIF-OGD 4h/R24h, e: ISO-1-OGD 4h/R24h

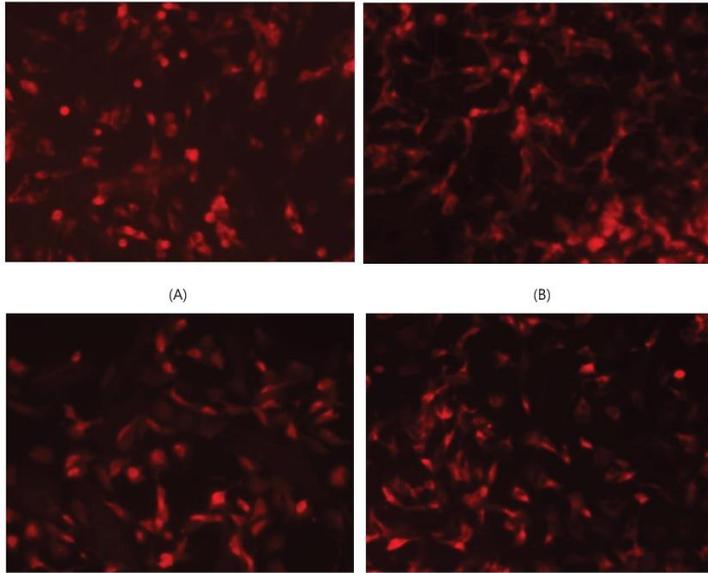


Figure 2. The histological findings of neuroblastoma cells with BDNF staining from immunocytochemistry.

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 14:40-14:50 Room C(5F)

OP2-4-5

The relation between loss of consciousness, severity of TBI and injury of ARAS in patients with TBI

Sung Ho Jang^{1†}, Jong Bum Kim^{1*†}

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Objectives

We investigated the relation between loss of consciousness (LOC), the severity of traumatic brain injury (TBI), and injury of the ascending reticular activating system (ARAS) on diffusion tensor tractography (DTT) in patients with TBI. Design: Retrospective survey. Participants: We enrolled 120 consecutive patients with TBI and 30 healthy control subjects.

Methods

In three components of the ARAS (lower dorsal, lower ventral, and upper), fractional anisotropy (FA) and tract volume (TV) were measured.

Results

The values of FA and TV were lower in the three TBI groups compared with the control group ($p < 0.05$). In the lower dorsal and ventral ARAS, the values of FA and TV in the mild group were higher than those of the moderate and severe groups, and there was no difference between the moderate and the severe groups ($p < 0.05$). In the upper ARAS, the FA value in the mild group was higher than in the moderate group, and in the moderate group was higher than in the severe group ($p < 0.05$). The TV value in the mild group was higher than that of the severe group ($p < 0.05$). The LOC showed moderate negative correlations with the TV value of the lower dorsal ARAS ($r = -0.348$), the FA value of the lower ventral ARAS ($r = -0.343$), and the FA value of the upper ARAS ($r = -0.416$).

Conclusions

We found injury of three components of the ARAS in all three TBI groups. Injury severity was different among the three TBI groups in the upper ARAS but did not differ between the moderate and severe groups in the lower dorsal and ventral ARAS. In addition, LOC could be an indicator for injury severity of the ARAS.

Table 1. Demographic characteristics of the patient and control groups

	Patient group			Control group
	Mild	Moderate	Severe	
Age (years)	47.4±10.01	46.09±12.5	39.9 ±13.09	46.8±17.5
Number (N)	75	20	25	30
Male : Female	26 : 49	14 : 6	23 : 2	19 : 11
LOC (Hours)	11±2.45 (min)*	5.8±5.25	171.1±26.1	
GCS score	14.57±0.69	10.14±1.15	4.85±1.51	
Duration (Months)	2.89±1.52	2.809±1.65	2.305±1.605	

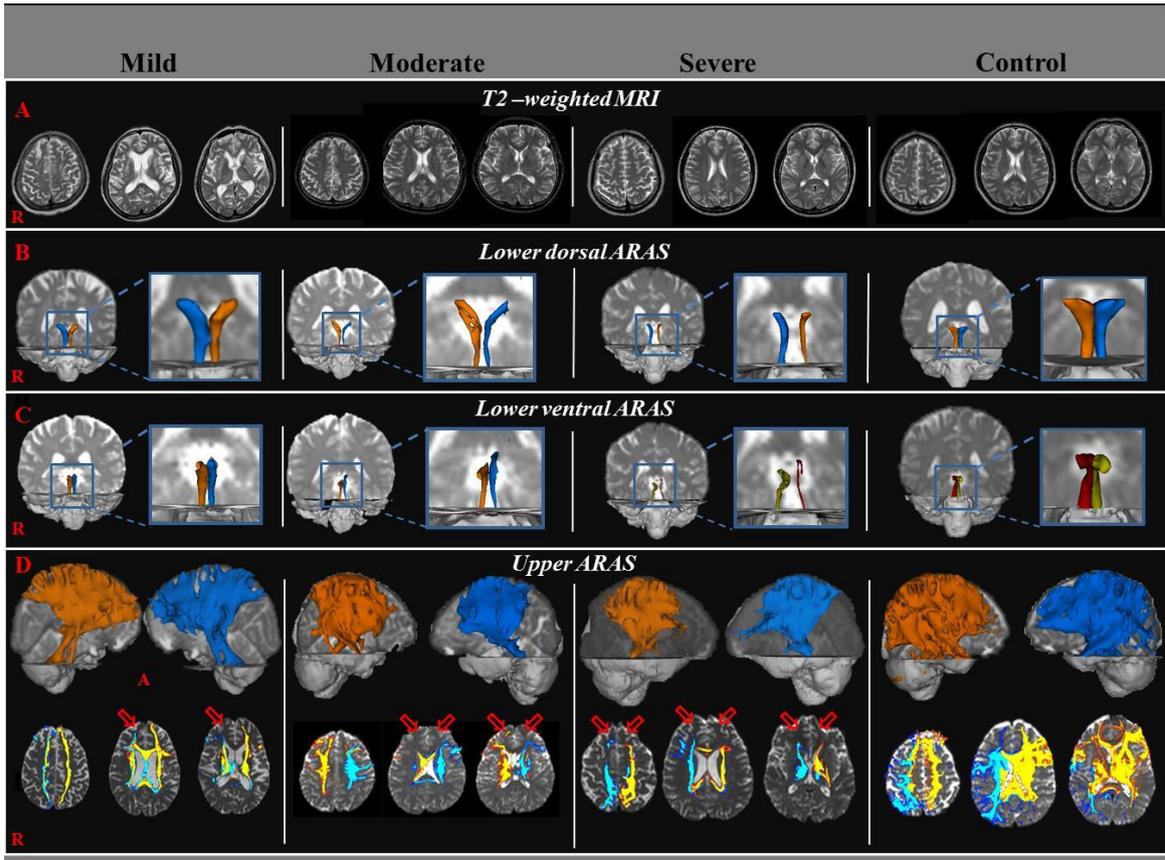
Values are presented as number or mean ± standard deviation, LOC: loss of consciousness, *LOC of the mild group is measured by minutes, Duration: duration from onset to diffusion tensor imaging.

Table 2. Comparison of diffusion tensor tractography parameters for three components of ascending reticular activating system between the patient and control groups

			FA	TV
Lower dorsal	TBI severity	Mild	0.372±0.03	523.31±136.5
		Moderate	0.354±0.62	350.76±153.96
		Severe	0.341±0.03	309.9±134.39
Lower dorsal	Control group		0.411±0.29	614.4±125.9
ARAS	p-value	†	0.040*	0.000*
		‡	0.357	0.486
		§	0.000*	0.000*
		∫	0.001*	0.021*
		∫∫	0.010*	0.000*
		∫∫∫	0.000*	0.000*
			FA	TV
Lower ventral	TBI severity	Mild	0.343±0.086	203.09±125.54
		Moderate	0.2935±0.12	89.81±56.88
		Severe	0.241±0.11	99.76±84.31
Lower ventral	Control group		0.392±0.036	255.6±78.8
ARAS	p-value	†	0.042*	0.000*
		‡	0.108	0.876
		§	0.000*	0.000*
		∫	0.049*	0.002*
		∫∫	0.010*	0.000*
		∫∫∫	0.000*	0.000*
			FA	TV
Upper ARAS	TBI severity	Mild	0.383±0.035	16753.38±1139.6
		Moderate	0.359±0.025	14458.95±2676.78
		Severe	0.323±0.049	11719.94±4057.08
Upper ARAS	Control group		0.408±0.044	19525.56±559.4
Upper ARAS	p-value	†	0.000*	0.124
		‡	0.000*	0.165
		§	0.000*	0.003*
		∫	0.001*	0.000*
		∫∫	0.000*	0.000*
		∫∫∫	0.000*	0.000*

Values are presented as mean ± standard deviation, ARAS: ascending reticular activating system, FA: fractional anisotropy, TV: tract volume, *Significantly different compared to the each group at $p < 0.05$. Bonferroni and Dunnett T3 post-hoc test were used for comparisons of diffusion tensor tractography parameters.

†: between the mild and moderate groups, ‡: between the moderate and severe groups, §: between the mild and severe groups, ∫: between the mild and control groups, ∫∫: between the moderate and control groups, ∫∫∫: between the severe and control groups



Brain MR images and diffusion tensor tractography of the three components of ascending reticular activating system in representative patients from mild, moderate, severe traumatic brain injury, and control groups.

뇌신경재활

발표일시 및 장소 : 10 월 27 일(토) 14:50-15:00 Room C(5F)

OP2-4-6

Factors affecting the duration of VRE colonization in patient with stroke

Sung Hwan Ryu^{1*}, In Hyun Kang², Ho Joong Jung¹, Young Joo Sim¹, Dong Kyu Kim¹, Ghi Chan Kim¹⁺

Kosin University Gospel Hospital, Department of Rehabilitation Medicine¹, dong-eui medical center, Department of Rehabilitation Medicine²

Objective

VRE Clearance is important because stroke patients with VRE colonization have limited intensive rehabilitation on account of isolation for prevention of infection transmission. However, there is a lack of research on which factors affect VRE clearance in stroke patients. In this study, we investigated which factors affect VRE clearance in stroke patients with VRE colonization.

Method

This study was performed on ischemic or hemorrhagic stroke patients with VRE colonization who are admitted to two hospitals between 2013 and 2017. If the VRE is grown in the rectal culture, the culture is performed periodically. The VRE clearance was defined as VRE-negative on three consecutive rectal cultures. The duration of VRE colonization is defined as the period from the VRE culture until the negative is identified. Age, sex, BMI, feeding type, ambulation, ICU care duration and antibiotic usage during VRE colonization were correlated in regression analysis with the duration of VRE colonization. Feeding type was classified into two types. The oral feeding group included patients who ingested food through the mouth regardless of dietary type. Nasogastric tube, PEG, and PRG were included as tube feeding group. Ambulation was classified into walking group and immobile group. Walking group was defined as patients who could walk regardless of the use of an orthosis such as cane and walker. Antibiotics use was included only when used for the duration of the VRE colonization. The antibiotic group was classified regardless of the method of administration and the type of antibiotics.

Result

A total of 52 patients were included in this study. Among 52 patients, 23 were male and 29 were female. The mean age was 65.63 ± 13.45 years. The mean duration of the VRE colonization was 39.08 ± 44.22 days and the BMI was 23.17 ± 4.21 . The mean ICU care period was 15.23 ± 21.98 (Table 1). On the day that VRE colonization was confirmed as negative, 27 patients were able to oral feeding, and 12 patients were able to walking. During the VRE Colonization, 36 patients were treated with antibiotics. Independent sample t-test showed the use of antibiotics ($p = 0.002$), oral feeding ($p < 0.001$), duration of ICU care were associated with duration of VRE colonization (Table 2). Bivariate

correlation analysis showed ICU care($p < 0.001$) was associated with duration of VRE colonization(Table 3). Cox proportional hazard model showed Oral feeding($p = 0.001$), Use of antibiotics($p = 0.003$) and Duration of ICU care($p = 0.001$) as independent factors of duration of VRE colonization (Table 4).

Conclusion

This study shows that careful attention should be paid to oral feeding, duration of ICU care, and use of antibiotics to receive intensive rehabilitation at the appropriate time without interruption due to isolation by VRE colonization in stroke patient.

Table 1. General characteristics of all subjects

Characteristics	Value
Age	65.63±13.45
Sex	
Male	23
Female	29
BMI	23.17±4.21
Duration of VRE colonization	39.08±44.22
Duration of ICU care	15.23±21.63
Feeding type	
Oral feeding	27
Tube feeding	25
Ambulation	
Walking	12
Non-walking	40
Use of antibiotics	
Administrated	36
Non-administrated	16

Values are presented as mean±standard deviation or number.

BMI, Body mass index

Table 2. Comparison of duration of VRE colonization(Independent sample t-test)

		N	Duration of VRE colonization	P value
Sex	Male	23	46.52±48.02	0.284
	Female	29	33.17±40.84	
Feeding type	Oral feeding	27	18.15±24.39	<0.001**
	Tube feeding	25	61.68±49.86	
Ambulation	Walking group	12	24.75±34.52	0.204
	Immobile group	40	43.38±46.25	
Use of Antibiotics	Administrated	36	51.39±48.22	<0.05*
	Non-administrated	16	11.38±6.40	

Values are presented as mean±standard deviation.

*p<0.05, **p<0.001.

Table 3. Correlation between variables and duration of VRE colonization (Bivariate correlation analysis)

Variables	Pearson's r	P value
Age	-0.216	0.124
BMI	-0.107	0.450
Duration of ICU care	0.647	<0.001**

BMI, Body mass index

*p<0.05, **p<0.001.

Table 4. Factors associated with duration of VRE colonization (Cox proportional hazard model)

Variables	B	HR(95% CI)	p-value
Age	0.19	1.02(0.99-1.05)	0.148
Sex	0.122	1.13(0.59-2.17)	0.713
BMI	-0.32	0.97(0.88-1.06)	0.490
Oral feeding	1.317	3.73(1.72-8.11)	<0.001*
Ambulation	-0.646	0.52(0.22-1.28)	0.155
Duration of ICU care	-0.035	0.97(0.95-0.99)	<0.001*
Use of Antibiotics	-1.306	0.27(0.11-0.65)	<0.05*

BMI, Body mass index; HR, Hazard ratio

*p<0.05, **p<0.001.

ORAL PRESENTATION 3-1

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 13:15-13:25 Room D(5F)

OP3-1-1

Changes of aerobic capacity over times in elderly patients with AMI after cardiac rehabilitation

Ki-Hong Kim^{1*}, Min-Keun Song¹, Hyeng-Kyu Park¹, Jae-Young Han^{1†}, In-Sung Choi¹

Chonnam National University Hospital & Medical School, Department of Physical & Rehabilitation Medicine¹

Objective

The purpose of this study is to establish a hypothesis that a longer period of time would be required for older patients compared with younger patients, and to compare the degree of improvement according to time with older and younger patients.

Methods

This retrospective study analyzed the medical records of 70 patients diagnosed with AMI (ST elevation and non-ST elevation myocardial infarction) between January 2011 and September 2017 who were referred to our rehabilitation center after undergoing percutaneous coronary intervention (PCI). Among the patients who underwent exercise tolerance test (ETT) at about 3 weeks after the onset of AMI (T0), about 6 weeks after completion of the first ETT (T1) and about 12 weeks after completion of the first ETT (T2). We divided patients older than 65 years were grouped into older group (24 patients) and the others were grouped into younger group (46 patients). (Table 1.) Study outcomes were estimated from the ETT at both aforementioned assessment points.

Results

The younger group showed improvement of METsmax and VO2max between T0 and T1. However older group showed no significant improvement between T0 and T1. The exercise capacity (METsmax and VO2max) of all groups showed improvement between T0 and T2. METsmax of younger group was 6.08 ± 0.75 at baseline and 7.52 ± 1.66 after 12 weeks, VO2max of younger group was 1.525 ± 0.297 at base line and 1.888 ± 0.511 after 12 weeks. METsmax of older group was 5.18 ± 1.32 at baseline and 6.29 ± 2.00 after 12 weeks, VO2max of older group was 1.120 ± 0.355 at base line and 1.325 ± 0.470 after 12 weeks. (younger group; $p=0.000$, $p=0.000$, older group; $p=0.031$, $p=0.046$) (Table 2., Table 3.)

Conclusion

Patients 65 years of age or younger showed improvement in their ability to exercise through a 6-week CR, whereas those aged 65 and older showed improvement in their

ability to exercise over a 6-week, at least 12-week CR. Therefore, elderly patients need more participation periods of CR than younger ones. Key Words: Cardiac rehabilitation, Old age, Acute myocardial infarction, Exercise capacity, Exercise tolerance test

Table 1. Clinical characteristics of the study population (n,%)

	Whole group (n=70)	Older group (n=24)	Younger group (n=46)	p-value
Age	60.17±11.09	72.87±5.10	53.53±6.65	0.000*
Sex (men)	53(75.7%)	14(70.8%)	39(84.7%)	
BMI (kg/m ²)	24.68±3.38	23.00±3.27	25.55±3.12	0.003*
LVEF(%)	56.00±9.55	60.97±7.87	53.41±9.39	0.001*
Hypertension	32(45.7%)	15(62.5%)	17(36.9%)	
Dyslipidemia	22(31.4%)	17(70.8%)	5(10.8%)	
Diabetes mellitus	20(28.5%)	7(29.1%)	13(28.2%)	
CHD type				
STEMI	37(52.9%)	14(58.3%)	23(50.0%)	
NSTEMI	33(47.1%)	10(41.6%)	23(50.0%)	
Medication				
B-blocker	50(71.4%)	17(70.8%)	33(71.7%)	
ACEI	30(42.8%)	8(33.3%)	22(47.8%)	
Statin	36(51.4%)	12(50.0%)	24(52.1%)	

Values are presented as mean±standard deviation or number (%) BMI, body mass index; LVEF, left ventricular ejection fraction; CHD, coronary heart disease; STEMI, ST elevation myocardial infarction; NSTEMI, non-ST elevation myocardial infarction; ACEI, angiotensin-converting enzyme inhibitor P values are for comparison between Older group and Younger group *statistically significant (p<0.05) in comparison of the Older and Younger group

Table 2. Comparison of effect on cardiopulmonary exercise capacity

	T0			T1			T2		
	Older group	Younger group	p-value	Older group	Younger group	p-value	Older group	Younger group	p-value
MET _{max}	5.18±1.32	6.08±0.75	0.004*	5.40±1.29	7.28±1.81	0.000*	6.29±2.00	7.52±1.66	0.008*
VO _{2max}	1.120±0.355	1.525±0.297	0.000*	1.156±0.355	1.808±0.524	0.000*	1.325±0.470	1.888±0.511	0.000*
HR _{max}	117.2±19.0	125.9±16.3	0.051	114.7±17.4	134.0±18.0	0.000*	119.2±23.2	131.1±18.1	0.021*
HR _{rest}	74.54±14.24	75.35±15.90	0.836	66.71±9.17	71.04±10.48	0.092	67.17±12.96	69.54±9.95	0.397
SBP _{rest}	124.2±18.4	112.2±17.8	0.010*	121.3±21.6	111.0±17.9	0.037*	122.5±24.2	113.93±19.2	0.111
BMI	23.00±3.27	25.55±3.12	0.002*	23.10±3.21	25.54±3.58	0.007*	22.93±3.35	25.43±3.33	0.004*
TET	603.0±153.9	679.4±134.5	0.035*	603.2±206.1	775.0±148.4	0.001*	649.4±204.2	780.8±160.4	0.004*

Values are mean±standard deviation; T0, exercise tolerance test at 3 weeks after acute myocardial infarction; T1, exercise tolerance test at 6 weeks after T0; T2, exercise tolerance test at 12 weeks after T0; MET_{max}, maximal metabolic equivalents; VO_{2max}, maximal oxygen consumption; TET, Total exercise time; HR_{max}, maximal heart rate; HR_{rest}, resting heart rate; SBP, Systolic blood pressure; BMI, Body mass index

Table 3. Cardiopulmonary exercise capacity at T0, T1 and T2

	T0	T1	T2	p-value T0-T1	p-value T0-T2
Older Group					
MET _{max}	5.18±1.32	5.40±1.29	6.29±2.00	0.455	0.031*
VO _{2max}	1.120±0.355	1.156±0.355	1.325±0.470	0.542	0.046*
HR _{max}	117.2±19.0	114.7±17.4	119.2±23.2	0.495	0.604
HR _{rest}	74.54±14.24	66.71±9.17	67.17±12.96	0.009*	0.032*
SBP _{rest}	124.2±18.4	121.3±21.6	122.5±24.2	0.491	0.718
BMI	23.00±3.27	23.10±3.21	22.93±3.35	0.296	0.836
TET	603.0±153.9	603.2±206.1	649.4±204.2	0.997	0.24
Younger Group					
MET _{max}	6.08±0.75	7.28±1.81	7.52±1.66	0.000*	0.000*
VO _{2max}	1.525±0.297	1.808±0.524	1.888±0.511	0.000*	0.000*
HR _{max}	125.9±16.3	134.0±18.0	131.1±18.1	0.001*	0.029*
HR _{rest}	75.35±15.90	71.04±10.48	69.54±9.95	0.021*	0.005*
SBP _{rest}	112.2±17.8	111.0±17.9	113.93±19.2	0.615	0.549
BMI	25.55±3.12	25.54±3.58	25.43±3.33	0.965	0.685
TET	679.4±134.5	775.0±148.4	780.8±160.4	0.001*	0.000*

Values are mean±standard deviation; T0, exercise tolerance test at 3 weeks after acute myocardial infarction; T1, exercise tolerance test at 6 weeks after T0; T2, exercise tolerance test at 12 weeks after T0; MET_{max}, maximal metabolic equivalents ; VO_{2max}, maximal oxygen consumption; TET, Total exercise time; HR_{max}, maximal heart rate; HR_{rest}, resting heart rate; SBP, Systolic blood pressure; BMI, Body mass index

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 13:25-13:35 Room D(5F)

OP3-1-2

CIPN and Phrenic Nerve Conduction Study in Patients with Prolonged Mechanical Ventilation

Won Jun Kim^{1*}, Won Kim^{1†}, Suk Kyung Hong², Nak Jun Choi², Sae Rom Park²

Asan Medical Center, Department of Rehabilitation Medicine¹, Asan Medical Center, Department of Surgery²

OBJECTIVE

Critical illness polyneuropathy (CIPN) is frequent and important complication in intensive care unit (ICU) patients. Prolonged mechanical ventilation has been associated with the prevalence of CIPN. Phrenic nerve conduction Results are highly relevant to the date of weaning from the ventilator. However, there are few studies on the occurrence of CIPN and phrenic nerve conduction study (NCS) in case of critically ill surgical patients. In addition, it is hard to perform a full electrophysiologic study for CIPN diagnosis in critically ill patients. The aim of this study is to investigate the incidence of CIPN and to recognize the correlation between the CIPN and patient's prognosis when simplified diagnostic criteria are applied. In addition, we investigate the characteristics of phrenic NCS in critically ill patients and investigate the association between the Results and patient's prognosis.

METHODS

This study was performed between November 2016 and May 2018 in surgical ICU of our hospital. Critically ill patients over 18 years of age, who were mechanically ventilated for ≥ 3 weeks were included. At 3 weeks of mechanical ventilation on ICU patients, they were subjected to the NCS in upper, lower extremities including phrenic nerve and tested muscle strength by using the Medical Research Council (MRC) scale. We employed three versions of the diagnostic criteria depending on the MRC scale and NCS result. (Table 1). We used ventilator-free days at 40 days — defined as days alive and free from mechanical ventilation — to compare patient's prognosis. Ventilator-free days were then calculated post-nerve conduction study. A ventilator-free day ≥ 1 day was defined as a good prognosis and 0 day was defined as a bad prognosis. Then, we evaluate the correlation between the prevalence of CIPN and patient's prognosis.

RESULTS

A total of 50 patients were enrolled in the study — the diagnosis of CIPN yielded as the following: 7 of 50 according to criteria A; 13 of 50 according to criteria B; 16 of 50 according to criteria C. As the authors diagnose CIPN on patients by criteria A, B, and C, respectively, the Results bring forth the following: CIPN patients according to criteria A

yields an odds ratio of 12.1, regarding the prognosis detrimental to patients; an odds ratio of 24.0 by criteria B, and an odds ratio of 12.4 by criteria C. Furthermore, when the amplitude of phrenic nerve compound muscle action potential(CMAP) divided into more than 0.3mV and less than 0.3mV, the prognosis was better in more than 0.3 mV group, though it was not statistically significant.

CONCLUSION

Our Results suggest that CIPN is common in critically ill patients and the diagnostic criteria of MRC in conjunction with the tibial and sural nerve conduction study show the most predictive value on the patient’s prognosis. Although there is no statistical significance, it seems like the low value of phrenic CMAP amplitude might be correlated with the poor prognosis.

Table 1. Diagnostic criteria for critical illness polyneuropathy

Criteria A	Criteria B	Criteria C
MRC sum score of <48	MRC sum score of <48	Dependence on mechanical ventilation
Dependence on mechanical ventilation	Dependence on mechanical ventilation	CMAP amplitudes are decreased to <80% of the lower limit of normal in posterior tibial nerve
CMAP amplitudes are decreased to <80% of the lower limit of normal in ≥ 2 nerves	CMAP amplitudes are decreased to <80% of the lower limit of normal in posterior tibial nerve	SNAP amplitudes are decreased to <80% of the lower limit of normal in sural nerve
SNAP amplitudes are decreased to <80% of the lower limit of normal in ≥ 2 nerves	SNAP amplitudes are decreased to <80% of the lower limit of normal in sural nerve	

Table 2. Clinical Illness Polyneuropathy versus Ventilator-free day

	Ventilator Free day = 0	Ventilator Free day \geq 1	<i>p-value</i> (<i>odds ratio</i>)
CIPN + (by Criteria A)	5 (41.7%)	2 (5.6%)	
CIPN – (by Criteria A)	7 (58.3%)	34 (94.4%)	.002 (12.14)
CIPN + (by Criteria B)	9 (75.0%)	4 (11.1%)	
CIPN – (by Criteria B)	3 (25.0%)	32 (88.9%)	<.001 (24.00)
CIPN + (by Criteria C)	9 (75.0%)	7 (19.4%)	
CIPN – (by Criteria C)	3 (25.0%)	29 (80.6%)	<.001 (12.43)

p values were calculated using the χ^2 -test, $p < .05$ was considered to be statistically significant

Table 3. Phrenic Nerve Amplitude versus Ventilator-free day

	Ventilator Free day = 0	Ventilator Free day \geq 1	<i>p-value</i> (<i>odds ratio</i>)
Phrenic nerve Amplitude < 0.3 (mV)	6 (66.7%)	10 (33.3%)	
Phrenic nerve 0.3 \leq Amplitude (mV)	3 (33.3%)	20(66.7%)	.075 (4.0)

p values were calculated using the χ^2 -test, $p < .05$ was considered to be statistically significant

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 13:35-13:45 Room D(5F)

OP3-1-3

Contributing factors to exercise induced desaturation in pulmonary arterial hypertension

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Objective

To evaluate the prevalence of exercise induced desaturation (EID) and elucidating the contributing factors in pulmonary arterial hypertension (PAH) patients.

Methods

Analyze 20 pulmonary arterial hypertension patients' data (EID group = 10) from April 2016 to May 2018. Comparisons of background characteristics, comorbidity, trans-thoracic echocardiography (TTE), cardiac catheterization, pulmonary function test (PFT), 6MWT with gas analysis, body composition test and muscle power test between EID and non-EID patients were conducted.

Results

Epidemiological characteristics, TTE data and cardiac catheterization data did not differ between 2 groups. Forced expiratory volume in the first second (FEV1), 6MWD and peak oxygen consumption (VO₂peak) were significantly low in EID group (Table 1). We suggest a "predictive scale for exercise induced desaturation in pulmonary arterial hypertension (PSEID)" (table 2). As PSEID is 4 or more, it showed 80% of sensitivity and 90% of specificity.

Conclusion

The EID was found in the half of PAH patients and FEV1, 6MWD and VO₂peak were most relevant factors. Result of TTE and cardiac catheterization was not correlated with EID.

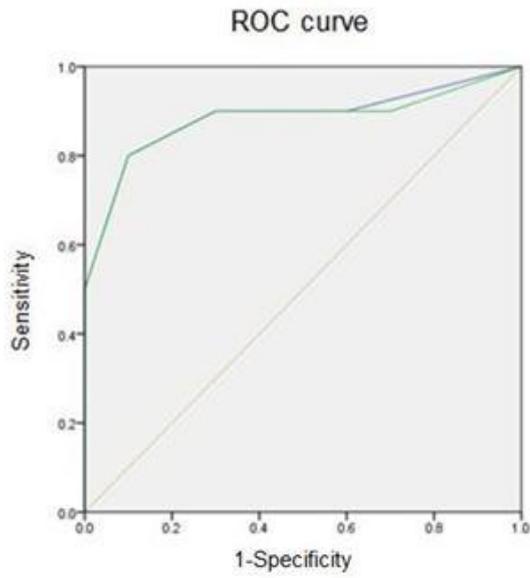
Table1. Pulmonary function and 2-minute walk test data

	Non-EID group (n = 10)	EID group (n = 10)	p- value*
FVC_%	89.00 [81.00, 90.00]	74.50 [65.00, 84.00]	0.078
FEV1_%	83.00 [81.00, 84.00]	70.00 [69.00, 80.00]	0.037*
DLCO_%	73.00 [58.00, 86.00]	55.00 [32.00, 70.00]	0.086
6_MWD(m)	503.00 [450.00, 520.00]	331.00 [252.00, 467.00]	0.021*
6_MWD_%	71.00 [65.10, 77.10]	48.65 [45.20, 64.30]	0.011*
VO2peak	15.73 [13.56, 20.12]	11.41 [10.48, 16.22]	0.021*
VO2peak_%	57.50 [52.00, 63.30]	48.00 [32.00, 57.20]	0.064
VE/VCO2_slope	37.85 [29.60, 39.10]	41.10 [32.80, 60.20]	0.241
peak HR_%	63.36 [57.40, 77.27]	63.96 [59.78, 72.20]	0.910

Table2. Predictive scale for exercise induced desaturation in pulmonary arterial hypertension (PSEID)

	Score
6 minute walk distance (m)	
≥ 450	1
450 > and ≥ 300m	2
< 300	3
Forced expiratory volume in the first second (% of predicted)	
≥ 80 of predicted value	0
80 > and ≥ 50	1
50 > and ≥ 30	2
< 30	3
Peak oxygen consumption (ml/min/kg)	
≥ 14	1
14 > and ≥ 10	2
>10	3
Diffusion capacity for carbon monoxide (% of predicted)	
≥50	0
< 50	1
Interstitial lung disease	
Present	0
Absent	1
Sarcopenia	
Present	0
Absent	1

Table3. Sensitivity and specificity of PSEID



Score	Sensitivity	1-Specificity
0	1.000	1.000
1.5	.900	.600
2.5	.900	.300
3.5	.800	.100
4.5	.500	.000
5.5	.400	.000
6.5	.200	.000
8	.000	.000

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 13:45-13:55 Room D(5F)

OP3-1-4

Health-related behaviors after heart valve surgery and their association with mortality.

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Seoul National University Bundang Hospital, Department of Rehabilitation Medicine¹, The Catholic University of Korea College of Medicine, Department of Biostatistics²

Background

Although recent studies suggest that cardiac rehabilitation and behavioral modification are recommended after various heart diseases, few data show health-related behavior changes after valvular heart disease (VHD) and their associations with survival. We designed this study to investigate the changes in smoking status and physical activity after heart valve surgery and their associations with mortality.

Methods and Results

Using the Korean National Insurance Health Service database, we included 6,447 subjects (61.4±12.2 yrs, M:F=3,130:3,317) who had VHD from 2010 to 2013 and underwent the regular health check-up before and after the onset of VHD. Subjects were grouped according to the smoking status and physical activity before and after VHD. Information of all-cause mortality was obtained until December 31, 2016. The 'smoker/smoker' group showed higher mortality (hazard ratio (HR) 1.561, 95% confidence interval (CI) 1.053-2.314) compared to the non-smoker/non-smoker group. The 'active/active' group and 'inactive/active' group showed less mortality (HR 0.582, 95% CI 0.422-0.804; HR 0.697, 95% CI 0.505-0.963, respectively), compared to the inactive/inactive group.

Conclusions

Smoking and physical activity is significantly associated with higher mortality in patients with VHD, in Korea.

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 13:55-14:05 Room D(5F)

OP3-1-5

Initial Ejection Fraction and Home-based Cardiac Rehabilitation in Acute Myocardial Infarction

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Objective

To evaluate the effects of home-based cardiac rehabilitation (CR) on functional capacity according to ejection fraction (EF) after acute myocardial infarction (AMI).

Method

We retrospectively reviewed the medical records of the AMI patients who had done home-based CR from 2015 to 2017. 62 patients were recruited. All patients underwent an exercise tolerance test (ETT) at about 2 weeks, 3 months and 6 months after AMI. The patients were divided into two groups according to EF. EF 50% and over were allocated to normal EF group and EF under 50% were to low EF group. According to the result of initial ETT and functional ability, patients started home-based CR. Detailed exercise regimen was prescribed and how to manage and modify the risk factor was also educated. Cardiopulmonary capacities were analyzed after every ETT which was done about 3-month interval. Evaluated cardiopulmonary capacities were heart rate and blood pressure (BP) at rest and maximum, peak oxygen consumption, anaerobic threshold, metabolic equivalent (MET) and exercise time.

Results

38 patients were allocated to normal EF group and 24 patients were allocated to low EF group. There were no significant differences in the baseline characteristics between two groups except for AMI type (Table 1). After home-based CR, both groups showed improvement in most of the measurements when compared to initial ETT except for maximal systolic BP of 3 and 6 month in normal EF group and maximal diastolic BP of 6 month in low EF group (Table 2). But the changes in all measurements after 3 and 6 month between groups have no significant differences (Table 3).

Conclusion

There was no relationship between the effects of home-based CR and the initial ejection fraction after AMI. And any adverse events related to home-based CR did not occur during this study. In the patients with low initial EF after AMI, home-based CR could be as effective as in the patients with normal EF. Because most patients' EFs in low EF group

were between 35 and 45, it is limitation that this result cannot apply to the severely low EF.

Table 1. Baseline characteristics

	Normal EF (n=38)	Low EF < 50 (n=24)	p-value
Age (year)	56.50±8.89	57.58±10.89	0.670
Sex (Man:Woman)	35:3	21:3	0.550
Type (STEMI:NSTEMI)	26:12	17:7	0.003*
BMI (kg/m ²)	25.46±2.29	24.85±2.77	0.350
Ejection fraction (%)	56.21±5.58	41.87±5.86	<0.001
Height (cm)	168.95±7.44	168.03±10.32	0.687
Weight (Kg)	72.84±9.97	70.56±13.67	0.451
DM	12 (31.6)	4 (16.7)	0.191
HTN	13 (34.2)	8 (33.3)	0.943
Dyslipidemia	12 (31.6)	8 (33.3)	0.941
Smoking	22 (57.9)	19 (79.2)	0.085
Alcohol drinking	20 (52.6)	12 (50)	0.840

Values are presented as mean±standard deviation or number of patients (%).

STEMI, ST-elevation myocardial infarction; NSTEMI, non-ST-elevation myocardial

infarction; BMI, body mass index; DM, diabetes mellitus; HTN, hypertension

*p<0.05 for comparison between groups by the Chi-square test

Table 2. Comparison of exercise capacity

	Normal EF (n=38)			Low EF (n=24)		
	Initial	3 month	6 month	Initial	3 month	6 month
HRrest	73.92±11.74	69.84±10.53*	71.73±12.10*	71.33±12.21	67.58±9.86*	66.33±10.20*
SBPrest	118.74±13.74	116.15±16.51*	118.58±17.60*	121.04±15.96	113.71±15.05*	114.21±18.13*
DBPrest	71.79±10.90	74.63±11.77*	76.24±11.45	70.16±9.16	69.25±9.40*	69.00±14.26*
HRmax	150.47±12.18	153.71±16.6*	155.57±19.50*	144.50±17.06	143.25±20.36*	142.96±19.90*
SBPmax	182.84±55.95	176.16±27.19	182.73±54.25	158.88±32.93	163.33±26.63*	164.25±29.56*
DBPmax	85.05±10.45	87.23±12.69*	86.45±13.21*	81.67±13.31	79.88±12.35*	79.67±13.88
VO2peak	29.98±7.67	32.76±7.20*	31.98±8.49*	28.20±7.30	30.07±7.29*	29.32±9.76*
Anaerobic threshold	23.61±7.20	24.51±5.80*	25.39±6.57*	21.75±6.26	23.30±7.17*	23.87±8.32*
METs	8.33±1.78	9.03±1.85*	9.19±1.92*	8.06±2.50	8.64±2.04*	8.93±2.07*
Exercise time (min)	14.52±1.67	15.11±1.61*	15.29±2.01*	14.38±2.34	14.79±1.84*	15.08±2.22*

Values are presented as mean±standard deviation.

HRrest, resting heart rate; SBPrest, resting systolic blood pressure; DBPrest, resting diastolic blood pressure; HRmax, maximal heart rate; SBPmax, maximal systolic blood pressure; DBPmax, maximal diastolic blood pressure; VO2peak, peak oxygen consumption; METs, metabolic equivalent tasks

*p<0.05 for comparison with initial results in each group by the Wilcoxon signed-rank test

Table 3. Comparison of % changes in exercise capacity after 3 and 6 months in both groups

	3 month			6 month		
	Normal EF	Low EF	p-value	Normal EF	Low EF	p-value
% change in HRrest	-7.92±18.88	-5.97±13.35	0.675	-4.68±17.68	-8.7±16.61	0.366
% change in SBPrest	-3.5±14.87	-7.3±14.51	0.340	-1.50±14.40	-7.6±17.22	0.174
% change in DBPrest	2.30±16.75	-2.44±15.88	0.254	4.45±16.64	-4.77±20.66	0.099
% change in HRmax	1.44±9.24	-1.69±9.48	0.242	2.28±10.31	-2.04±12.44	0.172
% change in SBPmax	-5.56±36.01	2.79±11.60	0.348	-3.32±26.89	2.27±16.90	0.578
% change in DBPmax	1.23±14.47	-3.04±13.80	0.170	0.51±12.33	-4.44±20.46	0.355
% change in VO2peak	7.82±15.56	6.11±10.02	0.394	3.54±21.52	-1.13±23.87	0.435
% change in Anaerobic threshold	3.65±17.93	5.18±22.74	0.553	5.31±24.00	5.69±24.97	0.988
% change in METs	5.01±23.83	6.40±18.76	0.872	6.36±24.35	8.21±23.91	0.766
% change in exercise time	3.53±8.66	2.73±11.08	0.968	4.18±10.69	3.98±13.36	0.914

Values are presented as mean±standard deviation.

HRrest, resting heart rate; SBPrest, resting systolic blood pressure; DBPrest, resting diastolic blood pressure;

HRmax, maximal heart rate; SBPmax, maximal systolic blood pressure; DBPmax, maximal diastolic blood pressure; VO2peak, peak oxygen consumption; METs, metabolic equivalent tasks

*p<0.05 for by the Mann–Whitney U test

심폐재활

발표일시 및 장소 : 10 월 26 일(금) 14:05-14:15 Room D(5F)

OP3-1-6

Successful application of noninvasive ventilators in patients with forced vital capacity below 10%

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Introduction

Reduced forced vital capacity (FVC) is one of the risk factors for respiratory complications in patients with restrictive lung disease such as neuromuscular disease (NMD), motor neuron disease (MND) and spinal cord injury (SCI) et cetera. Generally, patients with myopathy are recommended to apply the noninvasive ventilator (NIV) when the FVC is 45-55% of the predicted value (FVCpred) and when the FVCpred is less than 50% in the MND patients. If these periods are missed, tracheostomy may be required, which may lead to a decrease in the patient's overall qualities of lives (QOL) such as increased secretion, infection risk, and limitation of vocalization and swallowing. However, if adequate respiratory support is consistently achieved, NIV can be applied without tracheostomy even under FVCpred 10%. We aim to report cases of successful application of NIV instead of improper tracheostomy.

Method

We evaluated a total 945 of patients who were hospitalized and applied noninvasive ventilator successfully between March 1, 2000 and March 31, 2018. 110 patients who became successful correction of abnormal ventilatory status through application of NIV with under 10% of FVCpred were included in this report. The medical charts were retrospectively reviewed for pulmonary functions such as FVC, peak cough flow (PCF), maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP). Furthermore, we analyzed ventilation status and gas analysis via arterial blood gas analysis (ABGA) with continuous electric monitoring of transcutaneous blood gas.

Results

Among the 110 patients, there were 6 patients with SCI, 24 with ALS, 51 with DMD, 2 with congenital myopathy, 19 with other myopathies, 1 with myotonia, 3 with spinal

muscular atrophy (SMA) and patients with the other disease were 4. All the patients were divided into 3 groups. Group 1, who refused NIV application until development of hypoventilation symptoms or whose FVC decreased abruptly, included 26 patients who were followed up through outpatient clinic regularly before NIV application due to, group 2 was composed of 47 patients who were lost their follow-up until NIV application or already symptomatic or hypercapnic at 1st visit. The 37 patients divided into group 3 were transferred from another hospital or department or received inadequate treatment before NIV application. All 6 patients with SCI were successfully decannulated in our hospital after tracheostomy in another hospital. The 8 intubated patients transferred from other hospitals to our institution were extubated successfully. Although ALS is a progressive disease and the duration of NIV is not so long, ALS patients used NIV for at least 3 months to 2 years.

Conclusion

Suitable supported respiration has preventive effect for deterioration of respiratory function. As a result, even if FVCpred is less than 10%, proper respiratory support followed by NIV may postpone the tracheostomy surgery.

Table 1. Clinical assessments and characteristics.

	n=110
Age, years	31.4±17.9
Male, n	81
ABGA, %	
pCO ₂	48.8±15.5
SaO ₂	95.9±5.2
Non-invasive EtCO₂ monitoring during sleep	
On admission maximum, mmHg	54.1±12.0
On admission mean, mmHg	45.5±10.3
On discharge maximum, mmHg	42.4±5.9
On discharge mean, mmHg	34.7±6.2
Pulmonary function test	
FVCpred at sitting position, %	7.6±5.1
FVCpred at supine position, %	5.9±3.8
MIC, mL	969.7±440.2
PCF, L/min	58.4±82.3
MIP at sitting position, %	14.0±10.2
MIP at supine position, %	13.7±10.9
MEP at sitting position, %	10.7±8.4
MEP at supine position, %	11.1±9.2

Variables are expressed as mean±SD(Standard deviation).

EtCO₂: End tidal carbon dioxide; pCO₂: Partial pressure of carbon dioxide;

SaO₂: Oxygen Saturation; MIC: Maximan inspiratory capacity

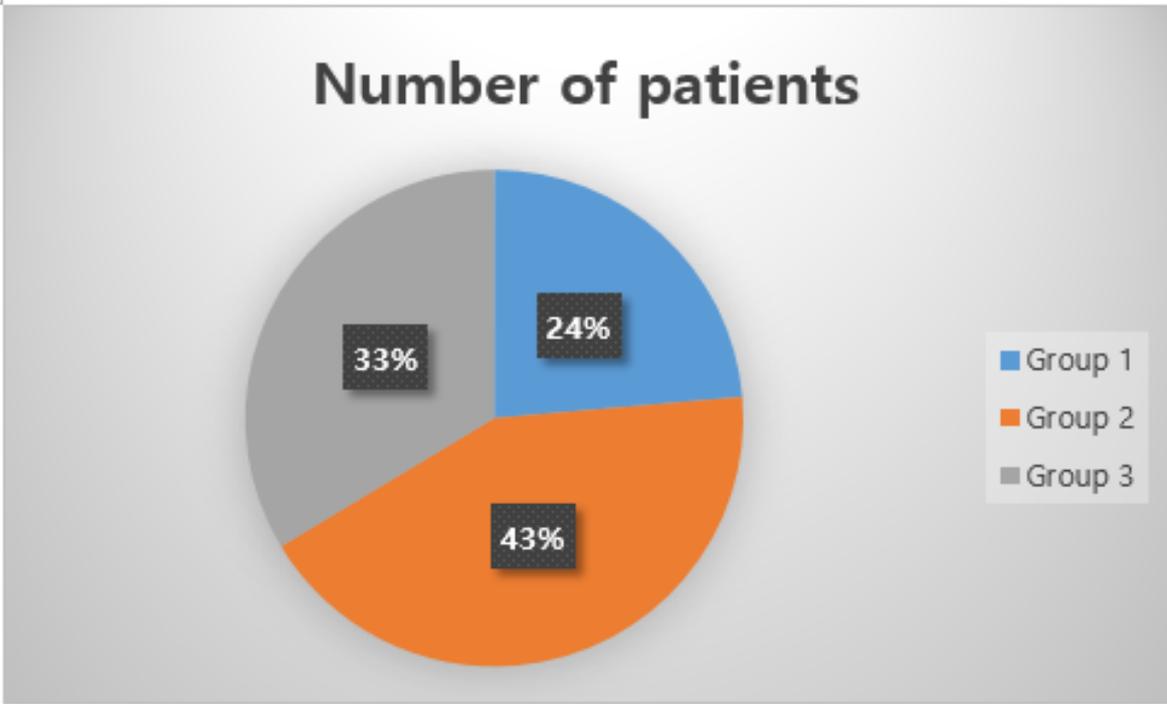


Figure 1. Patient proportions by groups.

ORAL PRESENTATION 3-2

척수재활

발표일시 및 장소 : 10 월 26 일(금) 14:15-14:25 Room D(5F)

OP3-2-1

Cerebral Blood Flow Change after Taking Midodrine in High-level Spinal Cord Injury: A Case Series

Kyo Jun Youn^{1*}, Chang-Won Moon¹, Il-Young Jung¹, Kang Hee Cho^{1,2†}

Chungnam National University, Department of Rehabilitation Medicine, School of Medicine¹, Chungnam National University, Institute of Biomedical Engineering²

Objective

In high-level spinal cord injury, patients suffered from cardiovascular and autonomic dysfunctions. The orthostatic hypotension occurs as a result of systemic loss of vascular resistance, accumulation of blood within the venous system, reduced venous return to the heart, and decreased cardiac output. In previous studies, we used duplex ultrasonography to identify changes in cerebral blood flow volume (CBFV) with posture changes. The purpose of this study was to evaluate the changes of cerebral flow volume before and after administration of midodrine using duplex ultrasonography.

Materials and Methods

The internal carotid artery on right side were studied and intravascular flow volumes were measured by using a 9 MHz linear array transducer. The CBFV measurements were automatically calculated by the built-in software of the ultrasound device (Siemens ACUSON, Siemens Healthcare, Erlangen, Germany). The CBFV and blood pressure (BP) were measured in the supine position, immediately tilted 50 degrees and after 5 minutes. To increase the reliability of the test, cerebral blood flow was measured three times in each position and the mean value was used. (Figure 1) Four patients with high-level spinal cord injury were measured for CBFV before and after taking midodrine. Midodrine was administered from 10 mg to 30 mg daily depending on the improvement of symptom of patients.

Results

Three of the four patients were male and the age ranged from 21 to 64 years. The period from onset to date of examination varied from 15 days to 682 days. Only in the fourth case, the patient was taking 7.5 mg of midodrine before initial ultrasonography, and the other patients were not. The last dose of midodrine taken by patients was 10 to 30 mg, and the interval between the first and second tests ranged from 13 to 36 days. In all patients, elevated CBFV and BP were observed in the tilted state after taking the midodrine. In particular, BFV showed an increase from 5.8% (Case 3) to 50.5% (Case 4)

immediately after tilting, and increased from 1.5% (Case 4) to 32.5% (Case 2) after 5 minutes of tilting. (Table 2)

Conclusion

This study was the first to observe the change in the cerebral blood flow after using the midodrine by using duplex ultrasonography. We could confirm the increase of the cerebral blood flow objectively after taking the midodrine in patients with orthostatic hypotension.

Table 1. Overall data of four high-level spinal cord injury patients with orthostatic hypotension

	Patient 1		Patient 2		Patient 3		Patient 4	
Gender/Age	Male/53		Female/64		Male/46		Male/21	
Level of injury (ASIA impairment scale)	C4(D)		C5(C)		C6(C)		C6(A)	
Onset to exam (days)	15		58		205		682	
	Initial	Follow up						
Midodrine dose (mg/day)	0	10	0	30	0	25	7.5	20
Duration of initial to follow up exam (days)	22		36		13		13	
BP (systolic BP/diastolic BP, mmHg)								
Supine	100/67	97/68	114/67	119/72	110/63	118/83	126/63	135/80
Tilt 50° 0min	73/45	73/51	102/67	117/72	76/43	89/51	87/49	121/71
Tilt 50° 5min	88/68	85/67	82/55	104/69	79/48	111/72	86/50	100/65
Difference of systolic BP between supine and tilt position (mmHg)								
Tilt 50° 0min - Supine	-27	-24	-12	-2	-34	-29	-39	-14
Tilt 50° 5min - Supine	-12	-12	-32	-15	-31	-7	-40	-35
CBFV (L/min)								
Supine	0.250	0.267	0.327	0.287	0.380	0.345	0.323	0.333
Tilt 50° 0min	0.181	0.218	0.215	0.261	0.238	0.236	0.148	0.321
Tilt 50° 5min	0.186	0.251	0.193	0.234	0.191	0.233	0.292	0.306
CBFV ratio of tilt to supine position								
Supine	100%	100%	100%	100%	100%	100%	100%	100%
Tilt 50° 0min	72.4%	81.6%	65.7%	90.9%	62.6%	68.4%	45.8%	96.3%
Tilt 50° 5min	74.4%	94.0%	59.0%	81.5%	50.3%	67.5%	90.4%	91.9%

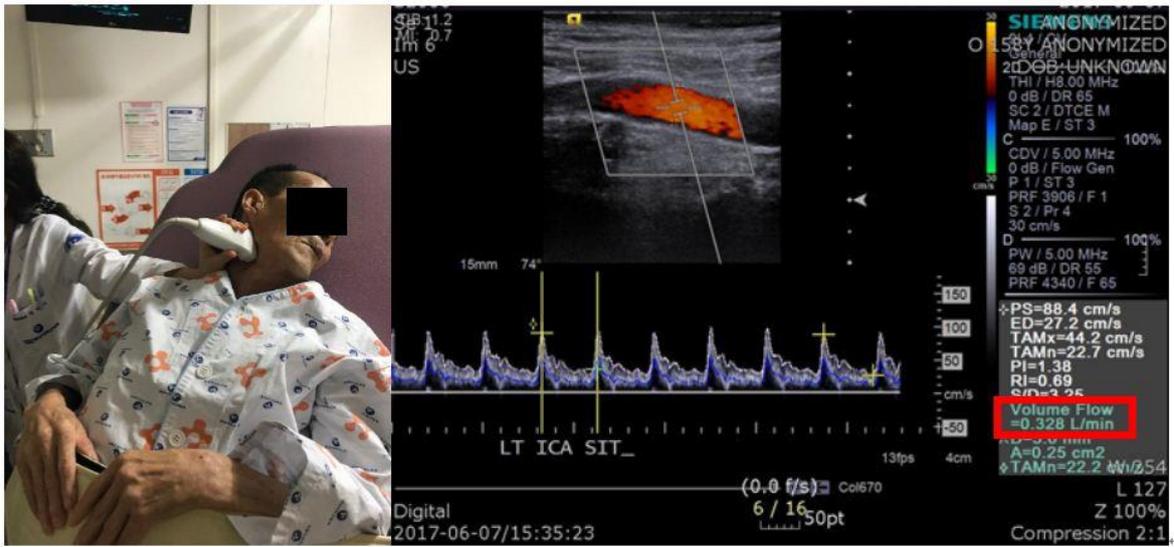


Fig 1. The position of patient and blood flow velocities measured by duplex ultrasonography

척수재활

발표일시 및 장소 : 10 월 26 일(금) 14:25-14:35 Room D(5F)

OP3-2-2

Correlation between Sudomotor Dysfunction, Severity, and Autonomic Dysreflexia in Patients with SCI

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Introduction

Quantitative sudomotor axon reflex test (QSART) is a test to evaluate the integrity of the postganglionic sudomotor system along the axon reflex to define the distribution of sweat loss. Sudomotor dysfunction is known to be common in patients with neurological disturbance affecting sympathetic activity. Most patients with spinal cord injury (SCI) show sudomotor dysfunction, more or less, depending on the level of injury. We investigated the correlation between quantitative sudomotor function, the completeness of SCI, and presence of autonomic dysreflexia (AD). In previous studies, sympathetic skin response (SSR) has been used as a test to predict AD in SCI. However, as SSR mostly cannot obtain the response cervical SCI, its clinical usefulness is very limited as a tool for evaluation of the sympathetic dysfunction in SCI. We purposed to investigate the effectiveness of QSART in predicting autonomic dysreflexia in patients with SCI.

Methods

Medical records of 39 patients with SCI above the level of injury T6 who performed QSART were reviewed. Peripheral polyneuropathy, diabetes mellitus, and other diseases that can affect autonomic function were considered as exclusion criteria. Neurologic level of injury was assessed by the International Standards for Neurological Classification of Spinal Cord Injury. We obtained quantitative values of volume and latency measured in the forearms from the QSART. The differences of the latency and total volume of sweat between complete and incomplete injury groups were analyzed. We also comparatively analyzed the difference of quantitative values of QSART parameters according to presence of AD.

Results

Subjects with complete injury showed statistically prolonged latencies and decreased sweat volume compared to those of the subjects with incomplete injury (Table 2.). We also found the significant differences of latency and sweat volume of QSART between subjects with and without AD. Subjects with AD showed significantly prolonged latencies and decreased sweat volumes in the forearms compared to subjects with no AD.

Conclusion

This study suggested that influence of postganglionic sympathetic cholinergic activities following SCI is strongly related with completeness of injury and presence of autonomic dysreflexia. Further studies about evaluation and quantification of altered postganglionic sympathetic activity following SCI should be performed. If efficacy of QSART for SCI is established, quantitative data of QSART may be more useful than SSR to evaluate autonomic function in patients with SCI.

Table 1. Demographics and clinical characteristics of the subjects

Variables	Number
Age (years)	56.7 ± 14.1
Gender	
Male	29 (74.4%)
Female	10 (25.6%)
Height (cm)	168 ± 8.6
Weight (kg)	63.4 ± 10.2
Neurologic level of injury	
Tetraplegia	34 (87.2%)
Paraplegia	5 (12.8%)
AIS	
A	13 (33.3%)
B	4 (10.3%)
C	7 (17.9%)
D	15 (38.5%)
Time since injury (months)	18.8 ± 48
AD symptom	11 (28.2%)

Table 2. Parameters of QSART according to completeness of injury

Variables	Complete injury	Incomplete injury	<i>p</i> -value
Number	13 (33.3%)	26 (66.7%)	
Mean of latencies in the right forearm	2 min 16 sec	1 min 33 sec	0.007
Mean of latencies in the left forearm	2 min 31 sec	1 min 55 sec	0.014
Mean of total volume of forearms	0.540 uL	1.146 uL	0.022

Table 3. Parameters of QSART according to presence of autonomic dysreflexia

Variables	SCI with autonomic dysreflexia	SCI without autonomic dysreflexia	<i>p</i> -value
Number	11 (28.2%)	28 (71.8%)	
Mean of latencies in the right forearm	2 min 30 sec	1 min 31 sec	0.002
Mean of latencies in the left forearm	2 min 59 sec	1 min 47 sec	0.001
Mean of total volume of forearms	0.544 uL	0.995 uL	0.027

척수재활

발표일시 및 장소 : 10 월 26 일(금) 14:35-14:45 Room D(5F)

OP3-2-3

Current State of Infection of Inpatients with Spinal Cord Injury in Tertiary Rehabilitation Center

Yin-Zhu Xu^{1*}, Kang Hee Cho^{1,2†}, Il-Young Jung¹, Chang-Won Moon¹, Hana Jung², Hyun Ah Kim²

School of Medicine, Chungnam National University, Daejeon, Korea, Department of Rehabilitation Medicine¹, Chungnam National University, Daejeon, Korea, Institute of Biomedical Engineering²

Objective

Diseases of the respiratory system are the leading cause of death following spinal cord injury(SCI), with pneumonia being the most common. Septicemia is third cause of death, usually associated with pressure ulcers(PU), urinary tract infection(UTI) or respiratory tract infections. In cervical cord injury, pneumonia is by far the leading cause of death. But heart disease, septicemia, and suicide are more common in below cervical cord injury. Infection is not only the main cause of death, but also common limitation factor of rehabilitation. But domestic epidemiology of infection in SCI is rarely reported, especially in tertiary rehabilitation center.

Subjects & Methods

We conducted retrospective chart review of 161 patients with cervical or thoracic SCI who admitted or transferred from other departments to our rehabilitation center from January 2015 to September 2016. Based on the presence or absence of increased C-reactive protein(CRP) patients were divided into two groups : uninfected group(115 patients) and infected group(46 patients). Demographic characteristics, and clinical characteristics were analyzed to identify factors influencing the presence or absence of infection. And we investigated whether rehabilitation is restricted or not during infection period.

Results

There was no statistically significant differences between two groups in sex, age, level of injury, cause of injury, duration of morbidity etc. But, in infected group, proportion of severe SCI was more and length of stay in our center was longer than uninfected group.(Table 1.) In Infected group, there were 79 events of infection and 18 patients experienced infection, repeatedly. Recurrent infection is significantly more in cervical SCI.(figure 1) Initial increasing in CRP was 9.83 ± 6.29 mg/dL(mean \pm SD). and initial increasing in body temperature was 37.64 ± 0.75 °C. Average days when rehabilitation was

not carried out due to infection was 1.16 ± 2.99 days. UTI was most common followed by lower respiratory tract (pneumonia etc.). (Figure 2.)

Conclusion

In our pilot study, there was no case of death due to infection. Infection was more common in severe SCI and they stayed longer in our rehabilitation center. It seems that infection caused rehabilitation blank for about one or two days. And patients with cervical SCI have more risk of recurrent infection. To evaluate other association factors and influences related to infection, further study is needed.

Table 1. Demographic characteristics

	Uninfected group (115)	Infected group (46)
Sex (n)	M:74 F:41	M:34 F:12
Age (years)	57.04 ± 14.94	59.19 ± 14.44
BMI (Kg/m^2)	23.14 ± 4.12	22.45 ± 3.80
Height (meter)	1.64 ± 0.89	1.63 ± 0.89
Level of Injury	C:67 T:47	C:23 T:23
ASIA impairment scale	A:11 B:2 C:28 D:75	A:16 B:2 C:10 D:18*
Duration of morbidity (days)	705.51 ± 1790.66	1035.78 ± 2434.57
Length of stay in rehabilitation center (days)	53.21 ± 34.79	$81.06 \pm 65.02^*$
History of Trauma (n)	61	24

ASIA, American Spinal Injury Association; *, P-value < 0.05

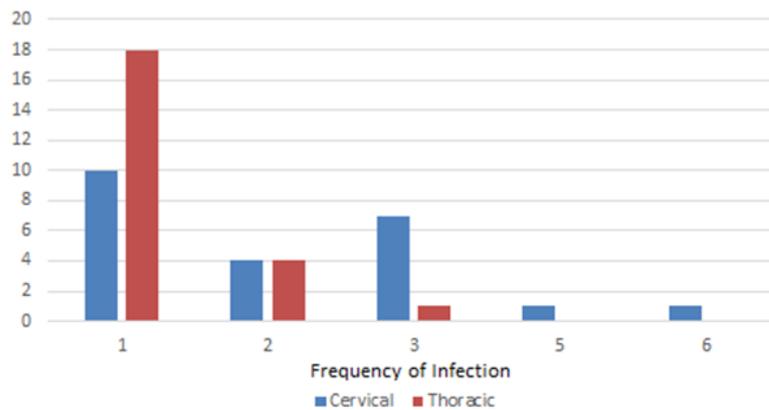


fig1. Distribution of patients with recurrent infection

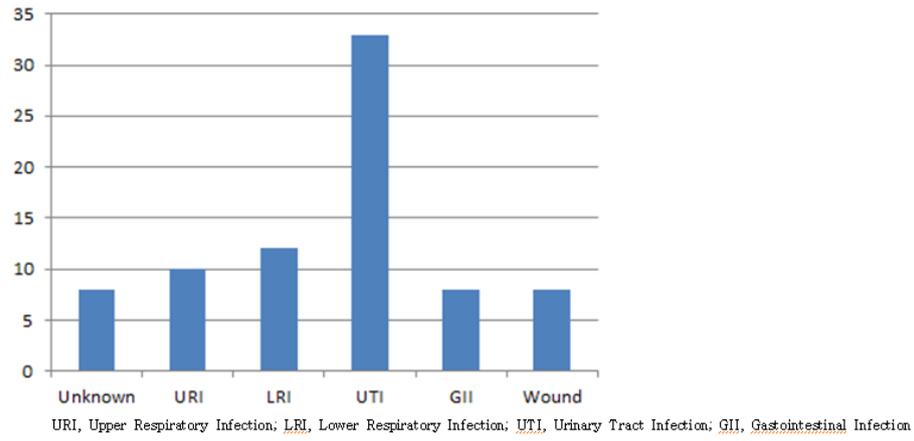


fig2. Distribution of patients according to infected system

척수재활

발표일시 및 장소 : 10 월 26 일(금) 14:45-14:55 Room D(5F)

OP3-2-4

Effects of Combined Upper Limb Robotic Therapy in Patients with Cervical Spinal Cord Injury

Joo Hwan Jung^{1*}, Hye Jin Lee^{1†}, Duk Youn Cho², Jung Eun Lim²

National Rehabilitation Center and Hospital, Department of Rehabilitation Medicine¹,
National Rehabilitation Center and Hospital, Department of Rehabilitation & Assistive
Technology²

Background

Therapy using robotics is more accurate and repetitive than conventional therapy and is expected to be effective in improving neuroplasticity in patients with spinal cord injury (SCI). Studies on the application of upper limb rehabilitation robot to tetraplegic patients with SCI is very lacking, especially on combined upper limb robotic therapy which simultaneously applies not only proximal but also distal upper limb.

Objective

To confirm the effects of combined upper limb robotic therapy (RT) in comparison with conventional occupational therapy (OT) in patients with cervical SCI. And based on these, to suggest treatment guidelines of combined upper limb RT in patients with cervical SCI for optimizing the effects.

Methods

Forty-three individuals with cervical SCI were enrolled and screened for eligibility. Participants were divided randomly into the RT (experimental) group and OT (control) group. The intervention included combined upper limb RT using Armeo power and Amadeo in the RT group or conventional OT in the OT group by experienced therapist in addition of daily inpatient rehabilitation program. The side of upper limb with lower manual muscle test (MMT) scores was chosen as the therapy side. Participants undergone 3 sessions of intervention per week, for 5 weeks, total 15 sessions. Before and after the intervention, we evaluated MMT scores of key muscles and grip strength as primary outcome measures, and Spinal Cord Independence Measurement III (SCIM-III), Graded and redefined assessment of strength, sensibility and prehension (GRASSP) as secondary outcome measures.

Results

After 5 weeks of intervention, both groups demonstrated improvements in strength and function of intervened upper limb measured by MMT, grip strength, SCIM-III and GRASSP compared to before intervention with different training effects. The RT group (n=17)

showed significant increases in MMT scores of elbow flexion/extension, 2-5th metacarpophalangeal extension and SCIM-III subscores of bathing-upper, dressing-upper, grooming which were not observable in the OT group (n=13). There was significant increase in GRASSP_Qualitative Prehension scores which were not significant in the OT group. There were no statistical differences between two groups in almost all measurements except for SCIM-III subscore of bathing-upper.

Conclusion

Combined upper limb RT demonstrated beneficial effects on upper limb motor and function in patients with cervical SCI which were comparable with conventional OT. It showed distinct training effects on proximal upper limb muscles that may lead to positive effects on activities of daily living and on distal fine motor. This Results may be helpful for selection of patients to treat with combined upper limb robotics.

척수재활

발표일시 및 장소 : 10 월 26 일(금) 14:55-15:05 Room D(5F)

OP3-2-5

Gait with Rewalk™ and KAFO in patient with SCI

Hae Young Kim^{1*}, Seung Hyun Kwon¹, Eun Joo Kim¹, Jung Ah Lee², Han Ram Pak³, Hyun Ki Kim³, Ho Jin Kim³, Wang Jae Lee³, Sung Pil Yang⁴, Tae Young Kim⁴, Ji Min Kim⁴, Hyun Ki Hwang⁴, Bum Suk Lee¹⁺, Bum Suk Lee¹⁺

National Rehabilitation Center, Department of Rehabilitation Medicine¹, National Rehabilitation Research Institute, Department of Clinical Research on Rehabilitation², National Rehabilitation Research Institute, Department of Rehabilitation & Assistive Technology³, National Rehabilitation Center, Department of Physical Medicine and Rehabilitation⁴

Background

Lower extremities orthoses prevents second complications of longterm use of a wheelchair and enable individuals with spinal cord injury(SCI) to ambulate overground and maintain standing position. In our countries, bilateral knee-ankle-foot orthoses(KAFO) are used for gait reconstruction in patients with paraplegia. A more recent technology for ambulation in individuals with SCI is powered exoskeletal devices that enable gait in individuals with SCI. However, although several systematic reviews of powered exoskeletons have recently been published in worldwide, there are no known domestic research that have examined the clinical effectiveness and safety of powered exoskeletons in spinal cord-injured patients. In the current study, we selected ReWalk™, the most commercialized exoskeletal robots, and compared with KAFO to suggest the clinical data about their ambulation training and its efficacy.

Method

The 7 patients with American Spinal Injury Association Impairment Scale(AIS)-A paraplegia was trained to walk over ground with KAFO and ReWalk™ exoskeleton. 5 subjects received gait training with KAFO for 1st 4 weeks and continued the exercise with ReWalk™ after KAFO training, and 2 patients received gait training with devices in reverse order. Between training with two devices, they had wash out time for 2 weeks. The walking distance, velocity, cadence were evaluated to assess how quickly each participant could walk, and the physiologic cost index(PCI), oxygen consumption(VO₂, VO₂max), heart rate, maximal heart rate, metabolic equivalents(METs), energy efficiency(EE) were evaluated to assess energy expenditure. Evaluation were performed 2 times at each intervention when after 2weeks(10 sessions) and after 4weeks(the time intervention finished). The usability of the orthoses was evaluated with questionnaires when training with each devices was finished. The questionnaires consisted of safety, efficacy, efficiency, and satisfaction of the orthoses based on International Organization for Standardization/International Electrotechnical Commission(ISO/IEC).

Result

The distance, velocity, cadence of walking with the ReWalk™ were not significantly different with those of walking with KAFO. The VO₂, HRmax, METs, EE in walking with the ReWalk™ were significantly higher than those with KAFO. The score of questionnaires for usability of orthoses was higher in KAFO than Rewalk™.

Conclusion

The powered exoskeletal device(ReWalk™) enabled the patient with paraplegia to walk with lower energy consumption. If we complement the ability to walk and usability of the powered exoskeletal device, it could be envisioned to be a good orthoses for gait reconstruction which has significant advantage of energy saving.

Table 1. The comparison of energy consumption between KAFO and Rewalk™ at 30minutes walking test

	KAFO(POST)	Rewalk(POST)	p
PCI	7.78 ± 3.89	5.08 ± 1.07	0.128
VO ₂ (ml/min/kg)	12.85 ± 2.65	9.31 ± 1.89	0.028*
VO ₂ max(ml/min/kg)	37.80 ± 26.17	24.50 ± 8.36	0.063
HR	140.56 ± 13.81	118.86 ± 15.19	0.028*
HR max	156.00 ± 18.51	131.57 ± 20.47	0.018*
METs	3.76 ± 0.58	2.66 ± 0.54	0.018*
EE(Kcal/min)	3.98 ± 0.96	2.98 ± 0.76	0.028*

(평균±표준편차), *p<0.05

Table 2. The comparison of usability between KAFO and Rewalk™ by 5-point Likert scale questionnaires.

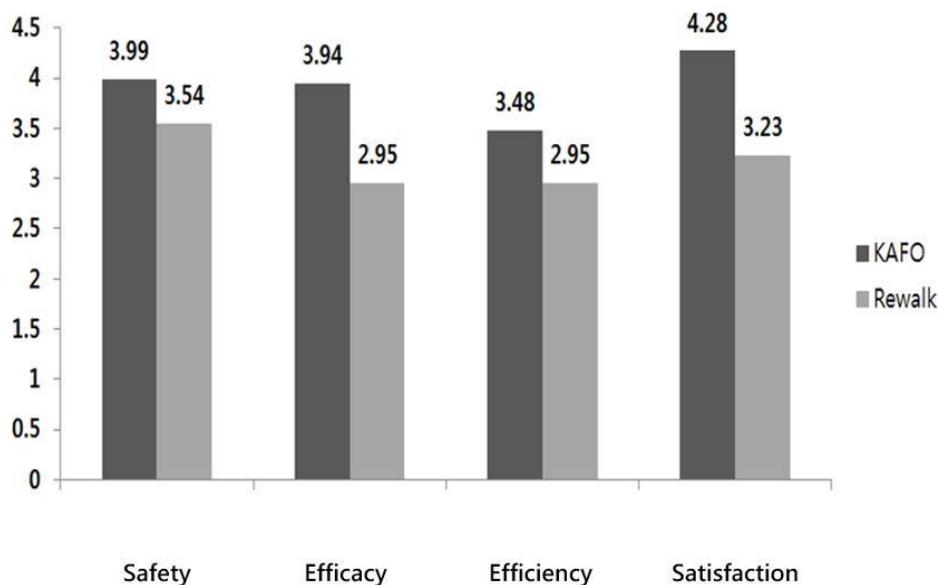




Fig 1. The patient walking over ground with KAFO and ReWalk™ for gait training

척수재활

발표일시 및 장소 : 10 월 26 일(금) 15:05-15:15 Room D(5F)

OP3-2-6

Is it appropriate to measure spine BMD in nonambulatory patients?

Hyehoon Choi^{1*}, Jaewan Yoo¹, Bomi Sul¹, Bo Young Hong¹, Seong Hoon Lim¹, Joon Sung Kim^{1†}

St. Vincent's Hospital, Department of Rehabilitation Medicine¹

Purpose

It is well known that bone loss occurs in nonambulatory patients. However, it is controversial whether bone mass loss of the vertebral column appears in nonambulatory patients. This study was designed to determine whether spine BMD measurements are appropriate by comparing spine BMD and other site BMD in nonambulatory patients.

Object and method

BMD was measured from 2014 to 2018 in 15 nonambulatory patients who visited the outpatient department of St. Vincent 's Hospital. There were 9 patients with SCI, 2 with polio, 2 with cerebral palsy, 1 with Charcot–Marie–Tooth disease, and 1 with meningocele. Since most of the participants were pre-menopausal women or men under 50 years of age, we analyzed using the Z-score.

Result

The mean of the spine BMD Z-score was 0.07. The mean Z-scores of the femoral neck, wards, and trochanter were -2.68, -2.01, and -2.91, respectively. Correlation analysis between SCI level and Z-score of spine BMD showed that Pearson correlation coefficient was -0.301 and p-value was 0.368. In case of femoral neck, ward, trochanter, there was a significant correlation between the femoral ward and the coefficient of 0.230 (p-value 0.497) 0.690 (p-value 0.019) and -0.052 (p-value 0.880). There was no significant correlation between duration of disease and BMD of spine/femur. Discussion In this study, the average of the spine BMD Z-score was in the normal range, while the mean Z-scores of all femur areas were below expected range for age. In 1988, there was a study of no BMD change in spine, and the reason for this was thought to be due to the fact that many SCI patients could be seated. Subsequent studies also suggested that BMD did not accurately reflect the state of spine due to degenerative changes in spine. To compensate for this, qCT can be used, but qCT is not recommended as routine test because of precision, radiation dose, and cost, etc. Therefore, it is recommended that BMD measurement be performed other than spine, and it is best to measure at distal femur according to Leslie R et al. The first limitation of this study is that the sample size is small. The sample size was too small to control the cofactor such as ASIA level and age. Second, we could not analyze whether the fracture risk of spine was actually low or because of the limit of the dual-energy x-ray absorptiometry.

Conclusion

In nonambulatory patients, BMD in spine is not useful because it does not adequately reflect the fracture risk. A follow-up study of why BMD is normal in spine should be done.

척수재활

발표일시 및 장소 : 10 월 26 일(금) 15:15-15:25 Room D(5F)

OP3-2-7

Safety of Urodynamic study for SCI patients with Asymptomatic pyuria or Bacteriuria

Seung Hyun Kwon^{1,1*}, Bum Suk Lee^{1,1†}, Hye Jin Lee^{1,1}, Zee A Han^{1,1}

National Rehabilitation Center and Hospital, Department of Rehabilitation Medicine¹

Purpose

1. Finding the percentage of incidental pyuria and bacteriuria in spinal cord injury patients 2. Assessing the impact of asymptomatic pyuria and bacteriuria on urinary tract infection after urodynamic studies in spinal cord injury patients when prophylactic antibiotics are administered.

Objectives & Methods

Patients were recruited from August 2015 to December 2016. A total 227 consecutive patients with spinal cord injury underwent urodynamic study during period were included in this study. UTI definitions ÿ Pyuria: ≥ 10 WBCs per HPF in urine microscopic examination ÿ Bacteriuria: $> 10^5$ CFU per ml in urine culture ÿ Symptomatic UTI : Pyuria + newly developed (fever or urethral pus discharge) All patients received urinalysis and urine culture in admission. Urinalysis and urine culture was done within 12 hours before urodynamic study. We use ciprofloxacin for First line Prophylactic antibiotics. Cefaclor was used for second line if previous urine culture in admission showed resistance to ciprofloxacin or when patients have contraindication for using ciprofloxacin. Prophylactic antibiotics was administered orally for 5 days after sampling urine. Twenty four hours after urodynamic study, urine microscopic examination and urine culture was done. We designed the criteria to define symptomatic UTI based on urine microscopic examination. Symptomatic UTI was defined as presence of pyuria with newly developed fever or urethral pus discharge. Fisher's exact test was used to compare the incidence of symptomatic UTI after urodynamic study. The level of statistical significance was defined as $p < 0.05$

Results

Of total 227 urine samples before urodynamic studies, pyuria was detected in 99 samples (44%), bacteriuria was detected in 159 samples (70%) . Symptomatic UTI was observed after urodynamic study in 5 patients. All 5 patients had a fever. 3(3.03%) of 99 patients had pyuria and 2 (1.56%) of 128 patients did not before urodynamic study present symptomatic UTI. There was no statistical difference ($P=0.431$) between two groups. 3(1.88%) of 159 patients had bacteriuria and 2(2.94%) of 68 patients did not before

urodynamic study present symptomatic UTI. There was also no statistical difference (P=0.212) between two groups.

Conclusion

Asymptomatic pyuria(44%) and bacteriuria(70%) was observed in many spinal cord injury patients. With oral prophylactic antibiotics, there was no significant difference of incidence of symptomatic UTI after urodynamic study between the patients who had pyuria or bacteriuria and patient did not. these Results suggest that Asymptomatic Pyuria and Bacteria do not increase UTI risk after UDS if prophylactic antibiotics are used.

Table 1. Comparison of general characteristics between Pyuria (n=99) and No-pyuria groups (n=128)

Variable	Pyuria(n=99)	No Pyuria(n=128)	Total
AGE	49.8+-15.17	47.1+-13.45	48.2+-15.17
Gender			
Male	58 (58.5)	96 (75)	154 (67.8)
Female	41 (41.5)	32 (25)	73 (32.2)
Neurological level			
Tetraplegia	46 (46.4)	62 (48.4)	108 (47.5)
Paraplegia	53 (53.6)	66 (51.6)	119 (52.5)
AIS			
A	33 (33.3)	38 (29.6)	71 (31.2)
B	14 (14.1)	17 (13.2)	31 (13.6)
C	16 (16.1)	23 (17.9)	39 (17.1)
D	36 (36.3)	50 (39.0)	86 (37.8)

Table 2. Incidence of symptomatic Urinary Tract Infection after UDS

		After UDS		P-value
		Symptomatic UTI	no UTI	
Before UDS	no Pyuria (n=128)	2	126	0.455
	Pyuria (n=99)	3	96	
	no Bacteriuria (n=68)	2	66	0.620
	Bacteriuria (n=159)	3	156	

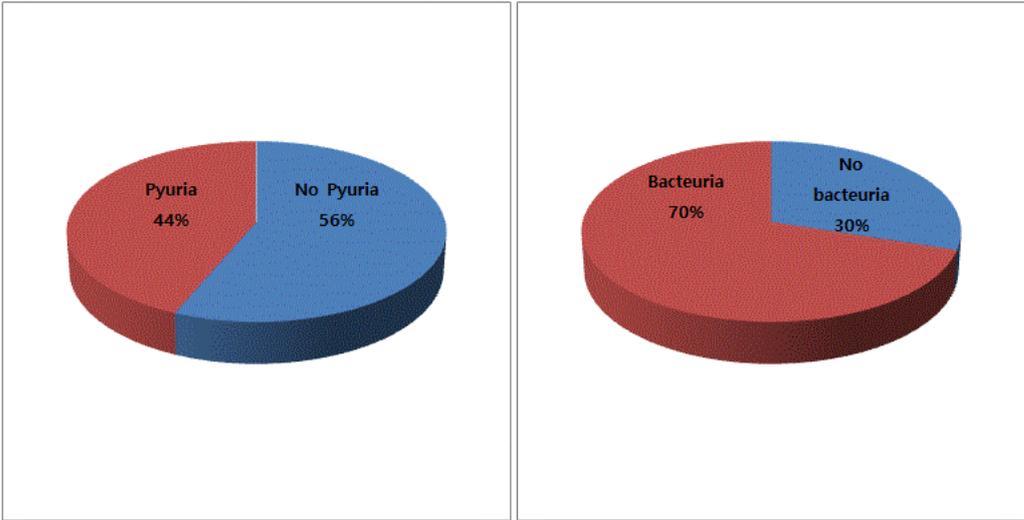


fig 1. Incidence of pyuria and bacteriuria in SCI patients.

척수재활

발표일시 및 장소 : 10 월 26 일(금) 15:25-15:35 Room D(5F)

OP3-2-8

Target Recovery Priorities of Patients with Spinal Cord Injury

So Jung Kim^{1*}, Sungchul Huh¹, Myung Hoon Moon¹, Hyun-Yoon Ko^{1†}

Pusan National University Yangsan Hospital, Department of Rehabilitation Medicine¹

Introduction

It is estimated that there are more than 64,000 individuals with a spinal cord injury (SCI) in Korea and increasing by about 2000 people every year. Healthcare for these individuals creates a significant economic burden for the society as well as the individuals or their family, not to mention the physical, psychological, and social suffering of these people. Regaining partial function and social support can lead greater independence and improvement of their quality of life. To ascertain what health and life domain are the most important to the SCI population in regard to enhancing quality of life, this survey was performed in which subjects were asked to rank each domains as an importance for their quality of life after SCI.

Methods

The survey questionnaire (Table 1) was designed to determine which areas of functional recovery and life domain were the most important to be achieved for the patient with SCI. We handed out the questionnaire to the responders either paraplegics or tetraplegics in inpatients and outpatients.

Results

A total number of 41 patients with SCI were recruited. To assess the target recovery priorities of patients with SCI, the responders were grouped into either tetraplegics or paraplegics. Twenty-five individuals were tetraplegics and 16 individuals were paraplegics. We have calculated the frequencies of their target functional recovery domain and life domain questionnaire. Figure 1 represents the areas of functional recovery ranked as the highest priority to tetraplegics and paraplegics. Figure 1A showed the first priority of tetraplegics and paraplegics, which were the arm/hand function (36%) for tetraplegics, while improvement of bladder and bowel function (56%) for paraplegics. Figure 1B showed the second highest priority of tetraplegics and paraplegics. It was an arm/hand function (32%) for the tetraplegics, and regaining walking movement (31%) and elimination of chronic pain and spasticity (31%) for the paraplegics. Figure 2 showed life domain priorities. The first priority for the tetraplegics and paraplegics were psychological health (36% and 16%). Income policy/financial matters were also the first priority for the paraplegics (16%) (Fig 2A). Secondary priority for the tetraplegics was friends/family relationships (40%) and psychological health (20%) for the paraplegics.

Conclusion

There were significant variations in health priorities but similar tendency in life domain priorities of patients with SCI. In order to improve the relevance of research in this area, the concerns of the SCI population must be better known and taken into account. This will provide basic data for the development of rehabilitation programs that can positively affect the quality of life of individuals with SCI.

Table 1. Survey questionnaire

1. What gain of function would dramatically improve your life?

Rank the following functional recovery in order of importance to you, 1 being most important and being least important:

A-1) Arm/hand function

B-1) Upper body/trunk strength and balance

C-1) Bladder/bowel function

D-1) Elimination of dysreflexia

E-1) Elimination of chronic pain and spasticity

F-1) Walking movement

G-1) Sexual function

H-1) Normal sensation

2. What is the importance things of life domains on your life?

Rank the following life domains in order of importance to you, 1 being most important and 8 being least important:

A-2) Psychological health

B-2) Friends/family relationships

C-2) Participating in community

D-2) Self-esteem

E-2) Employment issues

F-2) Income policy/financial matters

G-2) Communicating

H-2) Leisure/recreation

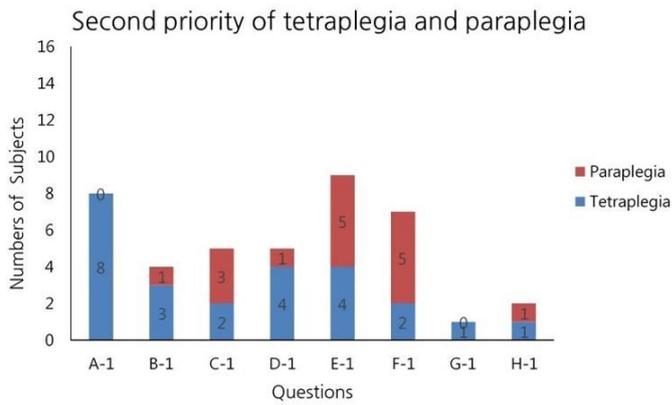
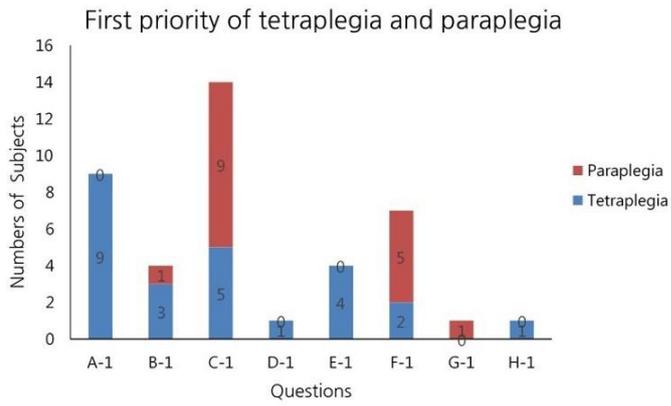


Figure 1. A representation of the areas of functional recovery ranked as the highest priority to quadriplegics (A) and paraplegics (B).

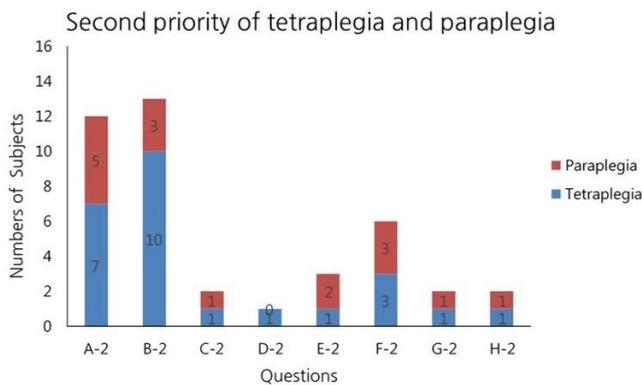
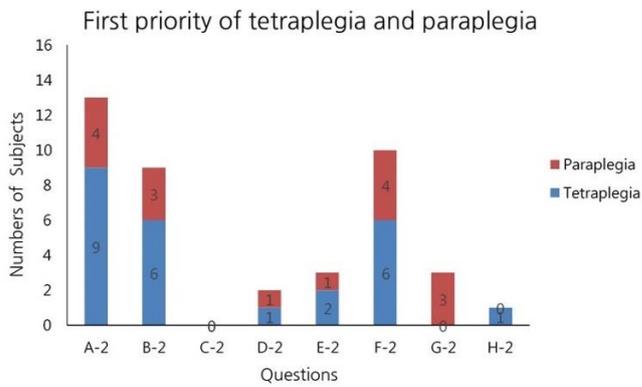


Figure 2. A representation of the areas of life domains ranked as the highest priority to quadriplegics (A) and paraplegics (B).

척수재활

발표일시 및 장소 : 10 월 26 일(금) 15:35-15:45 Room D(5F)

OP3-2-9

The Epidemiologic Study of Spinal Cord Injury Etiology and Complications in Northwest Gyeonggi-do

Jeehyun Yoo^{1†}, Kil-Byung Lim¹, Hong-Jae Lee¹, Jiyong Kim¹, Joongmo Kang^{1*}

Inje University Ilsan Paik Hospital, Department of Physical Medicine and Rehabilitation¹

Objective

Spinal cord injury (SCI) is a devastating condition resulting in high incidence of morbidity and disability. A study from the United States showed increased incidence of SCI in older patients associated with an increase in falls. Northwest Gyeonggi-do has a certain characteristics of mixed rural and urban population. The purpose of this study was to evaluate epidemiological patterns in age, etiology, and complications of SCI patients in this area.

Methods

Medical records of 289 SCI patients who were admitted to the department of Physical Medicine and Rehabilitation from January 2012 to June 2018 were reviewed. Unlike most studies where “falls” category includes fall off and trip over events, we separated “fall off” and “trip over” into two independent traumatic etiology because we believed each carried different injury mechanisms, occurring in different population.

Results

A total of 268 SCI patients were included after exclusion criteria. 195(72.8%) patients were traumatic SCI, while 73(27.2%) were non-traumatic SCI. Tetraplegia outnumbered paraplegia by 158 to 110. The mean age was 54.4±17.6 years. This was notably higher compared to other recent epidemiologic SCI study data in the country. Non-traumatic SCI was 61.1±14.9 years old, while traumatic SCI was 51.9±17.9 years old. Besides, SCI occurred predominantly in male, and this was significantly more evident in traumatic SCI (84.1%), when compared to non-traumatic SCI (56.2%). In traumatic SCI, the most common etiology was fall off (34.4%), followed by motor vehicle crash (28.2%) and trip over (23.1%). Overall, traumatic SCI patients from trip over (64.4±17.4 years) was significantly older than those from motor vehicle crash (p=0.001), motorcycle accidents (p=0.012), fall off (p=0.001), and diving injury (p=0.001) (Figure 1). Among the 45 tetraplegia caused by trip over, 38 presented with ossification of posterior longitudinal ligament. In non-traumatic SCI, tumor was the leading cause (32.9%). When comparing the distribution of American Spinal Injury Association Impairment Scale (AIS), AIS-D was the most common in both groups, but in traumatic SCI, AIS-A was the second most common, while in non-traumatic SCI, AIS-C followed thereafter (Table 1). When

evaluating the complications in elderly and non-elderly SCI, neuropathic pain was the most common in both groups, but urinary tract infection was significantly more common in age ≥ 65 compared to age < 65 (Table 2).

Conclusion

SCI patients in Northwest Gyeonggi-do was notable for its high mean age compared to other previous epidemiologic study in the country. In addition, the incidence of fall off was greater than motor vehicle crash. As we separated “fall off” and “trip over” into two categories, “trip over” was obviously the dominant etiology in the elderly. Among them, most of the tetraplegia were accompanied by degenerative changes of the spine. This suggests that elderly are at high risk of SCI from minor trauma.

Table 1. Characteristics & Complications in traumatic and non-traumatic spinal cord injury

Characteristics	Etiology		p-value
	Traumatic SCI	Non-traumatic SCI	
Male	164 (84.1)	41 (56.2)	<0.0001
Age (year) \pm SD	51.9 \pm 17.9	61.1 \pm 14.9	<0.0001
AIS			<0.0001
A	67 (34.4)	3 (4.1)	
B	9 (5.0)	1 (1.4)	
C	30 (15.4)	9 (12.3)	
D	89 (45.6)	60 (82.2)	
Total	195 (100)	73 (100)	
Complications	Traumatic SCI	Non-traumatic SCI	p-value
Pressure injury	59 (30.3)	8 (11.0)	<0.0001
UTI	54 (27.7)	13 (17.8)	0.107
Neuropathic pain	132 (67.7)	50 (68.5)	0.901
AH	13 (6.7)	0 (0)	0.024
HO	6 (3.1)	0 (0)	0.130

Values are presented as number (%) or mean \pm standard deviation.

Table 2. Characteristics & Complications in elderly and non-elderly spinal cord injury

Characteristics	Age		p-value
	Age <65	Age ≥65	
Male	139 (76.8)	42 (48.3)	0.001
Traumatic SCI	140 (77.3)	55 (63.2)	0.015
AIS			0.056
A	56 (30.9)	14 (16.1)	
B	6 (3.3)	4 (4.6)	
C	27 (14.9)	12 (13.8)	
D	92 (50.8)	57 (65.5)	
Total	181 (100)	87 (100)	
Complications	Age <65	Age ≥65	p-value
Pressure injury	44 (24.3)	23 (26.4)	0.706
UTI	42 (23.2)	25 (28.7)	0.005
Neuropathic pain	133 (73.5)	49 (56.3)	0.963
AH	8 (4.4)	5 (5.7)	0.636
HO	4 (2.2)	2 (2.3)	0.963

Values are presented as number (%).

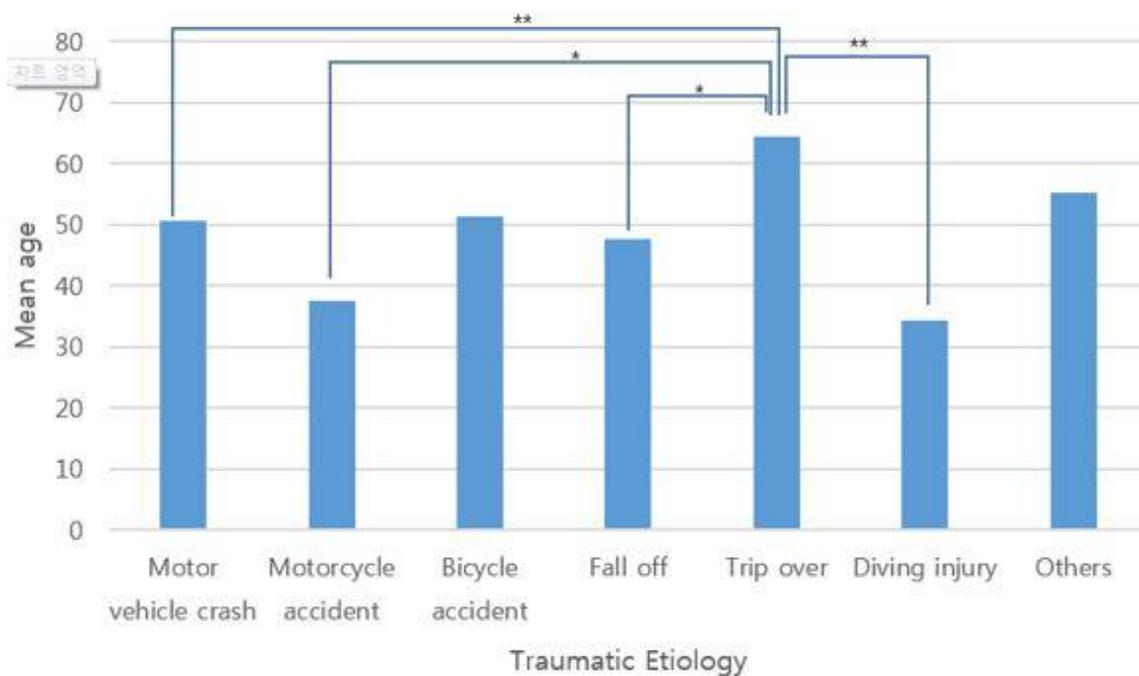


Figure 1. Difference of mean age in traumatic SCI etiology

ORAL PRESENTATION 3-3

심폐재활

발표일시 및 장소 : 10 월 27 일(토) 14:00-14:10 Room D(5F)

OP3-3-1

The Impact of Cardiac Rehabilitation on Clinical Outcomes following Acute Myocardial Infarction

Chul Kim^{1*†}, Jae-young Han², Sungju Jee³, Min Cheol Joo⁴, Ji Hee Kim⁴, Won-seok Kim⁵, Jong Hwa Lee⁶, Sook Joung Lee⁶, Eun Young Han⁷, So Young Lee⁷, Sora Baek⁸, Ae Ryoung Kim⁹, Heui Je Bang¹⁰, Goo Joo Lee¹⁰, Kyung Lim Joa¹¹

Inje University Sanggye Paik Hospital, Department of Rehabilitation Medicine¹, Chonnam National University Hospital, Department of Rehabilitation Medicine², Chungnam National University Hospital, Department of Rehabilitation Medicine³, Wonkwang University School of Medicine & Hospital, Department of Rehabilitation Medicine⁴, Seoul National University Bundang Hospital, Department of Rehabilitation Medicine⁵, Dong-A University Hospital, Department of Rehabilitation Medicine⁶, Jeju National University Hospital, Department of Rehabilitation Medicine⁷, Kangwon National University Hospital, Department of Rehabilitation Medicine⁸, Kyungpook National University Medical Center, Department of Rehabilitation Medicine⁹, Chungbuk National University Hospital, Department of Rehabilitation Medicine¹⁰, Inha University Hospital, Department of Rehabilitation Medicine¹¹

Introduction

It is believed that cardiac rehabilitation (CR) improves long term clinical outcomes in survivals after acute myocardial infarction (AMI). However, the prognostic effect of CR in the modern era of statins and acute revascularization remains unclear. Focusing on actual clinical practice, the purpose of this study was to observe the effect of contemporary CR program on clinical outcomes including mortality in survivals after AMI. This is the first multicenter study to determine the effect of CR on clinical outcomes in Korea.

Subjects and Methods

This study is a retrospective multicenter cohort study of 11 university hospitals including government initiative 10 regional cardio-cerebrovascular centers in South Korea. The rate of synchronization between medical claims data of Health Insurance Review and Assessment Service (HIRA) and the patients' electronic medical records (EMR) was 98% and the total of 7,136 matched patients were selected as final study subjects. 2,358 were CR users (35%) and 4,385 were non-users. Inclusion criteria were survivals following first ever AMI who received percutaneous coronary intervention and patient education for cardiovascular (CV) risk factor modification by CR staff before discharge. Patient entry ran from January 2012 to December 2015. Using HIRA medical claims data, primary and

secondary outcomes from 3 months after discharge to December 2016 were followed up. The primary outcome was all-cause mortality year one to four, and the secondary outcomes was major adverse cardiac event (MACE) including recurrence of AMI, CV or all-cause admission, and repeat revascularization at one to four years. We compared the rates of mortality and MACE using propensity-based matching paired 1,878 CR users with 1,878 nonusers using all observable risk factors.

Results

During the follow up periods, all-cause deaths occurred in 6.6 cases per 1,000 patients-year in CR users compared to 14 cases in nonusers. Repeat revascularizations were needed in 26.6 cases per 1,000 patients-year in CR users compared to 30.1 cases in nonusers (Table 1). By using Cox proportional hazard model, the risk of four year all-cause mortality decreased 59% in CR users compared to nonusers (HR=0.41, 95% CI 0.27-0.63) but the risks of four year MACE decreased by only 4% in CR users without statistical significance (HR=0.96, 95% CI 0.83-1.12) (Table 2). There was a dose–response relationship between the numbers of CR sessions and the risk of all-cause mortality (Figure 1).

Conclusion

Even though the rate of CR participation was low (35%), CR after AMI was associated with a substantial survival benefit up to four years in the modern era of AMI treatment. However, CR following AMI did not have a significant effect on the incidence of AMI recurrence, re-admission (CV and all cause), and repeat revascularization in this study. We need longer term prospective multicenter cohort study to verify the impact of CR on this secondary outcomes.

Table 1. MACE1 between CR users and nonusers after propensity score matching

	CR users (n=1,878)		Nonusers (n=1,878)		p-value
	Number (%)	per 1000-pys [†]	Number	per 1000-pys	
All-cause mortality	33 (1.8)	6.6	68 (3.6)	14.0	0.0004
AMI ²	269 (14.3)	59.4	249 (13.3)	56.5	0.3439
Revascularization	128 (6.8)	26.6	139 (7.4)	30.1	0.4849
CV ³ admission	323 (17.2)	72.4	299 (15.9)	68.8	0.2921
Other admission	555 (29.6)	133.0	538 (28.7)	134.9	0.5414
All MACE	343 (18.3)	76.7	338 (18.0)	77.4	0.8323

PYS[†]: person years

1. MACE: major adverse cardiac event, 2. AMI: acute myocardial infarction, 3. CV: cardiovascular

Table 2. Cox proportional hazard of MACE1 between CR users and nonusers after PS[†] matching

Outcome	Univariate		Multivariate*	
	HR ^{††}	95% CI	HR	95% CI
All-cause mortality	0.47	(0.31 - 0.72)**	0.41	(0.27 - 0.63)**
AMI ²	0.88	(0.69 - 1.12)	0.86	(0.68 - 1.1)
Revascularization	1.05	(0.88 - 1.25)	1.04	(0.88 - 1.24)
CV ³ admission	1.05	(0.9 - 1.23)	1.02	(0.87 - 1.2)
Other admission	0.98	(0.87 - 1.11)	0.96	(0.85 - 1.08)
All MACE	0.99	(0.85 - 1.15)	0.96	(0.83 - 1.12)

PS[†]: propensity score, HR^{††}: hazard ratio

1. MACE: major adverse cardiac event, 2. AMI: acute myocardial infarction, 3. CV: cardiovascular

* Sex, age, BMI, length of hospitalization, number of diseased vessel, left main lesion, left anterior descending lesion, residual stenosis (> 50%), left ventricular ejection fraction, etc.

** p<0.05

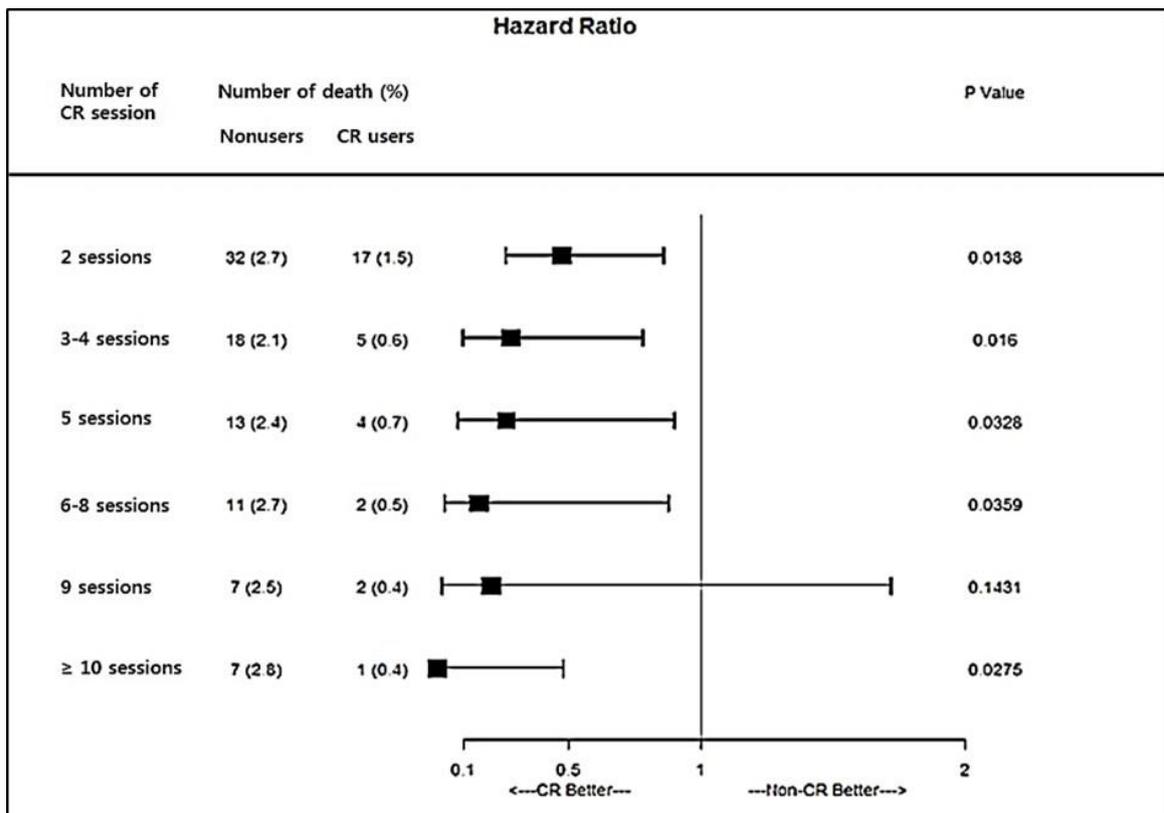


Figure 1. Subgroup analysis of hazard ratio for the effect of CR session number on mortality

신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 27 일(토) 14:10-14:20 Room D(5F)

OP3-3-2

Anatomical course and branching patterns of common peroneal nerve around knee

Goo Young Kim^{1*}, Dong Hwee Kim^{1†}, Da som Kim², Im Joo Rhyu²

Korea University College of Medicine , Department of Physical Medicine & Rehabilitation¹, Korea University, Department of Anatomy²

OBJECTIVES

Common peroneal nerve which is the smaller branch of the sciatic nerve travels along the medial side of the biceps femoris tendon and fibular head around the popliteal fossa. It gives off several banches in the popliteal fossa and then divides into terminal branches of superficial peroneal and deep peroneal nerves around fibular neck. The purpose of this study is to demonstrate the branching patterns of its cutaneous nerves including lateral sural cutaneous nerve and lateral cutaneous nerve of the calf, quantitative data of branches of the common peroneal nerve, and relative relationship between common peroneal nerve and fibular head.

SUBJECTS AND METHODS

Twenty-one lower legs from 12 fresh cadavers were dissected. We performed dissection from mid-thigh to ankle. We measured the distance from the tip of fibular head to the branching point of branches of common peroneal nerve including lateral sural cutaneous nerve, lateral cutaneous nerve of the calf, superficial peroneal nerve and deep peroneal nerve, and their thicknesses by a vernier caliper. Relative relationship between fibular head and common peroneal nerve at the mid-fibular head level was measured.

RESULTS

The median distance between fibular head and branching point of common peroneal nerve and lateral sural cutaneous nerve and lateral cutaneous nerve of the calf was 47.2mm (range: 11.0 ~ 85.0mm) and 20.6mm (range: -22.0 ~ 59.2mm) proximal to the fibular head, respectively. The median angle between common peroneal nerve and line parallel to tibial nerve at 5cm above the fibular head was 13.1 (range: 8.0 ~ 20.5mm). The median distance between the tip of fibular head and branching point of deep peroneal nerve and superficial peroneal nerve was 29.8mm distal to the fibular head. At the mid-fibular head level, common peroneal nerve ran across the fibular head in 16 cases and run posterior to the fibular head in 5 cases (Table 1). The median distance between common peroneal nerve and the anterior margin of mid-fibular head and the thickness of the mid-fibular head were 20.4mm (range: 14.9 ~ 24.5mm) and 24.0mm (range: 19.0 ~ 27.9mm), respectively. The branching patterns of lateral sural cutaneous nerve

demonstrated that type arising from lateral sural cutaneous nerve were most common (type 3, 10 cases) followed by type arising from medial margin of common peroneal nerve (type 2, 6 cases) and type from the lateral margin of common peroneal nerve (type 1, 3 cases) (Table 2).

Conclusion

There were various branching patterns of cutaneous nerves of common peroneal nerves around the popliteal fossa, especially lateral cutaneous nerve of the calf, which would be related with mononeuropathy of lateral cutaneous nerve of the calf although it is rare. Anatomical correlation (across type) between fibular head and common peroneal nerve at the mid-fibular head level could be related with development of common peroneal neuropathy because of stretching or compression on the fibular head.

Table 1. Anatomical Parameter of Common Peroneal Nerve Course at the Mid-fibular Head

	Cross type (16 legs)			Posterior type (5 legs)		
	MAX	MIN	Median	MAX	MIN	Median
CPN_Mid FH anterior margin (mm)	24.5	14.9	20.4	27.9	19.0	23.6

Cross: CPN run across the fibular head, Post: CPN run posterior to the fibular head

Abbreviation: CPN_Mid FH anterior margin, distance between middle fibular head (anterior margin) and common peroneal nerve

Table 2. Branching Patterns of Lateral Cutaneous Nerve of the Calf (LCNC)

Type 1	The LCNC arising from lateral margin of common peroneal nerve	3 cases
Type 2	The LCNC arising from medial margin of common peroneal nerve	6 cases
Type 3	The LCNC arising from lateral sural cutaneous nerve	10 cases
Type 4	Two LCNC arising from common peroneal nerve and lateral sural cutaneous nerve, respectively	1 case

Table 3. Anatomical parameter of common peroneal nerve thickness at multiple sites

	A. Cross (16 legs)			B. Post (5 legs)		
	MAX	MIN	Median	MAX	MIN	Median
CPN thickness_mid BFS (mm)	14.0	6.2	9.5	12.0	4.6	9.1
CPN thickness_PF (mm)	14.2	6.0	9.5	12.0	8.8	10.2
CPN thickness_FH+7cm (mm)	9.0	3.0	5.3	7.6	4.0	5.2
CPN thickness_FH+5cm (mm)	10.4	2.8	5.2	7.9	4.8	6.4
CPN thickness_FH+2cm (mm)	6.4	4.3	5.4	6.5	3.0	5.0
CPN thickness_FH (mm)	7.8	4.2	6.1	10.2	3.8	6.6
CPN thickness_mid FH (mm)	8.0	5.0	6.6	9.8	4.8	7.2
CPN thickness_FN (mm)	10.0	6.8	8.7	11.2	5.8	8.6

Cross: CPN run across the fibular head, Post: CPN run posterior to the fibular head

Abbreviation: CPN thickness_mid BFS, common peroneal nerve thickness at the mid biceps femoris short head muscle; PF, popliteal fossa (upper margin); FH+7cm, 7cm proximal to the fibular head; FN, fibular neck

Table 4. Classification of variations of lateral cutaneous nerve of the calf (LCN)

Type 1	The LCN arises from lateral margin of common peroneal nerve	3 cases
Type 2	The LCN arises from medial margin of common peroneal nerve	5 cases
Type 3	The LCN arises from sural nerve	5 cases
Type 4	The complex of LCN and sural nerve arise from common peroneal nerve and divided	2 cases
Type 5	The LCN arises from common peroneal nerve and branch off lateral sural cutaneous nerve	2 cases
Type 6	The LCN and sural nerves arise from common peroneal nerve, simultaneously	1 case
Type 7	Two LCN arises from common peroneal nerve and sural nerve	1 case

신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 27 일(토) 14:20-14:30 Room D(5F)

OP3-3-3

Early detection of diabetic neuropathy using paired stimulation studies of the sensory nerves

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Korea University Anam Hospital, Department of Rehabilitation Medicine¹

Introduction.

The relative refractory period (RRP) is known as a sensitive parameter for detecting early subtle changes in peripheral polyneuropathies. This study seeks to use the RRP as an aid for early detection of diabetic polyneuropathy (DPN) patients.

Methods.

Routine nerve conduction studies were performed, and the RRP of the median and sural sensory nerves were measured in 63 diabetic patients and 22 healthy control subjects. The shortest inter-stimulus interval, where the latency of the response to the second stimulus recovers to normal, was defined as the RRP (Figure 1). The severity of DPN was rated as 1 (suspected), 2 (probable), and 3 (definite) according to electrophysiologic parameters. Clinical symptoms and signs of DPN were also assessed using the Neuropathy Symptoms Score (NSC) and the Neuropathy Impairment Score (NIS).

Results.

The RRP of the median and sural nerves were significantly longer in diabetic patients (3.6 ± 0.6 msec and 3.8 ± 0.8 ms, respectively) than in the control group (2.9 ± 0.3 msec and 3.0 ± 0.4 ms, respectively). RRP values of both nerves (3.6 ± 0.6 msec and 3.6 ± 0.6 ms, respectively) were also significantly prolonged than the control group, even in diabetic patients without DPN based on conventional conduction studies (Table 1). Additionally, the RRP of the sural nerve was found to be positively correlated ($r=0.427$, $p=0.001$) with the severity of the DPN (Figure 2), and also with the NIS ($r=0.292$, $p=0.022$).

Conclusions.

The RRP, in contrast to the control group, was prolonged in diabetic patients even before other electrophysiologic abnormalities appeared. The RRP of the sural nerve delays even further as the electrophysiologic and clinical severity of the DPN increases. Our Results suggest that the RRP can be a possible early indicator of DPN.

Table 1. The Relative Refractory Periods of the Median and Sural Nerves in Each Group

	Control	DM	DM without DPN
Median nerve	2.9 ± 0.3	3.6 ± 0.6 *	3.6 ± 0.6 *
Sural nerve	3.0 ± 0.4	3.8 ± 0.8 *	3.6 ± 0.6 *

Abbreviations: RRP, relative refractory period (msec); DM, diabetes mellitus; DPN, diabetic polyneuropathy

Data are mean ± standard deviation.

* P < 0.05 compared to control group.

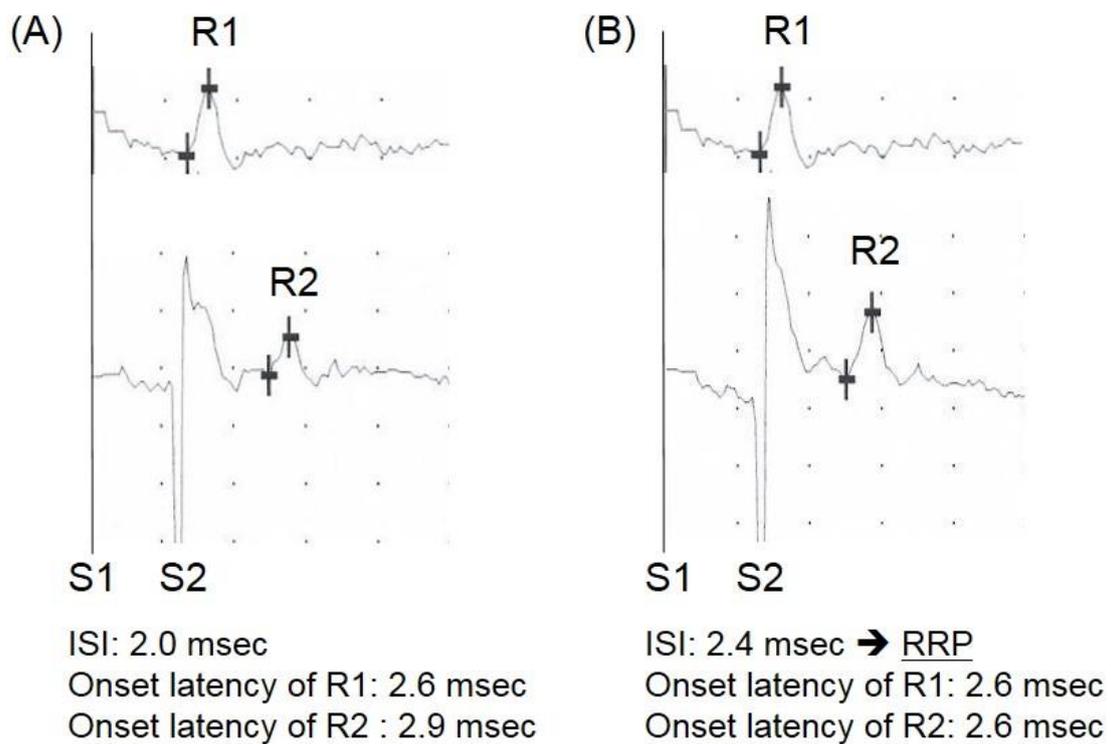


Figure 1. Method of measuring the relative refractory period (RRP). The RRP is defined as the shortest inter-stimulus interval (ISI, S2-S1) where the onset latency of R2 equals that of R1, depicted in (B).

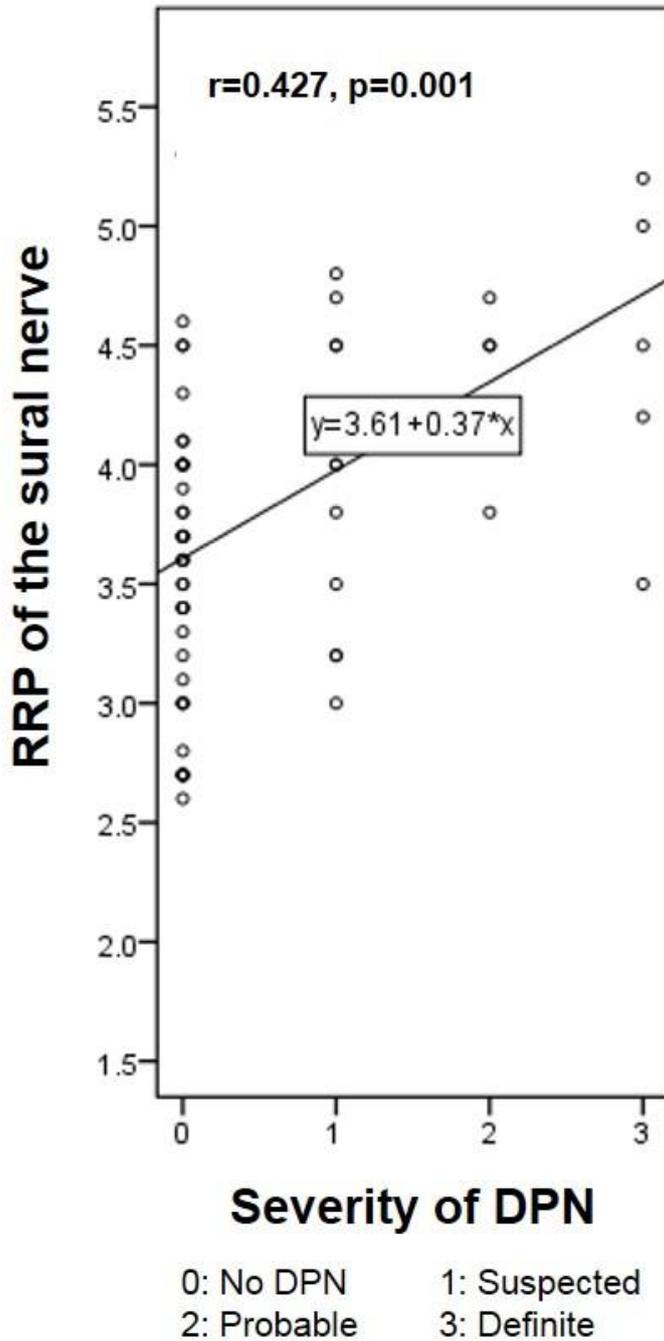


Figure 2. Scatter plot and Spearman's correlation coefficient (r) of severity of DPN versus RRP of the sural nerve. RRP, relative refractory period; DPN, diabetic polyneuropathy.

신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 27 일(토) 14:30-14:40 Room D(5F)

OP3-3-4

Effects of Traction on Lumbar Bone Mineral Density in Patients Duchenne Muscular Dystrophy

Da Hwi Jung¹, Ra Yu Yun¹, Mikyung Choi¹, Keunyoung Kim², Yun Kyung Jeon³, Jinmi Kim⁴, Sang Hun Kim MDa¹, Myung Jun Shin¹, Yong Beom Shin¹, Je-Sang Lee^{1*†}

Pusan National University School of Medicine and Biomedical Research Institute, Pusan National University Hospital, Department of Rehabilitation Medicine¹, Pusan National University Hospital, Department of Nuclear Medicine and Biomedical Research Institute², Pusan National University Hospital, Pusan National University School of Medicine, Division of Endocrinology, Department of Internal Medicine³, Department of Biostatistics, Clinical Trial Center, Biomedical Research Institute, Pusan National University Hospital⁴

Introduction

We compared the performance of dual-energy X-ray absorptiometry (DXA) and quantitative computed tomography (QCT) in evaluating the bone mineral density (BMD) of patients with Duchenne muscular dystrophy (DMD) and scoliosis. Here, we propose a new measurement method and diagnostic criteria that are more accurate than current options.

Methods

This study included 29 patients with DMD (mean age 19.72 ± 6.13 years) (Table 1). Participants underwent whole spine radiograph and DXA before and after traction (to render distance between shoulder and its ipsilateral anterior-superior iliac spine equal in all imaging tests). They underwent QCT only without traction. The scoliosis and vertebral rotation angles obtained before and after traction were compared, and the BMD values obtained by DXA were compared to those obtained by QCT, known to be unaffected by the effects of spinal deformity, to analyze the association among these parameters. The scoliosis angle was presented as Cobb's angle. In addition to the degree of curvature for each patient, the Cobb's angle of L1 to L4, which is used for bone density analysis in DXA, was also measured.

Results

The Cobb's angle significantly decreased from $30.38 \pm 24.83^\circ$ before to $22.78 \pm 20.41^\circ$ after traction ($p < .0001$), and Z-score from -1.88 ± 1.59 to -2.86 ± 2.16 ($p < .0001$) (Table 2). Changes in rotation angle, BMD, and bone mineral content were not significant. Post-traction BMD values and Z-scores showed a higher correlation with QCT measurements than pre-traction. We also found that the pre- and post-traction Z-scores (≤ -1.1 and -1.36 , respectively) used in the DXA measurements as cut-off values for the diagnosis of

osteoporosis were more accurate in identifying patients with osteoporosis according to QCT scans compared with the pre-existing Z-score of -2 or less (Table 3).

Conclusion

Lumbar BMD measured by DXA in patients with DMD and scoliosis allowed a more accurate diagnosis of osteoporosis when traction was applied.

Table 1. Clinical data of the participants

		No. of patients
Walking ability	Possible	1 (3%)
	Impossible	28 (97%)
History of steroid use	Yes	7 (24%)
	No	22 (76%)
Lower limb fracture history	Yes	9 (31%)
	No	20 (69%)
Vertebral fracture history	Yes	0 (0%)
	No	29 (100%)

Values are presented as numbers (%).

Table 2. Comparison of pre-traction and post-traction variables

		Pre-traction	Post-traction	p-value	
Scoliosis	Cobb's angle (°)	30.38 ± 24.83	22.78 ± 20.41	<.0001*	
	L1 to L4 Cobb's angle (°)	16.99 ± 13.23	10.58 ± 9.93	<.0001*	
Vertebral rotation	Nash-Moe Classification	L1	2.03 ± 1.43	1.97 ± 1.35	0.424
		L2	1.86 ± 1.33	1.86 ± 1.33	1.000
		L3	1.62 ± 1.35	1.59 ± 1.18	0.712
		L4	1.31 ± 1.39	1.28 ± 1.28	0.712
		L5	1.10 ± 8.75	1.03 ± 1.30	0.646
	Axial vertebral rotation angle	L1	18.13 ± 13.21	19.10 ± 14.13	0.874
		L2	18.58 ± 13.04	21.31 ± 15.26	0.110
		L3	17.65 ± 12.67	20.21 ± 14.24	2.212
		L4	15.81 ± 14.54	17.03 ± 13.91	0.745
DXA values (n = 29)	Mean aBMD (g/cm ²)	0.86 ± 0.23	0.82 ± 0.24	0.050	
	Mean BMC (g)	11.46 ± 4.37	11.05 ± 4.17	0.164	
	Z-score	-1.88 ± 1.59	-2.86 ± 2.16	<.0001*	
QCT values (n = 26)	Mean vBMD (mg/cm ³)	101.18 ± 29.72	-	-	
	Z-score	-3.15 ± 1.10	-	-	

Values are presented as a mean ± standard deviation.

aBMD, areal bone mineral density; BMC, bone mineral content; DXA, dual-energy X-ray absorptiometry; QCT, quantitative computed tomography; vBMD, volumetric bone mineral density.

Table 3. Optimal cutoff point of the Z-score measured with pre-traction and post-traction DXA to predict an abnormal QCT finding using the Youden index

	AUC	95% CI	Optimal cutoff point	Sensitivity	95% CI	Specificity	95% CI
Pre-traction Z-score	0.875	0.682 to 0.972	≤ -1.10	70.00	45.7 to 88.1	100.00	47.8 to 100.0
Post-traction Z-score	0.910	0.726 to 0.987	≤ -1.37	80.00	56.3 to 94.3	100.00	47.8 to 100.0

The optimal cutoff point was defined as the maximum point of the Youden function, which is the difference between the true-positive rate and false-positive rate among all possible cutoff point values.

AUC, area under the curve; CI, confidence interval; DXA, dual-energy X-ray absorptiometry.

신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 27 일(토) 14:40-14:50 Room D(5F)

OP3-3-5

Sonographic assessment of carpal tunnel syndrome: A comparison between non-DPN and DPN

Joon Shik Yoon¹⁺, Chung Ho Lee¹, Jun Ho Choi^{1*}

Korea University Guro Hospital, Department of Rehabilitation Medicine¹

Introduction

Nerve conduction studies are specific for diagnosis of diabetic neuropathy (DPN) or carpal tunnel syndrome (CTS). Recently, the diagnostic accuracy of high-resolution ultrasound has been greatly improved, helping to visualize the anatomic details of the peripheral nerves. Previous studies with ultrasonography have shown that there is no significant difference in the cross-sectional area (CSA) of the median nerve in patients with DPN and CTS compared to that of the patients with CTS alone. However, there are no previous study that compared the CSA of the median nerve according to the severity of CTS. The purpose of this study was to compare the CSA of the median nerve in patients with CTS alone and patients with both DPN and CTS according the severity of CTS.

Method

This study was a prospective study and was performed in healthy controls and patients with clinical symptoms and physical examination suspected of CTS. Ultrasonography was performed on the upper extremities of the controls and the patients. Other than diabetes, patients with another conditions that may cause peripheral neuropathy were excluded, and those with damage due to neck trauma or surgery were excluded as well. DPN is diagnosed according to the criteria modified from The Diabetes Control and Complications Trial. CTS was diagnosed by the modified Steven's criteria. In patients with DPN, CTS was diagnosed according to the criteria of the previous study. The severity of CTS in patients with CTS alone and patients with CTS and DPN was determined using Steven's classification. Ultrasonography was performed on the wrist in neutral position. The CSA of the median nerve was measured at the maximal swelling site in the distal wrist crease.

Results

The CSA values of median nerve at the wrist in healthy control, CTS alone, and CTS and DPN were 8.32 ± 1.16 , 14.96 ± 7.07 , 16.80 ± 3.47 (Table 1) respectively. In patients with CTS alone, the CSA values of median nerve at the wrist were 11.18 ± 3.00 , 16.43 ± 5.32 , and 18.10 ± 9.50 , respectively, according to the severity. In patients with CTS and DPN, the CSA values of median nerve at the wrist were 12.21 ± 0.45 , 16.01 ± 1.93 , and 19.91 ± 2.16 , respectively, according to the severity. The CSA values of the median nerve at the

wrist showed no significant difference in any severity between the patients with CTS alone and the patients with CTS and DPN (Table 2).

Conclusion

In this study, the CSAs of the median nerve were significantly larger in the CTS patients with or without DPN compared with those of the healthy controls. There was no significant difference between the CSAs of the median nerve of the patients with CTS alone and those of the patients with CTS and DPN. Therefore, the effect of swelling of median nerve by compression in CTS is thought to be greater than the swelling effect of DPN.

Table 1. Median nerve CSA at the wrist

	Normal(n,30)	CTS(n,28)	CTS and DPN(n,10)
Median nerve CSA (mm ²)	8.32 ± 1.16 ^{ab}	14.96 ± 7.07 ^a	16.80 ± 3.47 ^b

^aP, ^bP < 0.01

Table 2. Median nerve CSA at the wrist according the severity of the carpal tunnel syndrome

Median nerve CSA (mm ²)	CTS(n, 28)	CTS and DPN(n,10)	p-value
CTS, mild	11.18±3.00 (11)	12.21±0.45 (2)	0.641
CTS, moderate	16.43±5.32 (7)	16.01±1.93 (4)	0.788
CTS, severe	18.10±9.50 (10)	19.91±2.16 (4)	0.539

신경근육재활 및 전기진단

발표일시 및 장소 : 10 월 27 일(토) 14:50-15:00 Room D(5F)

OP3-3-6

Ultrasound Evaluation of Facial Nerve Diameter for Predicting Prognosis in Bell's Palsy Patients

Jae Joon Lee^{1*}, Hee-Sang Kim^{1†}, Jong Ha Lee¹, Seung Don Yoo², Dong Hwan Yun¹, Dong Hwan Kim², Jinmann Chon¹, Seung Ah Lee², Yun Soo Soh¹, Yong Kim¹, Young Rok Han²

Kyung Hee University Medical Center, Department of Rehabilitation Medicine¹, Kyung Hee University Hospital at Gangdong, Department of Rehabilitation Medicine²

Objective

Prognosis for Bell's palsy is good, but the proportion of patients with poor outcomes may reach 30%. Its exact etiology and pathogenesis are not well understood but one of the postulated theories is that the nerve gets entrapped and compressed in its bony canal as a result of epineural edema. Ultrasound (US) may provide a tool to assess the anatomical aspects of the nerve, complementary to the functional aspects assessed by electrodiagnostic studies. The aim of this study was to evaluate the prognostic role of neuromuscular ultrasound in Bell's palsy.

Method

A total of 45 patients (53.76±16.68 years) with acute onset of Bell's palsy were included in the study. We measured the bilateral diameter of the distal facial (VII) nerve using US, inside the parotid gland after its exit from the stylomastoid foramen, along with calculation of side to side differences in each patient. Direct facial nerve conduction studies (VII NCS) recording supramaximal compound muscle action potentials of 4 facial muscles (frontalis, orbicularis oculi, nasalis and orbicularis oris) were determined bilaterally and the percent amplitude reduction was calculated by comparing the affected side with the healthy side. If the percent amplitude reduction of any facial muscle satisfy the condition of more than 90% was assigned to the experimental group (i.e. unfavorable prognosis group), and the remainder to the control group (i.e. favorable prognosis group). Data from the experimental group consisting of bilateral facial nerve diameters and side to side differences were compared with the control group.

Results

There was no significant difference in mean facial nerve diameter at the healthy side between controls and experimental group (0.73±0.10 mm, 0.71±0.14 mm). Mean facial nerve diameter at the affected side was 0.80±0.11 mm in controls and 0.92±0.23 mm in the experimental group. Mean side-to-side differences in diameter was 0.08±0.11 mm in controls and 0.21±0.24 mm in the experimental group. In affected side, the facial nerve diameter was significantly larger in the experimental group than controls (p=0.036, 95%

CI=0.008~0.236), with a significant side-to-side difference in the experimental group as well ($p=0.017$, 95% CI=0.026~0.248).

Conclusion

The significant difference in facial nerve diameter and the side-to-side difference in diameter between the two groups denotes the ability of ultrasound to detect facial nerve enlargement which may be useful to predict prognosis in patients with Bell's palsy.

ORAL PRESENTATION 4-1

소아재활

발표일시 및 장소 : 10 월 27 일(토) 10:00-10:10 Room E(5F)

OP4-1-1

Efficacy of allogeneic cord blood cell with erythropoietin therapy in children with cerebral palsy

Kyunghoon Min^{1,2}, Kye Hee Cho^{1,2}, Sun Hee Lee¹, MinYoung Kim^{1,2**}

CHA Bundang Medical Center, CHA University School of Medicine, Department of Rehabilitation Medicine¹, CHA University, Rehabilitation and Regeneration Research Center²

Objectives

Stem cell therapy for cerebral palsy (CP) has been investigated for more than 10 years as an alternative therapeutic modality seeking cure for brain pathology which cannot be approached via conventional therapies including rehabilitation. As public interests for cell therapy increase, experimental researches continue to find ideal cell therapy which is yet proven to be effective in general. Umbilical cord blood (UCB) is considered as a safe source of cell therapy. Although autologous UCB would be ideal for this purpose, many children with CP do not have their own UCB banked which makes the allogeneic UCB an alternative for clinical application. In a previous study, CP children treated with allogeneic UCB and erythropoietin (EPO) showed higher improvements in motor and cognitive aspects. In addition, UCB alone provided enhancement in motor function with the evidence of immunomodulation. This 2 x 2 study aimed to measure the synergistic effects of UCB and EPO in children with CP.

Materials and Methods

The inclusion criteria were as follows: 1) a diagnosis of CP, 2) age between 10 months and 6 years, 3) appropriate UCB units, 4) written informed consents from parents. Participants were randomly assigned to four groups: UCB+EPO, UCB, EPO, and control groups. Brain MRI and FDG-PET scan were reassessed one year after the procedure. Allogeneic UCB units matching at least four of six human leukocyte antigen (HLA) types A, B, and DRB1 were selected if total nucleated cells were more than or equal to 3×10^7 cells/kg. A single infusion of UCB or placebo UCB was delivered intravenously. The UCB+EPO and UCB groups received oral cyclosporine. All participants in the UCB+EPO and the EPO groups received EPO six times every three other days at a dose of 500 IU/kg. For a double-blind trial, placebo materials of UCB, EPO, and cyclosporine were used. Once enrolled, all participants were followed up for at least 12 months to monitor any adverse events. Primary outcomes are changes of Gross Motor Function Measure (GMFM), Gross Motor Performance Measure (GMPM), Bayley Scales of

Infant Development II (BSID-II) mental and motor raw scales. Those outcomes were assessed 5 times at baseline, 1, 3, 6 and 12 months post-intervention. Any adverse events had been monitored for 12 months.

Results

There were no differences of age of participation, gestational age, and baseline motor and mental scales among four groups (Table 1). UCB+EPO group showed significant improvements in post-therapy GMFM at 1 month ($p=0.034$) and 12 months ($p=0.037$) (Fig. 1). In safety, ten serious adverse events were reported, all of which were resolved without group difference. Regarding HLA disparity, more HLA-matched UCB presented better improvement of post-therapy GMFM at 1 month ($p=0.036$) and 3 months ($p=0.050$) (Fig. 2).

Conclusion

These Results suggest that UCB therapy combined with EPO is feasible and effective for motor improvement in children with CP.

Table 1. Values are numbers unless otherwise noted. All baseline characteristics did not show differences between the three groups ($p>.05$ for all comparisons). aUCB+EPO group ($n=22$) received UCB and EPO. bUCB group ($n=24$) received UCB and placebo EPO. cEPO group ($n=20$) received placebo UCB and EPO. dControl group ($n=22$) received placebo UCB and placebo EPO. All groups received conventional rehabilitation during the trial. eCorrected age for preterm birth. fNBW was defined as birth body weight $\geq 2,500g$, LBW $< 2,500g$, VLBW $< 1,500g$, and ELBW $< 1,000g$. gTypology was divided as following: SB, SU, D, C, and A. Abbreviations: UCB, umbilical cord blood; EPO: erythropoietin; NBW, normal birth weight; LBW, low birth weight; VLBW, very low birth weight; ELBW, extremely low birth weight; SB, spastic bilateral; SU, spastic unilateral; D, dystonic; C, choreoathetoid; A, ataxic; PVL, periventricular leukomalacia

Table 1. Demographic and baseline characteristics (n=92)				
Group	UCB+EPO ^a (n=22)	UCB ^b (n=24)	EPO ^c (n=20)	Control ^d (n=22)
Demography				
Sex, no. % male	10 (45.5%)	11 (45.8%)	10 (50.0%)	15 (68.2%)
Age, year ^d ; mean (SD; range)	3.0 (1.2; 1.5-6.3)	2.9 (1.3; 1.0-5.0)	3.4 (1.3; 1.1-5.8)	3.0 (1.1; 1.2-6.0)
Gestational age, weeks; mean (SD; range)	32.3 (4.8; 26-41)	31.9 (3.9; 26-40)	31.9 (4.3; 26-40)	33.6 (5.4; 24-42)
Preterm, no. (%)	16 (72.7%)	16 (72.7%)	16 (72.7%)	13 (59.1%)
Birth weight (SD; range), kg	1.9 (0.8; 0.6 - 3.6)	1.9 (0.8; 0.8 - 3.4)	1.9 (0.8; 0.7 - 3.5)	2.2 (0.9; 0.7-4.2)
NBW / LBW / VLBW / ELBW ^e	6 / 7 / 8 / 1	5 / 10 / 7 / 2	5 / 8 / 5 / 2	10 / 7 / 3 / 2
GMFCS ³⁵ (I / II / III / IV / V)	1 / 2 / 5 / 6 / 8	2 / 2 / 5 / 3 / 12	1 / 6 / 3 / 7 / 3	0 / 1 / 5 / 10 / 6
Typology ^{1f} (SB / SU / D / C / A)	18 / 0 / 3 / 0 / 1	20 / 0 / 4 / 0 / 0	15 / 0 / 4 / 0 / 1	17 / 0 / 4 / 0 / 1
MRI findings³⁴				
Acquired lesions				
PVL with other areas of injury	17	20	14	15
Diffuse encephalopathy	4	4	5	5
Focal ischemic/hemorrhagic	0	0	0	1
Multicystic encephalomalacia	1	0	0	1
Malformations				
Abnormality of myelination or white matter signal	0	0	1	0

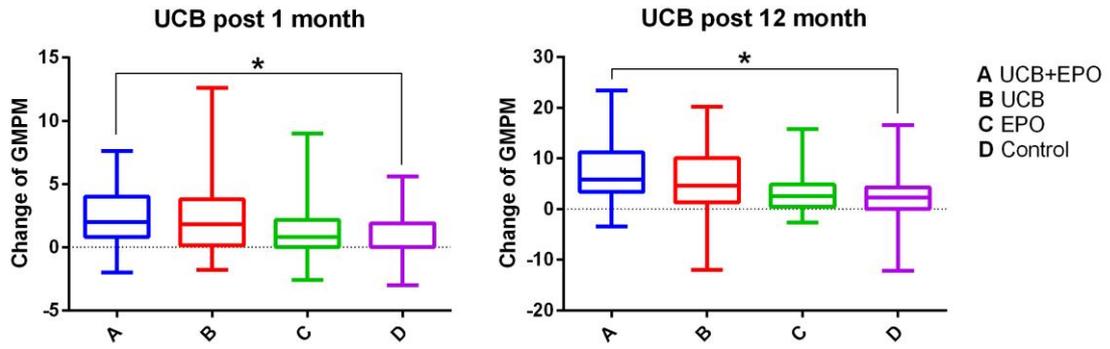


Fig. 1. Change of GMFM between groups the change of GMFM scores from baseline showed significant difference between UCB+EPO and Control group at post-UCB 1 month and 12 month. * $P < 0.05$, based on Kruskal Wallis test, post-hoc analysis

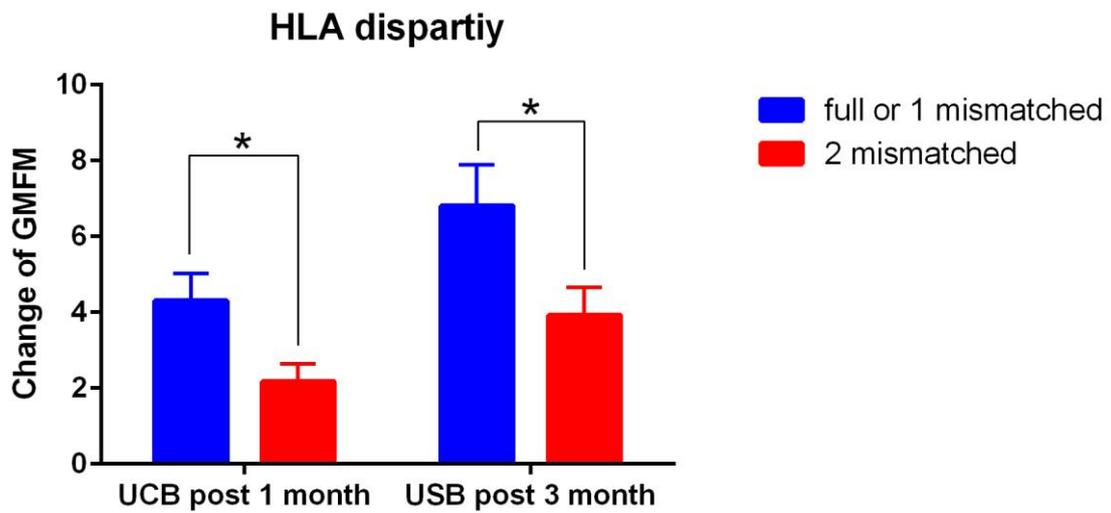


Fig. 2. Change of GMFM in UCB+EPO group based on HLA disparity the change of GMFM scores from baseline was significantly greater in full matched or 1 mismatched group than 2 mismatched group in UCB+EPO group. * $P < 0.05$, based on Mann-Whitney U-test

소아재활

발표일시 및 장소 : 10 월 27 일(토) 10:10-10:20 Room E(5F)

OP4-1-2

Factors associated with unaffected foot deformity in hemiplegic cerebral palsy

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Objectives

The aim of this study is to (1) assess the foot angular components of affected foot associated with valgus deformity of unaffected foot and to (2) re-define the actual leg-length inequality in hemiplegic cerebral palsy (CP).

Methods

We retrospectively reviewed the medical record and radiologic images of 110 hemiplegic cerebral palsies. The inclusion criteria were: 1) hemiplegic CP without upper motor neuron sign of unaffected side; 2) who can walk independently without walking aid. Exclusion criteria were: 1) age <5 years at the time of evaluation; 2) who had botulinum toxin injection within 6 months; 3) who had surgical treatment of either limb. Weight bearing plain radiography of bilateral foot was obtained from each subject. Angular measurement focused on collapse of the longitudinal arch, hind foot valgus, forefoot abduction. Valgus deformity of unaffected side was defined if the anteroposterior talocalcaneal angle (TCA) excess 30 degrees or lateral TCA excess 45 degrees. Leg length discrepancy (LLD) and pelvic tilting angle was measured.

Results

Among 76 patients, 40 (52%) patients had valgus deformity of unaffected side. There were no significant differences of age, affected side, deformity type of affected side, and application of bilateral biomechanical foot orthosis (BFO) between patients with or without valgus deformity of unaffected side. (Table 1) Numbers of patients incapable of voluntary ankle extension above neutral at affected side, LLD and lateral TCA were significantly increased in patients with valgus deformity. (Table 1,2,3) Lateral foot alignment angles focused on collapse of the longitudinal arch and hind foot valgus were significantly correlated between both feet. (Table 4) The optimal cutoff point of to predict valgus deformity was LLD over 10 mm or affected limb/unaffected limb length index below 0.98. (Table 5)(Figure 1) Discussion The factors inducing the coping mechanism of uninvolved foot is still not defined. In addition to several studies focused on gait analysis using kinematic features of uninvolved limb, all information available on both views in making assessment of foot alignment is necessary. Only effect of amount of correction by heel lift on gait symmetry cannot predict the progress of unaffected foot

deformity. Among various foot alignment angles, only hind foot valgus angle of affected side was associated with valgum deformity of unaffected foot. In addition, as children with hemiplegia can develop a leg length discrepancy that becomes more significant as they grow, cut off values of limb length discrepancy should be important index to predict valgus deformity of unaffected foot.

Conclusion

This was the first study focused on angular assessment associated with valgum deformity of unaffected foot in hemiplegia CP. Clinicians should also pay close attention to the unaffected foot deformity by overall associated factors including foot deformity of affected side and bilateral limb length ratio.

Table 2. Leg length asymmetry associated with valgus deformity of unaffected foot

Variables		With valgus deformity (N= 40)	Without valgus deformity (N= 36)	Total (N= 76)	<i>p</i> -value
Clinical LLD (%)	Yes	2 (5.56)	0 (0.00)	2 (2.63)	0.221
	No	40 (94.44)	34 (100)	74 (97.37)	
LLD (mean (SD))		1.67 (7.99)	3.63 (7.42)	52 (68.42) 24 (31.58)	0.024*
Pelvic tilting (mm) (mean (sd))		29 (72.50)	14 (38.89)	43 (56.58)	0.051

N, Number; SD, Standard Deviation; LLD, Leg length discrepancy

**p* < 0.05

Table 3. Foot alignment of affected side associated with valgus deformity of unaffected foot

Variables	With valgus deformity (N= 40)	Without valgus deformity (N= 36)	Total (N= 76)	<i>p</i> -value
TMA <u>Lat</u> (degrees), (mean (SD))	14.77 (11.42)	11.52 (7.25)	13.23 (9.75)	0.148
Calcaneal Pitch (degrees), (mean (SD))	14.1 (5.61)	11.96 (5.29)	13.08 (5.53)	0.092
TNA (degrees), (mean (SD))	16.61 (9.64)	12.56 (8.78)	14.67 (9.40)	0.062
TMA AP (degrees), (mean (SD))	13.29 (9.06)	10.13 (9.29)	11.77 (9.24)	0.141
TCA AP (degrees), (mean (SD))	26.66 (8.76)	23.45 (7.30)	25.12 (8.20)	0.091
TCA <u>Lat</u> (degrees), (mean (SD))	46.33 (8.63)	38.26 (11.03)	42.51 (10.58)	0.001*

N, Number; SD, Standard Deviation; TMA Lat, Lat 1st metatarsal talar angle; TNA, Talonavicular coverage angle; TMA AP, 1st metatarsal talar angle at anteroposterior view; TCA AP, Talocalcaneal angle at anteroposterior view; TCA Lat, Talocalcaneal angle at lateral view

**p* < 0.05

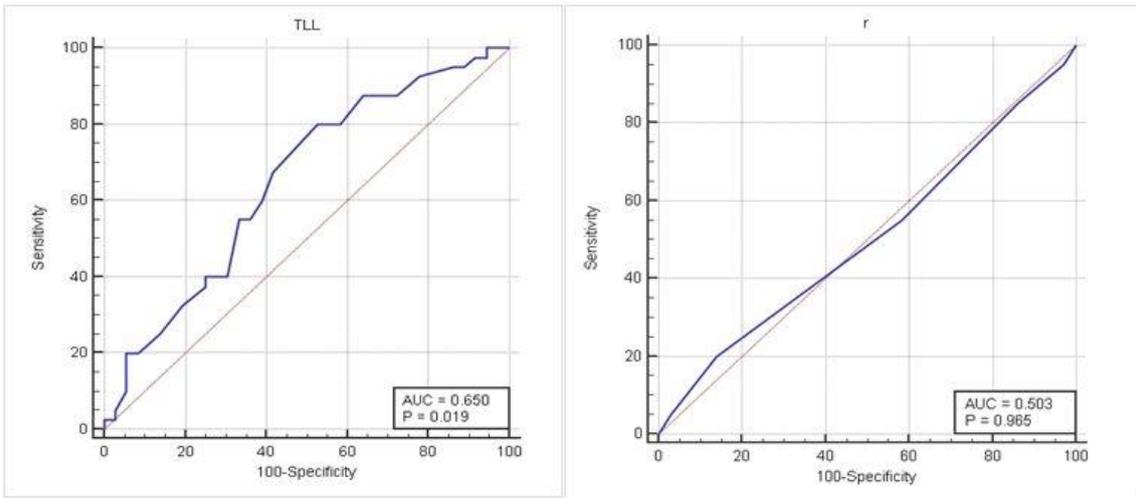


Figure 1. AUC of the ROC curve of LLD and affected/unaffected limb length index to predict valgus deformity of unaffected foot.

소아재활

발표일시 및 장소 : 10 월 27 일(토) 10:20-10:30 Room E(5F)

OP4-1-3

Growth Parameters as Mortality Risk Factors in Cerebral Palsy

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OBJECTIVE

Subjects with birth weight <1000 g have the highest risk of failure to thrive (FTT), and mortality in general population (GP) and cerebral palsy (CP). However, for children with birth weight <1000 g, a higher percentage of those children will inevitably have FTT, as their birth weight is at such a low point. Birth weight and FTT are not truly independent variables based on the current definition of failure to thrive. A more accurate approach would be to determine criteria based on the rate of weight gain over time. The objective of this study was to analyze growth parameters as mortality risk factors in CP.

METHODS

This was a birth cohort study based on the National Health Screening Program for Infants and Children database, which screens growth and development of children. The birth cohort consisted of 2 191 956 subjects, representing 93.5% of live births from 2007–2011, with a 10-year follow-up. CP subjects were identified and growth parameters in terms of birth weight, FTT, the rate of weight gain, and death were collected. We analyzed the mortality rate for subjects who were alive one year after birth.

RESULTS

Prevalence of CP was 2.0 per 1000 live births. All-cause mortality rate for subjects who were alive one year after birth was 0.6 deaths per 1000 live births in GP and 20.8 deaths per 1000 live births in CP during the 10-year follow-up period, indicating that the mortality rate was 35 times higher after the age of 1 year in CP subjects. When compared to GP, CP subjects had 10 times more subjects with birth weight \leq 2500 g, 8.98 times more FTT, significantly lower follow-up body weight and rate of body weight gain. Among three growth parameters, FTT was the only parameter showing significantly higher mortality rate ($P < .001$).

CONCLUSIONS

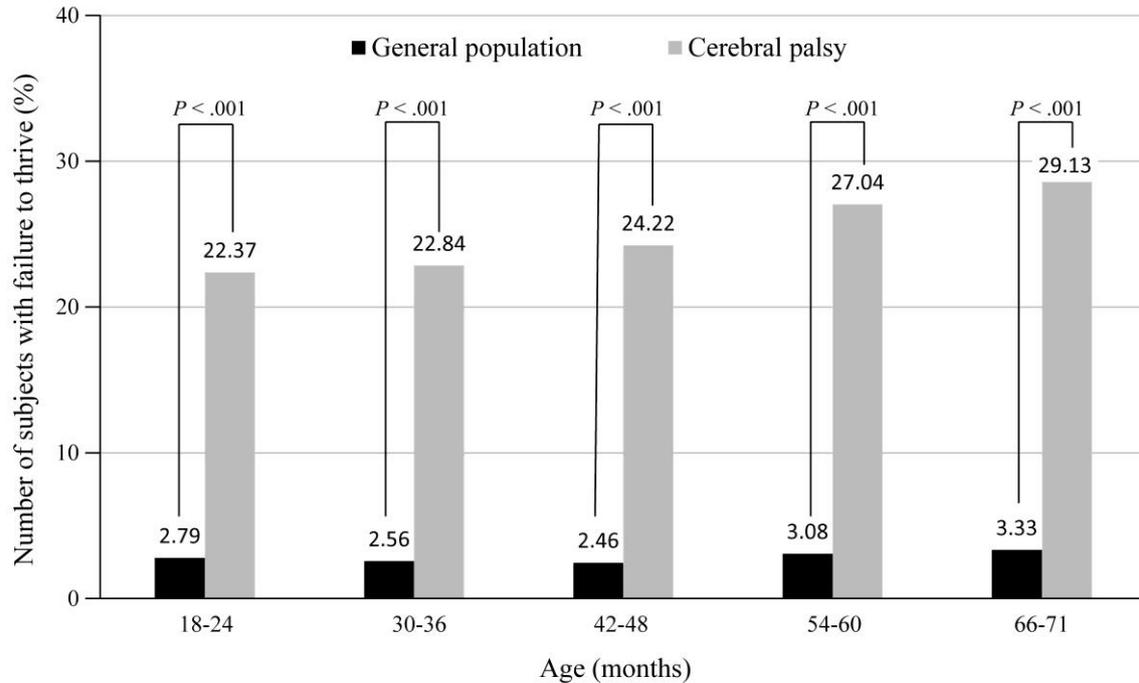
In a nationwide birth cohort, we found a CP prevalence rate of 2.0 per 1000 live births. CP subjects had 35 times more deaths after the age of 1 year compared to the GP. FTT was the strongest mortality risk factor in subjects with CP. This is the first study on growth and mortality rate which simultaneously followed up both the GP and CP subjects.

Comparison of All-Cause Mortality^a After the Age of 1 Year for 10 Years of Follow-Up Period

Gender	Subjects in General Population			Subjects With Cerebral Palsy		
	Number of Live Births	Number of Deaths	All-Cause Mortality	Number of Live Births	Number of Deaths	All-Cause Mortality
Boys	1 125 964	826	0.73	2540	40	15.75
Girls	1 060 481	588	0.55	1836	51	27.78
Total	2 186 445	1414	0.65	4376	91	20.80

^aAll-cause Mortality = number of deaths/number of live births X 10³.

Comparison of All-Cause Mortality After the Age of 1 Year for 10 Years of Follow-Up Period.



Comparison of failure to thrive.

Adjusted Hazard Ratio of Death After the Age of 1 Year by the Age of the Subjects at the Time of NHSCI Screening

Age at the NHSC Program (months)	18-24		30-36		42-48		54-60		66-71	
Number of Subjects	1 373 845		1 449 871		1 395 656		1 039 985		701 520	
Variables	Hazard Ratio (95% CI)	P								
Presence of cerebral palsy										
No	1.00		1.00		1.00		1.00		1.00	
Yes	11.74 (6.62-20.82)	<.001	11.30 (5.93-21.53)	<.001	15.38 (8.44-28.04)	<.001	17.96 (9.10-35.47)	<.001	24.52 (9.85-61.05)	<.001
Gender										
Boy	1.00		1.00		1.00		1.00		1.00	
Girl	0.71 (0.60-0.83)	<.001	0.71 (0.59-0.86)	<.001	0.60 (0.48-0.76)	<.001	0.59 (0.44-0.80)	<.001	0.55 (0.37-0.84)	.01
Birth weight (g)										
≥2500	1.00		1.00		1.00		1.00		1.00	
<1000	2.55 (0.96-6.74)	.06	2.25 (0.76-6.66)	.15	0.90 (0.21-3.92)	.89	0.52 (0.07-3.99)	.53	NA	NA
1001-2499	1.18 (0.96-6.74)	.33	1.38 (0.97-1.97)	.08	1.22 (0.79-1.86)	.37	0.99 (0.56-1.73)	.96	0.75 (0.31-1.81)	.52
Presence of failure to thrive										
No	1.00		1.00		1.00		1.00		1.00	
Yes	2.79 (2.06-3.79)	<.001	3.41 (2.33-4.98)	<.001	4.58 (3.00-7.00)	<.001	4.82 (2.96-7.83)	.00	3.33 (1.67-6.62)	<.001
Rate of body weight gain (percentile)										
>75 th	1.00		1.00		1.00		1.00		1.00	
≤25 th	1.08 (0.86-1.36)	.49	0.92 (0.69-1.22)	.55	0.94 (0.67-1.33)	.73	0.81 (0.54-1.22)	.31	1.24 (0.69-2.23)	.48
26-50 th	0.92 (0.73-1.15)	.46	1.07 (0.82-1.39)	.61	1.05 (0.76-1.45)	.76	0.73 (0.49-1.08)	.12	0.91 (0.50-1.66)	.76
51-75 th	1.02 (0.82-1.27)	.86	0.99 (0.76-1.29)	.93	0.94 (0.68-1.31)	.73	0.51 (0.33-0.79)	.00	0.85 (0.46-1.55)	.59

CI, confidence interval; NA, not applicable; NHSC, National Health Screening Program for Infants and Children.

Adjusted Hazard Ratio of Death After the Age of 1 Year by the Age of the Subjects at the Time of NHSCI Screening.

소아재활

발표일시 및 장소 : 10 월 27 일(토) 10:30-10:40 Room E(5F)

OP4-1-4

Quantitative assessment of associated reactions in the children with spastic cerebral palsy

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Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine¹, Seoul Rehabilitation Hospital, Department of Rehabilitation Medicine², Gangnam Severance Hospital, Yonsei University College of Medicine, Department of Rehabilitation Medicine³

Objectives

To quantify the associated reaction (AR) of upper limb and its impact on upper arm function in children with cerebral palsy (CP).

Participants and Methods

On thirty five children with CP (unilateral CP:21, bilateral CP:14) were recruited for this study. Their mean age (SD) was 9.6 years (3.7 years). Manual ability Classification system (MACS), Upper Limb Physician's Rating Scale (ULPRS), Modified House functional classification scale (MHFCS), Melbourne Assessment 2 (MA-2) and also the AR of upper limb while performing three tasks (of 1) opening and clenching of the fist, 2) finger opposition to thumb, 3) tapping with four fingers excluding the thumb) with the other hand, was quantified. The AR was scored into 0 to 4 (0; no clear imitative movement to 4; movement equal to that expected for intended hand). In addition, the surface electromyography (SEMG) were used to assess the root mean square (RMS) values of firing muscular activity on shoulder abductor, elbow flexor, elbow extensor and wrist and finger flexor and wrist extensor while performing the three tasks. The RMS ratio was calculated as the ratio between the RMS values of firing muscular activities and of baseline activities.

Results

The AR was observed in 57% of subjects. The presence of AR was significantly different between tasks. The frequency was higher while performing finger opposition, compared to opening and clenching fist or to finger tapping. The AR was more frequently observed in low functioning group in manual ability (MACS III to V) than in high functioning group. The scores of MA-2, ULPRS and MHFCS were significantly higher in children without AR than children with AR ($p < 0.05$). The RMS ratio was significantly higher in children with AR than children without AR ($p < 0.05$). The total scores of AR were significantly related with RMS ratio ($\rho = 0.476$, $p < 0.05$).

Conclusion

Over half of the children with CP demonstrated the AR. The clinical AR scores were significantly related with RMS ratio of surface EMG. In addition, this study revealed the significant adverse effect of AR on upper limb function.

Table 1. Characteristics of participants

Characteristics	Participants (n=35)
Age (year)	9.6±3.7
Gender (M/F)	21 (60) / 14 (40)
CP type (unilateral/bilateral)	21 (60) / 14 (40)
GMFCS	
I	8 (22.9)
II	13 (37.1)
III	8 (22.9)
IV	5 (14.3)
V	1 (2.9)
MACS	
I	7 (20.0)
II	15 (42.9)
III	8 (22.9)
IV	5 (14.3)
V	0 (0.0)

Values are presented as number (%) or mean±standard deviation.
CP, Cerebral palsy; GMFCS, Gross Motor Function Classification System; MACS, Manual Ability Classification System.

Table 2. Comparison of associated reaction

	AR total score		p-value
	AR(+)	AR(-)	
GMFCS			
I~II	11 (55.0)	10 (66.7)	0.728
III~V	9 (45.0)	5 (33.3)	
MACS			
I~II	8 (40.0)	14 (93.3)	0.002**
III~V	12 (60.0)	1 (6.7)	
MHFCS	5.55±1.54	6.80±1.47	0.013*
MA2			
ROM	65.19±28.23	88.65±14.22	0.007**
Fluency	80.60±24.36	98.13±3.66	0.018*
Accuracy	61.54±31.50	87.58±16.22	0.007**
Dexterity	54.05±28.24	79.68±21.41	0.008**
Average	65.34±27.01	88.51±13.36	0.005**
ULPRS	38.15±6.71	44.67±4.24	0.002**

Values are presented as number (%) or mean±standard deviation. AR, Associated Reaction; GMFCS, Gross Motor Function Classification System; MACS, Manual Ability Classification System; MA2, Melbourne Assessment 2; ULPRS, Upper Limb Physician's Rating Scale; MHFCS, Modified House functional classification scale.

Table 3. Comparison of RMS ratios by associated reaction

	AR(+) (n=15)	AR(-) (n=12)	p-value
hand grip	6.94±2.18	5.43±0.95	0.011*
thumb opposition	6.44±1.14	6.60±2.15	0.239
finger tapping	5.93±1.64	5.06±0.62	0.038*
Total tasks	6.44±1.11	5.70±0.77	0.030*

Values are presented as mean±standard deviation. AR, Association Reaction; RMS, root mean square; CP, cerebral palsy

소아재활

발표일시 및 장소 : 10 월 27 일(토) 10:40-10:50 Room E(5F)

OP4-1-5

The effect of digital rehabilitation system with wearable IMU sensors in children with brain injury

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Eulji University College of Medicine, Department of Physical and Rehabilitation Medicine¹, Seoul Rehabilitation Hospital, Department of Physical and Rehabilitation Medicine², Yonsei University College of Medicine, Department and Research Institute of Rehabilitation Medicine³

Purpose

This study investigated the effect of digital rehabilitation system with wearable multi-inertial measurement unit (IMU) sensors on upper limb functions in children with brain injury. Study design: A single blind randomized controlled trial, with an 8-weeks follow-up. Participants: Forty children (mean age 7.0 yrs) with cerebral palsy or static brain injury (6 months after the onset) were included at 3 rehabilitation institutions. Intervention: All participants received a daily rehabilitation treatment on upper limb for 60 minutes, 5 days per week for 4 weeks. The experimental group(n = 20) received 30 min of conventional occupational therapy(OT) and 30 min of therapy using the digital rehabilitation program with wearable IMU sensors. The control group(n = 20) received conventional OT alone for 60min per day for same duration. Training program using the digital rehabilitation system consisted of wrist and forearm articular movements: wrist flexion/extension, supination/pronation, ulnar/radial deviation correlated with visual stimuli using screen.

Outcome measure

Melbourne Assessment of Unilateral Upper Limb Function, version 2(MUUL-2) to measure the affected upper limb function; the Upper Limb Physician's Rating Scale(ULPRS) to measure each affected limb segment; the Pediatric Evaluation of Disability Inventory-computer adaptive test(PEDI-CAT) to assess activities of daily living capability. Assessments were performed by blinded assessors at baseline, after intervention, and 8 weeks after intervention. The percent score of MUUL-2 and scaled score of PEDI-CAT were used for analysis. Linear mixed analysis was used to assess differences in outcome measure over time and group.

Results

Thirty-nine subjects completed the intervention and no safety issues were reported. In the experimental group, upper limb functions measured by range, accuracy, and dexterity

domain of MUUL-2 were significantly improved after intervention ($p < 0.05$). Segmental movements in affected limb measured by wrist dorsiflexion and total score of ULPRS showed significant improvements in experimental group ($p < 0.05$). However, there were no significant differences in terms of interaction effect of group by time for any of the outcome measures of MUUL-2 and ULPRS. As for daily living capability, analysis of PEDI-CAT revealed group differences. The experimental group demonstrated significant improvements at 8-weeks follow up assessment in daily activity domain that were not observed in the control group.

Conclusion

Digital rehabilitation system with wearable IMU sensors is equally as effective as conventional OT in the training of upper limb function in children with brain injury. In addition, digital rehabilitation system remained superior for improving performances in daily activities. This new therapeutic approach using digital system may effectively complement standard rehabilitation by providing motivation and therapeutic support for children with brain injury.

Table 1. Characteristics of Participants

Characteristic	Intervention (n=20)	Control (n=19)	P-value [†]
Age (years)	7.10 ± 4.12 (3-16)	7.05 ± 3.29 (3-13)	0.749
Sex			
Male	10 (50.0%)	14 (73.7%)	0.191
Female	10 (50.0%)	5 (26.3%)	
MACS			
I-II	10 (50.0%)	8 (42.1%)	0.751
III-IV	10 (50.0%)	11 (57.9%)	
HFCS (study limb)			
4	3 (15.0%)	3 (15.8%)	0.892
5	7 (35.0%)	5 (26.3%)	
6	8 (40.0%)	10 (52.6%)	
7	2 (10.0%)	1 (5.3%)	
Involved side			
Hemiplegia/ Triplegia	9 (45.0%)	9 (47.4%)	>0.999
Quadriplegia	11 (55.0%)	10 (52.6%)	

Values are expressed as number (%) or mean ± standard deviation (range)

MACS, Manual Ability Classification System; HFCS, House Functional Classification System

[†] P-values were calculated by Mann-Whitney test, Chi-square tests, or Fisher's exact test.

Table 2. Descriptive Statistics of Outcome Measures at Baseline, After Intervention, and at 8 Weeks Follow-Up and Statistical Comparison

		Baseline	Post-intervention	8-week Follow-up	P-value	
					Time	Time x Group
Melbourne Assessment-II						
Range	Rapael	71.49 (22.06)	75.64[†] (20.04)	74.82[†] (21.62)	0.013[*]	0.488
	Control	66.47 (25.23)	69.40 (23.32)	67.25 (22.77)	0.100	
Accuracy	Rapael	84.40 (19.93)	89.00[†] (16.10)	87.40 (19.04)	0.031[*]	0.558
	Control	79.37 (26.68)	85.26[†] (21.67)	85.26[†] (23.48)	0.030[*]	
Dexterity	Rapael	63.02 (23.83)	68.56[†] (23.52)	69.69[†] (25.02)	0.003[*]	0.166
	Control	62.00 (24.26)	63.14 (23.28)	66.76 (24.39)	0.064	
Fluency	Rapael	62.14 (23.71)	64.52 (21.88)	64.29 (20.41)	0.457	0.715
	Control	52.88 (23.75)	55.39 (24.55)	56.39 (23.82)	0.101	
ULPRS						
Active elbow extension	Rapael	1.70 (0.66)	1.85 (0.37)	1.85 (0.37)	0.212	0.552
	Control	1.63 (0.68)	1.68 (0.67)	1.68 (0.67)	0.577	
Active supination in extension	Rapael	2.60 (0.82)	2.70 (0.73)	2.70 (0.73)	0.162	0.553
	Control	2.37 (0.96)	2.47 (0.91)	2.53 (0.91)	0.520	
Active supination in flexion	Rapael	2.70 (0.57)	2.80 (0.52)	2.80 (0.52)	0.162	0.352
	Control	2.47 (0.84)	2.68 (0.75)	2.68 (0.75)	0.042[*]	
Active wrist dorsiflexion	Rapael	2.70 (0.57)	2.80 (0.41)	2.77 (0.47)	0.133	0.429
	Control	2.63 (0.83)	2.84 (0.38)	2.84 (0.38)	0.085	
Wrist dorsiflexion	Rapael	1.00 (0.80)	1.20 (0.83)	1.35[†] (0.81)	0.049[*]	0.796
	Control	1.26 (0.81)	1.37 (0.68)	1.47 (0.70)	0.512	
Finger opening	Rapael	1.60 (0.68)	1.70 (0.66)	1.65 (0.67)	0.214	0.377
	Control	1.74 (0.56)	1.84 (0.50)	1.89 (0.32)	0.213	
Thumb in palm	Rapael	3.20 (1.32)	3.35 (1.14)	3.45 (1.10)	0.152	0.821
	Control	3.16 (1.17)	3.26 (1.15)	3.32 (1.16)	0.213	
Associated increase in muscle tone	Rapael	1.40 (0.82)	1.50 (0.89)	1.55 (0.83)	0.214	0.345
	Control	1.26 (0.73)	1.26 (0.73)	1.37 (0.83)	0.330	
Two-handed function	Rapael	1.50 (0.69)	1.55 (0.69)	1.55 (0.69)	0.291	0.377
	Control	1.26 (0.93)	1.26 (0.93)	1.32 (0.95)	0.330	
Total	Rapael	18.40 (4.75)	19.45[†] (4.54)	19.70[†] (4.56)	0.007[*]	0.736
	Control	17.79 (5.63)	18.68 (5.00)	19.11[†] (4.99)	0.033[*]	
PEDI-CAT						
Daily activity	Rapael	50.20 (3.16)	50.60 (2.84)	51.70^{††} (3.50)	0.002[*]	0.030[*]
	Control	48.58 (4.86)	49.00 (4.51)	49.05 (4.87)	0.335	
Mobility	Rapael	58.30 (5.78)	58.85 (5.37)	59.20 (4.87)	0.386	0.592
	Control	56.53 (7.88)	56.42 (7.27)	56.68 (6.78)	0.827	
Social cognitive	Rapael	64.50 (3.43)	64.80 (3.38)	65.70 (3.74)	<0.001	0.103
	Control	63.05 (3.26)	63.32 (3.43)	63.53 (3.37)	0.229	
Responsibility	Rapael	44.70 (4.43)	45.05 (4.11)	45.50 (3.47)	0.407	0.454
	Control	41.90 (6.34)	43.32 (5.09)	44.16 (4.81)	0.064	

ULPRS, upper limb physician's rating scale; PEDI-CAT, pediatric evaluation of disability inventory-computer adaptive test

* p <0.05 by linear mixed model

† p <0.05 by Bonferroni adjusted post hoc analysis, compared with baseline assessment

†† p <0.05 by Bonferroni adjusted post hoc analysis, compared with post-intervention assessment

소아재활

발표일시 및 장소 : 10 월 27 일(토) 10:50-11:00 Room E(5F)

OP4-1-6

The Excess of Mortality in Underweight Children of a Developed Country: 9-year Follow-Up

Hyun Jung Kim¹, Hyeong Sik Ahn¹, Shin-Young Yim^{2*†}

Korea University College of Medicine, Department of Preventive Medicine¹, Ajou University School of Medicine, Department of Physical Medicine and Rehabilitation²

Objectives

There is no study on the effects of underweight in the general pediatric population of a developed country where malnutrition is rare. The objective of this study was to demonstrate the effect of underweight on mortality in general pediatric population of a developed country, based on a 9-year follow-up of a nationwide birth cohort.

Methods

This study was based on the birth cohort of 2008-2013 in South Korea. We enrolled children who participated in National Health Screening Program for Infants and Children (NHSIC) at least once. NHSIC records screening data of growth and development of all children. Data on gender, age, birth weight, final weight-for-age (WA), and death were collected from the NHSIC database. Underweight was defined as WA<3rd percentile. All-cause mortality from the age of 1 year was calculated.

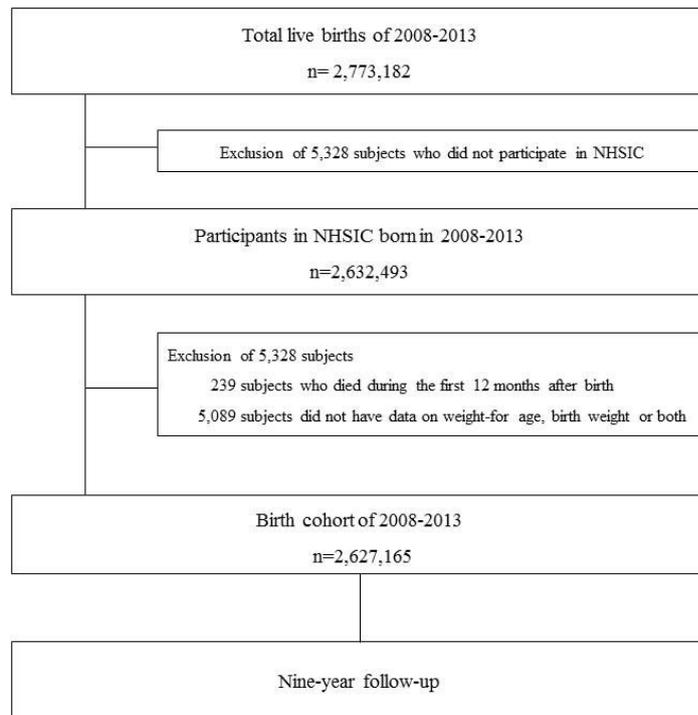
Results

The birth cohort of 2008-2013 consists of 2,627,165 subjects, representing 94.7% of total live births. There were 1,338 deaths from the age of 1 year, yielding 0.51 deaths per 1,000 live births of all-cause mortality during the 9-year follow-up. There were 1,125, 163 and 50 deaths in subjects with $3rd \leq WA \leq 97th$, $WA < 3rd$, and $WA > 97th$ percentile, indicating 0.45, 2.25, and 0.68 deaths per 1,000 live births, respectively. The survival curves of the birth cohort are shown in Figure, indicating that subjects with $WA < 3rd$ percentile showed significantly worse survival than subjects with $WA \geq 3rd$ percentile in both genders ($p=0.000$). After adjusting for BW as well as gender and age, subjects with $WA < 3rd$ percentile still showed 4.16 of adjusted hazard ratio (95% CI 3.51- 4.93) of death from the age of 1 year (Table).

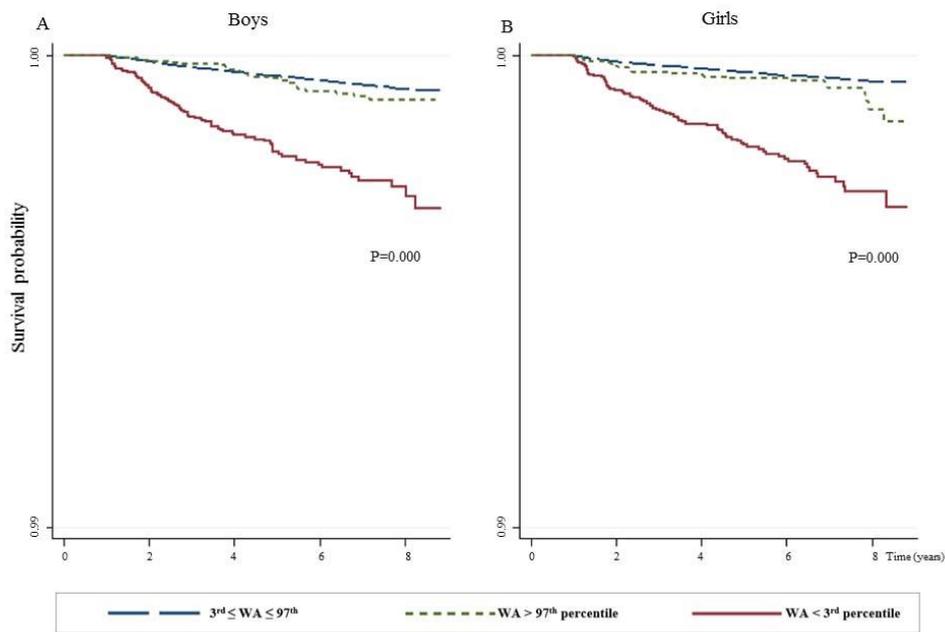
Conclusions

The Results show that underweight is clearly linked to an increased risk of mortality in the general pediatric population. This seems to be the first population-based study on the effect of underweight on child mortality in a developed country. Although a number of children in developed countries suffer from energy excess rather than nutrient deficiency,

about 45% of all child deaths are linked to malnutrition worldwide. Regardless of various etiologies and definitions of underweight, every society has underweight children. This finding incites awareness of underweight as a red flag of increased child mortality, not only in developing countries but also in developed countries. Clinicians need to determine the underlying causes of underweight and thus prevent deaths that can be seen more frequently in underweight children.



The flow diagram of development of the birth cohort of 2008-2013. NHSIC, National Health Screening Program for Infants and Children.



Survival after the age of 1 year by 3 categories of weight-for-age (WA). Kaplan-Meier estimates of survival after the age of 1 year for boys (A) and girls (B) show worse survival of children with WA<3rd percentile than children with WA≥3rd percentile in both genders (p=0.000).

Variables	Hazard ratio	95% confidence interval	
		Lower	Upper
Weight-for-age (WA)			
3 rd ≤ WA ≤ 97 th percentile	1.00	1.00	1.00
WA < 3 rd percentile	4.16	3.51	4.93
WA > 97 th percentile	1.42	1.07	1.89
Birth weight (BA)			
BW ≥ 2500 g	1.00	1.00	1.00
BW < 1000 g	3.12	1.55	6.31
1,000 g ≤ BW < 2,500 g	2.08	1.74	2.48
Gender			
Boys	1.00	1.00	1.00
Girls	0.80	0.71	0.89

^a Adjusted for age.

Adjusted hazard ratios of death after the age of 1 year by Cox proportional hazard model

ORAL PRESENTATION 4-2

소아재활

발표일시 및 장소 : 10 월 27 일(토) 14:00-14:10 Room E(5F)

OP4-2-1

The Scoliosis Curve Flexibility in Patients with Duchenne Muscular Dystrophy

Hyun Iee Shin^{1*}, Hyung Ik Shin^{1†}, Young-Ah Choi²

Seoul National University Hospital, Department of Rehabilitation Medicine¹, National Traffic Accident Rehabilitation Hospital, Department of Rehabilitation Medicine²

Objective

Non-ambulant Duchenne muscular dystrophy (DMD) patients frequently develop scoliosis. Management of scoliosis is crucial because it affects pulmonary function. Moreover, it extends the curve distally to cause pelvic obliquity. This Results in pain and limit of activity of daily living. Surgery has been a treatment of choice for scoliosis in the pre-steroid era. However, with the use of steroid, life expectancy and curve progression have been greatly improved. Hence, Use of orthosis should be considered. Spinal orthosis attempts to correct scoliosis by flattening the curve with pressure, which means that spine should be flexible. Thus, flexibility of the curve could be a significant influencing factor for the effectiveness of braces. The aim of this study was to investigate the extent and changes of Cobb angle, pelvic obliquity, and curve flexibility after loss of walking ability and correlations between them.

Methods

The medical records and whole spine x-rays of sitting and supine positions of 273 DMD boys visited the division of Pediatric Rehabilitation between March, 2017 and February, 2018 were retrospectively reviewed, and finally, 50 boys were extracted with at least 3 years of consecutive follow ups(Figure 1). Cobb angle and pelvic obliquity were measured (Table 1-1, 1-2). Flexibilities were measured by the change in curve angles with and without the gravitational force, which is the difference between Cobb angles in sitting and supine position in this study. Flexibilities of those who had scoliosis at the first year follow up (12 boys) were analyzed by repeated measure ANOVA (Figure 2). To evaluate the relationships among each index, Pearson correlation test was performed.

Results

The features of flexibility and pelvic obliquity were manifested by the time points after the loss of ambulation (Table 1-1, 1-2). It is notable that flexibility gradually decreased each year, from 86.21 ± 4.96 , 60.70 ± 6.45 , and to 49.10 ± 9.99 . Among 50 boys, 31 boys had scoliosis. Almost every patient with scoliosis, except 2 boys, went through the sequential

course of 1)no scoliosis, 2)full flexibility, when scoliosis is only measurable at sitting position, and 3)partial flexibility when scoliosis was also detectable at the supine position. Cobb angle in sitting position had significant correlation with pelvic obliquity both in sitting and supine position ($r=0.722$ and $r = 0.650$, $p < 0.05$). Cobb angle in supine also had significant correlation with pelvic obliquity in each position. ($r=0.806$ and $r = 0.786$, $p < 0.05$).

Conclusion

It is important for physicians to acknowledge of the course of scoliosis after the loss of ambulation, to detect the curve as soon as possible, as there is a time period of scoliosis with flexibility where orthotic intervention would be effective.

Table 1-1. Cobb angle of the subjects

	Number of boys	Cobb angle in sitting position (°)	Cobb angle in supine position (°)	Flexibility of scoliosis (%)
Time 1	31	22.43±2.76	8.22±2.97	86.21±4.96
Time 2	24	27.15±3.24	13.73±3.55	60.70±6.45
Time 3	12	34.40±4.40	22.23±6.34	49.10±9.99

Table 1-2. Pelvic obliquity of the subjects

	Number of boys	Pelvic obliquity in sitting position (°)	Pelvic obliquity in supine position (°)	Flexibility of Pelvic obliquity (%)
Time 1	18	8.60±1.00	2.54±0.81	71.90±9.17
Time 2	10	11.37±1.06	6.92±1.46	42.43±10.74
Time 3	4	18.43±7.28	12.58±5.83	32.45±12.67

Values are presented as mean standard deviation.

Time 1 represent the time when scoliosis was first detected after loss of walking ability

Time 2 represent the time 1 year after the detection of scoliosis

Time 3 represent the time 2 year after the detection of scoliosis

Figure 1. Participant inclusion process

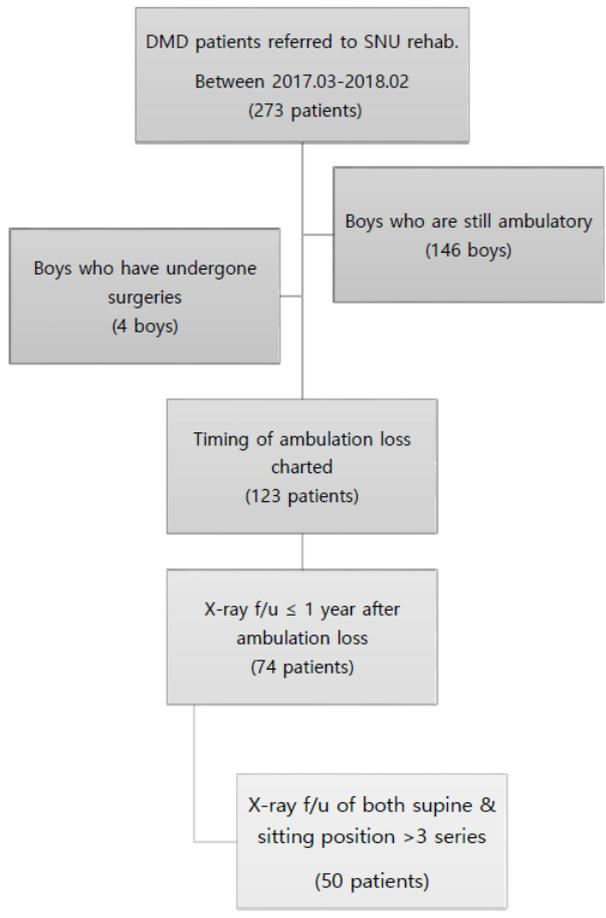
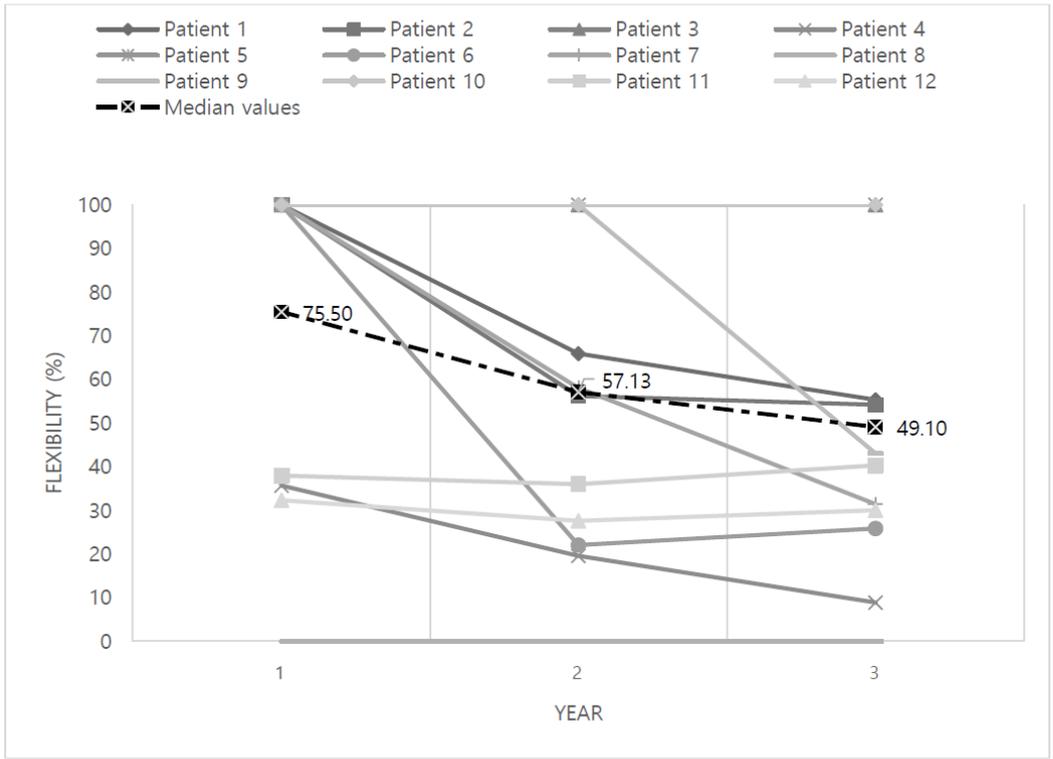


Figure 2. Flexibilities of patients who had scoliosis at the first year follow up.



암재활

발표일시 및 장소 : 10 월 27 일(토) 14:10-14:20 Room E(5F)

OP4-2-2

Effectiveness Of Physical Rehabilitation In Advanced Cancer Patients : A Systematic Review

Jangmi Yang², JinA Choi², Su-Yeon Yu², Mi-Young Choi², Ae Jung Jo², Min Joo Kang², Seung Hyun Chung³, Eun Joo Yang^{1*†}

Seoul National University Bundang Hospital, Department of Rehabilitation Medicine¹, National Evidence-based Healthcare Collaborating Agency, Department of Others², National Cancer Center, Department of Rehabilitation Medicine³

Purpose

To evaluate the efficacy of supervised-exercise rehabilitation in advanced cancer patients from systematic reviews.

Methods

A systematic search of electronic databases, including MEDLINE, EMBASE and the Cochrane Library, as well as three domestic databases from inception to 3 July 2017, was performed. Two reviewers independently screened all references according to selection criteria. The Cochrane Risk of Bias (RoB) tool for randomized controlled trials (RCT), and the Risk of Bias for Non-randomized Studies (RoBANS) were used to assess quality of literature. Data from RCTs and pre-post studies were combined and meta-analysis was performed.

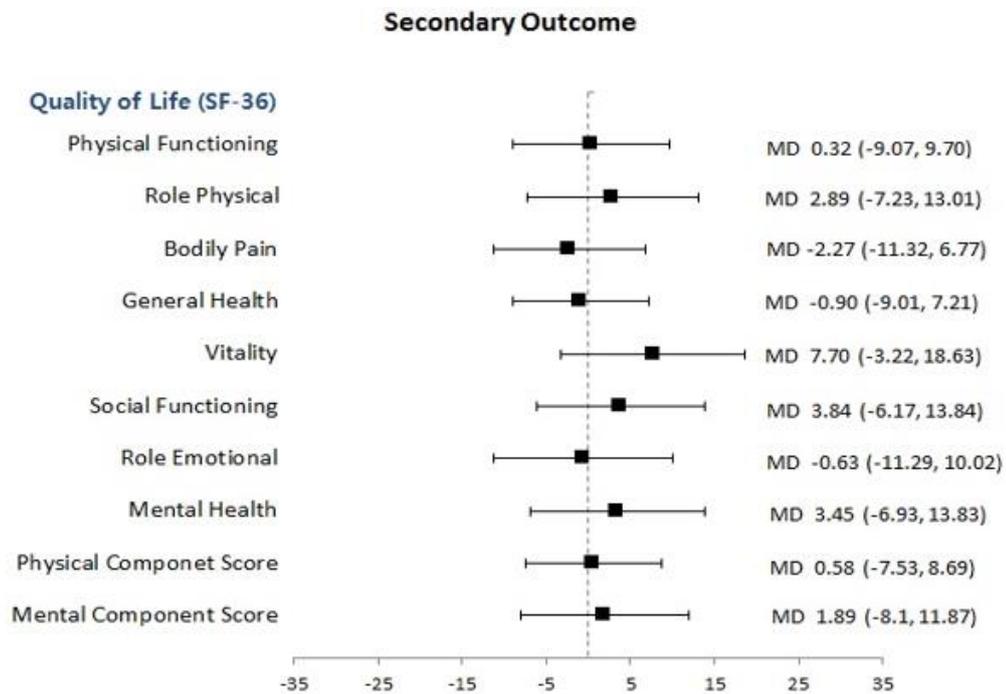
Results

A total of 11 studies were included. Four studies were RCTs and the remaining seven studies were pre-post studies respectively. Meta-analyses were performed by study design. For RCT meta-analyses, exercise interventions showed little reduction in fatigue compared to the control group with, standardized mean difference (SMD) of -0.62 and Confidence Interval (95% CI: $-0.87 - 0.37$). In meta-analyses for pre-post studies, exercise interventions resulted in improvements in muscular strength from baseline to follow-up: Leg press (mean difference (MD): 12.13, 95% CI: 5.90 - 18.35); Bench press (MD 4.81, 95% CI: 0.85 - 8.77); Abdominal crunch (MD 6.48; 95% CI: 2.01 to 10.96); Back (MD 5.18; 95% CI: 1.59 - 8.77). Exercise interventions have a positive impact on quality of life measured by EORTC-QLQ-C30 from baseline to follow-up (MD 9.86, 95% CI 1.56 -18.34).

Conclusions

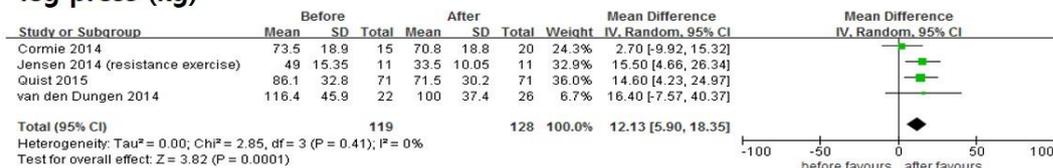
Exercise may have beneficial effects on fatigue and be effective to improve muscular strength for advanced cancer patients based on existing studies. However, the positive Results must be interpreted cautiously because of the heterogeneity of studies. More

studies are needed to further investigate how to sustain positive effects of exercise over time.

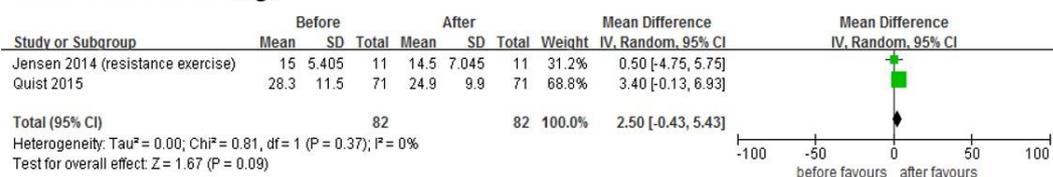


Effectiveness of rehabilitation on quality of life using systematic reviews with randomized controlled studies

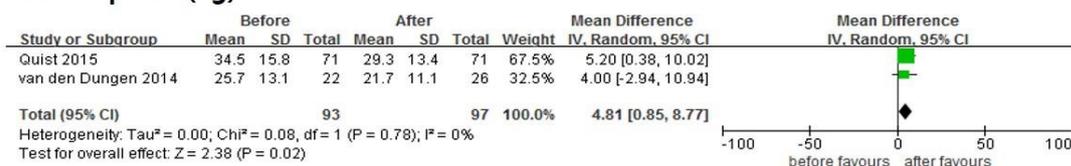
leg press (kg)



Knee extension (kg)



bench press (kg)



Effectiveness of rehabilitation on physical performance using systematic reviews with pre-post studies

EORTC-QLQ-C30: QOL/global health state



EORTC-QLQ-C30: role functioning



EORTC-QLQ-C30: fatigue



5

5

Effectiveness of rehabilitation on quality of life using systematic reviews with pre-post studies

암재활

발표일시 및 장소 : 10 월 27 일(토) 14:20-14:30 Room E(5F)

OP4-2-3

Hospital-based and home-based exercise in patients with SAN injury after head & neck cancer surgery

JaYoung Kim^{1*}, Jae Yong Jeon^{1†}, Jung Hwa Do¹

Asan Medical Center, Department of Rehabilitation Medicine¹

Objectives

The purpose of this study was to compare the effects of hospital-based and home-based exercise programs on quality of life (QOL) and neck and shoulder function of patients who underwent head and neck cancer (HNC) surgery.

Methods

This clinical trial included 40 patients with neck and shoulder dysfunction after HNC. The exercise program included range of motion (ROM) exercises, massage, stretching, and strengthening exercises. Twenty patients who were assigned to the hospital-based exercise group performed physical therapy for 40 minutes three times a week for four weeks., and the remaining 20 patients were assigned to the home-based group. The European Organization for Research and Treatment of Cancer Core Quality of Life Questionnaire (EORTC QLQ-C30), the EORTC Head and Neck Questionnaire (EORTC QLQ-H&N), the Neck and Shoulder Disability Index (NDI), ROM, and numeric rating scale (NRS) were assessed before and after the exercise program. The program consisted of a 10-minute ROM to the neck and shoulder, a 10-minute massage, and 15 minutes of progressive resistance exercises, followed by a five-minute stretching exercise.

Results

There were statistically significant differences in the changes of neck and shoulder disability index ($p < .05$). Additionally, there were significant differences in neck extension and rotation ROM and NRS in the hospital-based group compared with home-based group ($p < .05$). QOL was not significantly different between the two groups.

Conclusions

Home-based exercise group was effective for improving QOL, shoulder function, and pain relief. Hospital-based exercise had better effects on physical function of the neck and shoulder and reduced pain.

Table1. Baseline demographic and clinical characteristics of the patients

Characteristic	Hospital group (n=20)	Home group (n=20)	p-value
Age (years), mean \pm SD	56.2 \pm 15.0	49.6 \pm 13.0	.150
BMI	23.6 \pm 3.2	23.7 \pm 2.8	.904
Over 25	5 (25.0)	6 (30.0)	
Under 25	15 (75.0)	14 (70.0)	
Sex			.757
Female	11 (55.0)	12 (60.0)	
Male	9 (45.0)	8 (40.0)	
Education level			.206
High school education	6 (30.0)	10 (50.0)	
University education	14 (70.0)	10 (50.0)	
Marital status			.300
Married	16 (80.0)	13 (65.0)	
Single	4 (20.0)	7 (35.0)	
Stage of cancer			.218
0	1 (5.0)		
I	8 (40.0)	5 (25.0)	
II	2 (10.0)	2 (10.0)	
III	8 (40.0)	13 (65.0)	
IV	1 (5.0)		
Type of neck dissection			.757
MRND	9 (45.0)	8 (40.0)	
SND	11 (55.0)	12 (60.0)	
Staging of node			
N0	3(15.0)	2(10.0)	
N1	3(15.0)	3(15.0)	
N1b	8(40.0)	9(45.0)	
N2b	5(25.0)	4(20.0)	
N2c	0(0.0)	1(5.0)	
unknown	1(5.0)	1(5.0)	
Diagnosis			.211
Thyroidgland	8 (40.0)	10 (50.0)	
Other &unspec. part of tongue	5 (25.0)	7 (35.0)	
Parotid gland	-	1 (5.0)	
Base of tongue	-	1 (5.0)	
Larynx &hypopharynx	6(30.0)	1 (5.0)	
Pyriform sinus	1 (5.0)	-	
Lymphedema			.731
Yes	14 (70.0)	15 (75.0)	
No	6 (30.0)	5 (25.0)	
Radiotherapy			.324
Yes	12 (60.0)	15 (75.0)	
No	8 (40.0)	5 (25.0)	
Analgesic			.643
Yes	17 (85.0)	18 (90.0)	
No	3 (15.0)	2 (10.0)	

.Ca: Cancer.

Table2. Comparison of the mean values obtained for EORTC C-30 and H&N35 between the hospital-based exercise group and the home-based exercise group

	Hospital group		Home group		P value
	Pre	Post	Pre	Post	
EORTC QLQ-C30 ^a					
Global health status/QOL	52.3±18.3	72.9±21.9*	44.1±21.4	52.4±27.8*	.083
Functional Scales					
Physical functioning	66.3±11.9	81.3±14.4*	63.3±15.9	66.9±22.7	.051
Role functioning	68.3±20.8	74.9±18.3	54.1±22.8	61.6±23.0	.900
Emotional functioning	74.2±17.2	76.2±18.3	69.4±23.7	71.2±23.4	.969
Cognitive functioning	65.8±16.6	70.8±18.6	58.3±26.2	63.3±24.3	.100
Social functioning	69.9±27.8	74.1±22.6	66.6±31.0	68.3±26.9	.767
Symptom Scales					
Fatigue	40.5±22.6	29.9±19.7	48.6±24.1	43.8±23.4	.447
Nausea and vomiting	14.1±27.1	5.7±15.5	12.4±22.2	13.3±25.7	.336
Pain	33.3±22.2	19.1±12.4*	37.4±21.5	36.6±25.7	.093
Dyspnea	24.9±26.2	9.9±15.6.*	26.6±23.1	23.3±26.7	.162
EORTC QLQ-H&N35 ^b					
Pain	22.0±24.8	14.9±13.9	22.5±22.5	25.8±24.9	.127
Swallowing	24.9±16.2	20.4±19.7	22.0±21.1	26.6±21.0	.060
Sense problem	16.8±21.6	19.5±32.8	25.8±24.4	24.9±35.2	.724
Speech problem	36.1±21.8	31.1±27.1	34.4±22.1	31.6±25.3	.783
Social contact	33.3±27.9	24.5±19.1	37.4±33.7	34.5±24.9	.504

Quality of life questionnaire-cancer^a, Quality of life questionnaire-head & neck^b.

*an alpha of 0.05 is used as the cutoff for significance (p<.05)

Table3. Comparison of the mean values obtained for NDI, ROM, NRS between the hospital-based exercise group and the home-based exercise group

	Hospital group		Home group		P value
Neck and Shoulder Disability Index	22.1±5.4	14.8±2.3*	22.3±6.8	20.1±4.7	.006*
ROM					
Neck extension	21.9±7.5	40.7±5.6*	21.5±7.7	33.0±6.5*	.007*
Neck rotation (sum)	40.7±17.8	109.2±18.7*	45.0±16.5	84.7±21.4*	.001*
Neck lateral flexion (sum)	28.7±8.2	61.0±19.7*	30.0±9.7	52.5±18.2*	.054
Shoulder flexion	145.2±34.8	180.0±.0*	144.2±34.5	178.2±7.8*	.946
Shoulder abduction	121.0±33.2	180.0±.0*	129.2±29.4	174.7±14.6*	.215
NRS	5.6±1.0	2.6±.7*	5.5±1.5	4.6±.9*	.001*

*an alpha of 0.05 is used as the cutoff for significance (p<.05)

암재활

발표일시 및 장소 : 10 월 27 일(토) 14:30-14:40 Room E(5F)

OP4-2-4

QUANTIFIABLE SUPRA-FASCIAL FIBROSIS IN LYMPHEDEMA USING HOUNSFIELD UNIT FROM COMPUTERIZED TOMOGRAPHY

Kyo-in Koo^{1†}, Chang Ho Hwang^{1,2**}

School of Electrical Engineering, University of Ulsan, Department of Biomedical Engineering¹, Ulsan University Hospital, University of Ulsan College of Medicine, Department of Physical Medicine and Rehabilitation²

Purpose

To verify feasibility of computerized tomography (CT)-based quantification of supra-fascial microscopic fibrosis.

Method

Retrospective, observational, cross-sectional study had been conducted from January 2017 to March 2018. Patients with only unilateral lymphedema were included. Three types (maximum, mean, minimum) of CT reticulation indexes (CTRIs) were digitally subtracted from the cross-sectional images by narrowing window width of absorptive values (Hounsfield unit [HU]) and then were compared with the measurements used in common for lymphedema: 1KHz-based impedance in affected limb standardized by value in the un-affected one, lymphoscintigraphic stages (I to IV) of Peeking et al., circumference difference between limbs standardized by value in the un-affected limb, and International Society of Lymphedema (ISL) sub-stages.

Result

A mean value of cross-sectional images on CT per patients was 127 (7 to 557 scans). Two third of the patients had breast cancers and one third gynecologic cancers except one patient (Table 1). CTRIMEAN was related with months from onset of limb swelling to being taken CT ($r = 0.52$, $p < 0.01$). CTRIMAX also showed the same result ($r = 0.45$, $p < 0.05$). Significant relation with ISL stages was noticed; CTRIMEAN ($r = 0.86$, $p < 0.01$), CTMIN ($r = 0.79$, $p < 0.01$), and CTRIMAX ($r = 0.68$, $p < 0.01$). CTRIMIN showed relation with 1 KHz-based impedance ratio ($r = -0.46$, $p < 0.05$) and with the proximal limb circumference difference ratio ($r = 0.45$, $p < 0.05$) (Figure 1). No significance was notice in the serum albumin level, lymphoscintigraphic stages, or the distal limb circumference differences ratio. Based on receiver operating characteristics curve analysis, CTRIMAX showed the discriminating sensitivity of 0.78 and specificity of 0.60 against lymphoscintigraphic stage IV (no visualization of superficial and deep lymph nodes) and the sensitivity of 0.75 and specificity of 0.56 against lymphoscintigraphic stage III (no visible superficial lymph node, but visualization of deep lymph nodes) with the cut-off value of

17.57 (Figure 2). No significance was found in the contributing factors such as underlying cancers, history of taking radiotherapies, rehabilitative managements, or anti-edemic drugs.

Conclusion

CTRIs are significantly related with the duration of swelling, the ISL sub-stages, circumference difference ratio in the proximal limb, and 1 KHz-used impedance ratio. CTRIMAX showed reasonable degree of sensitivity and specificity in discriminating deep lymphatic system dysfunction. Considering that information technology has been developed very fast, this innovatory quantification using digital subtraction from CT using HU may lay a foundation on further progress in early screening on inaccessible deep-located fibrosis in persistence of lymphedema and in early intervention from the beginning.

Table 1. Demographic characteristics CTNUMBER, the number of cross-sections on CT scan; OPTOCT, months from operation to CT; LETOCT, months from onset of lymph edema to CT; OPTOLE, months from operation to onset to lymph edema; ISL, International Society of Lymphology

		Number (%) or Mean \pm S.D.
Age		57.46 \pm 13.41
Sex	Male	0 (0.0)
	Female	24 (100.0)
Side	Right	11 (45.8)
	Left	13 (54.2)
Weight (kilograms)		58.52 \pm 10.06
CTNUMBER		127.38 \pm 122.32
OPTOCT (months)		82.65 \pm 50.74
LETOCT (months)		50.21 \pm 42.99
OPTOLE (months)		34.04 \pm 32.29
Albumin level in serum (mg/dl)		4.16 \pm 0.36
Cancer	Breast cancer	16 (69.6)
	Gynecologic cancer	7 (30.4)
History of Radiotherapy	No	6 (25.0)
	Yes	18 (75.0)
ISL sub-stage	IIA	8 (33.3)
	IIB	13 (54.2)
	IIC	3 (12.5)
History of rehabilitative management	No	7 (29.2)
	Yes	17 (70.8)
History of drug intake	No	7 (29.2)
	Yes	17 (70.8)

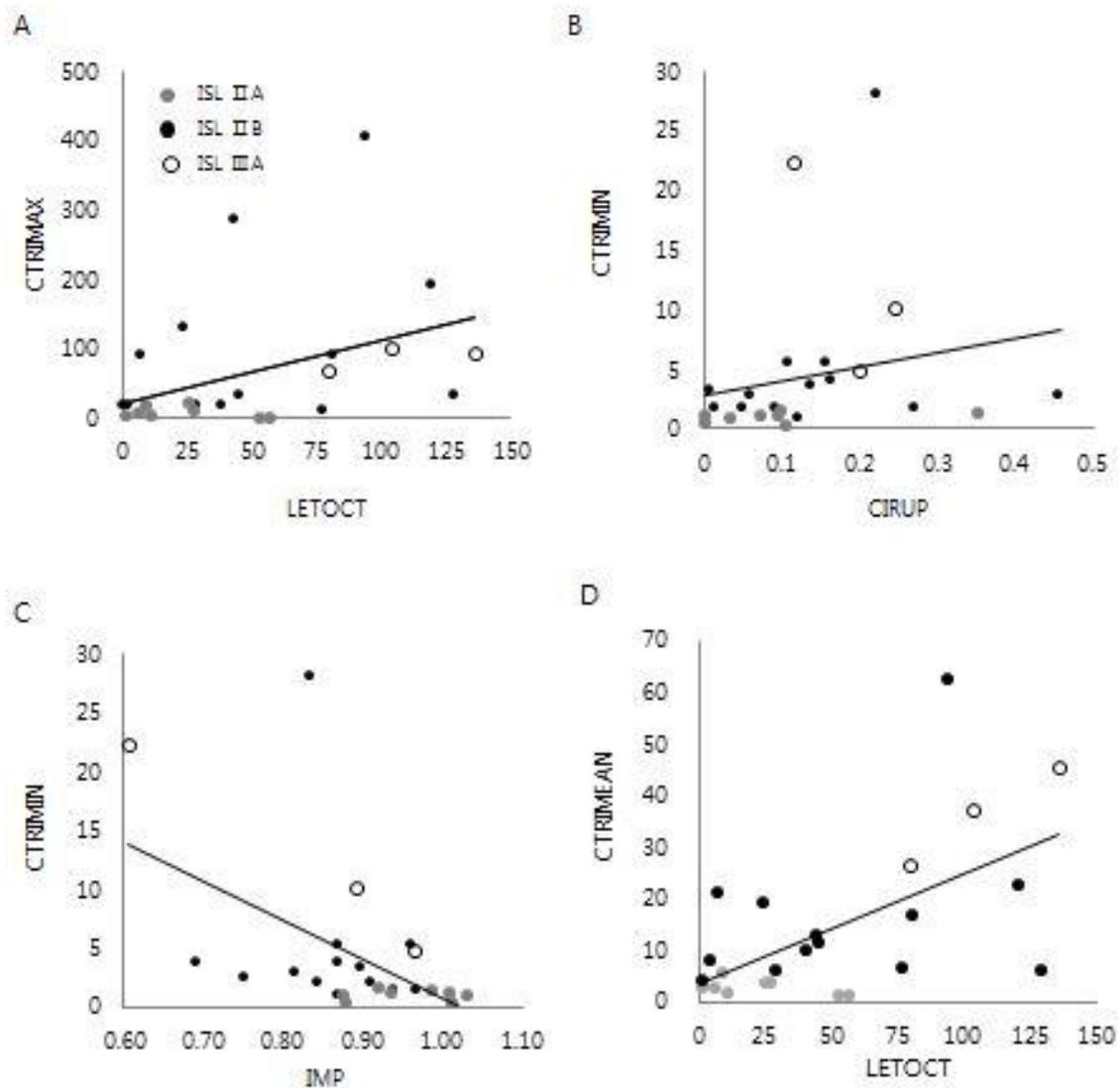


Figure 1. Correlation between the CT reticulation indexes and other clinical measurements A ; B ; C ; D, CTRIMAX, maximal CT reticulation index; LETOCT, months from onset of lymph edema to CT; CTRIMIN, minimal CT reticulation index; CIRUP, circumference difference between affected limb and non-affected limb measured 5 cm proximal to the anatomical landmarks (cm); IMP, 1 KHz-based impedance of affected limb divided by impedance of non-affected limb; CTRIMEAN, mean CT reticulation index; ISL, International Society of Lymphology stage, Spearman correlation analysis.

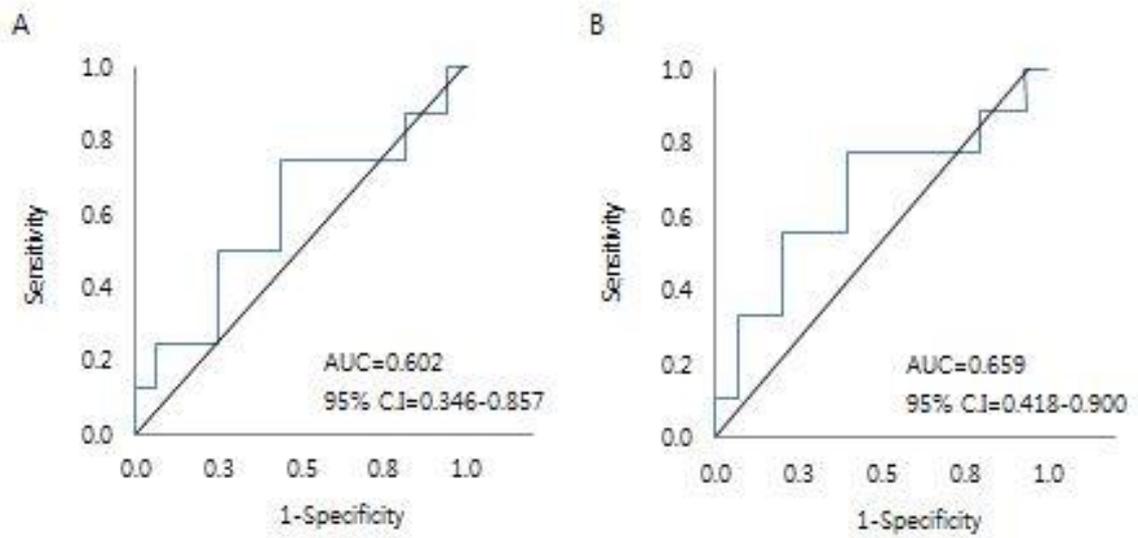


Figure 2. Receiver operating characteristics curve analyses of the CT reticulation indexes on superficial and deep lymphatic system dysfunction A; lymphoscintigraphic stage I, II versus III, IV, B; lymphoscintigraphic stage I, II, III versus IV, AUC, Area under the curve; CI, confidence interval.

암재활

발표일시 및 장소 : 10 월 27 일(토) 14:40-14:50 Room E(5F)

OP4-2-5

The efficacy and feasibility of prescribed exercise by mobile health in hepatocellular carcinoma

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Samsung Medical Center, Department of Physical and Rehabilitation Medicine¹, National Rehabilitation Center, Department of Rehabilitation Medicine², Samsung Medical Center, Department of Medicine³

Introduction

Exercise has proven to positively influence cancer patients biologically and functionally in various cancers, especially in breast and prostate cancer. Recent studies support that even patients undergoing acute cancer treatments can benefit from individualized prescribed exercise program. In previous studies of hepatocellular carcinoma (HCC), continuous regular exercise reduced the risk of primary development of HCC and lowered mortality after cancer diagnosis. However, fear of developing hepatic decompensation has led cancer patients and even physicians to ignore the benefit of exercise. The aim of this study was to evaluate the efficacy and feasibility of individualized prescribed exercise on quality of life, physical performance, biological profile, and body composition change of HCC patients on compensated stage, via smartphone application and wearable device.

Material and method

The HCC patients on compensated stage who visited the HCC clinic in a tertiary hospital were enrolled. The inclusion criteria were HCC patients aged > 18 years, < 70 years on compensated stage who were able to walk independently for 30 minutes. The participants were provided with a mobile health application and wearable device. We provided individually prescribed exercise program (aerobic, strengthening, stretching exercise) which was adjusted according to the test Results at initial and 6 weeks follow up. The participants' physical performance status (6 minutes' walk test, 30-second chair stand test, grip strength test) was tested initially, at 6 weeks and 12weeks. At initial and terminal assessment, questionnaires of quality of life (EORTC QLQ C30), physical activity level (IPAQ-SF) and measurement of body composition alongside with complete blood count and blood chemistry profile were done.

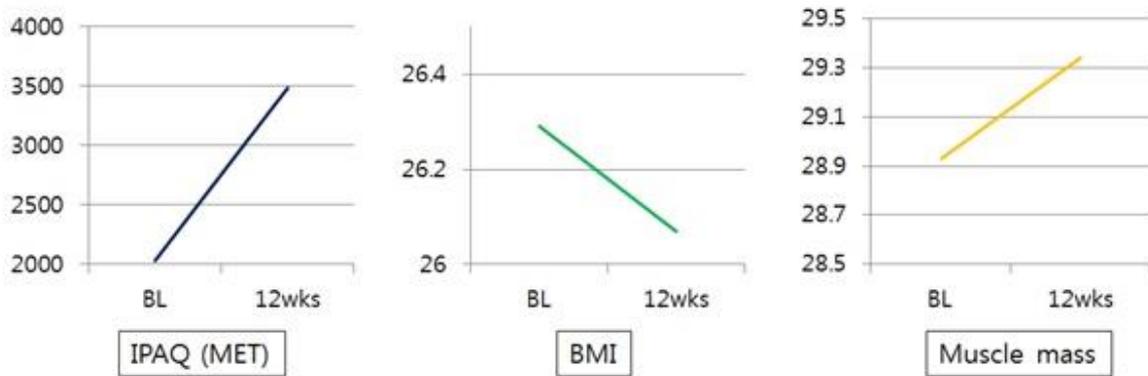
Results

Among 37 patients, 30 patients completed 12 weeks of exercise and measurements. Although compliance of aerobic and strengthening exercise gradually decreased, the average terminal compliance was 62.90% and 41.94%, respectively. After 12 weeks of individually prescribed exercise intervention, participants showed significant

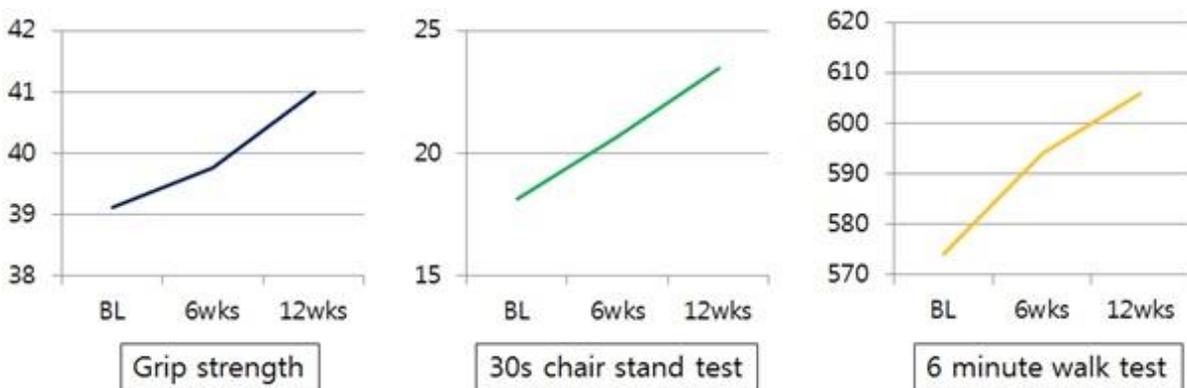
improvement in body composition (increased muscle mass, physical activity, $p=0.026$, 0.011 , respectively) and even in functional terms (6 minutes' walk test, 30-second chair stand test, grip strength test, $p<0.001$, <0.001 , 0.008 , respectively). Among items of quality of life, only pain improved significantly ($p=0.043$). None of the participants reported hepatic decompensated complications and any key biological markers (albumin, bilirubin, liver enzymes) did not deteriorated.

Conclusion

By 12 weeks of prescribed rehabilitation exercise intervention via mobile health application assisted by wearable device, participants showed significantly improved in body composition and in functional terms. All participants terminated 12 weeks of exercise safely without any complication of hepatic decompensation or biological deterioration.



Change of body composition after 12 weeks of individually prescribed exercise with mobile health application



Change of physical performance status after 12 weeks of individually prescribed exercise with mobile health application

	baseline	12 weeks	p value
WBC(x10 ⁹ /μL)	5.84±2.37	5.92±2.50	.758
Hb(g/dL)	14.41±1.85	14.50±1.38	.658
PLT(x10 ⁹ /μL)	151.96±44.49	148.25±43.41	.278
Alb(g/dℓ)	4.43±0.39	4.42±0.34	.881
Cholesterol(mg/dℓ)	144.06±25.04	148.87±24.85	.243
Bilirubin, Total(mg/dℓ)	0.81±0.53	0.74±0.40	.217
AST(U/ℓ)	32.64±14.61	32.61±14.08	.986
ALT(U/ℓ)	28.83±17.75	27.61±21.42	.643
ALP(U/ℓ)	78.80±23.09	74.29±19.04	.093
GGT(U/ℓ)	41.80±39.12	38.80±34.37	.366
Creatinine(mg/dℓ)	0.88±0.18	0.85±0.20	.074
Glucose, Fasting(mg/dℓ)	103.90±18.79	111.03±37.73	.194
Osteocalcin	15.92±5.63	16.45±6.73	.255
PT(INR)	1.07±0.11	1.05±0.11	.136

* p <0.05

Change of biological profiles after 12 weeks of individually prescribed exercise with mobile health application

암재활

발표일시 및 장소 : 10 월 27 일(토) 14:50-15:00 Room E(5F)

OP4-2-6

The impact of individually inpatient rehabilitation on function of advanced cancer patients

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Seoul National University Bundang Hospital, Department of Rehabilitation Medicine¹, National Evidence-based Healthcare Collaborating Agency, Department of Others², National Cancer Center, Department of Rehabilitation Medicine³

Purpose

To examine the impact of an individually inpatient rehabilitation on functional improvement among patients with diagnosed advanced cancer

Method

This is a retrospective cohort study of newly diagnosed patients with advanced cancer between 2012 and 2017. Total 3832 data for newly diagnosed patients with advanced cancer were examined; of these patients, 331 underwent inpatient rehabilitation and 3501 did not undergo inpatient rehabilitation. At baseline and after 2 weeks Overall functional improvement were evaluated by Functional ambulation category (FAC). Type of cancer, site of metastasis, age, sex, dosage of intervention, baseline functional level were collected from medical records and adjusted on the ANCOVA analysis.

Results

A total of 331 patients (8.6%) who underwent inpatient rehabilitation improved in functional status from admission to discharge, with the highest gain observed in mobility (FAC; 2.09 ± 1.87 vs 2.37 ± 1.87 , $p < 0.001$). After adjusting the covariates, we found statistical functional improvement ($R^2 = 0.904$, $p < 0.001$). Among the patients who underwent inpatient rehabilitation, better baseline FAC (F value = 3240.2; $p < 0.001$) and more days of intervention (F value = 7.7; $p = 0.006$) were significantly associated with greater functional improvement.

Conclusions

Patients who undergo inpatient rehabilitation demonstrate significant functional improvements, primarily in the mobility domain. Baseline functional level and dosage of rehabilitation are main factors related with functional improvement. This study contributes with evidence on the effectiveness of implementing rehabilitation in standard oncology treatment. Further larger and randomized control trials are needed to confirm our Results.

POSTER SESSION 1

게시 및 질의응답 일시 : 2018 년 10 월 26 일(금) 08:30-12:20/10:00-10:45

장소 : 3F 그랜드볼룸

P 1-1

Impact of Socioeconomic Status and Demographics on the Pattern of Stroke Rehabilitation Utilization

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Pohang Stroke and Spine Hospital, Department of Rehabilitation Medicine¹, National Health Insurance Service Ilsan Hospital, Research and analysis team², National Health Insurance Service Ilsan Hospital, Department of Rehabilitation Medicine³

Background and Purpose

Stroke is a disease that causes disability in a considerable number of patients and requires rehabilitation treatment after onset. As such, rehabilitation of stroke patients can be a social burden. The aim of this study is to find the influence of socioeconomic status and demographics in rehabilitation utilization after stroke.

Methods

We analyzed the National Sample Cohort from 2008 to 2013 with regards to the relationship between socioeconomic status and the pattern of using the rehabilitation resources after stroke. We divided the patients into two groups according to the types of insurance premium payment and the rehabilitation treatment period into acute and chronic stages by six months after the onset. We confirmed the pattern of rehabilitation facility utilization and the mean of hospitalization days. One Way ANOVA was utilized for detecting the relationship between the income grade and the hospitalization days of each medical facility. A Bonferroni correction was correction was applied for multiple comparisons.

Results

In both premium payment systems, there were many male insurance holders and, on the contrary, beneficiaries were women (Table 1). In both types of health insurance premium in acute and chronic stages, beneficiaries had been hospitalized longer than insurance holders. The gap of age and hospitalization days between insurance holders and beneficiaries in Self-employed was lesser than that of the employed. In acute stage of stroke, there was no relationship between the income grade and the type of hospital utilization. However, in chronic stage, the highest income group were more likely to be hospitalized in a general hospital in both types of premium payment. Mean hospitalization days of income grade 1 was not longer than those of other groups. Higher

income did not correlate with longer hospitalization days in both insurance premium groups (Table 2, 3).

Conclusions

The difference of demographics due to insurance payment types and socioeconomic status influenced the pattern of rehabilitation medical facility utilization. Thus, we hope to provide background data for making a new, reasonable and universal stroke rehabilitation referral system through our study Results.

Table 1. Demographic factor classified by health insurance type

	Self-employed insured								Employed insured							
	Insurance holder (high → low)				Beneficiary (high → low)				Insurance holder (high → low)				Beneficiary (high → low)			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Subject, no.	208	406	585	728	179	336	304	184	95	190	158	228	939	1803	931	623
Sex, no.																
Male	186	332	429	368	34	68	61	50	91	177	133	182	396	844	456	296
Female	22	74	156	360	145	268	243	134	4	13	25	46	543	959	475	327
Age, no.																
20-29	0	0	0	2	3	8	3	4	0	2	4	5	3	7	8	5
30-39	0	12	14	16	7	16	13	7	6	30	14	14	6	21	12	7
40-49	15	47	85	41	17	43	29	16	26	67	35	46	19	30	42	46
50-59	46	125	105	98	25	55	37	25	44	58	61	71	22	141	170	121
60-69	64	109	137	141	36	70	64	33	11	17	27	66	131	498	240	155
70-79	59	77	173	243	51	65	87	54	8	7	13	24	473	778	277	183
> 80	24	36	71	187	40	79	71	45	0	9	1	2	285	328	182	106
Mean Age	66.11	61.90	64.64	70.20	67.31	64.91	67.70	67.71	53.21	50.89	53.06	55.88	74.94	71.23	68.57	66.93
(mean ±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±	±
SD)	11.26	12.29	13.45	13.35	15.79	16.54	15.26	15.79	9.45	12.80	11.62	11.45	9.81	10.72	12.96	13.01
Disability rating*																
Severe	49	82	126	142	28	47	41	27	7	18	26	42	194	400	206	132
Moderate	31	40	77	109	23	58	57	34	10	10	9	10	151	305	134	98
Mild	128	284	382	257	474	231	206	124	78	162	123	176	597	1098	591	393
Mean	0.62±	0.50±	0.56±	0.54±	0.41±	0.49±	0.51±	0.52±	0.25±	0.24±	0.39±	0.41±	0.57±	0.61±	0.59±	0.58±
Disability Grade	0.84	0.81	0.82	0.80	0.71	0.77	0.79	0.79	0.58	0.61	0.75	0.78	0.81	0.83	0.83	0.82
(mean ±																
SD)																
Stroke type†																
Ischemic	145	265	378	490	106	196	193	113	106	196	193	113	663	1216	627	426
Hemorrhagic	40	107	147	161	58	106	74	50	58	106	74	50	163	364	219	138
Others	23	34	60	77	15	34	37	21	15	34	37	21	113	203	85	59

* Disability rating is categorized by Korean disability grade measured by modified barthel index

† Stroke type : Ischemic stroke includes I63 (cerebral infarction), hemorrhagic stroke includes I60 (Subarachnoid hemorrhage), I61 (Intracerebral hemorrhage), and I62 (Other nontraumatic intracranial hemorrhage) and another type of stroke include I64 (Stroke, not specified as hemorrhage or infarction) and I69(Sequelae of cerebrovascular disease).

Table 2. The total and mean rehabilitation utilization days between hospital grade and income grade of self-employed insured

		Self-employed insured							
		Insurance holder (high → low)				Beneficiary (high → low)			
		1	2	3	4	1	2	3	4
Acute	General Hospital	14.06±13.36	14.50±11.03	14.36±10.14	15.06±12.59	15.70±12.15	15.63±11.67	12.89±10.80*	16.43±11.72
	Inpatient Rehabilitation Hospital	18.14±12.82	18.49±7.95	18.57±10.50	17.90±10.49	21.23±14.12	19.17±11.26	19.32±8.92	20.05±8.14
	Convalescent Hospital	21.15±6.48	21.97±7.82	21.54±7.02	21.19±7.15	20.14±7.97*	22.12±6.18	22.68±7.71	20.70±5.91*
	Outpatient Rehabilitation Therapy	18.62±8.35	12.88±7.09	15.62±12.71	8.91±9.36*	25.93±19.03	19.20±10.46	12.14±7.45*	24.20±10.40
	Total Mean	16.01±12.46*	16.16±10.40	16.72±10.29	17.37±11.09	17.95±11.84	18.16±10.67	16.83±10.50*	18.64±9.63
Chronic	General Hospital	16.99±16.78	13.87±9.84*	10.96±8.83*	12.53±9.48*	17.50±13.66	13.39±9.88*	14.90±9.84	13.49±9.48*
	Inpatient Rehabilitation Hospital	22.45±10.56	22.53±7.22	20.73±9.57	18.97±8.77*	20.30±7.55	21.55±10.13	19.49±10.44*	23.46±8.41
	Convalescent Hospital	22.59±6.11*	23.11±6.10	27.07±4.40	25.64±5.15	26.70±5.01	24.29±5.82*	26.40±5.15	24.58±6.11*
	Outpatient Rehabilitation Therapy	8.07±9.45*	11.41±9.85*	5.76±7.97*	16.84±12.70	27.97±9.21	10.68±7.49*	10.16±8.65*	5.50±7.04*
	Total Mean	19.68±13.08	19.38±9.18	19.39±10.73	20.95±9.28	23.51±9.53	20.71±9.16	20.96±9.78	21.99±8.69

Values are presented as days (mean ± SD).

*One Way ANOVA was used, p-value < 0.05

Table 3. The total and mean medical utilization days and income grade of employed insured

		Employed insured							
		Insurance holder (high → low)				Beneficiary (high → low)			
		1	2	3	4	1	2	3	4
Acute	General Hospital	11.39±8.72	12.50±10.67	11.73±9.18	11.18±8.35	13.66±10.56*	14.56±11.53	15.46±10.71	14.03±10.72*
	Inpatient Rehabilitation Hospital	17.13±12.14	19.35±9.03	18.47±13.46	15.90±12.23	17.67±9.36*	19.46±10.44	19.85±10.51	20.50±9.65
	Convalescent Hospital	26.00±2.30	22.23±3.76	24.25±5.15	23.51±8.38	20.74±7.18	20.09±7.02	21.46±6.36	21.87±7.10
	Outpatient Rehabilitation Therapy	7.50±11.09	6.50±6.03	15.44±4.39	18.06±15.20	11.10±7.52*	14.71±9.59	16.53±11.72	12.50±8.20
	Total Mean	12.63±9.62	13.26±10.21	14.28±10.59	12.78±9.74	16.84±9.79	17.10±10.53	17.95±10.05	17.45±10.29
Chronic	General Hospital	12.91±13.77	13.50±12.19	6.63±4.70*	8.73±7.72*	12.81±9.90	12.10±9.15	13.75±9.73	10.07±8.68*
	Inpatient Rehabilitation Hospital	24.91±7.01	17.79±7.84*	23.77±10.48	15.20±9.51*	20.13±8.94*	21.21±8.80	22.37±10.95	21.56±9.20
	Convalescent Hospital	31±00.	25.04±2.63*	24.15±3.28*	27.79±4.09	24.77±5.83	24.30±5.86	25.43±5.21	23.97±6.30*
	Outpatient Rehabilitation Therapy	1.00±0.00	13.00±10.69	10.96±12.22	3.69±6.18	8.81±10.78	12.02±11.07	12.85±11.83	11.98±11.40
	Total Mean	16.65±13.24	19.28±9.72	14.96±11.02	15.15±11.25	20.94±9.25	19.99±9.52	21.61±9.59	20.40±9.46

Values are presented as days (mean ± SD).

*One Way ANOVA was used, p-value < 0.05

P 1-2

Cortical Activation Pattern after Long-term Gait Training with Wearable Hip-assist Robot in Elderly

Su-Hyun Lee^{1*}, Hwang-Jae Lee^{1,2}, Dong-Seok Kim², Won Hyuk Chang¹, Byung-Ok Choi³, Gyu-Ha Ryu⁴, Yun-Hee Kim^{1,2†}

Samsung Medical Center, Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular Stroke Institute, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea¹, Samsung Medical Center, Department of Health Sciences and Technology, Department of Medical Device Management & Research, Department of Digital Health, SAIHST, Sungkyunkwan University², Samsung Medical Center, Department of Neurology, Neuroscience Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Korea³, Samsung Medical Center, Office of Biomechanical science, Research Center for Future Medicine, Samsung Medical Center, Sungkyunkwan University, Seoul, Korea⁴

Objective

The purpose of this study was to investigate the effect of the long-term gait training with wearable hip-assist robot on cortical activation pattern during walking in elderly persons.

Methods

Seven elderly persons (mean age, 74±6.24, 3 males) participated. A wearable type hip-assist robot, Gait Enhancing Mechatronic System (GEMS, Samsung Electronics Co., Ltd., Korea), was used. Participants received over ground gait training with GEMS in various environments, 24 sessions for consecutive 8 weeks. Cerebral oxygenation was measured by oxyhemoglobin (OxyHb) concentration using the 49 channels of functional near infrared spectroscopy (fNIRS) imaging system (NIRScout, NIRx Medical Technology, LLC, Germany) covering bilateral prefrontal cortices (PFC), premotor cortices (PMC), supplemental motor areas (SMA), and lower limb sensorimotor cortices (SMC). Cortical activation was assessed at pre- and post-intervention, and at 4 weeks follow-up time points.

Results

After completion of 24 gait training sessions with GEMS, we observed less OxyHb concentration over bilateral SMCs, SMAs, and PMCs in the late period of gait, between 31 and 60 seconds after initiating walking task ($p < .05$). These changes were maintained until 4 weeks after the cessation of training ($p < .05$).

Conclusion

The long-term intensive gait training in elderly persons with GEMS demonstrated decreased activity of specific cortical regions related with gait which might represent increased efficiency of cortical neural resources during walking.

P 1-3

A kinematic analysis during stair climbing in frail elderly subjects

Hyo Seon Choi^{1*}, So Young Park², Sun Mi Lee², Yejin Jo², Hyung Cheol Shin³, Joonyoung Jung³, Ju Sun Kim⁴, Deog Young Kim^{4†}

Nowon Eulji Medical Center, Eulji University, Seoul, Department of Rehabilitation Medicine¹, Yonsei University College of Medicine, Seoul, Research Institute of Rehabilitation Medicine², Electronics and Telecommunications Research Institute, Daejeon, Wearable Computing Research Section³, Yonsei University College of Medicine, Seoul, Department and Research Institute of Rehabilitation Medicine⁴

Introduction

With aging and frailty, the deterioration of the ability to climb stairs constitutes a major source of disability and a factor contributing to the loss of autonomy. The aim of this study was to investigate the kinematic characteristics of stair climbing in frail elderly.

Methods

Fifteen frail elderly subjects and fifteen young adult controls were recruited for this experiment. The frailty was defined as $\geq 3/5$ on the Korean version of the FRAIL (K-FRAIL) scale. The all subjects underwent three-dimensional motion analysis (VICON MX-T10 Motion Analysis System) during stair ascent with laboratory three steps staircase. The kinematic and the spatiotemporal parameters were compared between groups using the independent t-test.

Results

In the sagittal plane, the frail elderly group presented greater anterior pelvic tilt angles than the young adult group during stair climbing ($p < 0.05$). Compared to the young adult group, the frail elderly group demonstrated greater hip flexion angle at initial contact, less maximal hip extension angle in the stance phase, and greater maximal hip flexion angle during swing phase ($p < 0.05$). The frail elderly group also demonstrated smaller knee flexion and ankle dorsiflexion angles than the young adult group at initial contact ($p < 0.05$). In the coronal plane, the frail elderly group demonstrated less maximal pelvic upward obliquity and greater maximal knee varus angles than the young adult group during stair climbing ($p < 0.05$). In the transverse plane, the frail elderly group presented greater maximal hip internal rotation and external rotation angles than the young adult group during stair climbing ($p < 0.05$) (Table 1). Spatiotemporal characteristics of frail elderly group showed decreased cadence and velocity, and increased stride time and stance time ratio compared to young adult group ($p < 0.05$) (Table 2).

Conclusion

The Results showed that frail elderly subjects had the different kinematic alterations in the pelvis, hip, knee, and ankle compared to young adults during stair climbing. This study provides data for use in basic research into safe gait on stairs for frail elderly people.

ACKNOWLEDGMENTS This work was supported by the ICT R&D program of MSIT/ IITP

Table 1. Comparison of kinematic variables between frail elderly subjects and young adults in stair climbing

	Frail elderly (N=15)	Young adult (N=15)	p value
(unit: degree)			
Pelvis			
Maximum pelvic tilt during stair climbing	27.15±4.79	19.05±4.16	<0.001
Mean pelvic tilt during stair climbing	22.92±4.87	16.69±3.95	0.001
Maximum pelvic upward obliquity during stair climbing	4.90±2.82	7.59±2.36	0.009
Maximum pelvic downward obliquity during stair climbing	-7.34±3.30	-7.82±1.79	0.626
Maximum pelvic internal rotation during stair climbing	7.52±3.50	7.23±3.16	0.812
Maximum pelvic external rotation during stair climbing	-7.03±4.78	-7.05±4.29	0.991
Hip			
Hip flexion angle at initial contact	66.80±5.58	59.87±5.95	0.003
Maximum hip extension angle during stance phase	-20.00±6.79	-14.34±5.62	0.019
Maximum hip flexion angle during swing phase	79.98±6.16	65.60±6.56	<0.001
Maximum hip internal rotation during stair climbing	19.84±7.72	13.95±5.61	0.024
Maximum hip external rotation during stair climbing	-31.75±15.54	-14.96±6.40	0.001
Maximum hip adduction angle during stair climbing	10.06±3.43	10.06±3.43	0.297
Maximum hip abduction angle during stair climbing	-7.36±2.81	-8.16±3.10	0.462
Knee			
Knee flexion angle at initial contact	53.69±10.82	60.82±6.99	0.041
Maximum knee extension angle during stance phase	14.13±5.20	16.95±4.49	0.122
Maximum knee extension angle during loading response	59.44±8.06	62.41±4.02	0.216
Maximum knee flexion angle during swing phase	98.20±9.21	95.74±5.92	0.391
Maximum knee varus angle during stair climbing	35.58±10.80	22.66±5.62	<0.001
Ankle			
Dorsiflexion angle at initial contact	3.81±6.07	11.44±5.11	0.001
Maximum dorsiflexion angle during stance phase	17.00±3.31	18.61±2.80	0.161
Maximum plantarflexion angle at push off	-23.28±8.66	-17.85±5.18	0.050
Maximum dorsiflexion angle during swing phase	18.18±4.05	18.37±4.98	0.909

Positive values indicate pelvic anterior tilt, pelvic upward obliquity, pelvic internal rotation, hip flexion, hip adduction, hip internal rotation, knee flexion, knee varus and ankle dorsiflexion, while negative values indicate pelvic external rotation, hip extension, hip abduction, hip external rotation and ankle plantarflexion.

Table 2. Comparison of spatiotemporal variables between frail elderly subjects and young adults in stair climbing

	Frail elderly (N=15)	Young adult (N=15)	p value
Cadence (steps/min)	56.60±14.76	77.38±9.42	<0.001
Stride Time (s)	2.28±0.70	1.57±0.21	0.002
Step Time (s)	1.77±1.11	1.47±0.46	0.341
Stance Time (%)	73.27±5.35	63.83±3.42	<0.001
Swing Time (%)	26.73±2.35	36.17±3.42	<0.001
Single Support (%)	16.20±2.03	17.38±2.81	0.199
Double Support (%)	67.59±4.05	65.24±5.63	0.199
Gait Velocity (meter/s)	0.32±0.08	0.43±0.05	<0.001

Appearance of transcallosal fibers from the injured corticospinal tract by intensive rehabilitation

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A 57-year-old, right-handed male patient was diagnosed as hemorrhagic transformation following an infarction in the region of the left middle cerebral artery. He underwent craniectomy at three days after onset and cranioplasty at six months after onset. In addition, he underwent rehabilitation from one month to two years after onset at several rehabilitation hospitals. At two years after onset, he was admitted to the rehabilitation department of our hospital for intensive rehabilitation. The patient showed severe weakness of his right upper and lower extremities including complete weakness of finger extensors and ankle dorsiflexors (Motricity Index [MI]: 38/100). Brain magnetic resonance imaging revealed leukomalactic lesions in the left fronto-parieto-temporal areas including the entire primary somatosensory-motor cortex (Fig. 1-A). He underwent intensive rehabilitation, including repetitive transcranial magnetic stimulation therapy (rTMS; MAGPRO, Medtronic Functional Diagnostics, Skovlunde, Denmark) using a precentral knob, 10 Hz frequency, 80% motor threshold intensity, and a total of 160 pulses for 8 minutes repeated in 14 sessions per week, for facilitation of the right (unaffected) corticospinal tract (CST) [1], neurotrophic drugs (pramipexole: 0.5 mg, ropinirole: 1.85 mg, amantadine: 300 mg, and levodopa: 750 mg), and muscle wash and motor branch blocking of the tibial nerve using alcohol were used to relieve spasticity of the right finger flexors and ankle plantarflexors, respectively. As a result, at five weeks after starting the intensive rehabilitation at our hospital, his motor weakness showed mild recovery, particularly his right finger extensors and ankle dorsiflexors (MI: 48/100; right finger extensor and ankle dorsiflexor: 2-/5). Diffusion tensor images were obtained twice (at 2 years, and at 2 years and 5 weeks after onset) by using a sensitivity-encoding head coil on a 1.5-T Philips Gyroscan Intera (Hoffman-LaRoche, Best, Netherlands). Three-dimensional reconstructions of the fiber tracts were obtained by using the PRIDE tracking tool (Philips, Best, Netherlands). The termination criteria were fractional anisotropy < 0.2 and angle < 60° [2]. Two regions of interest were drawn in the CST areas of the mid-pons and the upper medulla on the two-dimensional fractional anisotropy color maps. Diffusion tensor tracking revealed that the left CST was discontinued in the left subcortical white matter on the 2-year images, but, on the 2-year and 5-week images, the discontinued left CST was shown to be connected to the right hemisphere via the transcallosal fibers (Fig. 1-B). An ipsilateral motor pathway via the transcallosal fibers from the unaffected motor cortex to the affected extremities has been suggested as a motor recovery mechanism in stroke [3-5]. Motor outcome via this mechanism has been reported to be effective as patients have been able to perform grasp-release with the affected hand [3, 4]. In the present case, with intensive

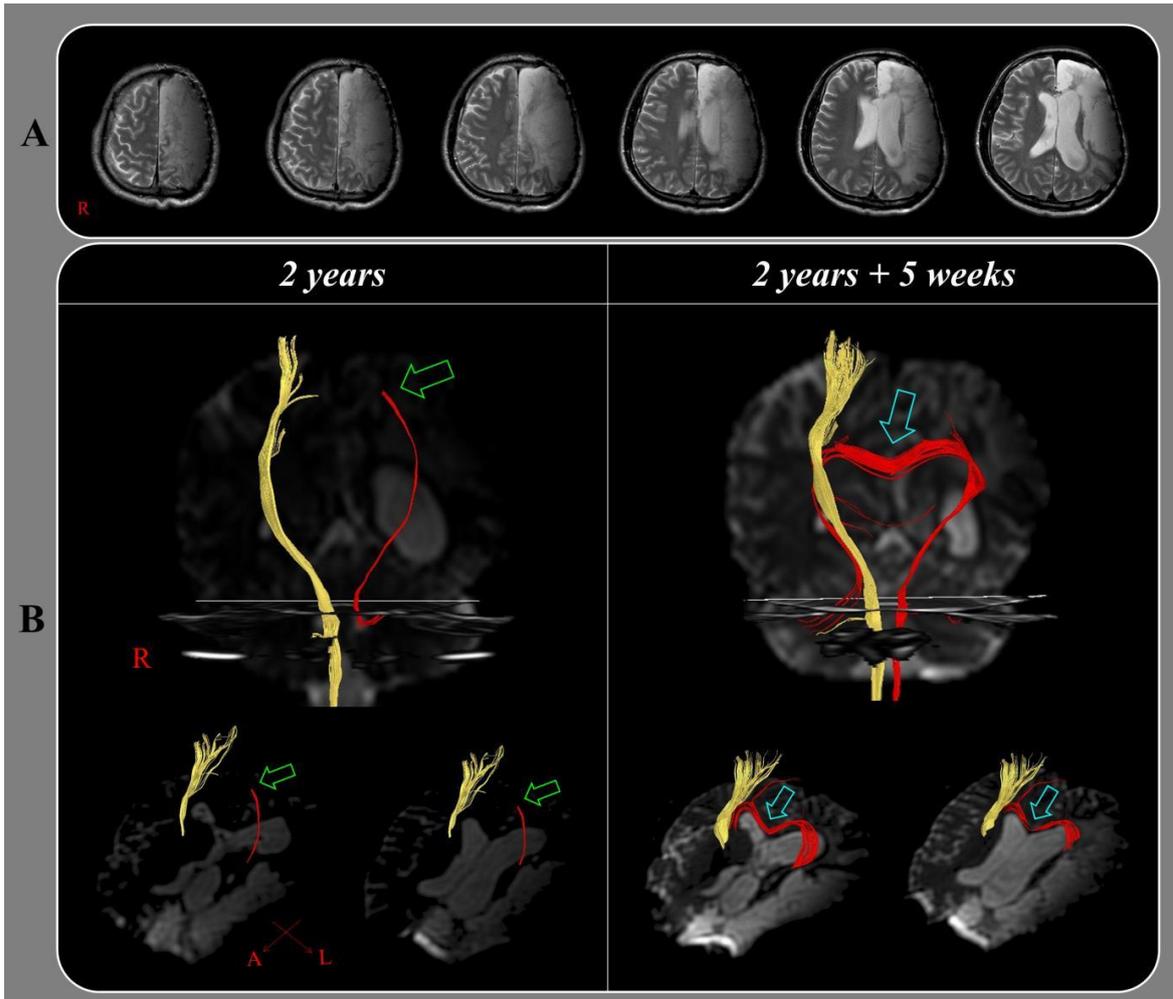


fig1. T2-weighted magnetic resonance images at two years after onset show leukomalactic lesions in the left fronto-parieto-temporal areas including the entire primary somatosensory-motor cortex.

Effect of Inhibition of DNA Methylation Combined with Task-Specific Training on Chronic Stroke Recovery

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Objective

To develop new rehabilitation strategies for chronic stroke, this study examined the effectiveness of task-specific training (TST) and TST combined with DNA methyltransferase inhibitor in chronic stroke recovery.

Methods

Rats underwent a photothrombosis surgery to impair the sensorimotor cortex. Eight weeks after stroke, animals were trained on the staircase test. 5-Aza-dC infusion was started on the contralesional hemisphere using an osmotic pump and lasted for 28 days after stroke. During 5-Aza-dC delivery, animals were exposed to TST for 4 weeks. Functional recovery was assessed using the staircase test, the cylinder test, and the modified neurological severity score (mNSS) every 2 weeks. A biotinylated dextran amine tracer was injected into the non-lesioned forelimb sensorimotor cortex at the end of behavioral test, to determine axonal plasticity in the corticospinal tract (CST). Expression of BDNF was determined by Western blotting on contralateral motor cortex tissues.

Results

TST and TST combined with 5-Aza-dC significantly improved the skilled reaching ability in the staircase test and ameliorated the mNSS scores and cylinder test performance. TST and TST with 5-Aza-dC significantly increased the crossing fibers from the contralesional red nucleus, reticular formation in medullar oblongata, and dorsolateral spinal cord. Mature BDNF was significantly upregulated by TST and TST combined with 5-Azd-dC. Functional recovery after chronic stroke may involve axonal plasticity and increased mature BDNF by modulating DNA methylation in the contralesional cortex.

Conclusion

Our Results suggest that combined therapy to enhance axonal plasticity based on TST and 5-Aza-dC constitutes a promising approach for promoting the recovery of function in the chronic stage of stroke. **Keywords:** stroke; chronic stage; task-specific training; DNA methylation; axonal plasticity; functional recovery; mature brain-derived neurotrophic factor

Kinetic Modeling of the Hyoid Movement Revealed Co-Contraction of Protractor and Retractor Muscles

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Background

The hyoid bone movement is essential for safe and effective swallowing. The muscles that exert forces on the hyoid bone during swallowing can be categorized into three groups according to the direction of force; Forward (“Protractor” muscle group), downward (“Depressor”) and back-upward (“Retractor”) muscle groups. The aim of this study was to establish and validate a kinetic model of hyoid movement during swallowing based on the Results of hyoid motion analysis.

Methods

A total of 8 healthy adults were recruited and underwent the videofluoroscopic swallowing study (VFSS) with the simultaneous surface electromyography (sEMG) recording. A thin liquid of diluted barium sulfate of 2 mL was administered to the participants. The antero-inferior margin of the hyoid bone was digitized and the Results were calculated using in-house MATLAB script and Statistics Toolbox (R2014b; MathWorks, Natick, MA, USA). The sEMG was recorded with the reference electrode attached on the chin and the active electrode on the submandibular area, which was expected to be over the suprahyoid muscles. The sEMG and VFSS data were synchronized using a cue signal at the start of recording. The synchronization of the VFSS images and sEMG was achieved by a simultaneous signaling through custom-made printed circuit board. A kinetic model was made with the following assumption: (1) the linear elasticity modulus of the protractor/retractor/depressor of 0.0231/0.0173/0.0347, (2) a constant 1 to 1 ratio of repulsive to attractive linear modulus, (3) when a force vector is calculated at a moment, the force is assumed to have been generated by combination of possible minimal forces of 3 muscle groups at the moment.

Results

The model showed consistent earlier recruitment of the retractors as compared to the protractors (Fig 1). The difference between onset latency of the EMG bout and the modeled protractors was 0.532 s (95% CI, 0.265-0.798). Rather, the onset latency difference between the sEMG and the retractors was much smaller (0.225; 95% CI, 0.086-0.363). The peak of sEMG coincided with the peak activity of the retractors, but not with the protractors (Fig 2).

Conclusion

Synchronized EMG and kinetic modeling of the hyoid movement revealed the co-contraction of the protractors and retractors at the beginning of swallowing. Surprisingly enough, the maximal exertion of the suprahyoid muscles occurs at the maximal retractor activity. More complex kinetic modeling with incorporation of co-contraction and eccentric contraction should be needed.

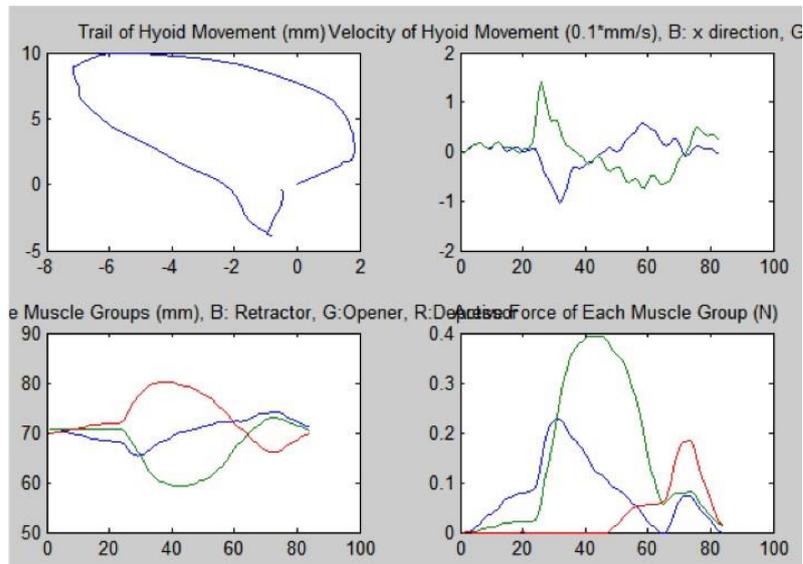


Figure 1. The sequential processes of the kinetic modeling of hyoid movement during swallowing. Upper left. A Trail of the hyoid movement during swallowing. Upper right. Velocity of the hyoid bone during swallowing (blue, horizontal movement; green, vertical movement). Lower left. The calculated changes in the length of each muscle group. Lower right. The active muscle force calculated from the length change in (blue, retractor; green, protractor; red, depressor)

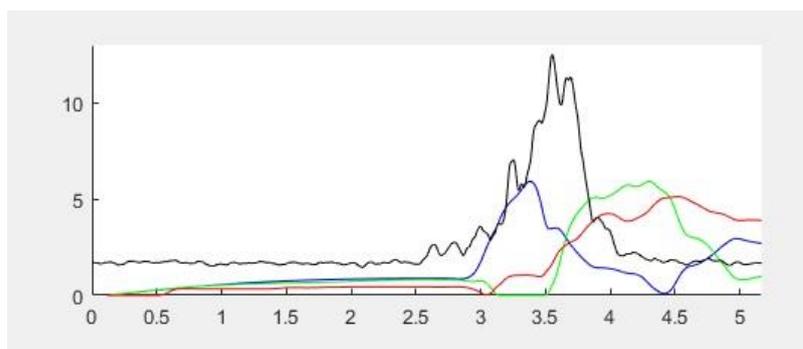


Figure2 The modeled muscle activities (blue, retractor; green, protractor; red, depressor) and the measured sEMG (black). The modeled peak activity of the retractors coincides with the measured peak sEMG activity.

Onset latency	sEMG	Retractor	Depressor	Protractor
No.1	2.227	2.367	2.400	2.467
No.2	1.947	2.283	2.967	2.817
No.3	1.989	2.300	2.767	2.833
No.4	0.432	0.517	0.583	0.850
No.5	2.435	2.683	2.650	2.717
No.6	3.099	3.217	3.383	3.900
No.7	2.523	2.883	3.050	3.500
No.8	3.184	3.833	3.667	4.067
Peak latency	sEMG	Retractor	Depressor	Protractor
No.1	2.663	2.900	2.883	2.900
No.2	2.451	2.850	3.517	3.350
No.3	2.537	2.867	3.483	3.300
No.4	0.591	0.633	0.633	1.333
No.5	3.183	3.000	4.017	4.117
No.6	3.551	3.683	4.450	4.250
No.7	3.552	3.383	4.500	4.300
No.8	3.792	3.983	4.633	4.583

Onset latency and peak latency of sEMG and kinematic modeling of each muscle group.

P 1-7

Difference in ARAS between persistent vegetative and MCS following putaminal hemorrhage

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Objectives

We investigated differences in the ascending reticular activating system (ARAS) of persistent vegetative state (PVS) and minimally conscious state (MCS) patients following putaminal hemorrhage (PH).

Methods

We recruited 17 patients with PH, and classified them into PVS (7 patients) and MCS (10 patients) groups. Eight parts of the ARAS were reconstructed: the dorsal lower ARAS, ventral lower ARAS, whole upper ARAS, prefrontal cortex (PFC)-upper ARAS, premotor cortex-upper ARAS, primary motor cortex-upper ARAS, primary somatosensory cortex-upper ARAS, and posterior parietal cortex-upper ARAS. For each ARAS part, diffusion tensor tractography (DTT) parameters (fractional anisotropy [FA] and tract volume [TV]) were estimated.

Result

The FA value did not differ significantly among the eight parts of the ARAS between the PVS and MCS groups ($p > 0.05$). The TV value of the PFC-upper ARAS was significantly lower in the PVS group than in the MCS group. There were no other significant TV differences in other parts of the ARAS ($p < 0.05$).

Conclusions

The sole ARAS difference between PVS and MCS patients following PH was a decrement in neural fibers in the PFC-upper ARAS in PVS patients compared to MCS ones. Based on the Results, it appears that the prefrontal portion of the upper ARAS is a critical area when discerning between PVS and MCS in patients with PH.

Table 1. Demographic data of the patients in the persistent vegetative state and minimally conscious state groups.

	PVS	MCS
Patient number (Male:Female)	7 (3:4)	10 (7:3)
Mean age (years)	55.71 ± 13.23	58.21 ± 10.23
GCS	7.71 ± 1.80	13.38 ± 2.26
CRS-R	5.86 ± 1.02	19.63 ± 3.21
Mean duration to DTI (months)	4.29 ± 1.39	6.50 ± 3.65

Values indicate mean ± standard deviation, PVS: persistent vegetative state, MCS: minimally conscious state, GCS: Glasgow Coma Scale, CRS-R: Coma Recovery Scale-Revised, DTI: diffusion tensor imaging.

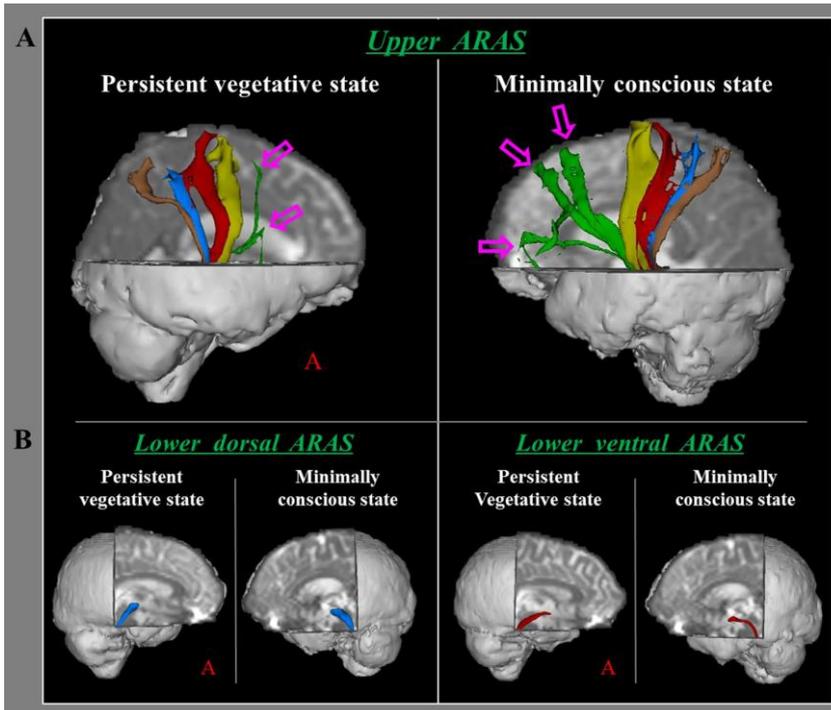
Table 2. Comparison of diffusion tensor tractography parameters between the persistent vegetative state and minimally conscious state groups.

		PVS	MCS	<i>p</i> -value
Dorsal ARAS	FA	0.19±0.21	0.29±0.14	0.41
	TV	76.29±99.01	283.43±213.19	0.69
Ventral ARAS	FA	0.18±0.17	0.30±0.14	0.79
	TV	63.44±85.10	257.50±182.74	0.53
Upper ARAS	FA	0.23±0.05	0.26±0.06	0.21
	TV	4486.20±1741.38	5301.60±2067.14	0.30
PFC	FA	0.15±0.17	0.21±0.18	0.35
	TV	148.75±229.61	493.56±607.61	0.04*
PMC	FA	0.17±0.13	0.20±0.18	0.45
	TV	756.45±334.51	1102.23±645.48	0.31
M1	FA	0.19±0.18	0.23±0.20	0.28
	TV	721.11±411.31	1217.54±774.51	0.16
S1	FA	0.15±0.14	0.19±0.11	0.11
	TV	564.88±313.46	841.56±311.64	0.17
PPC	FA	0.16±0.15	0.20±0.18	0.21
	TV	664.49±345.65	911.57±546.66	0.41

PVS: persistent vegetative state, MCS: minimally conscious state, ARAS: ascending reticular activating system, PFC: prefrontal cortex, PMC: premotor cortex, M1: primary motor cortex, S1: primary somatosensory cortex, PPC: posterior parietal cortex, FA: fractional anisotropy, TV: tract volume.

Values indicate mean ± standard deviation

*: indicates significant difference between the persistent vegetative state and minimally conscious state groups, $p < 0.05$



Results of diffusion tensor tractography (DTT) for the eight parts of the ascending reticular activating system (ARAS) of two representative patients, one in a persistent vegetative state (PVS: 51-year-old male) and the other in a minimally conscious state (MCS: 56-year-old male)

P 1-8

Effects of head lift exercise on swallowing function according to reclining angle in stroke patients

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BACKGROUND

Recently, HLE in a reclining position was introduced, and the potential for therapeutic effects was confirmed by surface electromyography. However, the clinical evidence of the effect is still lacking.

OBJECTIVE

The purpose of this study was to compare the effects of HLE in the supine position and HLE in a reclining position, on swallowing function in patients with dysphagia after stroke.

METHODS

Thirty-five patients with stroke and dysphagia were randomly assigned to either the HLE in supine position group (n=18), or the HLE in a 45-degree angle reclining position group (n=17). Both groups performed HLE 5 days a week for 4 weeks and received the same conventional dysphagia therapy. The primary outcome measures were evaluated using videofluoroscopic dysphagia scale (VDS) based on videofluoroscopic swallowing study. Secondary outcome measures were evaluated using functional oral intake scale (FOIS). Finally, this study checked the dropout rate and subjective feedback.

RESULTS

In total, 25 participants completed this study. Both groups showed significant improvement in the oral and pharyngeal phase of VDS and FOIS ($p < 0.05$). After the intervention, there were no significant differences between groups ($p > 0.05$). In addition, 4 of 18 patients undergoing HLE in the supine position, and 1 of 17 patients undergoing HLE in a reclining position dropped out of the study due to neck discomfort, temporary pain, or fatigue.

CONCLUSIONS

This study suggests that both exercises have similar effects in patients with dysphagia after a stroke. However, compliance is considered to be better in the group of patients undergoing HLE in a reclining position than that in the patients undergoing HLE in a supine position because it is less strenuous to perform HLE in a reclining position.

Table 1. Characteristics of participants

Characteristics	HLE group(n=13)	RHLE group(n=12)
Age(year),mean±SD	63.00±10.55	63.40±6.65
Gender (male/female)	7/6	6/6
Type of stroke (Hemorrhage/Infarction)	6/7	7/5
Side of stroke (Right/Left)	5/8	7/5
Time since onset of stroke months, mean ± SD	3.00±1.18	3.90±1.28

SD: standard deviation.

Table 2. Comparison of results between both group

	HLE group				reclined HEL group				Between groups P-values
	Before treatment	After treatment	Mean difference	p-value	Before treatment	After treatment	Mean difference	p-value	
VDS (Score)									
Oral phase	13.86(5.24)	26.63(10.27)	12.77(5.08)	.005*	10.55(4.43)	20.30(8.69)	9.75(4.31)	.005*	.055
Pharyngeal phase	37.54(7.60)	71.81(14.44)	34.27(6.97)	.003*	29.95(9.05)	58.10(17.51)	28.15(8.60)	.005*	.120
FOIS (Score)	3.27(0.78)	4.82(0.40)	1.55(0.68)	.000*	3.20(1.31)	4.20(1.13)	1.00(0.66)	.001*	.089
Dropout-rate related compliance (%)	18	14		22 %	17	16		6%	

The values are mean (standard deviation), VDS:videofluoroscropydysphagia scale, FOIS: functional oral intake scale
*p< 0.05 by Mann Whitney Utest, †p<0.05 Wilcoxon signed ranktest.

The Effect of Continuous Positive Airway Pressure Treatment in Subacute Stroke Patients with OSA

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Objective

Sleep-disordered breathing can cause acute neurologic deterioration and prolonged hospital stay in stroke patients, which affects short-term and long-term prognosis after stroke. Obstructive sleep apnea (OSA) in stroke patients is associated with worsening functional and cognitive status during inpatient rehabilitation. Continuous positive airway pressure (CPAP) is the primary treatment for obstructive apnea. The aim of this study was to evaluate the effectiveness of CPAP treatment in stroke patients during inpatient rehabilitation period using neuropsychological and functional assessments.

Materials and Methods

We performed a randomized controlled trial in subacute stroke patients (ischemia and hemorrhage) admitted to department of rehabilitation medicine after November 2017. To diagnose OSA, we performed sleep examination by portable polysomnography (Stardust II™, Respironics Inc. USA). Obstructive sleep apnea was diagnosed when Apnea-Hypopnea index (AHI) is higher than 20/h. Patients were randomly divided to 2 groups as follow : control group (rehabilitation treatment as usual) or CPAP group (CPAP treatment). Baseline clinical data were evaluated at the time of admission to department of rehabilitation medicine. We assessed stroke severity, neurologic function, cognitive impairment, and quality of life. Quality of sleep was assessed by using Epworth Sleepiness Scale (ESS). Tests were performed at baseline and after the two-week of intervention period.

Results

Thirty nine patients participated in this study, 16 patients were excluded from the study. Because they were not OSA patients. Twenty three OSA patients were included. There was no difference in improvement of National Institute of Health Stroke Scale (NIHSS), modified Rankin scale (mRS), functional ambulation categories (FAC), Korean version modified Barthel Index (K-MBI), Berg balance scale (BBS) and EuroQol 5 dimensions questionnaire (EQ-5D) between two groups (CPAP vs control group). The CPAP group showed improvement in daytime sleepiness and cognitive function (Table 2 and 3). In polysomnographic study, the CPAP group showed improvement in obstructive apnea, hypopnea and Apnea-Hypopnea index compared with the control group (Table 2).

Conclusion

Continuous positive airway pressure treatment improved cognitive status, quality of sleep and daytime sleepiness in stroke patients with OSA. Additional patient enrollment is

required to determine the effects of CPAP treatment on cognitive and functional status in subacute stroke patients.

Table 1. Clinical characteristics of intervention group and non-OSA patients

	CPAP (n=13)	Control (n=10)	Non-OSA (n=16)	Total (n=39)	<i>p</i> value
Age (years)	63.8±13.8	71.4±11.7	58.1±16.4	63.4±15.0	0.088
Sex, n (men/women)	8/5 (61.5/38.5%)	7/3 (70.0/30.0%)	12/4 (75.0/25.0%)	27/12 (69.2/30.8%)	0.736
Type of stroke, n (ischemic/hemorrhagic)	8/5 (61.5/38.5%)	9/1 (90.0/10.0%)	12/4 (75.0/25.0%)	29/10 (74.4/25.6%)	0.300
Lesion type, n (Supratentorial/ Infratentorial)	10/3 (76.9/23.1%)	7/3 (70.0/30.0%)	16/0 (100.0/0.0%)	33/6 (84.6/15.4%)	0.077
HTN (+/-)	4/9 (30.8/69.2%)	2/8 (20.0/80.0%)	9/7 (56.3/43.8%)	15/24 (38.5/61.5%)	0.142
Diabetes (+/-)	10/3 (76.9/23.1%)	8/2 (80.0/20.0%)	13/3 (81.3/18.8%)	31/8 (79.5/20.5%)	0.959
MoCA-K	16.0±9.1	13.2±10.9	13.1±10.7	14.1±10.1	0.718
NIHSS	7.0±4.1	5.7±5.4	6.5±4.5	6.5±4.5	0.801
MMSE	18.2±8.7	18.7±8.6	15.7±10.8	17.3±9.4	0.678
FAC	1.4±1.7	1.7±1.9	2.3±1.7	1.8±1.8	0.373
mRS	3.9±1.3	3.5±1.3	3.4±1.2	3.6±1.2	0.538
BBS	16.5±19.2	25.5±23.1	33.8±21.8	25.9±22.0	0.109
K-MBI	40.5±30.3	51.3±33.1	52.9±25.5	48.3±29.0	0.494
EQ-5D	0.2±0.3	0.4±0.3	0.5±0.2	0.4±0.3	0.165
ESS	6.1±6.6	7.3±6.6	4.2±2.8	5.6±5.4	0.340
Obstructive apnea	29.4±17.6	15.1±9.8	3.7±3.4	15.2±15.8	0.000*
Hypopnea	9.4±9.6	9.9±5.8	2.2±3.2	6.6±7.4	0.005*
Total apnea	48.0±17.9	29.3±9.1	7.2±5.1	26.5±21.2	0.000*

OSA, Obstructive sleep apnea; MoCA-K, Korean version of Montreal Cognitive Assessment; NIHSS, Korean version of the National Institute of Health Stroke Scale; MMSE, Korean version of Mini-Mental State Examination; FAC, functional ambulation categories; mRS, modified Rankin Scale; BBS, Berg Balance Scale; K-MBI, Korean version modified Barthel index; EQ-5D, EuroQol-5 Dimension; ESS, Epworth Sleepiness Scale

Table 2. Comparison of daytime sleepiness index and polysomnographic data between CPAP and control group

	CPAP (n=13)	Control (n=10)	Total (n=23)	p value
Δ ESS	2.3 \pm 2.4	-1.3 \pm 4.4	0.7 \pm 3.8	0.019*
Δ obstructive apnea	12.8 \pm 14.0	1.4 \pm 7.6	7.8 \pm 12.8	0.031*
Δ Hypopnea	1.8 \pm 8.9	4.8 \pm 5.2	3.1 \pm 7.5	0.356
Δ AHI	18.0 \pm 14.8	4.5 \pm 11.2	12.1 \pm 14.8	0.026*

CPAP, Continuous positive airway pressure; ESS, Epworth Sleepiness Scale; AHI, Apnea-Hypopnea index

Table 3. Comparison of clinical outcome between CPAP and control group

	CPAP (n=13)	Control (n=10)	Total (n=23)	p value
Δ NIHSS	1.4 \pm 1.0	0.9 \pm 1.3	1.2 \pm 1.2	0.330
Δ MMSE	3.8 \pm 2.8	2.2 \pm 2.3	3.1 \pm 2.7	0.079
Δ FAC	0.7 \pm 0.9	0.8 \pm 1.0	0.7 \pm 1.0	0.797
Δ mRS	0.8 \pm 0.7	0.7 \pm 0.8	0.7 \pm 0.8	0.833
Δ BBS	6.8 \pm 5.9	9.9 \pm 11.8	8.2 \pm 8.8	0.423
Δ K-MBI	15.2 \pm 11.5	15.2 \pm 9.5	15.2 \pm 10.4	0.992
Δ EQ-5D	0.2 \pm 0.2	0.2 \pm 0.3	0.2 \pm 0.2	0.752

CPAP, Continuous positive airway pressure; NIHSS, Korean version of the National Institute of Health Stroke Scale; MMSE, Korean version of Mini-Mental State Examination; FAC, functional ambulation categories; mRS, modified Rankin Scale; BBS, Berg Balance Scale; K-MBI, Korean version modified Barthel index; EQ-5D, EuroQol-5 Dimension

P 1-10

Effects of Dual-site Transcranial Direct Current Stimulation on Motor Function

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Objective

This study aimed to investigate the effect of dual-site transcranial direct current stimulation (tDCS) application over the primary motor cortex (M1) and premotor cortex (PMC) on neurophysiologic and hemodynamic changes of motor cortical activity and hand function in healthy young subjects.

Materials and Methods

Twenty-three right-handed healthy subjects (11 females; mean age 29.5±3.92 years) participated in this single-blind, randomized cross-over study. Participants reported no history of neurological or psychiatric symptoms. Stimulation consisted of two channels of a single continuous direct current delivered by two battery-driven stimulators. In each channel, simultaneous anodal tDCS (1 mA, 30 min) was delivered. Four conditions were randomly applied to all participants through 4 experimental sessions with 24 hours of washout period between each session: Condition 1, simultaneous application of anodal tDCS on the Rt. M1 with cathodal tDCS on Lt. M1 and sham tDCS on Rt. PMC; Condition 2, simultaneous application of sham tDCS on bilateral M1 and anodal tDCS on Rt. PMC; Condition 3, simultaneous sham stimulation tDCS on the bilateral M1 and Rt. PMC; Condition 4, simultaneous stimulation on bilateral M1 and Rt. PMC. Changes of motor evoked potentials (MEPs) were examined before (T0), immediately after (T1) and 30 minutes after (T2) the stimulation for each condition. In addition, the hemodynamic responses were recorded as oxyhemoglobin concentration changes by an fNIRS system (NIRScout®, NIRx Medical Technologies, Germany) at T0 and T1. Total 74 channels consisted of 24 sources and detectors mainly covered motor cortical areas. An fNIRS paradigm consisted of alternating resting state and sequential finger tapping task with their non-dominant hand for 6 minutes.

Results

In condition 1, 2, and 3, increment of MEP amplitudes was observed at T1 and T2 but there was no statistical significance compared to T0. In condition 4, the amplitude of MEP was significantly increased at T2 compared to T0. In fNIRS measurement, single anodal tDCS application on M1 and dual stimulation on M1 and PMC increase the oxyhemoglobin activity over the of stimulation sites.

Conclusions

The dual-site tDCS application on both M1 and PMC showed more long-lasting effect than single site stimulation in neurophysiological measure without additional discomfort. In addition, fNIRS measurement demonstrated more cortical activities in dual-site stimulation than single stimulation. To confirm the potential of dual-site tDCS as a neuromodulation method for neurorehabilitation, its effect on motor function of healthy or diseased subjects are needed to investigate.

P 1-11

Visualization and quantitative analysis of skeletal muscle NMES by 18F-FDG PET/CT scan

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Objectives

To visualize the skeletal muscle contractions generated by neuromuscular electric stimulation (NMES) using 2-deoxy-2-[fluorine-18]fluoro- D-glucose integrated with computed tomography (18F-FDG PET/CT) and to evaluate relationship between muscle contraction force and FDG uptake amount.

Methods

18F-FDG PET/CT were scanned after muscle contraction stimulation with NMES on both Vastus Medialis (VM) muscles of 10 healthy males with a mean age of 25.0 ± 2.7 years. Before NMES stimulation, maximum isometric knee extension strength was evaluated with dynamometer and then electric stimulation level was determined as intensity generating 5% of the maximum extension peak torque. Subjects were undergone total 40 minutes of electric stimulation before scan. In the middle of stimulation, 15 minutes of break time were given and the FDG were administered intravenously to subjects at the end of the break time. PET/CT images were obtained immediately after the second 20 minutes of electric stimulation. To quantify the FDG uptake of VM, the volume of interest, 18 F-FDG PET / CT images were reconstructed in 3-dimensional voxels and the amount of radioactivity was estimated. The Standard Uptake Value (SUV) was calculated by dividing amount of radioactivity in VM by the FDG units per body weight administered.

Results

Average NMES stimulation intensity was 9.3 ± 6.9 mA and range were 20-45 mA. The torque generated by the NMES stimulus averaged 8.6 ± 2.2 Nm and ranged 5-13 Nm. The SUV value averaged 803.8 ± 279.2 and ranged 477-1441. Throughout the group, the torque and SUV value did not clearly correlate. But the ratios of SUV to torque for same subject showed good consistency in both left and right VM (Intraclass correlation coefficient = 0.7, 95% CI 0.16-0.91).

Conclusion

The effect of skeletal muscle contraction by NMES could be visualized by 18FDG-PET/CT. It was also found that calculated amount of FDG uptake in PET / CT images reflects the strength of contraction.



Figure 1. NMES stimulation of Vastus Medialis



Figure 2. ^{18}F -FDG PET/CT image of Vastus Medialis after NMES

P 1-12

Synergic regenerative effects of PDRN and microcurrent on full-thickness rotator cuff tear in rabbit

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Daegu Catholic University Medical Center, Department of Anatomy²

Objective

The aim of this study was to investigate regenerative effects of ultrasound (US)-guided injection with polydeoxyribonucleotide (PDRN) injection with micocurrent therapy (MT) in a chronic traumatic full thickness rotator cuff tendon tear (FTRCTT) in a rabbit model.

Methods

Rabbits (n = 24) were allocated into 3 groups. After a 5-mm sized FTRCTT just proximal to the insertion site on the subscapularis tendon was created by excision, the wound was immediately covered by silicone tube to prevent natural healing. After 6 weeks, 3 different treatment regimens (0.2 mL normal saline, G1-SAL; 0.2 mL PDRN with Sham MT, G2-PDRN+ShamMT, ShamMT; 0.2 mL PDRN with MT, G3-PDRN+MT) were performed into FTRCTT under US guidance. G2-PDRN+SHAMMT+Sham MT was injected with 0.2mL PDRN, weekly four injections and sham MT for 4 weeks after the first PDRN injection. G3-PDRN+MT was injected with 0.2mL PDRN, weekly four injection and MT was applied daily for 1 hours for 4weeks. We evaluated gross morphologic changes on all rabbits after sacrifice. Proliferating cell nuclear antigen, vascular endothelial growth factor and platelet endothelial cell adhesion molecule stain were performed to evaluate histological changes. Motion analysis was also performed.

Results

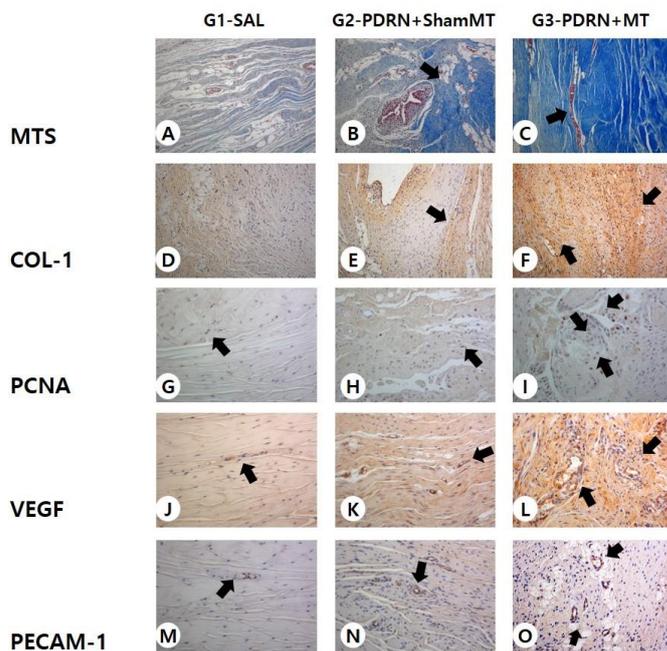
The gross morphologic mean tendon tear size in G3-PDRN+MT was significantly smaller than that of G1-SAL and G2-PDRN+SHAMMT+Sham MT ($p < .05$). In G3- PDRN+MT, regenerated collagen type 1 fibers, angiogenesis, walking distance, fast walking time, and mean walking speed were greater than in the other two groups on histological examination and motion analysis.

Conclusions

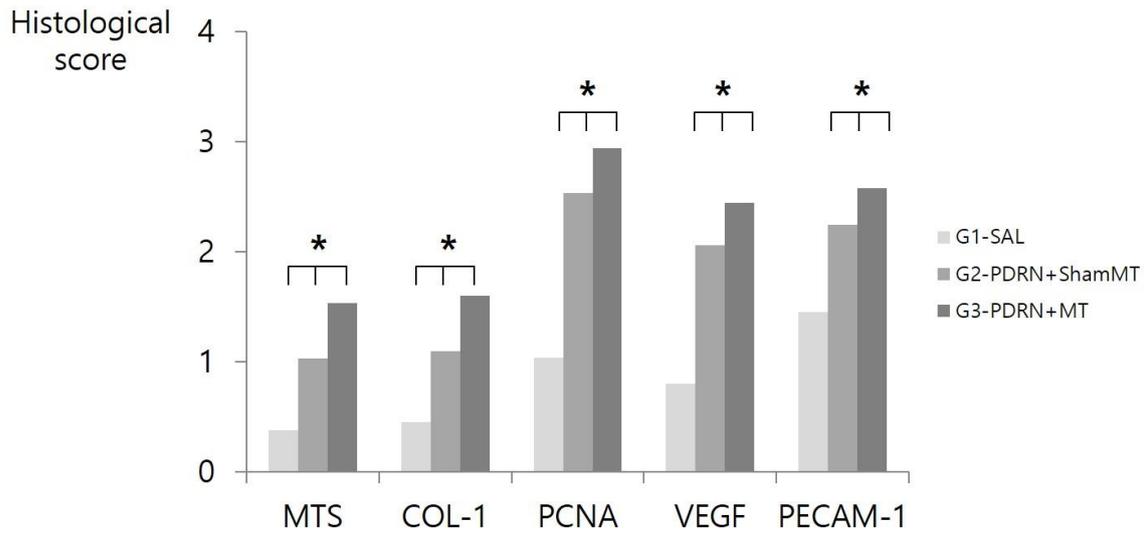
Combined therapy of PDRN with MT was more effective than PDRN alone in gross morphologic, histological and motion analysis in a rabbit model of chronic traumatic FTRCTT.

Groups (Injection regimens)			
	G1-SAL (n=8)	G2-PDRN+ShamMT (n=8)	G3-PDRN+MT (n=8)
Gross			
Tear size	15.93±2.33	12.42±1.63 [*]	8.78±3.54 ^{††}
Histological score			
MTS	0.38±0.49	0.98±0.86 [§]	1.53±0.93 ^{¶¶}
Anti-type collagen 1	0.45±0.6	1.1±0.74 [§]	1.6±0.8 ^{¶¶}
PCNA	1.04±0.91	2.53±0.95 [*]	2.94±0.81 ^{††}
VEGF	0.8±0.82	2.06±0.81 [*]	2.44±0.73 ^{††}
PECAM-1	1.45±1.06	2.24±0.7 [*]	2.58±0.71 ^{††}
Motion analysis			
Walking distance(cm)	4852.75±137.27	5514.38±257.25 [*]	6391.38±196.94 ^{††}
Fast walking time(%)	5.62±1.42	7.97±0.82 [*]	10.94±1.14 ^{††}
Mean walking speed(cm/sec)	6.3±0.57	8.21±0.58 [*]	11.98±1.47 ^{††}

The proportion of positive cells of PCNA, VEGF, PECAM-1 was scored as 0 = no cells stained positive, 1 = between 1% and 10%, 2 = between 11% and 33%, 3 = between 34% and 66%, and 4 = between 67% and 100%. PDRN, Polydeoxyribonucleotide; ESWT, Extracorporeal shockwave therapy; MIC, Microcurrent therapy; PCNA, proliferating cell nuclear antigen; VEGF, Vascular endothelial growth factor; PECAM-1, Platelet endothelial cell adhesion molecule.



Immunohistochemical (A-O) findings of the subscapularis tendons in G1-SAL, G2-PDRN+SHAMMT, and G3-PDRN+MT. Newly regenerated tendons are shown in the blue-stained fibers (black arrow; Masson's trichrome stain; X200) in G2-PDRN+ShamMT, and G3-PDRN+MT. Few regenerative collagen fibers were seen in G1-SAL. (A-C) Regenerated tendon fibers (black arrow; X200) were stained with anti-type 1 collagen antibody in G2-PDRN+ShamMT, and G3-PDRN+MT. Few regenerated tendon fibers were seen in G1-SAL. (D-F) Numerous PCNA stained cells (black arrow, X200) were observed in regenerated tendon fibers in G2-PDRN+ShamMT, and G3-PDRN+MT. Few PCNA stained cells were observed in G1-SAL (G-I) Numerous VEGF-positive cells and PECAM-1 positive microvascular densities (black arrows, X200) were observed in G2-PDRN+ShamMT, and G3-PDRN+MT. Few VEGF-positive cells and PECAM-1 positive microvascular densities were observed in group G1-SAL. (M-O)



Semiquantitative score of histological findings, immunoreactivity of stain. The proportion of PCNA-, VEGF-, and PECAM-1-positive cells were scored as detailed in Materials and Methods. *P < .05 one-way ANOVA, Turkey's post hoc test among group. Abbreviations are PDRN : polydeoxyribonucleotide; MIC : Microcurrent therapy; MTS : Masson's trichrome stain; COL-1 : Anti-type 1 collagen stain; PCNA: proliferating cell nuclear antigen; VEGF : vascular endothelial growth factor; and PECAM : platelet endothelial cell adhesion molecule.

P 1-13

Development of a new portable automatic urinary catheterization device: Cadaver study

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Introduction

Neurogenic bladder dysfunction is one of the most important sequelae after spinal cord injury, stroke, traumatic brain injury, or multiple sclerosis. In addition, many geriatric patients show voiding difficulty owing to dementia, Parkinson's syndrome, or benign prostate hypertrophy. Intermittent catheterization (IC) is an effective bladder management strategy for patients with incomplete bladder emptying. However, since self IC requires precise hand functions, the patients with impaired hand function, such as high level spinal cord injury, are difficult to perform and dependent to caregivers. We had developed an automatic urinary catheterization device for the patients with bladder dysfunction and upper extremity impairment. However, the size and design of the device were not applicable in practical environment. Thus, we developed a new small-sized portable device for self catheterization. In this study, we aimed to evaluate the efficacy of the new small portable device for urinary catheterization using fresh cadavers.

Methods

This study was performed using 4 fresh cadavers. At first, the bladder was filled with 400 ml of normal saline through manually inserted urinary catheter. The bladder scanner confirmed that the bladder was filled with saline. Then, the urinary catheterization was done using the newly developed device. The catheterizations were performed 3 times. The ultrasonography was performed on the lower abdomen during the catheterization to confirm whether the catheter was inserted into the bladder. To evaluate effective evacuation, the volume of normal saline discharged through the catheter was measured and the residual volume was evaluated using the bladder scanner.

Results

The catheterization using newly developed device was conducted smoothly without any resistance in all cadavers. In the ultrasonography, the catheter was successfully observed after catheter insertion. The bladders were evacuated well. The average amount of normal saline discharged through catheter from the cadaver was 261.17 ± 25.14 ml. The average amount of residual saline after catheter removal was 113.83 ± 28.69 ml. The urethrovesical junction was not injured during the catheterization.

Conclusion

The newly developed automatic urinary catheterization device could insert the catheter effectively and safely. This device would be a useful tool for the urinary catheterization of spinal cord injury patients.



The urinary catheterization using a new portable automatic device. (A) The catheterization is advanced by the operating part combined with disposable penis cap. (B) The operating part is separated from the penis cap after the catheterization is completed.



The ultrasonographic findings after catheter insertion. Arrows indicate the urinary catheter. Dotted circle is the neck of bladder.

Balanced measure equipment to improve lateral balance in disabled weightlifters

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Objectives

The number of disabled athletes is increasing. And the sports for the disabled are being developed into the elite sports, but with the lack of the expensive specialized equipment for training, it is difficult for Korean disabled athletes to exert the best performance against the developed athletes. In most sports, including 'weight lifting', the balance of body and the power is very important and closely related to the result of the competition. In wheelchair, athletes require the equipments that can provide a feedback on the left and right balance accordingly. In addition, a low-cost equipment is required for the disabled athletes to receive a visual feedback on their own training without professional assistance. Therefore, we suggested the balance measuring equipment and the application that visualized through smart phones and providing the immediate data for the disabled weightlifters.

Methods

We provided the player with information about the balance between left and right during the bench press operation by using balance measuring equipment and smart phone. As shown in Fig. 1, the balance measuring equipment has been designed to allow the mounting of the acceleration sensor in the center of the barbell to identify the left and right balance of the barbell. In order to identify the balance of the player's shoulder and hip on the bench, the load cell sensors have been designed to fit the size of the bench. As shown in Fig. 2, we designed and provided a smart phone application that receives the sensor values from the barbell side and bench side to the Bluetooth module and visually outputs the data. Fig. 3 shows the overall system configuration of the balance measuring equipment. Through the developed equipment, the balance data and equipment were used for the first time use of the equipment for the disabled weightlifters and the training was performed in parallel to re-measure the balance improvement after 6 weeks.

Results

This study was conducted with a bench press training for the disabled using the balance measuring equipment and smart phone. The balance between the barbell side and bench side of the athletes showed a great difference when measured using the balance equipment for the first time. However, the balance of the barbell side was leveled close

to 0 ° by using the equipment for 6 weeks of training. In the case of the balance of the bench, the difference between the left and right pressures was big before using the equipment, but the difference after training was remarkably reduced.

Conclusion

The developed equipment can be used as a low-cost equipment in many aspects, not only for the disabled weightlifters, but also for the non-disabled people with bench presses, or by real-time monitoring of balance in sitting position using bench side sensors. We have improved balance between left and right after training by using the balance measuring equipment and smart phone.

Keywords

Balance, Disabled weightlifting

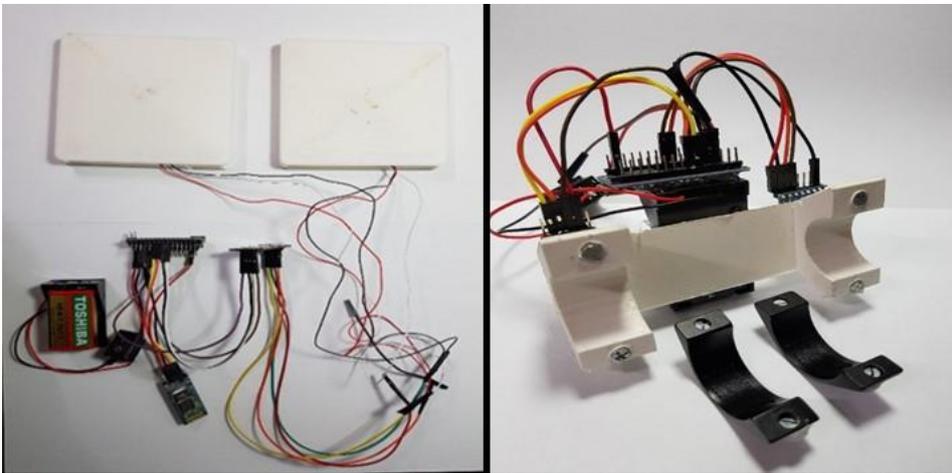


Fig.1 Balance measuring equipment

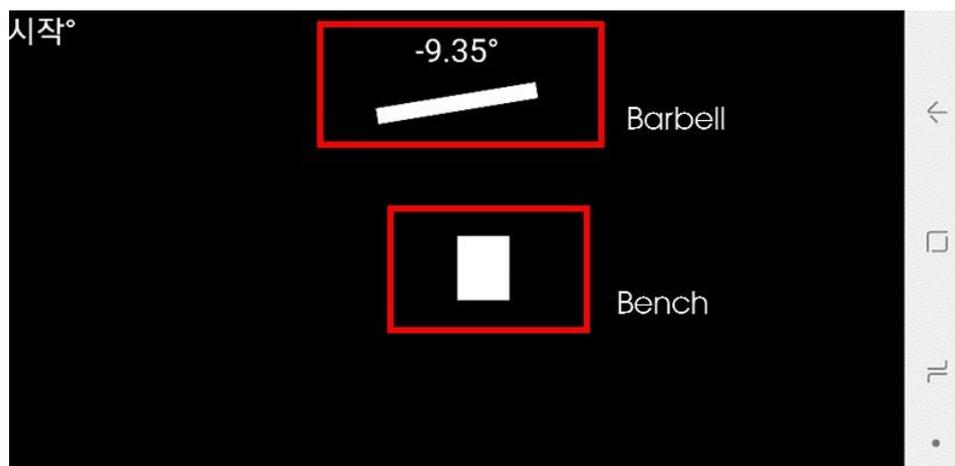


Fig.2 Smart phone application output screen

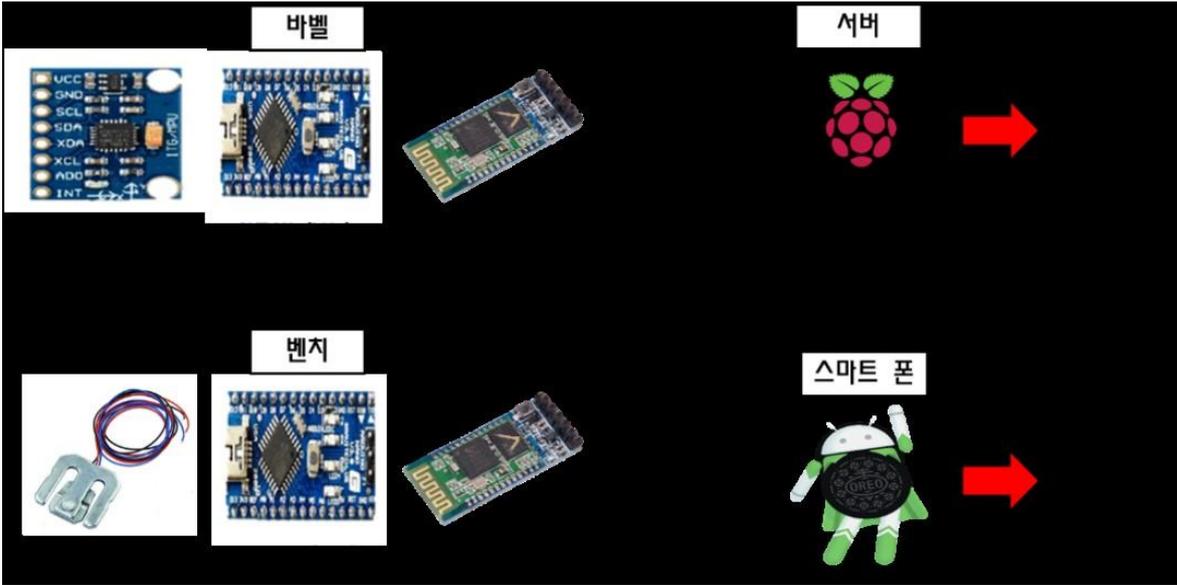


Fig.3 Balance measuring equipment overall system configuration diagram

Mesenchymal stem cells combined with PDRN on full-thickness rotator cuff tendon tear

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BACKGROUND

Beneficial effect of mesenchymal stem cells (MSCs) transplantation is mainly due to paracrine actions in host tissue. However, MSCs therapy has not yet completely regenerated full-thickness rotator cuff tendon tear (FTRCTT) of the shoulder.

Methods

We investigated combined effects of ultrasound (US)-guided human umbilical cord blood-derived (UCB)-MSC with polydeoxyribonucleotide (PDRN) injection in chronic FTRCTT in a rabbit model. New Zealand white rabbits (n = 24) were randomly allocated into three groups (8 rabbits per group). FTRCTT near the insertion site of the subscapularis tendon was created. Three different injectants (G1-S, 0.2 mL UCB-MSCs; G2-P1, 0.2 mL UCB-MSCs with one injection of 0.2 mL PDRN; G3-P4, 0.2 mL UCB-MSCs and weekly four injections of 0.2 mL PDRN) were injected into FTRCTT under US-guidance. We conducted gross morphologic examinations for all rabbits after they were euthanized and classified each tendon tear as complete healing, partial- or full thickness. Masson's trichrome (MT), anti-type 1 collagen antibody (COL-1), bromodeoxyuridine (BrdU), proliferating cell nuclear antigen (PCNA), anti-vascular endothelial growth factor polyclonal antibody (VEGF), and platelet endothelial cell adhesion molecule (PECAM-1) staining were performed to evaluate histological changes. Motion analysis was also performed.

Results

There were significant differences in gross morphologic changes between before injection and at four weeks after injection in all three groups. However, there were no significant differences in tendon tear size among the three groups (fig 1). Immunohistochemistry staining revealed numerous MT stained cells. COL-1 positive cell densities in G2-P1 and G3-P4 were significantly higher than those in G1-S. There was no significant difference in MT or COL-1 staining results between G2-P1 and G3-P4. There were no significant differences in PCNA staining results among the three groups (fig 2,3). On motion analysis, walking distance and fast walking time in G2-P1 and G3-P4 were significantly longer/higher than those in G1-S. There were no significant differences in walking distance or fast walking time between G2-P1 and G3-P4.

Conclusions

These results demonstrated that there was no significant difference in gross morphologic change of tendon tear between UCB-MSCs only and combination with PDRN injection in rabbit model of chronic traumatic FTRCTT. Furthermore, there were no significant differences in regenerative effects between high (0.8 mL) and low (0.2 mL) doses of PDRN.

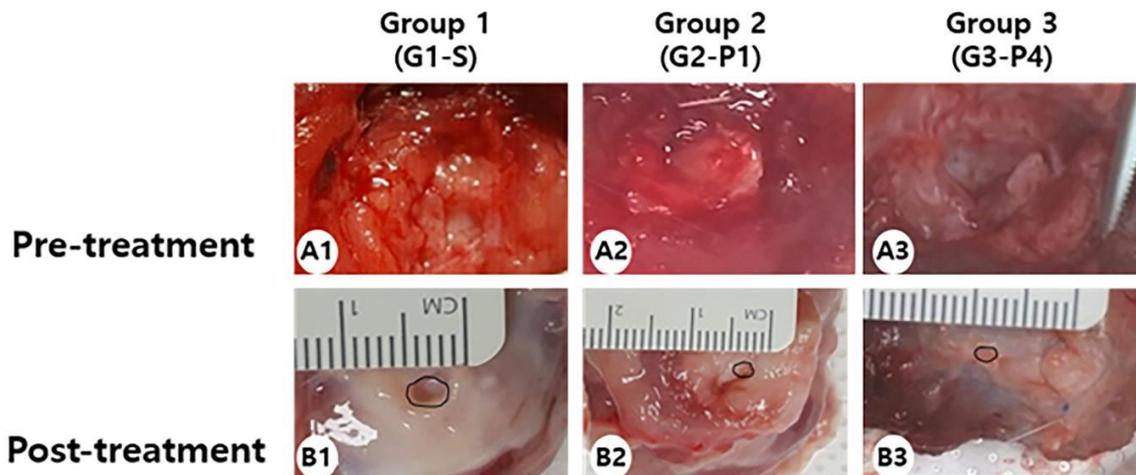


Figure 1. Gross morphological (A1-B3) findings of subscapularis tendons in groups 1, 2 and 3. (A1-A3) Pre-treatment images. FTT is observed in all three groups. (B1-B4) Post-treatment images. There were significant differences in gross morphologic changes between before injection and at four weeks after injection in all three groups.

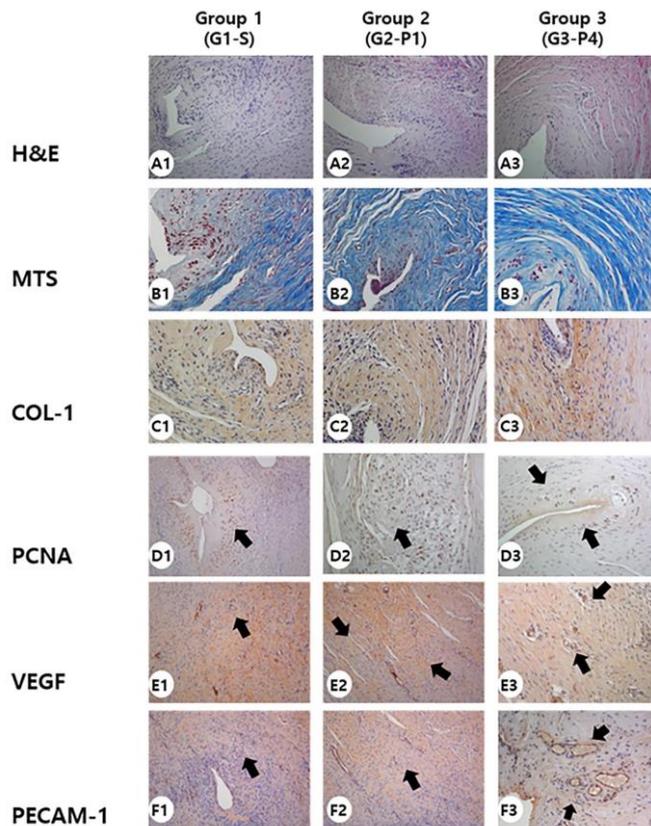


Figure 2. Histologic (A1-F3) findings of subscapularis tendons in groups 1, 2, and 3.

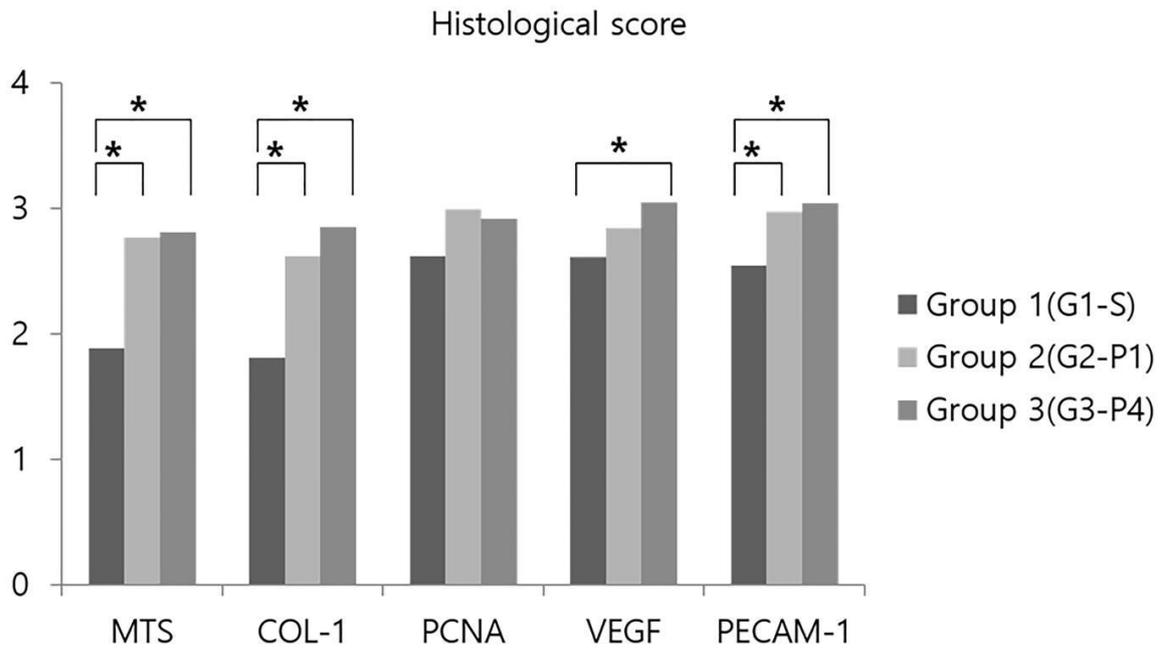


Figure 3. Semiquantitative score of histological findings for immunoreactivity of stain.

The C6 nerve root could be injured during the C7 transforaminal epidural injection procedure.

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Introduction

Cervical transforaminal epidural steroid injections (C-TFESI) are conducted for the management of axial neck pain and upper extremity radiating pain. Generally the C-arm guided procedures are performed, but the soft tissue structures, such as nerve roots or vessels, could not be visualized. The ultrasound guided periradicular injections are performed to overcome the risk of complications. However, the ultrasound guided procedure has limitation of extraforaminal injection. When performing C7 TFESI, many patients complaints the radiating pain on C6 dermatome. This is a pilot study investigating the location of C6 nerve root in the C-arm guided C7 TFESI. We assessed the risk of C6 nerve root injury during C7 TFESI using the ultrasonography.

Method

This pilot study was carried out on the cadavers and the healthy volunteers. We performed the C7 transforaminal epidural needle insertion on the bilateral neck of two fresh cadavers (4 cases of TFESI). Under the C-arm guidance, the needle was inserted in 45 degree and targeted to the anterior to the superior articular process (SAP). After the needle was located in the middle of lateral mass in AP view, we performed the ultrasonography for the evaluation of relation between the needle position and C6 nerve root location. We also performed the ultrasonographic examination on the bilateral neck of ten healthy volunteers (20 cases). The location of C6 nerve root was evaluated using ultrasonography at the level of C7 foramen (SAP level). The subjects were performed the ultrasonography in supine position with neck rotation to the contralateral side. The probe was applied on the bilateral neck of the healthy volunteers in 45 degree with minimal pressure. We defined the virtual needle pathway in C7 TFESI as the space between the anterior border of SAP and the posterior border of internal jugular vein and vertebral artery. If the C6 root located within the virtual needle pathway area, we assessed that there is a risk of injury during the TFESI. If the C6 root located out of the virtual needle pathway, we measured the distance between the anterior borders of SAP and C6 nerve root.

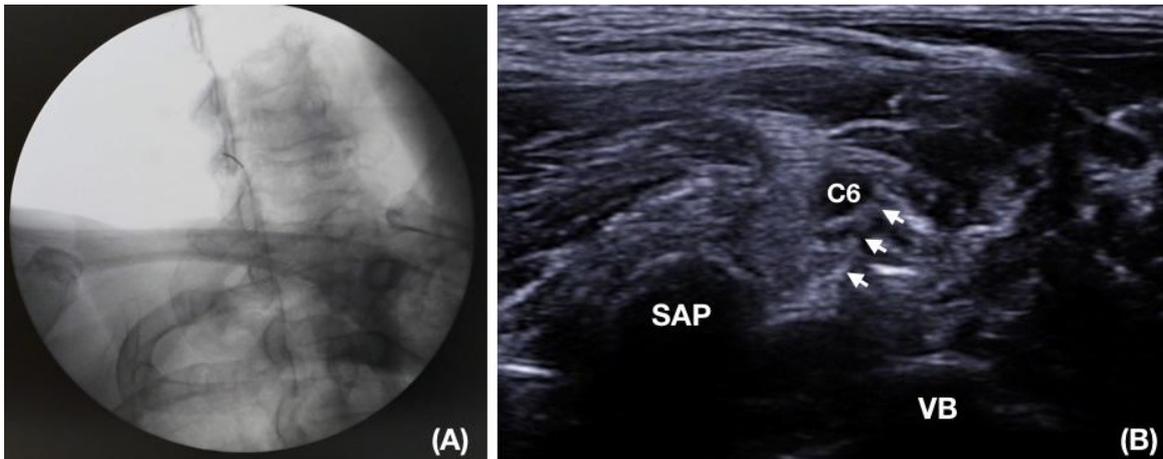
Results

In cadaver study, there was one case in which the C6 nerve root was contact with the needle on the ultrasonographic examination after C7 TFESI. In this case, the C6 nerve root located anterior to the SAP. In other 3 cases, the C6 nerve root located posterior to the anterior border of SAP and away from the needle pathways. In human study, there were 8 cases in which the C6 nerve root was located in the risk zone of injury. However, there

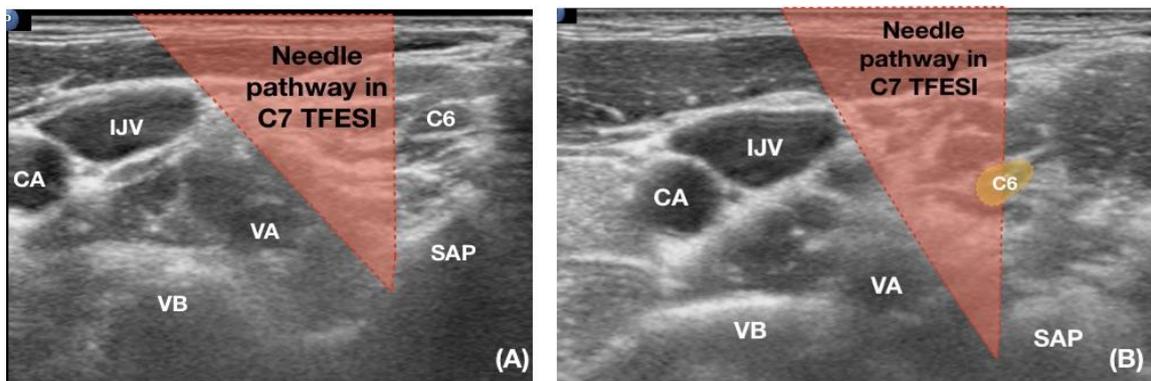
was no case that the C6 nerve root located fully anterior to the SAP. In other 12 cases, the mean distance between the C6 nerve root and the SAP was 4.9 ± 2.5 mm.

Conclusion

This pilot study indicates that the C6 nerve root injury could occur during the C-arm guided C7 TFESI. Careful assessment should be needed about the location of C6 nerve root before the C7 TFESI.



Cadaver study. (A) shows the C7 transforaminal epidural needle insertion under C-arm guide. (B) shows the ultrasonographic findings after the needle insertion. The C6 nerve root contacts with the needle (arrows). VB, vertebral body; SAP, superior articular process.



Ultrasonographic examinations. (A) The C6 nerve root locates outside of the virtual needle pathway. (B) The C6 nerve root locates within the needle pathway. CA, carotid artery; IJV, internal jugular vein; VA, vertebral artery; VB, vertebral body; SAP, superior articular process.

No.	Gender	Age (yr)	Height (cm)	Weight (kg)	Body Mass Index	Risk of injury	Side	Distance between C6 and SAP (mm)
1	M	30	170	70	24.22	Y	R	
	M	30	170	70	24.22	Y	L	
2	M	52	173	70	23.39	N	R	8.22
	M	52	173	70	23.39	Y	L	
3	F	39	165	55	20.2	Y	R	
	F	39	165	55	20.2	N	L	5.57
4	F	30	165	50	18.37	N	R	4.9
	F	30	165	50	18.37	N	L	1.34
5	M	39	178	88	27.77	N	R	2.32
	M	39	178	88	27.77	Y	L	
6	F	46	160	53	20.7	N	R	8.07
	F	46	160	53	20.7	Y	L	
7	F	38	170	52	17.99	N	R	0.37
	F	38	170	52	17.99	Y	L	
8	M	27	171	68	23.26	N	R	4.68
	M	27	171	68	23.26	Y	L	
9	M	31	172	80	27.04	N	R	6.61
	M	31	172	80	27.04	N	L	5.17
10	M	26	172	62	20.96	N	R	5.22
	M	26	172	62	20.96	N	L	6.92

The demographic characteristics, risk assessments and distance measurements of 10 healthy volunteers.

P 1-17

Effect of substrate stiffness and nanotopographic cue in mouse tendon derived stem cell

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Tendon-derived stem cells (TDSCs) are key factors associated with regeneration and healing in tendinopathy and tendon injury. Mechanical stimulation, topographic signals, biochemical factors, and their combinations have been attempted to regulate stem cell differentiation into teno-lineage. We compared TDSCs from normal tendon with TDSCs from tendinopathic tendon and compared characteristics of TDSCs according to the nanotopographic-cues and surface stiffness. TDSCs from 5-week normal tendon showed high expression of type III collagen and tenomodulin on the flat NOA86 substrate. In TDSCs from 5-week tendinopathy and 15-week normal tendon, type III collagen and tenomodulin were high expressed on the 800 nm NOA86 substrate. Gene expression of scleraxis increased on the 800 nm PUA substrate in TDSCs from 5-week normal tendon. In TDSCs from 15-week normal tendon, scleraxis was prominently expressed on the 800 nm nanotopographic signals. However, the expression of type I collagen was not different. These results show therapeutic application needs to be diverse because the effects of substrate stiffness and nanotopographic cues on the TDSCs were different based on the mechanism of tendinopathy. Further in-vivo studies should be conducted to determine how stiffness and nanotopographic cues can be delivered to the TDSCs in the animal model or patients with tendinopathy.

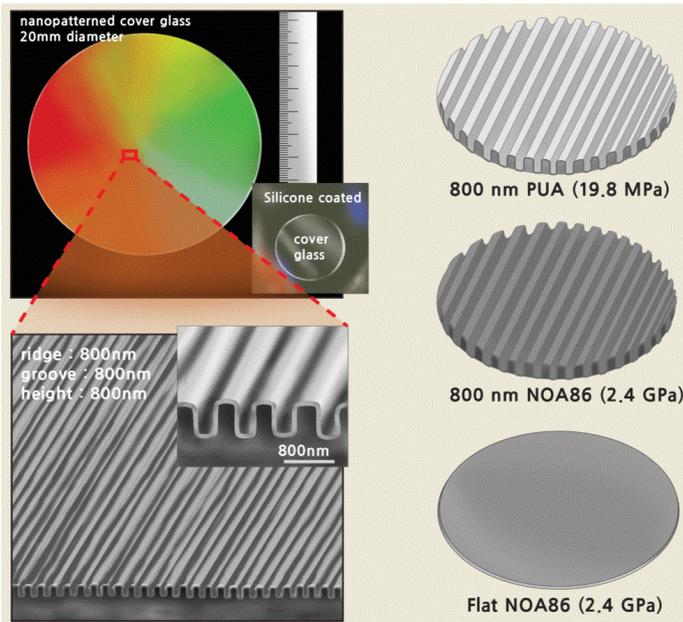
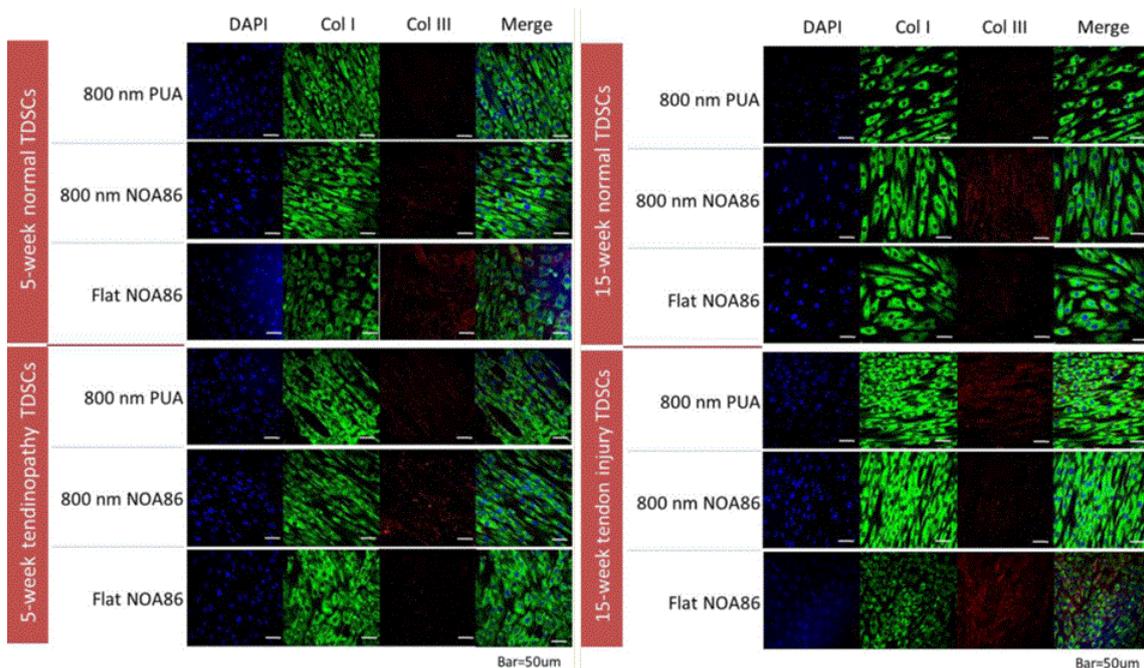
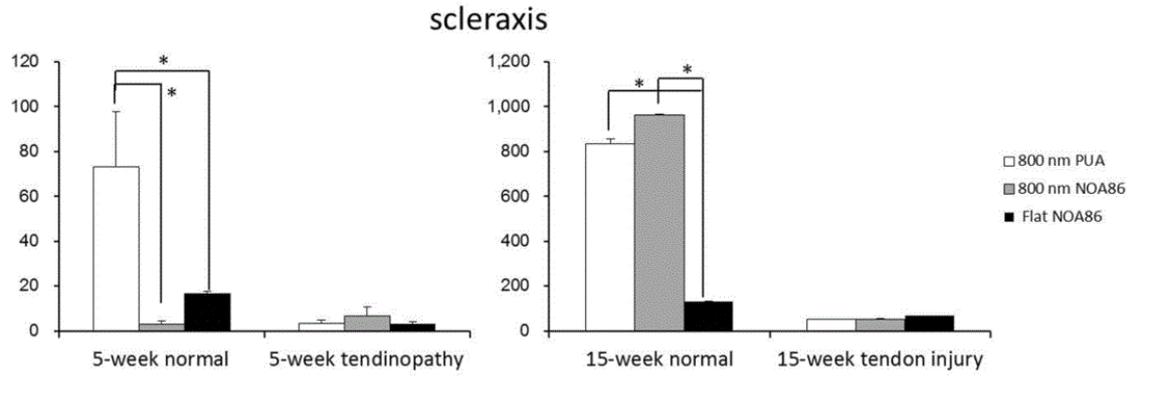


Figure 1. A Norland Optical Adhesive 2.48 GPa stiffness (NOA86) and a polyurethane acrylamide 19.8 MPa (PUA) substrates were prepared to provide an environment with mechanical properties comparable to a developing tendon. The NOA86 and PUA were coated with silicone and carved to create 800-nm-wide nanogrooves for nanotopographic cues. Flat NOA86 with the same stiffness was prepared to determine the effects of nanotopographic cues



Expression of type I and type III collagen was observed in the TDSCs extracted from 5-week normal and 5-week tendinopathy models cultured on the 800 nm NOA86 (2.4 GPa), flat NOA86, and 800 nm PUA (19.8 MPa) substrates. In the 5-week normal condition, high expression of type III collagen was found on the flat NOA86, while this expression was increased on the 800 nm NOA86 in the 5-week tendinopathy model. There was no difference in expression of type I collagen between the substrates. Expression of type I and type III collagen was observed in the TDSCs extracted from 15-week normal and 15-week tendon injury models cultured on the 800 nm NOA86 (2.4 GPa), flat NOA86, and 800 nm PUA (19.8 MPa) substrates. In the 15-week normal tendon model, expression of type III collagen was highly expressed in TDSCs cultured on the 800 nm NOA86 substrates. However, in the 15-week tendon injury model, type III collagen was highly expressed in TDSCs cultured on the 800 nm PUA and flat NOA86 substrate. The expression of type I collagen was not different between the substrates.



Gene expression of scleraxis increased in TDSCs cultured on the 800 nm PUA substrate in the 5-week normal tendon model ($P < 0.01$). In the 15-week normal tendon model, scleraxis was highly expressed in TDSCs cultured on the 800 nm PUA and 800 nm NOA86 substrate ($P < 0.01$). However, the gene expression was not significantly different between the substrates in the 5-week tendinopathy and 15-week tendon injury models.

Stiffness quantification of carpal tunnel structures during hand motion with shear wave elastography

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Introduction

Repetitive use of wrist and finger is well known cause of damage of the median nerve and the soft tissue around it and contribute to development of the carpal tunnel syndrome. The aim of this study is to unveil the stiffness variation of the structures in the carpal tunnel according to the hand and the wrist motions.

Materials and Methods

This study was designed as a prospective, cross-sectional study and 26 healthy volunteers were enrolled (Table 1). Target structures for shear wave velocity (SWV) measurement in the carpal tunnel were median nerve (MN), transverse carpal ligament (TCL), and tendon of flexor digitorum superficialis (FDS) and profundus (FDP). SWV measurement were done transversely at the carpal tunnel inlet (pisiform bone to scaphoid tubercle) of non-dominant hand in combination of the 2 wrist joint motions; wrist neutral and wrist extension(30°), and the 3 finger motions; finger neutral, finger grasp, and finger extension(30°) (Figure 1). Those six wrist-finger motion combinations were named A to F as follows; (A) wrist neutral (0°)-finger neutral (relaxed), (B) wrist neutral-finger grasp, (C) wrist neutral-finger extension, (D) wrist extension (30°)-finger neutral, (E) wrist extension-finger grasp, and (F) wrist extension-finger extension.

Results

SWV (SD, m/s) measured in different structures in the carpal tunnel from position A were as follows; MN 2.3 (0.5), FDS 2.9 (0.2), FDP 3.2 (0.3), and TCL 3.3 (0.4) (Table 2). SWV of position A were then compared with other five wrist-finger positions. MN and FDP showed significantly higher SWV (m/s) in position B to F than position A and in position D to F than A to C. FDS and TCL showed significantly higher SWV in wrist extension position than wrist neutral position and finger grasp and extension position than finger neutral position. SWV of the median nerve cross section area (CSA, mm²) showed no significance among all six positions.

Conclusions

Comparing stiffness among the all six wrist-finger joint motions shows that wrist and finger joint movement increases stiffness of the structures in carpal tunnel compared to

the wrist neutral-finger neutral position. Further study with large sample size and with carpal tunnel syndrome patients should be required to clarify these tendencies.

TABLE 1. Demographics of the participants

Sex, Male/Female(n and %)	20/6 (76.9/23.1)
Age (years, mean±SD) (range)	24.7±3.7 (19-38)
Height (cm, mean±SD) (range)	171.7±6.6 (157-185)
Weight (kg, mean±SD) (range)	69±11.8 (47-90)
Comorbidities (n and %)	
Atopic dermatitis	1/26 (3.8)
Asthma	1/26 (3.8)

TABLE 2. Ultrasonographic and ARFI parameters of the carpal tunnel structures according to the wrist-finger position

	Wrist _{neu} -Finger _{neu}		Wrist _{neu} -Finger _{grasp}		Wrist _{neu} -Finger _{ext}		Wrist _{ext} -Finger _{neu}		Wrist _{ext} -Finger _{grasp}		Wrist _{ext} -Finger _{ext}		<i>p-value</i>
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
MN (m/s)	2.3	0.5	2.7	0.5	2.7	0.4	2.9	0.5	3.0	0.5	3.1	0.5	0.032
FDS (m/s)	2.9	0.2	3.1	0.4	3.2	0.4	3.3	0.4	3.4	0.6	3.4	0.4	0.084
FDP (m/s)	3.2	0.3	3.7	0.5	3.7	0.5	3.7	4.0	4.0	0.9	3.7	0.4	0.000*
TCL (m/s)	3.3	0.4	3.8	0.5	3.7	0.4	3.8	0.4	4.0	0.6	4.1	0.5	0.226
MN_CSA (mm ²)	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.285

* P value <0.05

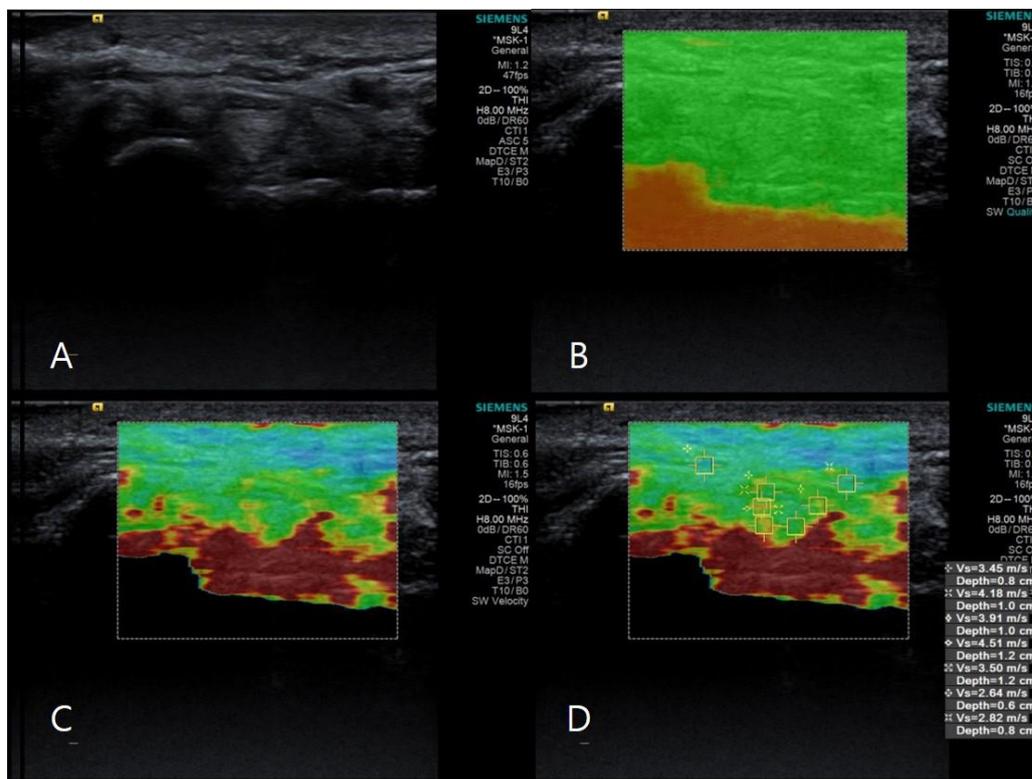


Figure 1. ARFI quantification method

Intra-articular Pressure Characteristics of the Knee Joint

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Objectives

Knee joint synovitis and effusion are common findings of painful knees. It is speculated that, in a closed joint space, pressure profiles by infusing fluid could reveal synovial integrity, joint fluid dynamics, and capsular tightness in various pathologic conditions. To explore potential diagnostic utility of pressure profiles, we investigated the relationships between pressure profiles and clinical and radiological parameters.

Subjects and Methods

We reviewed outpatients records from January 2017 to May 2018 and enrolled 22 subjects who underwent intra-articular cortico-steroid injection with real-time pressure monitoring in painful knees. The pressure profiles created by constant-volume-speed injection were analyzed to characterize the injected volume (V200) at 200 mmHg, maximum pressure (Pmax), and ratio (Rpv= Pmax/Vpmax) of Pmax and the volume at the Pmax. The three pressure parameters were related with the results of McMurray's and knee flexion pain tests, Kellgren-Lawrence (KL) grades by plain X-rays, existence of suprapatellar swelling by ultrasonography.

Results

V200 was substantially larger in knees with negative McMurray's test than in the positive ones (33.07 ± 16.14 ml vs 19.47 ± 7.55 ml, $p=0.040$ by Wilcoxon test). Pmax showed significant relationships with KL grade ($r=0.502, p=0.024$, by Spearman's correlation test), and was 132.47 ± 57.96 mmHg and 219.81 ± 99.79 mmHg at negative and positive McMurray's test, respectively ($p=0.075$). Rpv showed significant relationships with the KL grade ($r=0.472, p=0.036$), While the slope of rising section was higher in knees with positive flexion pain test (4.91 ± 2.87) than in those with negative results (3.63 ± 0.63), it gained no statistical significance.

Conclusions

In this explorative study, knees with positive McMurray test, higher KL grades, tend to reveal steeper slope, lower volume at 200mmHg, and higher maximal pressure, which suggests intra-articular pressure profiles can be utilized to evaluate painful knees after further clinical researches with more specific clinical conditions.

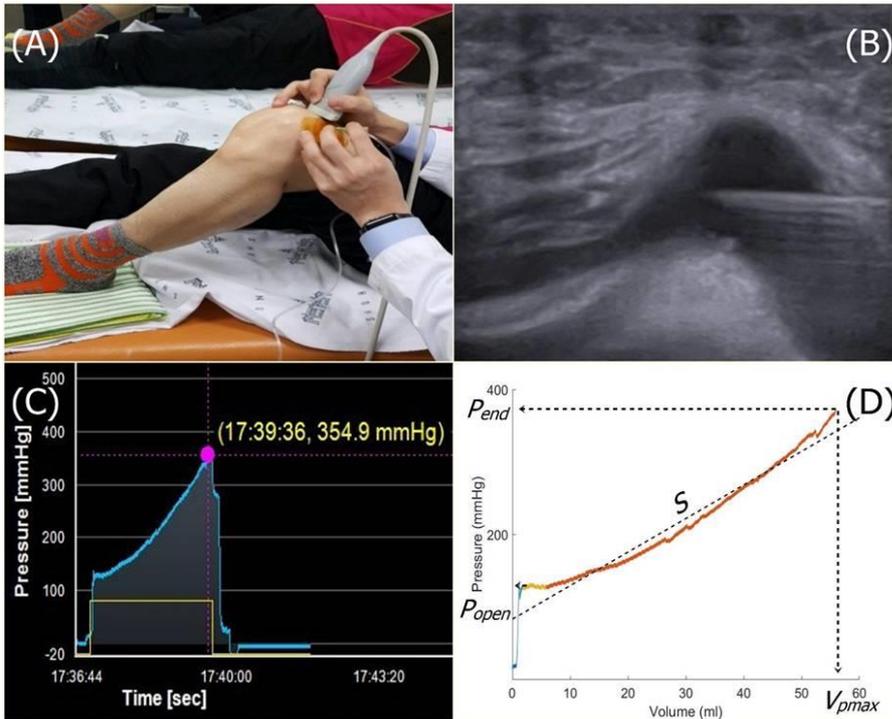


Fig. 1. Insert needle to suprapatellar synovial recess at 90 degrees knee flexion during constant-volume-speed injection (A). The ultrasonography demonstrate exact intra-articular position of needle (B). Generated data from real-time pressure monitor (C) were processed to pressure-volume curve by a MATLAB software (D). The maximum pressure ($P_{max} = P_{end} - P_{open}$), volume (V_{pmax}) at the P_{max} , and slope (S) of rising section (orange curve), were measured.

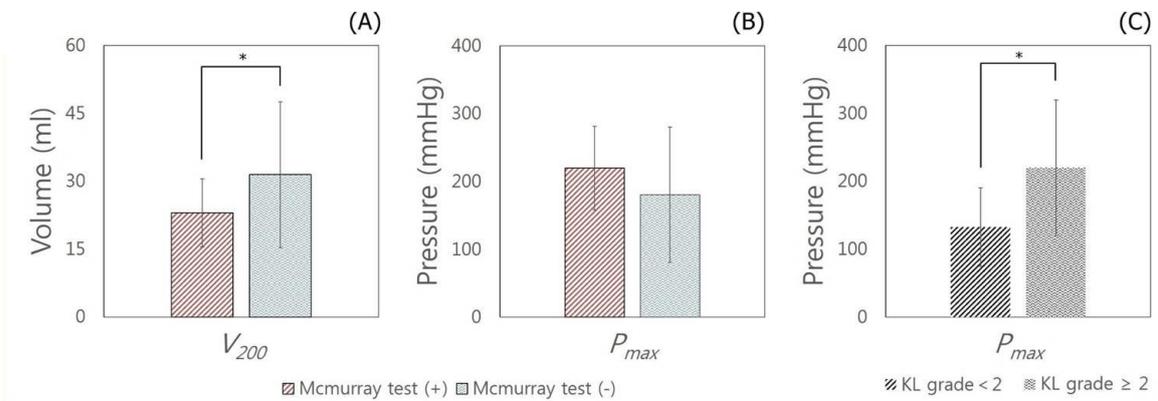


Fig. 2. Comparison of injected volume (V_{200}) at 200 mmHg (A) and maximum pressure (P_{max}) (B). The subjects with positive McMurray's test showed lower V_{200} and higher P_{max} compared with the negative ones. P_{max} also higher at the osteoarthritic knees which more than KL grade 2 (C). * $p < 0.05$

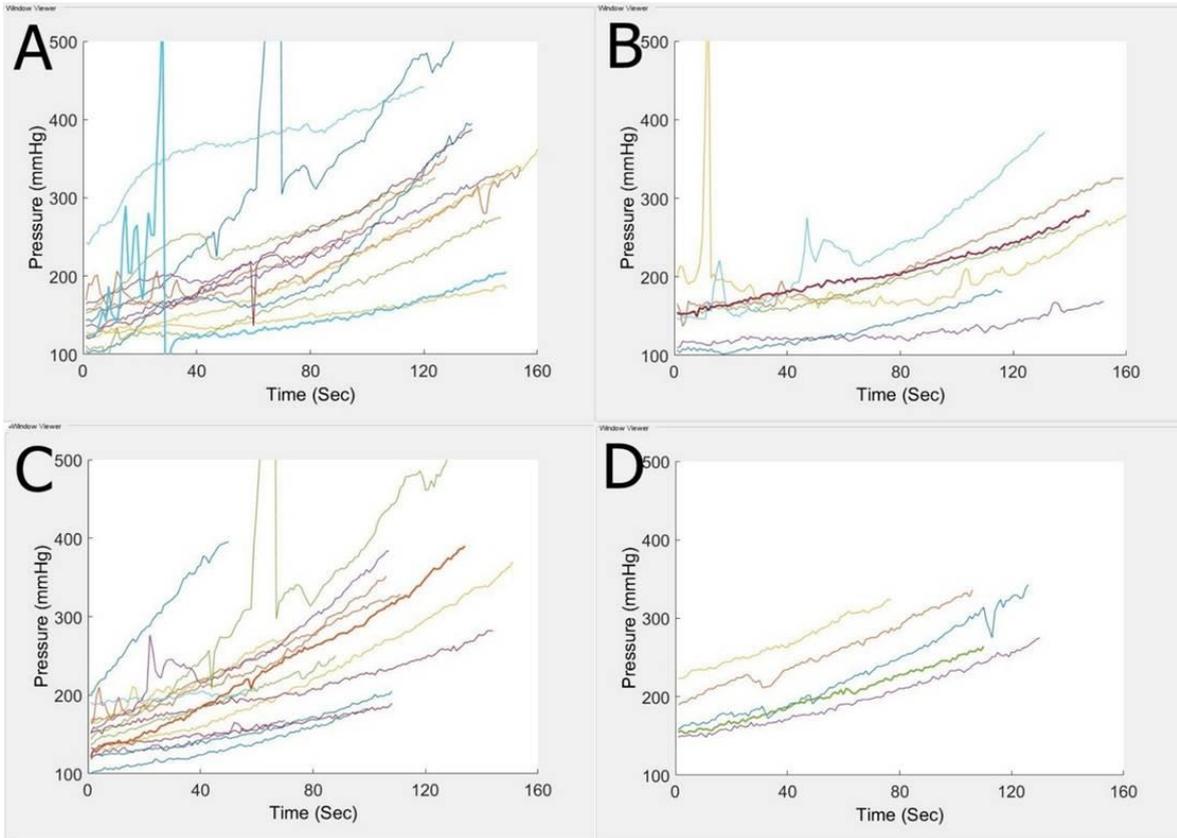


Fig. 3. The upper two stacks of pressure-time graphs show subjects with KL grade more than 2 (A) and under 2 (B). (A) graphs show higher Pmax and Pmax / Vpmax Ratio than (B) graphs ($P < 0.05$). And the both stacks of graphs below, which are rising section of each pressure-time graphs, show subjects with the positive (C) and negative (D) flexion pain test. The mean slope of (C) graphs are higher than (D) graphs, it gains no statistical significance.

EFFECTS OF VIRTUAL REALITY-BASED REHABILITATION ON BURNED HANDS

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Introduction

Hands are the most frequent sites of burn injury, and proper management is essential to assure that optimal functional recovery is achieved. Many interventions have been developed and tried for burn patients, however, hand rehabilitation tool is limited. Virtual reality(VR)-based rehabilitation has been proven to be beneficial on upper extremity function. In this study, we investigated the effects of VR-based based rehabilitation on burned hands, and compare the findings to those of amount-matched conventional rehabilitation in burn patients.

Method

The present study was a single-blinded, randomized controlled trial. The study included 31 burned patients with dominant right-hand function impairment. The patients were randomized to a Smart Glove(SG) group or a conventional intervention(CON) group. The each intervention was applied to the affected hands for four weeks. We evaluated the clinical and functional variables. Hand function was evaluated by the Jebsen-Taylor hand function test(JTT), Purdue pegboard test(PPT), Grasp and pinch power test and Michigan hand function Questionnaire(MHQ). These assessments were evaluated before the intervention and four weeks after the intervention.

Results

The 16 subjects showed significant interval changes in the hand grip strength after the 4 weeks of treatment in the SG group($p<.05$). The times used for conducting each test in the JTT were improved in every domains. Feeding and Checker scores were decreased significantly after SG intervention ($p<.05$). The Scores on hand function items of of the Korean version of Michigan Hand Outcomes Questionnaire(MHQ) were improved. Function, Activity of Daily Living, Satisfy and Pain Scores were significantly improved ($p<.05$). The improvements in the JTT, PPT, grasp and pinch power test, and MHQ scores were significantly greater in the SG group than in the CON group.

Conclusion

The results of this study suggest that the VR-based rehabilitation might be more effective than amount-matched conventional rehabilitation for recovering hand function on burned hand. VR-based rehabilitation may be considered as a treatment option for burned hands

P 1-21

Dysphagia as the First Symptom of Hyperthyroidism without Goiter: A Case report

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Introduction

Dysphagia is a common problem in elderly persons. The exact prevalence of dysphagia is not clear, but there are reports that 15% of elderly persons have dysphagia. Common causes of dysphagia were stroke, Parkinson's disease, and esophageal carcinoma. Hyperthyroidism has been reported as a rare cause of dysphagia. The most likely mechanism is an enlarging goiter which causes direct impingement of esophagus. However, only a few Case reports presented patients with dysphagia due to acute bulbar palsy with unclear muscle wasting in hyperthyroidism. In this Case report, we report a case of dysphagia as the first symptom who was diagnosed as hyperthyroidism and improved dysphagia with anti-thyroid agents and swallowing rehabilitation.

Case report

A 81-year-old man was hospitalized due to recurrent aspiration symptom and cough, sputum for 2 months. He had no specific disease. The vital signs were normal, but intermittent tachycardia was observed. There were no ptosis, ophthalmoplegia and no suspicious symptoms of bulbar palsy such as dysarthria. The neck mass and goiter were not palpated. There were no objective weakness except subjective fatigue. Thyroid function tests showed low level of TSH 0.006 uIU/ml (0.55 - 4.78), and high level of total T3 623.64 ng/dl (60 - 181) and free T4 9.53 ng/dl (0.89 - 1.8). In addition, microsomal Ab increased to 1149.9 U/ml (0 - 60), TSH-receptor-Ab increased to 22.5 IU/L (0 - 1.0) and TS Ab increased to 429.0% (0 - 140). Paraneoplastic antibody was negative. In the first videofluoroscopic swallow study (VFSS), aspiration, oral transit time deterioration, vallecular residue, laryngeal elevation deterioration, pyriform sinus residue and pharyngeal wall coating were observed and measured as penetration-aspiration scale (PAS) 6, videofluoroscopic dysphagia scale (VDS) 39.5. In addition, repeated retching was observed during the examination. The patient was diagnosed with Graves' disease and we started methimazole, propranolol and Lugol solution. The conventional swallowing rehabilitation also provided the patient for 60 minutes a day. After 2 weeks, thyroid function tests showed the improvement as TSH 0.007 uIU/ml, Total T3 194.62 ng/dl, and Free T4 was 1.79 ng/dl. In the second VFSS at 2 week after starting of medication, PAS and VDS were the same as before, but the aspiration disappeared in thick fluid, puree ingestion. Patient started oral feeding with thickener and discharged. Three weeks after, the thyroid function test showed TSH 0.010 uIU/ml, total T3 180.80 ng/dl, and free T4 1.12 ng/dl (Table 1), and dysphagia scales were improved to PAS 2 and VDS 26 in the VFSS (Table 2).

Conclusion:

We present an interesting case of a patient who presented with reversible dysphagia caused by Graves' disease without goiter. Especially in the elderly dysphagia patients, we recommend that dysphagia may be the first symptom of hyperthyroidism.

Table 1. Changes of thyroid function tests

	1 st week	2 nd week	3 rd week
TSH	0.006uIU/ml	0.007uIU/ml	0.010uIU/ml
Total T3	623.64 ng/dl	194.62 ng/dl	180.80 ng/dl
Free T4	9.53 ng/dl	1.79 ng/dl	1.12 ng/dl

Table 2. Changes of videofluoroscopic swallow study

	1 st week	2 nd week	3 rd week
Videofluoroscopic dysphagia scale			
Total score	39.5	39.5	26
Oral phase	3	3	0
Lip closure	0	0	0
Bolus formation	0	0	0
Mastication	0	0	0
Apraxia	0	0	0
Tongue to palate contact	0	0	0
Premature bolus loss	0	0	0
Oral transit time	3	3	0
Pharyngeal phase	36.5	35.5	26
Triggering of pharyngeal swallowing	0	0	0
Vallecular residue	2	2	2
Laryngeal elevation	9	9	9
Pyriform sinus residue	4.5	4.5	0
Coating on the pharyngeal wall	9	9	9
Pharyngeal transit time	0	0	0
Aspiration	12	12	6
Penetration-aspiration scale	6	6	2

Treatment of Oropharyngeal Dysphagia by Lowering Nadir Pressure of the Upper Esophageal Sphincter

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Objective

A cricopharyngeal muscle dysfunction (CPD) has been mainly treated by pneumatic dilatation, cricopharyngeal myotomy or botulinum toxin A(BTA) injection. The manometry of upper esophageal sphincter has been used as a complementary measure for videofluoroscopic swallowing study (VFSS) as diagnostic assessment tools for dysphagia. Previous studies focused on the resting(basal) pressure of upper esophageal sphincter in manometry. However, the correlation between the declining resting pressure and improved dysphagia still remains unclear. Only a few number of reports suggest the nadir(residual) pressure as a possible determinant of esophageal clearance. We reported four cases in which the nadir pressure were decreased or increased after BTA injections or pneumatic dilatations, trying to evaluate the value of a nadir pressure as an outcome predictor of dysphagia treatment.

Cases

1) Patients 4 male patients ranging 52 to 69 years old, with each diagnosis of schwannoma(Number 1), nasopharyngeal cancer(Number 2), hemangioblastoma(Number 3), and ruptured Rt. frontal arteriovenous malformation(Number 4) were included in this study. The patient with nasopharyngeal cancer received radiotherapy and chemotherapy, but other three patients had operations. Dysphagia duration was ranged from 1 month to 2 years. 2) Methods Manometry, VFSS and diet parameters were evaluated at the time of pre- and post-treatments of CPD, respectively. Manometry results included basal and nadir pressures, relaxation time to nadir, and relaxation duration, etc. Resting pressure is calculated as the mean value of the pressure obtained after at least 10 seconds at resting position. Nadir pressure is defined as the lowest residual pressure during the state of swallow-induced relaxation. 3) Results There were no significant changes in basal pressures of the manometry between pre and post treatments in all patients. The nadir pressure of 2 patients (number 1 and 4) were decreased, and they consequently resulted in the improvement of swallowing function. One patient (number 2) showed increased nadir pressure after treatments, resulting in no improvement of dysphagia. A relaxation time to nadir and relaxation duration were also increased in the effective groups of number 1 and 4, but decreased in the ineffective group of number 2. The radiation induced fibrosis of pharynx was considered as a cause of poor treatment outcome of the number 2 patient. The patient with hemangioblastoma (number 3) was not evaluated with

manometry after treatments, but he already had showed the lowest nadir pressure before starting treatments, and dysphagia was improved fast up to normal.

Conclusion

This study suggests that nadir pressure could be meaningfully valuable as a pre-treatment outcome predictor of interventions, and also as a post-treatment outcome predictor, although case studies clearly verifying this argument is currently lacking. Further large case studies will be needed.

Table 1. Demographics and clinical characteristics of the study population

Patient no.	Age	Gender	Diagnosis	Management	MMSE	Function	Days from dysphagia onset	Dysphagia therapy	Botox injection	Balloon dilatation
1	69	Male	Schwannoma	Operation	28	ID gait	66 days	O	1	X
2	52	Male	Nasopharyngeal cancer	CTx, RTx	30	ID gait	2 years	O	2	2
3	59	Male	Hemangioblastoma	Operation	23	ID gait	30 days	O	2	X
4	53	Male	Rt. Frontal AVM	Operation	30	ID gait	310 days	O	0	3

CTx, chemotherapy; RTx, radiotherapy

Table 2. Changes in manometry, VFSS, Diets between pre- and post-treatment

Patient no.	Manometry								VFSS					
	Basal Pressure (mmHg)		Nadir Pressure (mmHg)		Relaxation time to nadir (ms)		Relaxation duration (ms)		CPD grade		Aspiration type		Diet	
	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post	pre	post
1	7.9	8.4	5.9	0.8	13	184	33	385	3	2	D1	LL	D1	SD
2	15.1	15.3	0.9	5.3	293	108	472	215	4	4	SL	D1	Tube	Tube
3	12.5	-	-0.9	-	102	-	793	-	4	1	D1	X	Tube	GD
4	14.3	13.7	10.3	1.4	243	527	539	907	2	2	D1	SL	D1	D3

VFSS, Videofluoroscopic Swallowing Study; CPD, cricopharyngeal dysfunction; D1, dysphagia diet 1; D3, dysphagia diet 3; SL, small liquid; LL, large liquid; SD, soft diet; GD, general diet; Tube, tube feeding;

Injury of the ascending reticular activating system by multiple brain herniations: A Case report

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College of Medicine, Yeungnam University, Department of Rehabilitation Medicine¹

Objectives

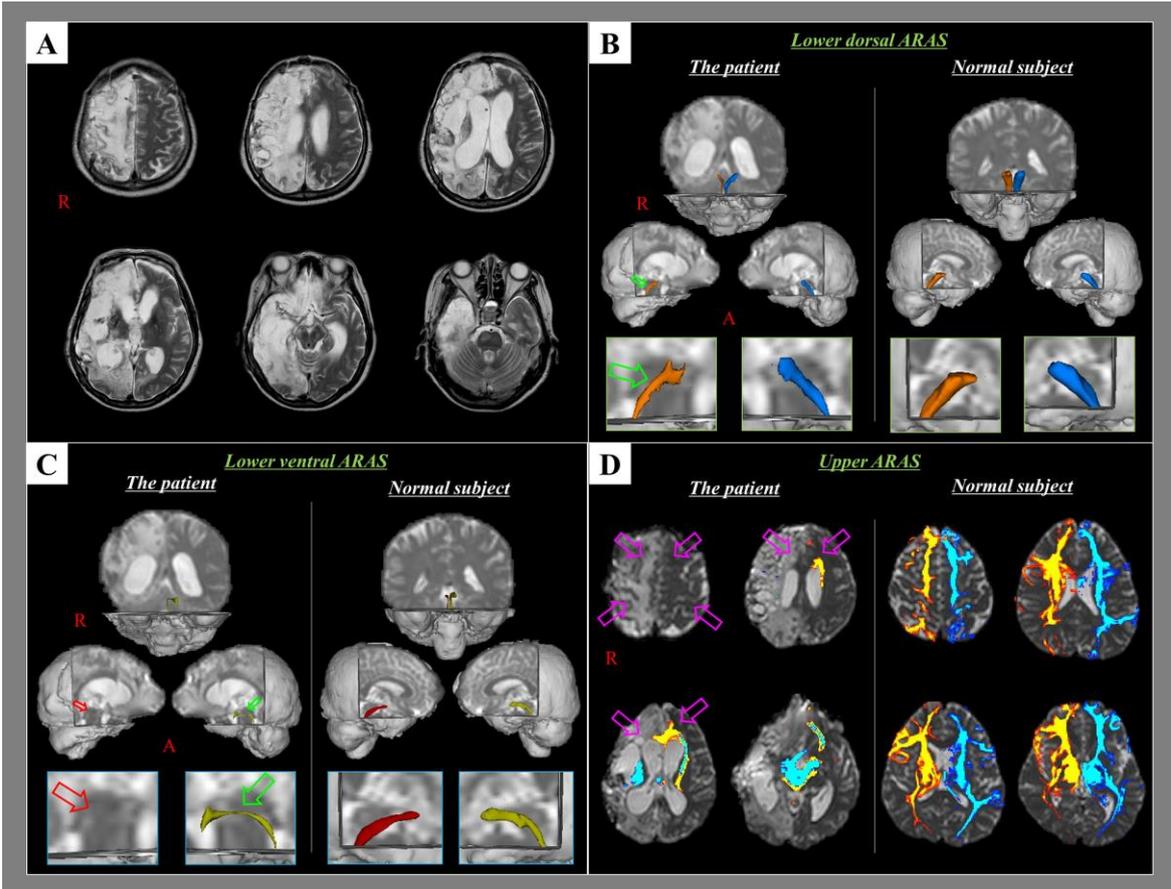
We report on a patient who showed injury of the ascending reticular activating system (ARAS) by transtentorial herniation, Kernohan's notch phenomenon, and subfalcine herniation following stroke, using diffusion tensor tractography (DTT).

Case report

A 53-year-old female patient was diagnosed as subarachnoid hemorrhage and underwent coiling of a ruptured aneurysm of the right middle cerebral artery bifurcation. The next day, she also underwent decompressive craniectomy on the right fronto-parieto-temporal areas and hematoma removal for an intracerebral hemorrhage in the right fronto-temporal lobes. After seven months from onset, she was transferred to the rehabilitation department of the other university hospital for rehabilitation. The patient exhibited impaired alertness, with a Glasgow Coma Scale score of 11 and Coma Recovery Scale-Revised score of 14. On 7-month DTT, narrowing of the right lower dorsal ARAS and left ventral ARAS, and non-reconstruction of the right lower ventral ARAS were observed. In the upper ARAS, the neural connectivity between the thalamic intralaminar nucleus and the cerebral cortex was decreased in both prefrontal and parietal cortices.

Conclusions

Injury of the ARAS by transtentorial herniation, Kernohan's notch phenomenon, and subfalcine herniation was demonstrated in a stroke patient. Our results suggest that evaluation of the ARAS using DTT would be helpful to understanding the state of the ARAS in patients with brain herniation.



(A) Brain MR images at seven months after onset show multiple leukomalactic lesions in the right fronto-parieto-temporal lobes. (C) Results of diffusion tensor tractography for the ascending reticular activating system (ARAS) of the patient. On 7-month DTT, narrowing (green arrows) of the right lower dorsal ARAS and left ventral ARAS, and non-reconstruction (red arrows) of the right lower ventral ARAS were observed. In the upper ARAS, the neural connectivity between the thalamic intralaminar nucleus and the cerebral cortex was decreased in both prefrontal and parietal cortices (pink arrows) compared with a normal subject (58-year old female).

Tapia syndrome after resection of tumor in the foramen magnum

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Introduction

Tapia syndrome manifests neurologic deficit caused by vagus nerve (CN X) and hypoglossal nerve (XII) damages. Very little has been reported about Tapia syndrome but it gets worse the life of quality of patient in Tapia syndrome because of dysphagia, dysphonia, and paresthesia on tongue. Previous studies reported that patients with Tapia syndrome have been observed during rhinoplasty, mandibular, or odontoid bone fracture. . The CN X injury in patients with Tapia syndrome resulted from mainly recurrent laryngeal branch and rarely from superior laryngeal or pharyngeal branch. In this study we present a case of patient with Tapia syndrome is caused by superior laryngeal and recurrent laryngeal branches, simultaneously.

Case represent

A 44 year old female without previous medical history except hypothyroidism visited a local hospital due to headache stated since early May 2018 and CT images of the brain showed mass like lesions. The patient was referred to the department of neurosurgery in our hospital. The brain MRI identified suspicious of meningioma in the foramen magnum and tumor resection operation was performed on late May 2018 [Figure 1]. After an intubation was maintained for one day and the patient complained dysphagia and voice change. On neurological examination, we found atrophic change on right tongue but uvular deviation was not showed [Figure 2]. The laryngoscopic findings indicated that palsy of left vocal cord and hematoma on left arytenoid area. Approximately one month after the operation, the video-fluoroscopic swallowing study for the patient' dysphagia showed weakness on pharyngeal muscles and lowering laryngeal protection. She were not able to drink water and thin food. On electrophysiological finding identified showed abnormal spontaneous activities on right tongue. We gave him a diagnosis of superior laryngeal and recurrent laryngeal palsies of CN X on left side and CN XII on right side. Voice analysis of hoarseness has measured that habitual F0=291, jitter (%) = 0.48(<0.5), shimmer (%) = 4.96(<3.0), NNE=-5.60, HNR=14.78, hoarse voice=2, harsh voice=1, and breathy voice=3. One month after rehabilitation VFSS showed that there was reversal of pharyngeal muscle weakness and increased laryngeal protection. Additionally, voice analysis showed that habitual F0=297, jitter(%)=0.29, shimmer(%)=3.47, NNE(glottal noise energy)=-14.76(<-10.0), HNR(harmonics-to-noise ratio)=22.42, hoarse voice=1, harsh voice=1, and breathy voice=0. The reading prosody test showed 1 min 24 sec consumption and, although unstable voice quality change was observed, voice loudness has been improved to show possible smooth communication.

Conclusions

This case study was about the patient with Tapia syndrome after brain tumor resection on left medullary area. Distinguished from previous studies, we have been tracking the improvement of hoarseness and dysphagia serially using VFSS and, voice analysis.

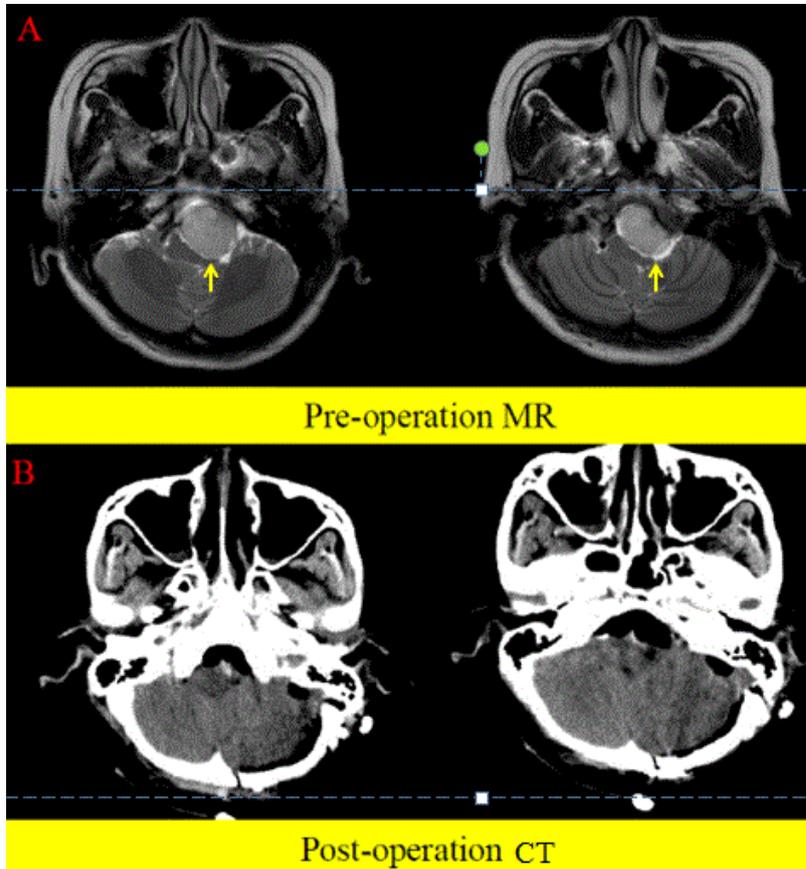


fig1. Brain MRI showed suspicious of meningioma in the foramen magnum

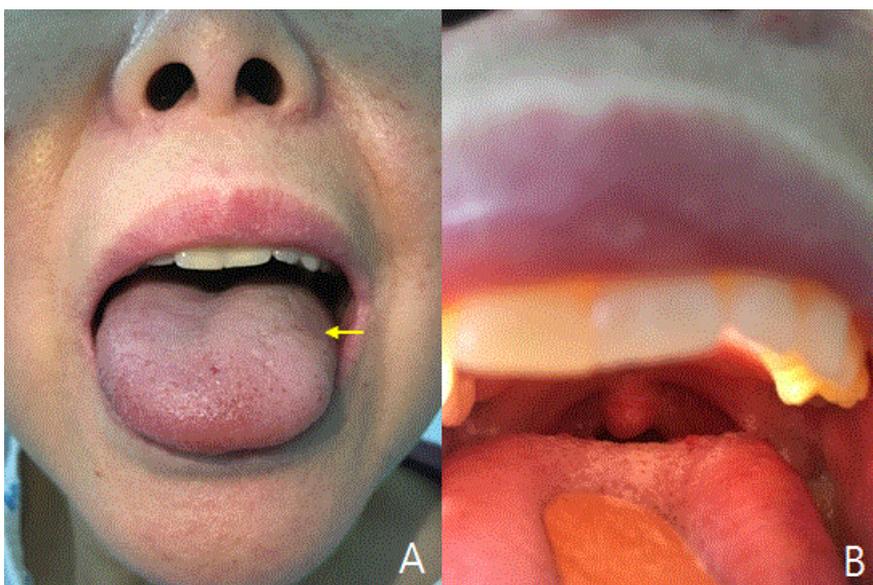
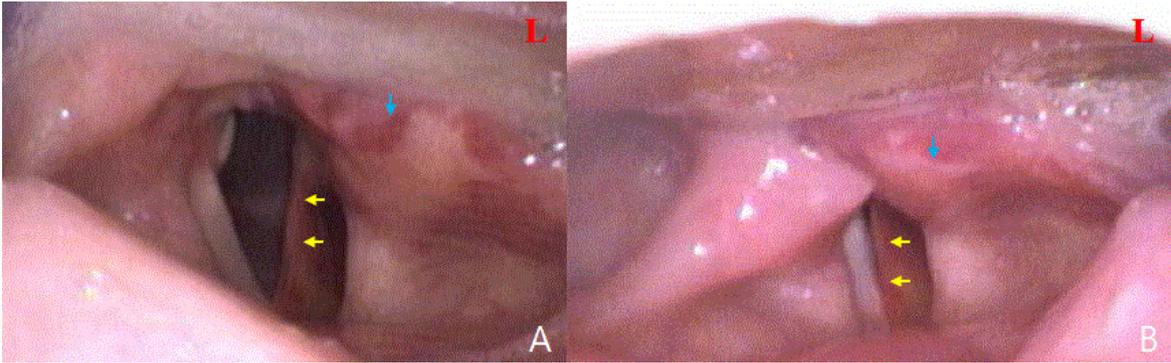


fig2. On neurologic examination, we found atrophic change (white arrow) on right tongue but uvular deviation was not showed



The laryngoscopic finding indicated that palsy of left vocal cord (yellow arrow) and hematoma on left arytenoid area (blue arrow).

Successful Pulmonary Rehabilitation in Bilateral Medial Medullary Infarction: Two Case reports

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Introduction

Bilateral medial medullary infarction is a very rare occurrence and a constellation of various neurologic manifestations seen in cerebrovascular accidents. The medulla oblongata deals with the autonomic functions, such as breathing, heart rate, and blood pressure. The ventral or dorsal respiratory groups of medulla are neurons involved in the regulation and send electrical signals about blood acidity to intercostal and phrenic muscles to increase their contraction and oxygenation of the blood. Thus, bilateral medullary infarction disrupts respiratory circuits and can cause the acute and chronic respiratory difficulty. These cases describe the patients with the successful pulmonary rehabilitation of respiratory failure caused by bilateral medial medullary infarction. It is the first Case report of its kind.

Case Presentation

Patient 1 A 54-year-old man with a history of diabetes mellitus suddenly presented left side weakness and dizziness, and gradually developed right side weakness. He admitted to the department of the neurology and magnetic resonance imaging (MRI) was taken, and it showed a recent infarction in bilateral medullary infarction (Fig. 1). At that time, the patient experienced acute respiratory arrest and tracheostomy was done. He transferred to another hospital and received rehabilitation treatment. The decannulation of tracheostomy was carried out before admission to our hospital. However, during hospitalization in our hospital, he displayed shallow breath and excessive use of neck accessory muscles and the volume of voice was very weak. Fluoroscopy showed decreased movement on bilateral diaphragms. The patient's initial vital capacity was 1720 cc at the supine position, 1250 cc at the sitting position, and the peak cough flow was 100 L/min. We started pulmonary rehabilitation including home mechanical ventilator management.

Patient 2 A 77-year-old woman with a history of hypertension and hepatitis C virus carrier developed dizziness and admitted to the department of the neurology. MRI showed bilateral medullary infarction and she treated with intravenous tissue plasminogen activator (t-PA). Her voice and respiratory weakness are very similar to above case. Fluoroscopy showed decreased movement on bilateral diaphragms. The patient's initial vital capacity was 530 cc at the supine position, 610 cc at the sitting position, and the peak cough flow was uncheckable. The patient experienced respiratory failure and tracheostomy was done at the previous hospital. After admission to our hospital, decannulation of tracheostomy was done and the non-invasive home mechanical ventilator was applied via nasal mask.

Conclusion

This study is the first Case report describing the successful pulmonary rehabilitation of respiratory failure caused by bilateral medullary infarction. The patients with medial medullary infarction can be suffered from respiratory failure and pulmonary rehabilitation can prevent exacerbation of symptoms.

Changes in neural activity in cognitive network after low frequency rTMS: A report of two cases

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Introduction

Dorsolateral Prefrontal Cortex (DLPFC) plays an important role in executive functions, such as working memory and attention. Repetitive Transcranial Magnetic Stimulation (rTMS) is a non-invasive brain stimulation tool that regulates cortical excitability and it is especially proven in motor recovery after brain injury but, there is little report about therapeutic effect on cognition. This study was conducted to observe changes in neural activity in concordance of clinical findings when rTMS was given with low frequency in contra-lesional DLPFC for cognitive function improvement.

Case reports

Protocol Patients received cognitive assessments such as Korean-Mini Mental Status Exam (K-MMSE) and Intellectual Quotient (IQ) before the examination. We performed fMRIs undergoing working memory before and after rTMS. rTMS was applied just before the fMRI with 1-Hz, 55s, 55 trains, 5s interstimulus interval and total 1,100 pulses to the contra-lesional dorsolateral prefrontal cortex (DLPFC). The forward and backward digit spans by the verbal serial numbers were performed as working memory tasks for 30 seconds, resting for 30 seconds, and 5 sets during fMRI scanning (3T GE/IDX scanner, in blood oxygen level dependent signal time-course, using a whole-body radiofrequency coil for signal excitation and an 8-channel phased-array head coil for signal reception using gradient-echo T2-weighted and spin-echo T2-weighted echo-planar sequences). Case 1 Patient A was a 17-year-old woman who complained of right hemiparesis after left basal ganglia hemorrhage. After 6 weeks of intensive rehabilitation, daily activities can be performed with minimal help. Her K-MMSE, IQ, digit span scores at the time of the fMRI are described in Figure 1-(A). Compared to the fMRI without rTMS, fMRI immediately after receiving inhibitory rTMS at contra-lesional DLPFC showed changes in neural activity during working memory task (Figure 2). Case 2 Patient B was a 40-year-old woman who complained of right hemiparesis after tumor removal with a central neurocytoma of the left corpus callosal body area. After 6 weeks of intensive rehabilitation, daily activities can be performed with minimal help. Her K-MMSE, IQ, digit span scores are described in Figure 1-(B). Compared to the fMRI without rTMS, fMRI immediately after receiving inhibitory rTMS at contra-lesional DLPFC showed changes in neural activity during working memory task (Figure 3).

Conclusion

When the inhibitory rTMS was performed on the contra-lesional DLPFC, immediate changes were observed in the superior temporal, inferior frontal lobe or

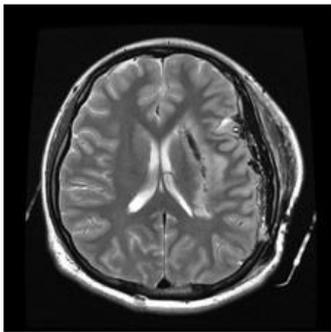
parahippocampal area those play and important role in attention and working memory in both patients. Further study with a larger number of patients and with a longer duration of rTMS treatment will be helpful (This research was respectfully funded by the Ministry of Trade, Industry & Energy (MOTIE) (No.10051152)).

Figure 1. Demographics of patients

(A)

Patients	Age	Brain lesion	Laterality	Onset after injury (days)	K-MMSE score	IQ	Forward digit span	Backward digit span
A	17	Basal ganglia	Left	82	30	84	9	5

K-MMSE, Korean version of mini mental status exam; IQ, full scale Wechsler's Intellectual Quotient

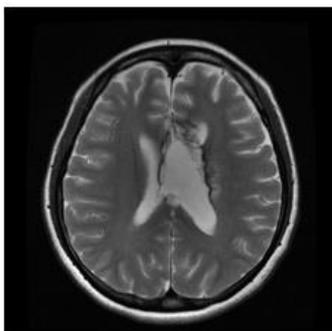


s/p craniectomy and hematoma removal with drainage tube insertion in left basal ganglia and deep white matter

(B)

Patients	Age	Brain lesion	Laterality	Onset after injury (days)	K-MMSE score	IQ	Forward digit span	Backward digit span
B	40	Corpus callosum	Left	80	25	98	9	6

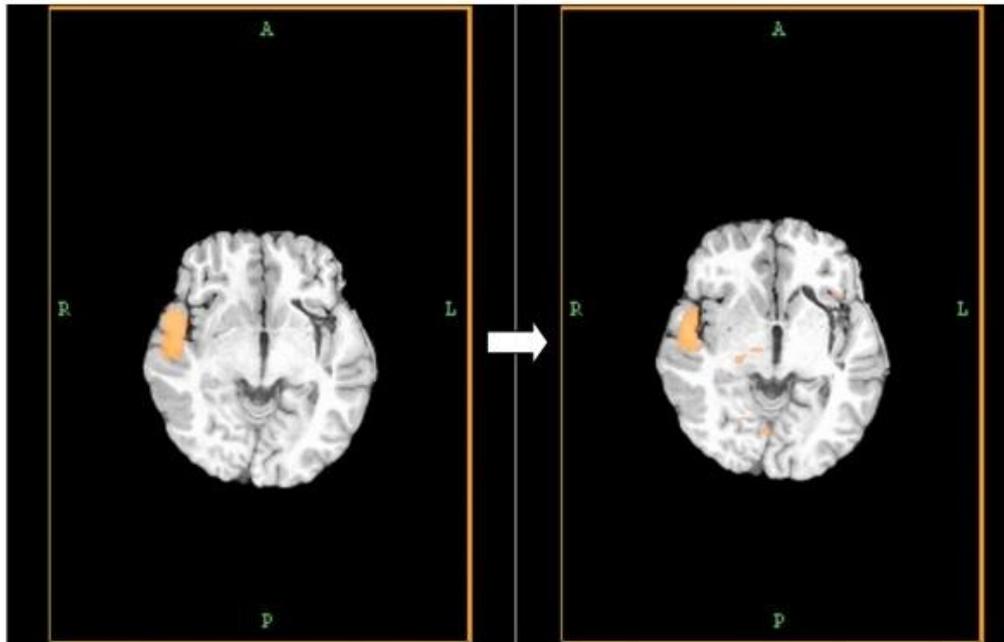
K-MMSE, Korean version of mini mental status exam; IQ, full scale Wechsler's Intellectual Quotient



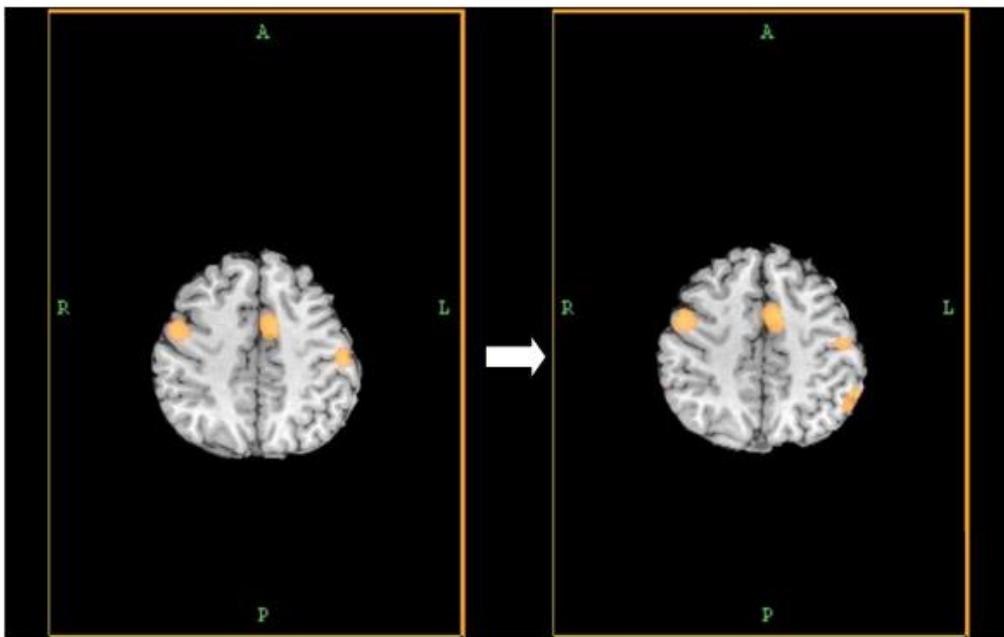
s/p left intraventricular tumor removal with thin contusional injuries in the left periventricular white matter, corpus callosum and anterior portion of the left basal ganglia

Figure 1. Changes in fMRI after inhibitory rTMS on contra-lesional DLPFC in patient A

(A)



(B)



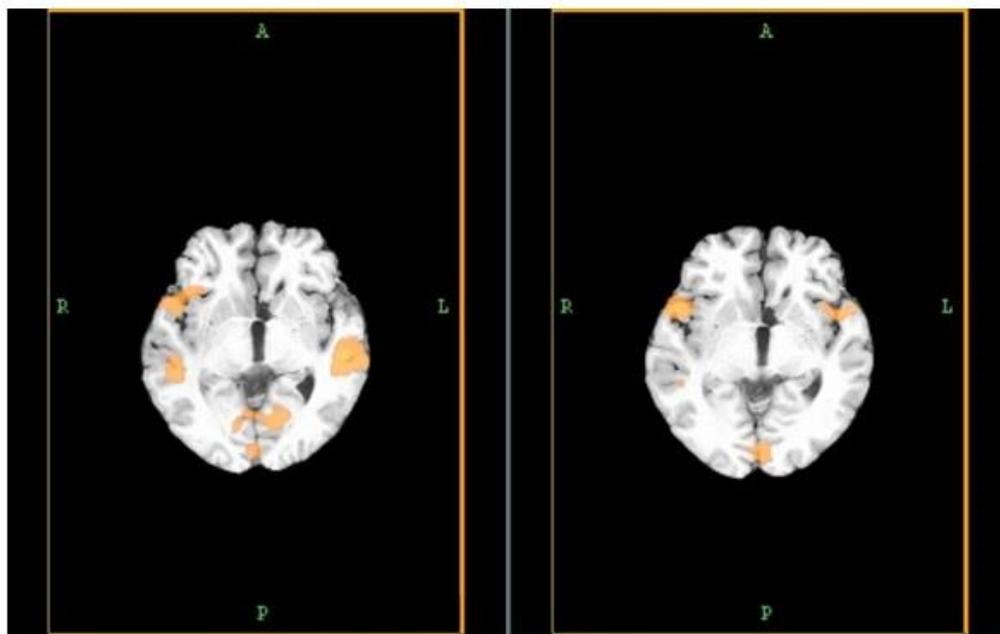
rTMS, repetitive Transcranial Magnetic Stimulation; DLPFC, Dorsolateral Prefrontal Cortex

(A) The activities of the left inferior frontal area and right thalamus were increased.

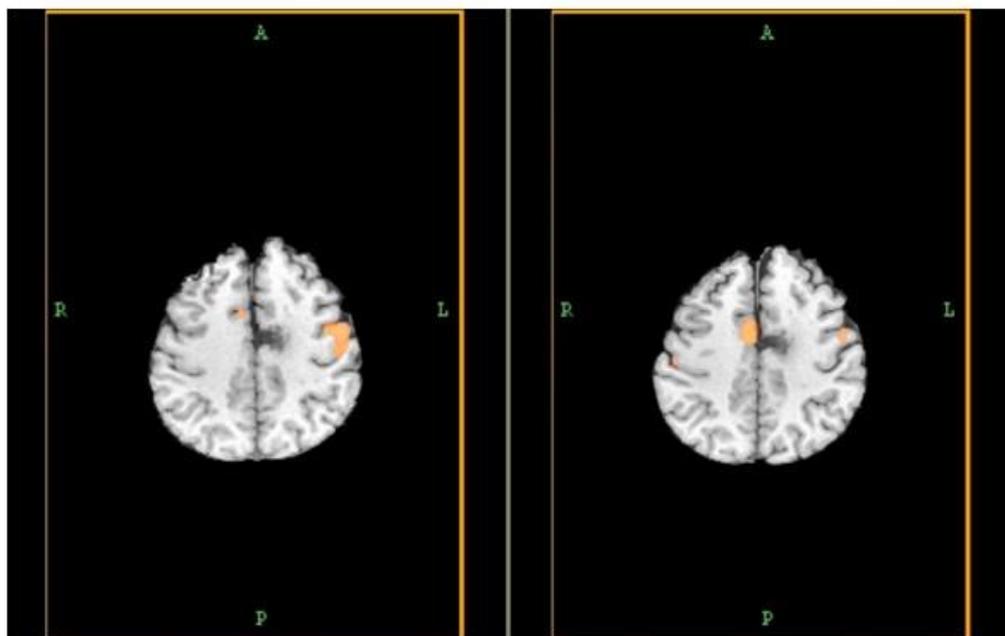
(B) The activity of the left superior temporal area was decreased.

Figure 2. Changes in fMRI after inhibitory rTMS on contra-lesional DLPFC in patient B

(A)



(B)



rTMS, repetitive Transcranial Magnetic Stimulation; DLPFC, Dorsolateral Prefrontal Cortex

(A) The activity of the left parahippocampal area was increased.

(B) The activity of the left superior temporal area was decreased.

P 1-27

Improved coughing function after injection laryngoplasty in post-stroke dysphagia, case-series study

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Improved coughing function after injection laryngoplasty in post-stroke dysphagia, a case-series study

Introduction

Vocal fold paralysis can be associated with a brainstem stroke, or lateral medullary syndrome (Wallenberg syndrome) in cerebrovascular accident and may result in dysphagia and increased risk of pulmonary complication. Injection laryngoplasty has been demonstrated to be effective means of reducing risk of aspiration and improving swallowing function in head and neck cancer patients with vocal fold immobility. However, the effect of injection laryngoplasty on stroke associated dysphagia is uncertain. These case series aimed to show that injection laryngoplasty may enhance swallowing and coughing force in post stroke dysphagia patients accompanied with glottic insufficiency.

Subjects and Methods

A retrospective chart review was performed of all injection laryngoplasty procedures from February 2015 to December 2017. Total of 6 patients with post stroke dysphagia who showed glottic gap associated with vocal cord palsy were included. Participants underwent quantification of peak airflow during maximal cough a week before the procedures and followed at 2 weeks after procedures. Glottal closure, represented by the peak airflow during cough, protects the airway from aspiration of respiratory secretions and bolus of foods, and provides adequately high expiratory flow to remove material from the airway. PAS and FOIS, the degree of dysphagia, were also confirmed by VFSS and/or FEES. Initial and follow-up times of VFSS and/or FEES were scheduled to be the same as those of the peak cough flow.

Results

Among all patients, peak airflow increased significantly from pre-procedure airflow with a median improvement of 73.75 L/min (p-value=.016). All participants showed improvement of PAS and FOIS and the improvements were statistically significant. Postoperative PAS decreased (6.00 ± 2.23 , $p=0.048$) and FOIS increased (5.00 ± 0.75 , $p=0.027$). (Table 1.) No complications were observed after the injections.

Conclusion

Injection laryngoplasty was associated with positive outcome in improving peak cough flow and improving swallowing ability in stroke patients who accompanied with vocal

cord paralysis. Conventional management of dysphagia includes modifying food and fluid, altering posture and changing swallowing strategies with some rehabilitative techniques. In addition to these rehabilitative techniques, injection laryngoplasty can be an effective and feasible treatment that leads to improved glottic closure, subsequently resulting in higher peak cough flow and improved airway closure to result in reduced aspiration and improved swallowing function. The results of these case series support the need to carry large scale prospective studies of this procedure in stroke patients who show insufficient glottic closure associated with vocal fold palsy.

Table1. Peak Airflow Measurements, FOIS and PAS score Before and After Injection Laryngoplasty *: Penetration aspiration scale, +: Functional oral intake sacle

Sex	Age	Airflow Measurements, L/min		PAS*		FOIS+	
		Pre	Post	Pre	Post	Pre	Post
M	62	188.5	254.5	8	6	1	5
M	69	119	164.5	8	7	5	5
M	73	145.5	372	8	2	3	6
M	49	106	240.5	8	3	1	5
M	69	314	330.5	8	7	1	4
M	67	42.5	124	8	7	1	5
Median		152.58	247.67	8.00	6.00	1.00	5.00
SD		92.53	94.48	0.00	2.23	1.67	0.75
P-value			0.016		0.017		0.027

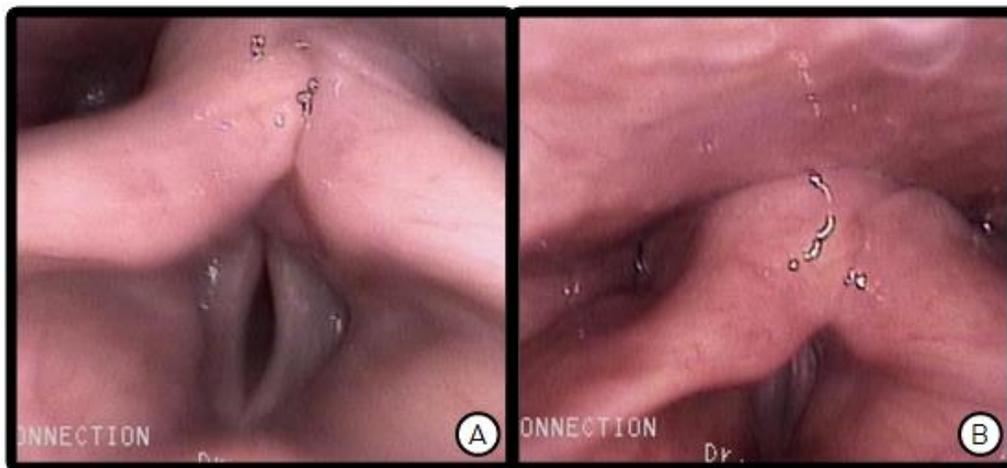


Figure1. FEES finding showing noticeable glottic gap associated with vocal cord palsy(A), and improved glottic closure post laryngoplasty (B).

Effects of modified constraint-induced movement therapy in infant and young toddler

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Objective

To address the issue of whether modified constraint-induced movement therapy (mCIMT) is feasible for infants and young toddlers aged 7 months to 18 months with spastic hemiparetic cerebral palsy (CP).

Methods

A randomized control group design (pre, post and 2-month follow up test) was applied for sixteen infants and young toddlers with spastic hemiparetic CP (mean = 12.5 months). Participants were randomly assigned to mCIMT or conventional therapy (control) group for 3-week (15 sessions excluding weekends); only mCIMT group wore a resting splint for 23-hour per day including a session (2 hours/day). Blinded Evaluators measured children 1-week prior, 1-week and 2-month after the intervention with the Pediatric Motor Activity Log (PMAL), the Peabody Developmental Motor Scales-2 (PDMS-2), the Gross Motor Function Measure (GMFM66&88), the Pediatric Evaluation of Disability Inventory (PEDI), and the Clinical Global Impression (CGI-S&CGI-I).

Results

Compared with the control group, the mean rank of the mCIMT group was higher in the How often ($Z=-2.631$, $p<0.01$) and How well ($Z=-2.365$, $p<0.05$) of the PMAL, and the Visual motor integration ($Z=-1.993$, $p<0.05$) of the PDMS-2 at post-treatment. Both groups showed statistically significant gains in the PEDI and GMFM. In all measures, the mCIMT group did not show significantly lower results than the control group.

Conclusion

mCIMT applied to infant and young toddlers had a positive impact on their affected hand use and did not cause motor development delays. The findings supported the hypothesis of feasibility in applying mCIMT to young children at corticospinal tract (CST) refinement period. Further research is required to enroll larger samples and address the long-term effect.

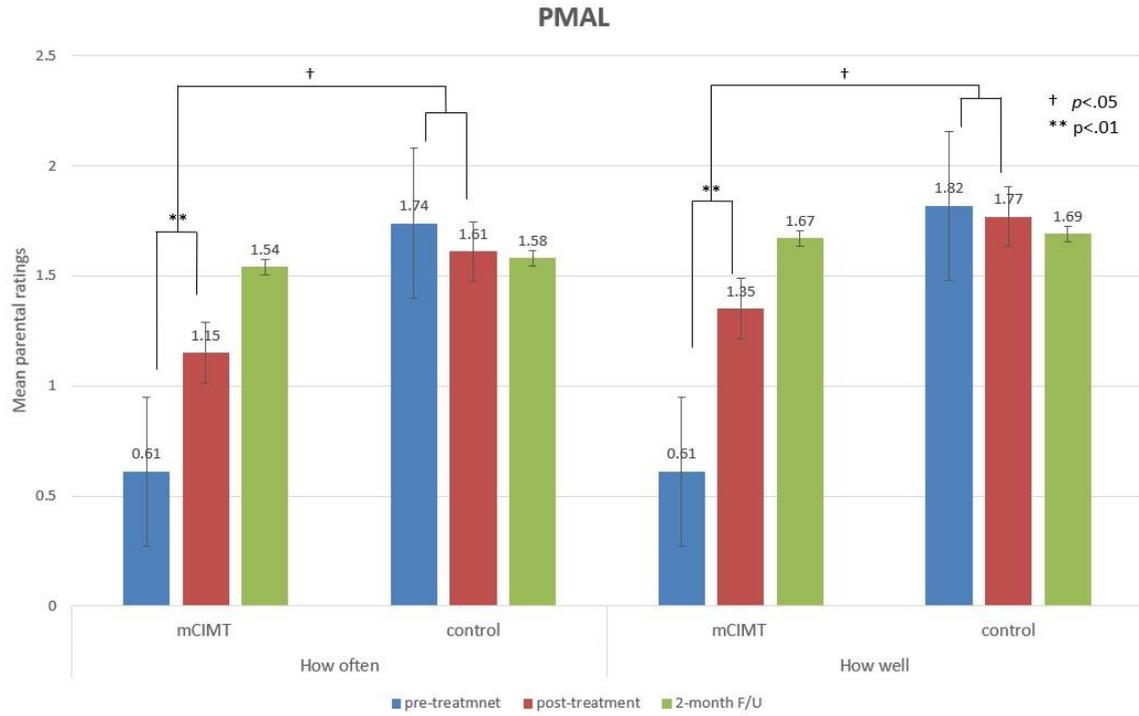


Fig 1. Pediatric Motor Activity Log.

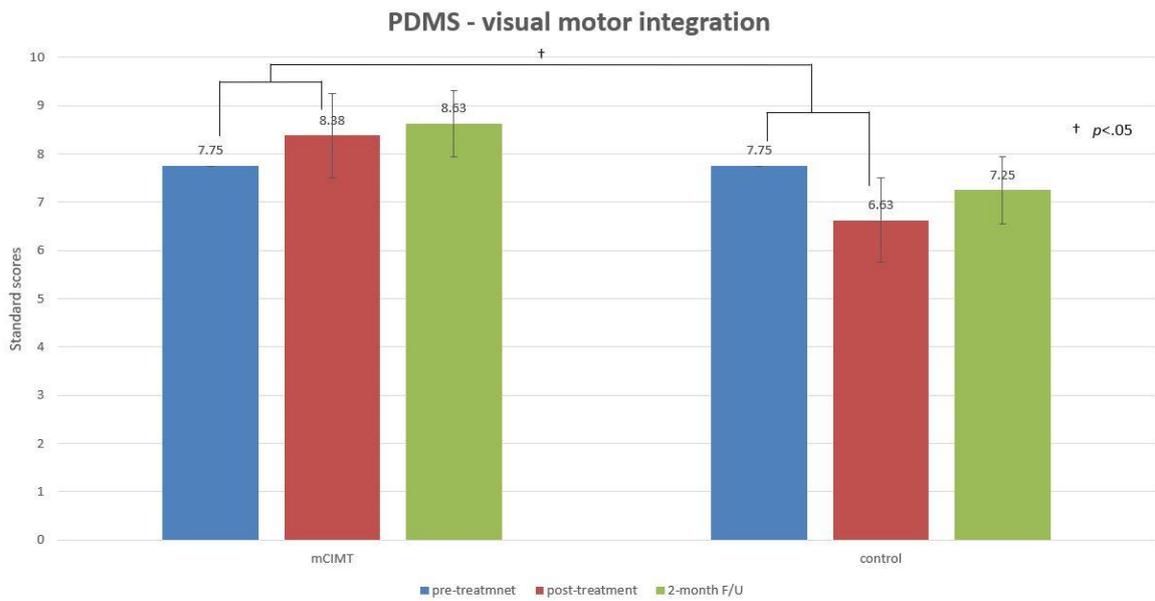


Fig 2. PDMS - Visual motor integration.

Man presenting with sudden weakness of the left hand and pain by non-SCLC with brain metastasis

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BACKGROUND

Incidental sensory polyneuropathy is common, but such patients tend to be overlooked by clinicians due to its typically benign course and the absence of proper treatment. However, sensory polyneuropathy without predisposing factors should be traced back to its cause.

Case presentation

A 63-year-old male visited the Department of Neurosurgery for radiating pain in his right arm and elbow with mild weakness of the right hand, especially the fourth and fifth fingers. Cervical spine magnetic resonance imaging (MRI) showed minimal central disc protrusion at C6-7, mild central disc protrusion and C6-7 spondylosis. He was referred for an electrodiagnostic study to evaluate weakness inconsistent with MRI findings. Nerve conduction studies revealed distal symmetric sensory polyneuropathy in both the upper and lower extremities. Needle electromyography showed denervation potential of the right pronator teres and extensor carpi radialis longus muscles. The patient was diagnosed with mid to C6 and C7 radiculopathies. However, the findings were inconsistent with his symptoms. The patient's sensory polyneuropathy could not be explained by his medical or social history. Predisposing undiscovered disease was evaluated by physicians, including a pulmonologist and a gastroenterologist. Chest computed tomography (CT) revealed a 7.2-cm heterogeneously enhancing mass in the right lower lobe anterobasal segment (Fig. 1) that was diagnosed as squamous cell carcinoma on biopsy. Brain MRI revealed a 2.4 x 2.0 x 2.5-cm necrotic mass with vasogenic edema in the left 'hand knob' of the primary motor cortex (Fig. 2). Therefore, we concluded that the sensory polyneuropathy was related to a paraneoplastic syndrome, and that the hand weakness was caused by brain metastases in the primary motor cortex of the hand. Indeed, denervation potentials of the right forearm have been related to trans-synaptic denervation. The patient was referred to another hospital for further radiotherapy and other oncologic treatment.

Conclusions

When axonal sensory polyneuropathy or denervation potentials do not correlate with a patient's symptoms, clinicians should trace etiologies. This Case report describes incidental sensory polyneuropathy caused by paraneoplastic syndrome. Considering the increasing prevalence of cancer, this case highlights the importance of proper concern on

the part of physicians with regard to subtle and incidental changes in nerve conduction studies and needle electromyography.

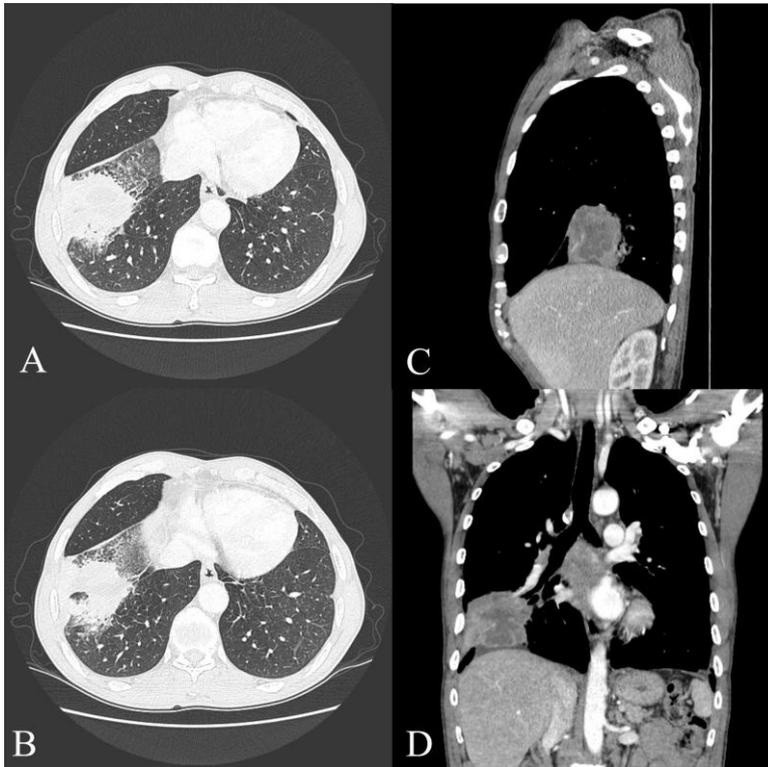


Fig. 1. CT scan showed a 7.2 cm sized heterogeneously enhancing mass with necrosis in RLL anterobasal segment. A, B: axial images of lung, C: coronal image of lung, D: sagittal image of lung.

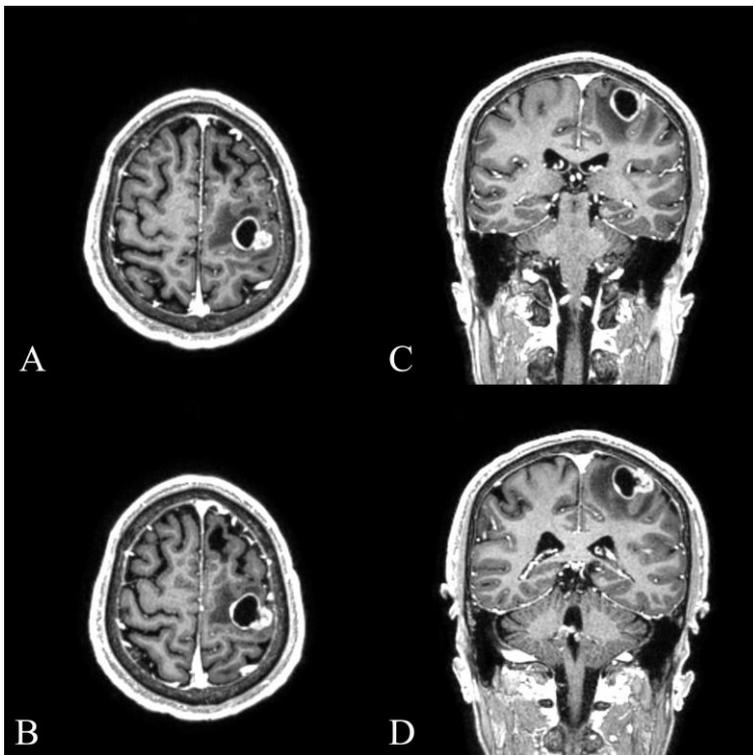


Fig. 2. MRI (enhance) revealed 2.4 x 2.0 x 2.5 cm sized necrotic mass with peritumoral edema was located at left hand knob of primary motor cortex. A, B: axial images of brain, C, D: coronal images of brain

Insole pressure measurement to assess weight shift and task effect in AK amputee gait – Case report

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BACKGROUND

During above-knee (AK) amputee gait training, proper weight shifting to affected limb is an essential requirement for independent gait. However, amputee, therapist, and physiatrist frequently have difficulties in evaluation how well it is performed and what task is appropriate for current status of the patient. Although 3D gait analysis is gold standard, it has limitations in various tasks and environments. Therefore, we used insole pressure meter to assess weight shift with task effect. A 67-year-old man presented to our medical center after traffic accident and diagnosed right femur fracture. He had recurrent osteomyelitis and got operation; AK amputation in right femur. On postoperative day 30 (POD 30), he was transferred to rehabilitation medicine department for gait training. He did not have definite motor weakness in hip muscles. He had prosthesis with ischial containment socket, fluid vortex intelligent control knee and dynamic foot (Figure 1). On POD 37, insole pressure measurement was conducted. He walked with a crutch with 3-point partial weight bearing mode and 4-point mode. He was more familiar to modified 3-point mode than 4-point mode. Maximum load on prosthetic foot was 2.3 N/cm² in 3-point mode and 4.8 N/cm² in 4-point mode (Figure 2). On POD 72, test was repeated with a cane. He walked with holding the cane on the ipsilateral side as his injury and on the contralateral side. He was more familiar to holding the cane on the contralateral side of amputation. Maximum load on prosthetic foot was 6.1 N/cm² in contralateral mode and 9.7 N/cm² in ipsilateral mode (Figure 3).

Conclusion

Insole pressure measurement system can provide information for weight shifting in AK amputee gait. 4-point mode is more relevant for increasing weight shift than modified 3-point mode. Ipsilateral cane mode is more relevant for increasing weight shift than contralateral cane mode.



Figure 1. An X-ray of this patient: above knee amputation with prosthetic leg

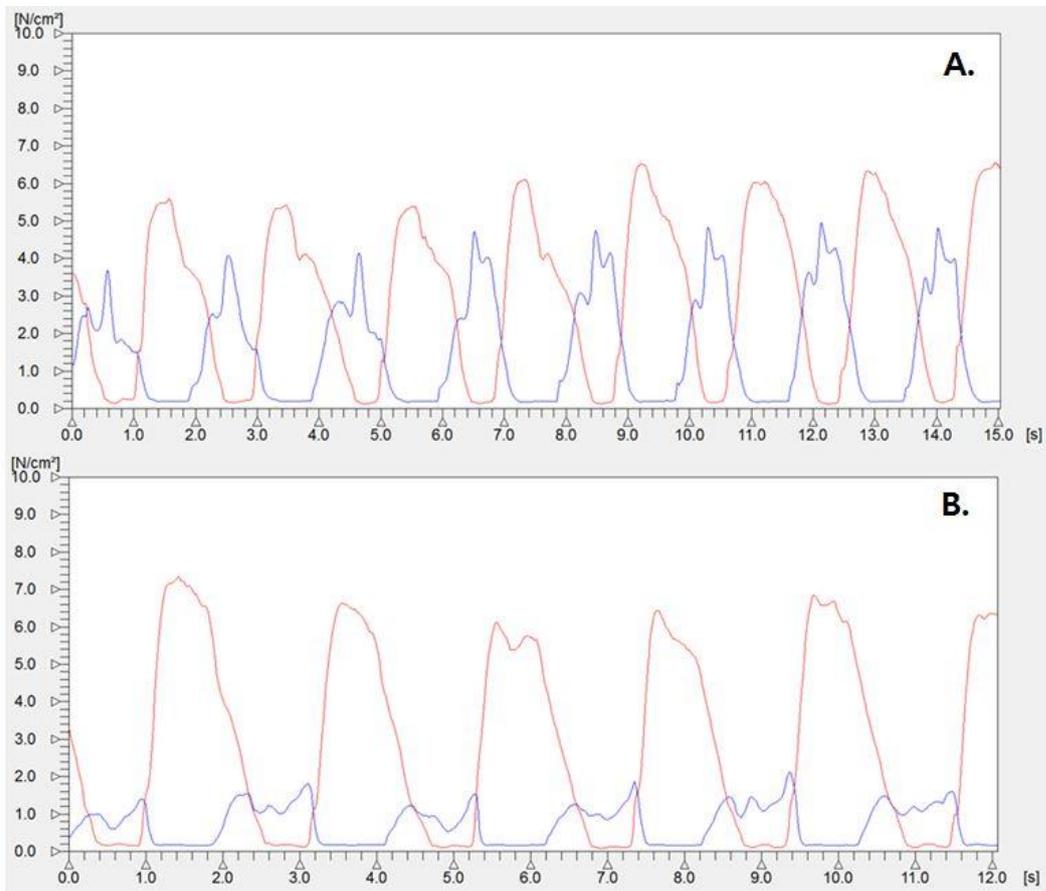


Figure 2. Insole pressure measurement, A. 4-point mode, B. 3-point mode (red: left, blue: right)

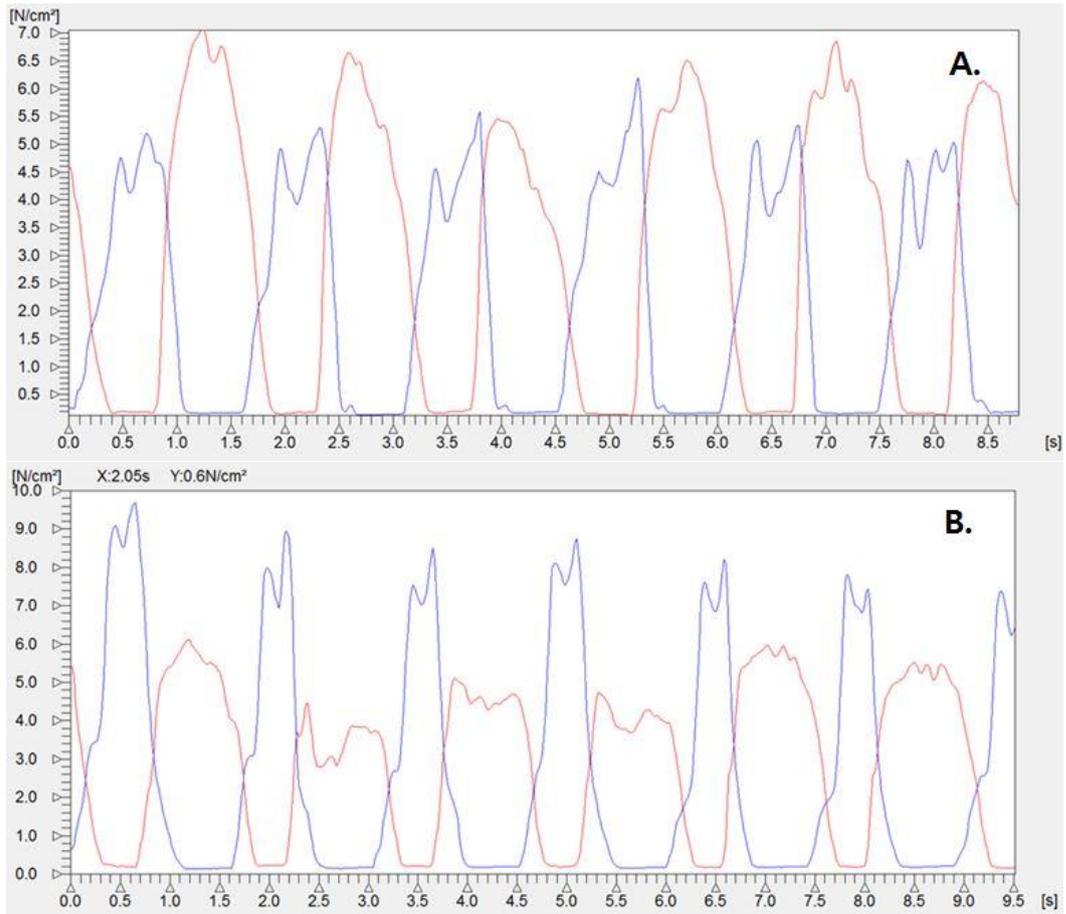


Figure3. Insole pressure measurement, A. Cane on the contralateral side, B. ipsilateral side (red: left, blue: right)

P 1-31

Ultrasonographic Muscle Thickness Measurement Verified NMES Decrease Muscle Atrophy After TKR

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This study is designed to find the change of reduction in thickness of quadriceps femoris muscle, especially in vastus medialis, which is reflect the muscle atrophy, by conducting the electrical stimulation therapy and voluntary isometric contraction exercise, as a way of management method for muscular weakness associated with arthrogenic muscle inhibition and quadriceps muscular atrophy from a short term period after surgery. Total of 63 patients, 70 cases treated with total replacement of the knee were included in the study initially, and 43 patients, 58 cases (36 patients, 48 cases in the study group and 7 patients, 10 cases in the control group) finally participated in this study. Both study and control groups started the therapy program at 5th post operation day and experimental group received both voluntary isometric contraction exercise and neuromuscular electrical stimulation therapy (2 times per day, each 30 minutes) while control group received only voluntary isometric contraction exercise. Ultrasonographic muscle thickness measurements was done on the day before the operation (PRE), the 5th day after operation (POD5), the 9th day after operation (POD9) and the 13th day after operation (POD13). There was no statistical difference between study and control groups in demographics on the independent two sample t-test. There was statistical difference in vastus medialis thickness between PRE and POD13 of control group, while it shows no statistical difference in study group. This results shows the prevention effect for the atrophic change of vastus medialis muscle during first 2 weeks after total knee replacement by combining the muscle contraction by electrical stimulation and voluntary isometric contraction. This study verified this effect via measuring the thickness of the vastus medialis muscle by ultrasonographic scanning. This study suggest a muscle contraction by electrical stimulatino therapy as auseful treatment method for maintaining the muscular strength of quadriceps femoris muscle that usually hard to exercise due to pain and edema after early phase after surgery. This study is particulary important because if affiremed muscle thickness change and effect of muscle contraction by electrical stimulation during ultrashort period (within 2 weeks) after total knee arthroplasty.

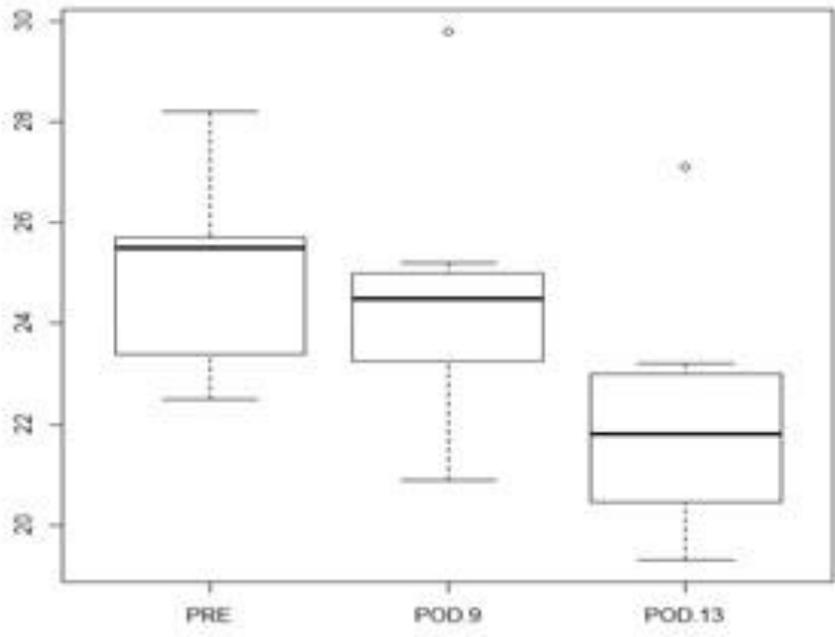


Fig 1. Box plot of control group shows statistical differences between PRE and POD13.

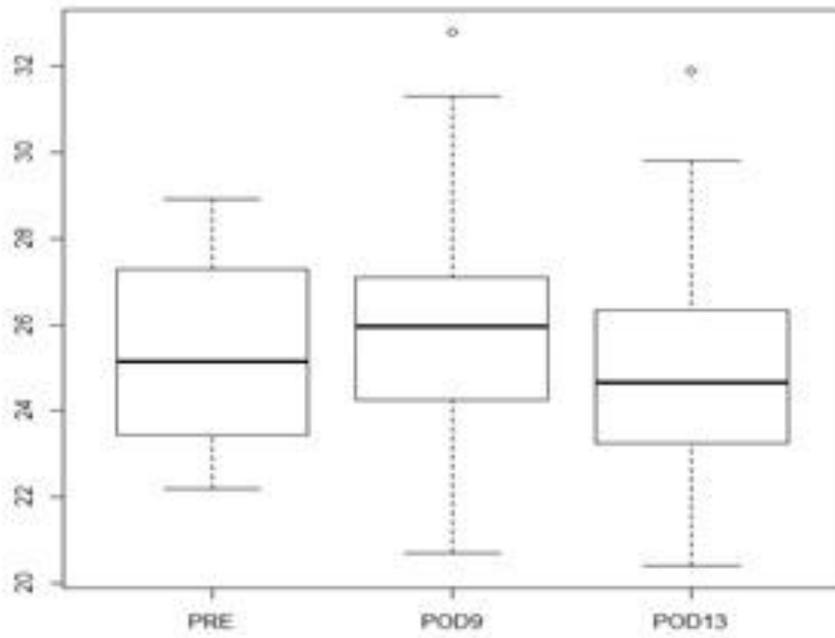


Fig 2. Box plot of study group shows no statistical differences between PRE and POD13.

Dysphagia Symptoms in Adults with Cerebral Palsy: Prevalence and Impact on Quality of Life

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Objectives

To investigate the prevalence and characteristics of dysphagia symptoms, evaluate the dysphagia-related quality of life (QOL), and determine the factors affecting dysphagia-related QOL in adults with cerebral palsy (CP).

Methods

This cross-sectional, interview-based survey study enrolled adults with CP (N = 117) and healthy individuals (N = 117). The Swallowing-QOL (SWAL-QOL) questionnaire, Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), and Functional Oral Intake Scale (FOIS) were evaluated by a rehabilitation physician. The Swallowing-QOL (SWAL-QOL) scores were the main outcome measure, with lower scores indicating symptoms with stronger effect on QOL. The SWAL-QOL questionnaire included 14 items regarding dysphagia symptoms and 30 regarding swallowing-related QOL.

Results

Among pharyngeal symptoms, choking on food occurred most frequently (sometimes or more 76.9%), followed by coughing and choking on liquid. Among oral symptoms, chewing problems occurred most frequently (sometimes or more 59.8%), followed by food dribbling from the mouth (sometimes or more 53.8%). Compared to healthy adults, those with CP showed worse QOL across all SWAL-QOL items, with the lowest scores obtained for meal duration, followed by communication, burden, fatigue, sleep, and eating desire. On multiple linear regression analysis, higher MACS level, lower FOIS level, and older age were predictors of worse SWAL-QOL score.

Conclusions

In adults with CP, dysphagia symptoms are very frequent and have a profound effect on SWAL-QOL. Thus, when managing CP patients, it is necessary to evaluate swallowing function and establish an active intervention plan even if total oral diet is established. Interventions for environmental factors, as well as medical interventions, might be also necessary in this population because factors associated with SWAL-QOL are less modifiable (hand function) or not modifiable (age).

Table 1. Demographics and functional status of adults with cerebral palsy

Characteristic	GMFCS level I– III (<i>n</i> = 50)	GMFCS level IV (<i>n</i> = 31)	GMFCS level V (<i>n</i> = 36)	Total (<i>N</i> = 117)
Sex, male	29 (58)	19 (61.3)	22 (61.1)	70 (59.8)
Age, years*	41.2±12.5	39.0±13.6	33.0±9.4	38.1±12.4
BMI	21.1±3.1	21.3±3.4	19.6±5.6	20.7±4.1
History of epilepsy	25 (50)	13 (41.9)	19 (52.8)	57 (48.7)
Preterm birth	11 (22)	12 (38.7)	16 (44.4)	39 (33.3)
Dominant type of motor impairment				
Spastic	17 (34)	14 (45.2)	19 (52.8)	50 (42.7)
Dyskinetic	30 (60)	15 (48.4)	16 (44.4)	61 (52.1)
Ataxic	2 (4)	1 (3.2)	0 (0)	3 (2.6)
Mixed spastic and dyskinetic	1 (2)	1 (3.2)	1 (2.8)	3 (2.6)
Distribution of motor impairment				
Hemiplegia	13 (26)	4 (12.9)	0 (0)	17 (14.5)
Diplegia	9 (18)	4 (12.9)	1 (2.8)	14 (12.0)
Quadriplegia	28 (56)	23 (74.2)	35 (97.2)	86 (73.5)
MACS level				
Level II	21 (42)	6 (19.4)	0 (0)	27 (23.1)
Level III	25 (50)	17 (54.8)	1 (2.8)	43 (36.8)
Level IV	4 (8)	7 (22.6)	10 (27.8)	21 (18.0)
Level V	0 (0)	1 (3.2)	25 (69.4)	26 (22.2)
FOIS level				
Level 5	13 (26)	6 (19.4)	19 (52.8)	38 (32.5)
Level 6	25 (50)	16 (51.6)	11 (30.6)	52 (44.4)
Level 7	12 (24)	9 (29.0)	6 (16.7)	27 (23.1)

Values represent frequency (percentage) or mean ± standard deviation.

**P* < .01 for the analysis of variance test.

Table 2. Prevalence of dysphagia symptoms in adults with cerebral palsy (*N* = 117)

Symptom	Almost always	Often	Sometimes	Hardly ever	Never	Converted score*
Pharyngeal symptoms						
Choking on food	7 (6.0)	33 (28.2)	50 (42.7)	20 (17.1)	7 (6.0)	47.2
Coughing	8 (6.8)	24 (20.5)	42 (35.9)	34 (29.1)	9 (7.7)	52.6
Choking on liquid	2 (1.7)	26 (22.0)	54 (46.2)	24 (20.5)	11 (9.4)	53.4
Coughing out food or liquid stuck in the mouth	5 (4.3)	22 (18.8)	52 (44.4)	26 (22.2)	12 (10.3)	53.8
Having to clear the throat	2 (1.7)	21 (17.9)	50 (42.7)	30 (25.6)	14 (12.0)	57.1
Food sticking in the throat	4 (3.4)	19 (16.2)	46 (39.3)	36 (30.8)	12 (10.3)	57.1
Gagging	3 (2.6)	6 (5.1)	31 (26.5)	47 (40.2)	30 (25.6)	70.3
Oral symptoms						
Problems chewing	18 (15.4)	23 (19.7)	29 (24.8)	35 (29.9)	12 (10.3)	50.0
Food or liquid dribbling from the mouth	9 (7.7)	26 (22.2)	28 (23.9)	37 (31.6)	17 (14.5)	55.8
Food sticking in the mouth	2 (1.7)	22 (18.8)	43 (36.8)	37 (31.6)	13 (11.1)	57.9
Drooling	11 (9.4)	17 (14.5)	25 (21.4)	45 (38.5)	19 (16.2)	59.4
Food or liquid coming out through the nose	0 (0)	6 (5.1)	33 (28.2)	45 (38.5)	33 (28.2)	72.4
Salivary symptoms						
Thick saliva or phlegm	5 (4.3)	25 (21.4)	39 (33.3)	35 (29.9)	13 (11.1)	55.6
Excess saliva or phlegm	5 (4.3)	22 (18.8)	43 (36.8)	34 (29.1)	13 (11.1)	56.0

Prevalence is expressed as frequency (percentage).

*Dysphagia symptom scores are shown after conversion to a 0–100 scale, with lower scores indicating symptoms with stronger effect on quality of life.

Table 3. Swallowing-Quality of Life (SWAL-QOL) score in adults with cerebral palsy and in healthy participants

SWAL-QOL item	Healthy participants (<i>n</i> = 117)		Adults with cerebral palsy (<i>n</i> = 117)		<i>P</i> -value
	Mean	SD	Mean	SD	
Food selection	99.36	3.97	71.90	18.56	<.001
Burden	98.83	4.92	57.16	23.92	<.001
Mental health	99.62	2.09	66.75	20.88	<.001
Social functioning	99.87	1.03	65.00	22.58	<.001
Fear	99.04	3.82	65.17	18.02	<.001
Eating duration	95.62	10.03	49.89	25.08	<.001
Eating desire	97.08	6.59	63.25	15.29	<.001
Communication	99.89	1.16	51.50	27.03	<.001
Sleep	91.45	11.21	61.00	24.30	<.001
Fatigue	93.16	10.01	57.98	22.96	<.001
Overall SWAL-QOL composite score	97.39	3.04	60.96	13.30	<.001

Scores are shown after conversion to a 0–100 scale. The overall SWAL-QOL composite score represents the average of converted scores of all items, as recommended by the SWAL-QOL developers.

P 1-33

New parameters of computerized motion analysis represent upper limb function in children with CP.

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Objectives

There are various tools that measure upper limb function in children with cerebral palsy (CP) clinically, but this measurement method depends on the subjective judgment of the examiner and the upper limb function is not measured as a continuous variable, which makes it difficult to quantitatively evaluate. The purpose of this study is to evaluate the correlation between Melbourne Assessment 2 (MA2) and computerized motion analysis in children with CP and to see if the new parameters derived from kinematics reflect the upper limb function in the clinical upper limb function evaluation result.

Subjects and Method

A total of 27 children with CP (age, 3 to 15 years) participated in this study. MA2 and Computerized upper limb motion analysis test were conducted. MA2 is a validated evaluation tool that measures the range of motion (ROM), Accuracy, Dexterity, and Fluency of the unilateral upper extremity function during 14 tasks. Computerized motion analysis test was conducted during the Reach & Grasp Cycle. The computer recognizes the movement of the markers attached to the upper limb of children during this task. The task is composed of four parts; reach out to the cup and grab the cup (T1), lift the cup to the mouth (T2), put the cup back in its original position (T3), and put the hand back in place (T4). New parameters (movement time, number of movement unit, index of curvature, movement speed) were derived from kinematic data. Movement time is time spent in each part of task. Number of movement unit is the number of acceleration-decelerations in the velocity profile of the wrist marker. Index of curvature is the path length of the wrist during each part of task divided by the linear distance between the initial and final positions. Movement speed is the distance travelled per unit time. For correlations between MA2 and kinematic parameters, the Spearman rank coefficient was used.

Results

Most of MA2 scores showed moderate negative correlation with movement times during T2 ($r_s = -0.464, -0.500, -0.441$; ROM, accuracy, fluency, respectively; $p < 0.05$), T3 ($r_s = -0.431, -0.395, -0.412$; accuracy, dexterity, fluency, respectively; $p < 0.05$), and T4 ($r_s = -0.456, -0.527, -0.446, -0.474$; ROM, accuracy, dexterity, fluency, respectively; $p < 0.05$). All dimensions of MA2 (ROM, accuracy, dexterity, fluency) showed negative correlation with

index of curvature during T2 ($r_s=-0.559, -0.523, -0.388, -0.424$, respectively; $p<0.05$) and T3 ($r_s=-0.737, -0.716, -0.590, -0.708$, respectively; $p<0.01$)

Conclusion

We calculated quantitative parameters to measure unilateral upper limb function using computerized motion analysis during each part of the task. Most dimensions of MA2 correlated with more straight movement during lifting the cup to the mouth and put the cup back. In addition, all dimensions of MA2 correlated with the faster time to lift the cup to the mouth, put the cup back and put the hand back in place.

Table 1. Correlation between Melbourne assessment-2 and Movement time during each task

	Movement time(s)			
	T1	T2	T3	T4
MA2 ROM(%)	-0.216	-0.464*	-0.337	-0.456*
MA2 Accuracy(%)	-0.246	-0.500**	-0.431*	-0.527**
MA2 Dexterity(%)	-0.168	-0.369	-0.395*	-0.446*
MA2 Fluency(%)	-0.228	-0.441*	-0.412*	-0.474*

* $P<0.05$ by Spearman's rank correlation test

** $P<0.01$ by Spearman's rank correlation test

MA2, Melbourne assessment-2; ROM, range of motion; T1, reach out to the cup and grab the cup; T2, lift the cup to the mouth; T3, put the cup back in its original position; T4, put the hand back in place

Table 2. Correlation between Melbourne assessment-2 and Curvature index of kinematic data

	Index of curvature			
	T1	T2	T3	T4
MA2 ROM(%)	-0.205	-0.559**	-0.737**	-0.006
MA2 Accuracy(%)	-0.215	-0.523**	-0.716**	-0.114
MA2 Dexterity(%)	-0.263	-0.388*	-0.590**	-0.043
MA2 Fluency(%)	-0.191	-0.424*	-0.708**	-0.021

* $P<0.05$ by Spearman's rank correlation test

** $P<0.01$ by Spearman's rank correlation test

MA2, Melbourne assessment-2; ROM, range of motion; T1, reach out to the cup and grab the cup; T2, lift the cup to the mouth; T3, put the cup back in its original position; T4, put the hand back in place

The Development Aspect of Children with Delayed Development between Patients with or without CNVs

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Introduction

Microarray-based comparative genomic hybridization (array CGH) has been widely adopted as a valuable clinical diagnostic test for children with delayed development. Bradley P Coe et al. suggested copy number variants (CNVs) are associated with many neurocognitive disorders. Patients with CNVs may present with varying clinical features, but presented with delayed development, it is more likely CNV played a role in the manifestation of symptoms. Hence, it would be meaningful to compare the clinical development aspect of children suspected of delayed development between patients with or without copy number variations.

Objective

To compare and analyze the clinical development aspect of children suspected of delayed development between patients with or without Copy Number Variations (CNV).

Method

A retrospective chart review was done in 65 children who underwent array CGH after visiting PM&R Department outpatient clinic with delayed development as chief complaints. Children were evaluated for Denver Developmental Screening Test (DDST), Sequenced Language Scale for Infants (SELSI)/Preschool Receptive-Expressive Language Scale (PRES). Data were collected from January 2016 to November 2017. A Mann-Whitney U test was conducted to determine statistical differences of Developmental Quotient (DQ), Receptive Language Quotient (RLQ) and Expressive Language Quotient (ELQ) between two groups: 19 children with CNVs and 46 children without CNVs.

Results

Of 65 children who underwent array CGH after visiting PM&R Department outpatient clinic with delayed development as chief complaints, average age was 34 months (mean age 34±25.3) and 19 patients (29.2%) had copy number variations (Table 1, 2). Among CNV (+) group, 14 children underwent DDST; among CNV (-) group, 29 children underwent DDST. Among variables, gross motor scale was significant lower ($p=0.0381$) in CNV (+) group compared with CNV (-) group (Table 3). Among CNV (+) group, 5 children underwent either SELSI or PRES; among CNV (-) group, 27 children underwent above language assessment examination. Both receptive and expressive language scores did not reveal significant difference between two groups.

Conclusion

Of children with delayed development who took array CGH, 29.2% were diagnosed with CNVs. The gross motor domain in DQ was significantly lower in children with CNV compared to children without CNV. This result suggests that additional genetic factors may contribute to this variability. Active detection of genomic imbalance could play some vital role when presented with prominent gross motor delay in children with delayed development.

Table 1. General demographics

	(N=65)
Age (months)	34 ± 25.3
Gender (male : female)	40 : 25
DDST Developmental Quotient	(N=43)
Personal social	63.6 ± 20.4
Fine motor	71.1 ± 19.9
Gross motor	64.0 ± 19.1
Language	57.1 ± 22.1
SELSI or PRES	(N=32)
Receptive Language Quotient	49.6 ± 20.6
Expressive Language Quotient	47.9 ± 17.2

Values are presented as mean ± standard deviation

DDST, Denver Developmental Screening Test; SELSI, Sequenced Language Scale for Infants; PRES, Preschool Receptive-Expressive Language Scale

Table 2. Array-CGH results and clinical features of the 19 patients with CNVs

Patient	Age (months)	Gender	Array result	Size	Inheritance	Clinical features
1	8	M	arr[hg19]8q21.11q21.13(76,069,471_81,532,974)x1	5.5 Mb	de novo	DD, DLD, Facial dysmorphism, Simian crease, Abnormal patterns of toes, Neonatal <u>hypotonia</u>
2	2.5	M	arr[hg19]12p13.33p11.1(450,479_34,345,585)x3~4	33.9 Mb	Unknown	DD, Dextroversion of the heart, ICH, Hypotonia
3	48	F	arr[hg19]14q13.3q21.1(36,747,497_42,447,650)x1	5.7 Mb	Maternally inherited	DD, DDH, ID, Spastic diplegia, Hypotonia
4	0.9	F	arr[hg19]4q35.1q35.2(185,274,461_190,469,337)x1, 10p15.3p11.23(148,206_29,975,521)x3	5.2 Mb and 30 Mb	Unknown	DD, Cardiomegaly, ASD secundum with septal aneurysm, Severe <u>hypotonia</u> , Congenital arachnoid cyst
5	42	M	arr[hg19]13q12.3(30,656,355_31,905,182)x3	1.2 Mb	Unknown	DD, DLD, Hyperactivity, Bronchomalacia, ID, ASD, Facial dysmorphism, Hypotonia
6	22	M	arr[hg19]21q21.1(20,090,068_22,116,178)x1	2.0 Mb	Unknown	DD, Congenital <u>hypotonia</u> , Pes planus, Ataxic gait, Hypotonia
7	13	F	arr[hg19]15q11.2q13.1(23,739,358_29,213,461)x1	5.5 Mb	Unknown	DD, Severe <u>hypotonia</u> , DDH
8	18	M	arr[hg19]1q21.1q21.2(146,564,743-149,224,043)x1	2.7 Mb	Unknown	DD, DLD, HIE, Ataxic gait, Planovalgus, Hammer toe
9	34	M	arr[hg19]8p23.2(3,710,810-5,922,013)x3	2.2 Mb	Unknown	DD, DLD, Facial dysmorphism, Hypotonia
10	60	F	arr[hg19] Xp22.33p22.2(61091_10125133)x1	10 Mb	Unknown	DD, DLD, Facial dysmorphism, Moderate ID
11	36	F	arr[hg19] 16p11.2(29673954_30197341)x3	523 kb	Unknown	DD, DLD, Epilepsy, Severe ID, Facial dysmorphism
12	48	F	arr[hg19] 17q12(34817422_36168104)x3	1.4 Mb	Unknown	DD, DLD
13	17	F	arr[hg19] 9q33.2q33.3(124628147_127176303)x1	2.5 Mb	de novo	DD, Inguinal hernia, Hypotonia
14	72	M	arr[hg19] 3q29(195740357_197395697)x1	1.7 Mb	Unknown	DD, DLD, Exotropia
15	16	M	arr[hg19] 16p11.2(16899617_28574419)x3	11.7 Mb	de novo	DD, Facial dysmorphism, Hypertelorism, High arched palate, Hypotonia, ID
16	10	F	arr[hg19] 17p11.2(16822683_20193169)x1	3.4 Mb	Unknown	DD, CoA, PDA, Hypotonia
17	9	F	arr[hg19] 12q23.1q23.3 (98731852_104856429)x1	6.1 Mb	Unknown	DD, Cleft lip, Hypotonia
18	48	M	arr[hg19] 15q13.1q13.3 (29213402_32914140)x1	3.7 Mb	Unknown	DD, DLD, ITP
19	19.2	M	arr[hg19] Xp22.31 (6552712_8115153)x3	1.6 Mb	Unknown	DD, Facial dysmorphism, Frontal boldness, Hypotonia, High arched palate

DD, Delayed development; DLD, Developmental language delay; ID, Intellectual disability; DDH, Developmental dysplasia of the hip; HIE, Hypoxic-Ischemic Encephalopathy; ITP, Idiopathic thrombocytopenic purpura; CoA, Coarctation of aorta; PDA, Patent ductus arteriosus

Table 3. Comparison between the groups classified by copy number variations

	CNV(+)	CNV(-)
DDST Developmental Quotient	N=14	N=29
Personal social	67.5±17.4	61.7±21.7
Fine motor	69.4±21.1	71.9±19.7
Gross motor	<u>57.7±13.2*</u>	<u>67.1±21.0*</u>
Language	65.9±25.0	52.9±19.7
SELSI or PRES	N=5	N=27
Receptive Language Quotient	47.8±16.9	49.9±21.4
Expressive Language Quotient	51.9±20.6	47.1±16.9

Values are presented as mean ± standard deviation **p*<0.05
 DDST, Denver Developmental Screening Test; SELSI, Sequenced Language Scale for Infants;
 PRES, Preschool Receptive-Expressive Language Scale

Clinical usefulness of Korean Developmental Screening Test for Infants and Children (K-DST)

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Objective

Developmental disability is a decline in physical, mental, cognitive, and verbal abilities during development. Unlike adults, because infants and children should go through developmental milestones, earlier detection of developmental disabilities is critical for timely interventions. The Korean-Ages and Stages Questionnaire (K-ASQ) and the Denver Developmental Screening Test II (DDST-II) have been used as tools for developmental screening. However, there are limitations in both methods. Korean Developmental Screening Test for Infants and Children (K-DST) was developed for Korean infants and children from 2011 to 2014 through a study of related departments such as Korean Society of Pediatric Rehabilitation and Developmental Medicine and Korean Pediatric Adolescent Psychiatric Association. It is said to be more suitable for the cultural BACKGROUND of Korea and reliability and validity are already verified. The aim of this study is to investigate whether K-DST is suitable as a screening tool for developmental disorders by comparing K-ASQ and K-DST, which are the same caregiver report types.

Method

This study was performed in patients between 4 months and 71 months from April 2010 to November 2013. All caregivers of the patients were asked to carry out both K-DST and K-ASQ questionnaires and if necessary, K-BSID II and K-WPPSI were used as reference scale. The final diagnosis was made by three experienced specialists (physiatrist, pediatric psychiatrist and pediatric neurologist) at the developmental delay clinic. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of each K-DST and K-ASQ were calculated based on the final clinical diagnosis. In addition, we analyzed how well the two screening tests reflect the results of the K-BSID II or K-WPPSI test.

Results

A total of 145 infants and children were included in this study. The mean age was 39.1 (\pm 16.4) months, of which 100 were boys. 123 children were finally diagnosed clinically as developmental disability, 40 with autistic spectrum disorder (ASD), 46 with mental retardation (MR)/global delayed disorder (GDD), and 37 with developmental language disorder (DLD). The K-BSID or K-WPPSI were assessed in 93 children, 55 and 38, respectively. There was no statistically significant difference in sensitivity, specificity, PPV,

NPV, and accuracy between K-ASQ and K-DST (Table 1). The correlation between K-DST/K-ASQ average and K-BSID-II and K-WPPSI is shown in Table 2. Overall, there is no statistically significant difference between K-DST and K-ASQ.

Conclusion

K-DST is a fairly good screening tool for developmental delay which is suitable for the cultural BACKGROUND of Korea and is expected to replace K-ASQ with high validity.

Table 1. Sensitivity, specificity and accuracy of K-DST and K-ASQ

	K-ASQ		K-DST		p-value
	Fail	Pass	Fail	Pass	
Disease group (n=123)	103	20	102	21	
Normal group (n=22)	5	17	2	20	
Sensitivity(%)	83.7 (77.2-90.3)		82.9 (76.3-89.6)		0.7629
Specificity(%)	77.3 (59.8-94.8)		90.9 (78.9-100.0)		0.1615
PPV(%)	95.4 (91.4-99.3)		98.1 (95.4-100.0)		0.1804
NPV(%)	45.9 (29.9-62.0)		48.8 (33.5-64.1)		0.5734
Accuracy	82.8 (76.6-88.9)		84.1 (78.2-90.1)		0.6168

K-DST : Korean Developmental Screening Test for Infants and Children, K-ASQ : Korean-Ages and Stages Questionnaire, PPV : positive predictive value, NPV : negative predictive value

Table 2. Correlation analysis between K-DST/K-ASQ average and K-BSID-II, K-WPPSI (Pearson correlation)

	K-BSID-II (n=55)				K-WPPSI (n=38)					
	MDI (p value)		PDI (p value)		TIQ (p value)		VIQ (p value)		PIQ (p value)	
	r	P	r	P	r	P	r	P	r	P
K-DST_average	0.576‡		0.515‡		0.5879†		0.5665†		0.5959‡	
		0.8344		0.9662		0.7441		0.8687		0.7788
K-ASQ_average	0.617‡		0.575‡		0.4586*		0.4703*		0.4749*	

K-DST : Korean Developmental Screening Test for Infants and Children, K-ASQ : Korean-Ages and Stages Questionnaire, K-BSID-II : Bayley Scales of Infant Development-II, K-WPPSI : Korean-Wechsler Preschool and Primary Scale of Intelligence, MDI : mental development index, PDI : psychomotor development index, TIQ : total intelligence quotient, VIQ : verbal intelligence quotient, PIQ : performance intelligence quotient

*: correlation p-value < 0.05

†: correlation p-value < 0.001

‡: correlation p-value < 0.0001

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Factors influencing the gross motor outcome of hippotherapy in children with cerebral palsy

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Aim

The aim of this study was to identify individual factors influencing the gross motor outcome in children with cerebral palsy (CP) after hippotherapy.

Method

One hundred forty six children with CP (mean age: 5.78 ± 1.72 years, male: 56.2%) presenting variable function (Gross Motor Function Classification System [GMFCS] levels I–IV) participated in this study. Participants received 30 minutes of hippotherapy twice a week for 8 weeks. Clinical information including GMFCS level, age, sex, CP distribution, CP type, Gross Motor Function Measure-88 (GMFM-88), GMFM-66, and Pediatric Balance Scale (PBS) score were collected retrospectively. We regarded the children with GMFM-66 score increased by 2.0 points as good responders to hippotherapy. Further we analyzed factors affecting good responders.

Results

GMFCS level I–II compared to IV (OR=6.83) and III compared to IV (OR=4.45) were significantly associated with a good response to hippotherapy. Higher baseline GMFM E (OR=1.05) and lower baseline GMFM B (OR=0.93) were also significantly associated with a good response to hippotherapy.

Interpretation

The children with CP, GMFCS level I-III with relatively poor postural control in sitting might have more chances to improve their GMFM-66 scores through hippotherapy. It supports that hippotherapy is a context-focused therapy to improve postural control in sitting.

Table 1. Characteristics of the patients and the difference in GMFM-66 score among the groups (n = 146)

Characteristic	n (%)	Difference in GMFM-66 score		
		Mean	SD	p Value
Sex				
Male	82 (56.2%)	2.27	1.77	
Female	64 (43.8%)	2.45	2.10	0.227
Age (mean±SD, y)	5.78±1.72			
3 ≤ age < 6	77 (52.7%)	2.30	1.79	
6 ≤ age < 11	69 (47.3%)	2.40	2.07	0.199
Distribution (spastic type)	n=128			
Unilateral	12 (9.4%)	2.46	2.17	
Bilateral	116 (90.6%)	2.34	1.90	0.771
GMFCS level				
I*,†	24 (16.4%)	3.33	2.26	
II [§]	48 (32.9%)	2.82	2.07	0.020*
III [†]	44 (30.1%)	1.98	1.57	0.001 [†]
IV*, [§]	30 (20.5%)	1.35	1.17	0.004 [§]
Neuromotor type, n (%)				
Spastic	128 (87.7%)	2.32	1.94	>0.05
Dyskinetic	10 (6.8%)	2.39	1.50	>0.05
Ataxic	8 (5.5%)	2.78	2.23	>0.05

Table 2. Differences in GMFM-66, GMFM-88, and PBS scores between before and after intervention

	Before	After	Difference	p Value
GMFM-66	59.15±12.44	61.50±13.22	2.35±1.92	0.000
GMFM-88	73.75±17.68	76.71±17.18	2.96±2.43	0.000
PBS	24.58±17.81	27.94±18.31	3.36±3.19	0.000

Table 3. Factors that influence the therapeutic effect of hippotherapy

Factors		Univariable logistic analysis		Multivariable logistic analysis	
		Odds ratio (95% CI)	p Value	Odds ratio (95% CI)	p Value
Sex	Boys	Reference			
	Girls	1.10 (0.57–2.12)	0.770		
Age	3 ≤ age < 6	Reference			
	6 ≤ age < 11	1.05 (0.55–2.01)	0.883		
Distribution	Unilateral	Reference			
	Bilateral	0.65 (0.20–2.16)	0.485		
GMFCS	I or II	5.81 (2.20–15.38)	0.0004	6.83 (1.03–45.09)	0.046
	III	2.28 (0.81–6.42)	0.121	4.45 (1.03–19.16)	0.045
	IV	Reference		Reference	
Neuromotor type	Spastic	Reference			
	Dyskinetic	1.07 (0.29–3.86)	0.924		
	Ataxic	1.07 (0.26–3.86)	0.932		
Baseline gross motor	Baseline GMFM A	0.93 (0.69–1.25)	0.626		
	Baseline GMFM B	1.04 (0.99–1.09)	0.124	0.93 (0.87–1.00)	0.046
	Baseline GMFM C	1.06 (1.02–1.11)	0.006		
	Baseline GMFM D	1.05 (1.02–1.08)	0.001		
	Baseline GMFM E	1.04 (1.02–1.05)	<0.0001	1.05 (1.01–1.11)	0.031
	Baseline PBS	1.04 (1.02–1.06)	0.0002		

Current tendency of rehabilitation therapy according to functional status in children with CP

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Objective

Various attempts have been made to improve the functional status of the children with cerebral palsy (CP). However, because of the heterogeneity of the disease, factors that play a decisive role in functional improvement are still unclear. The aim of this study is to investigate the current tendency of rehabilitation therapy in children with CP and effect of therapeutic intensity affect functional improvement in them.

Methods

A total of 112 participants (72 males and 40 females) with CP (mean age: 33.44±17.90 months) were recruited. Demographic data, GMFCS level, Gross Motor Function Measure (GMFM), Pediatric Evaluation of Disability Inventory (PEDI), age of initial rehabilitation therapy started and number of physical therapy given to the participants were recorded at base line, 6 months, and 12 months based on the study started date by qualified investigators. The subjects were divided into groups that received conventional physical therapy more than 5 times a week and those who did not. Treatment beginning age, and changes in GMFM and PEDI sub-scores were analyzed according to GMFCS level and age.

Results

Demographic data of the subjects are shown in Table 1. As the functional status of the subjects was worse, age of initial rehabilitation therapy started was younger and the intensity of treatment was higher ($p < 0.05$) (Table 2). There were no significant changes in GMFM and sub-scores of PEDI between two groups according to intensity of physical therapy (Table 3).

Conclusion

This study showed current status of rehabilitation therapy for children with CP through one-year follow-up cohort study. There was the tendency that the children with poorer functional status revealed starting treatment earlier and more intensive rehabilitation therapy. This may be due to the early diagnosis of CP in children with poorer functional status. Intensity of physical therapy did not affect the functional improvement of the patients. Considering the fact that rehabilitation treatment can be expected to have a greater effect in CP patients with lower GMFCS level, early identification and treatment are even more important in children with better functional status.

Table 1. Demographic data of participants

Characteristics		Number (%)
Age in month (Mean±SD)		33.44±17.90
Sex	Male	72 (64.3%)
	Female	40 (35.7%)
GMFCS level	Level I	40 (35.7%)
	Level II	10 (8.9%)
	Level III	18 (16.1%)
	Level IV	21 (18.8%)
	Level V	23 (20.5%)
Physical therapy intensity	> 5 times a week	64 (57.1%)
	≤ 5 times a week	48 (42.9%)

GMFCS, Gross Motor Function Classification System

Table 2. Treatment beginning age and therapeutic intensity according to GMFCS level

GMFCS level	Treatment beginning age (mean±SD)	p-value	Therapeutic intensity (sessions per week)	p-value
Level I	13.15±11.46		9.34±7.47	
Level II	10.2±5.85		8.89±4.72	
Level III	6.78±4.52	0.002*	11.77±6.56	0.044*
Level IV	6.90±5.51		15.25±12.27	
Level V	5.70±3.52		13.69±9.90	

GMFCS, Gross Motor Function Classification System

*Asterisk means $p < 0.05$

Table 3. Repeated measure ANOVA of GMFM and sub-scores of PEDI according to physical therapy intensity

	Physical therapy intensity	Base line (Mean±SD)	6 months (Mean±SD)	12 months (Mean±SD)	p-value
GMFM	> 5 times a week	46.85±19.50	49.85±18.98	52.30±18.59	0.07
	≤ 5 times a week	41.34±17.86	43.71±17.98	44.81±18.18	
PEDI Self-care	> 5 times a week	22.00±18.04	25.73±18.50	29.23±19.03	0.09
	≤ 5 times a week	17.25±12.37	20.15±13.88	23.12±15.30	
PEDI Mobility	> 5 times a week	21.14±18.37	26.23±19.36	29.62±19.58	0.07
	≤ 5 times a week	16.38±15.43	19.90±17.08	21.73±18.51	
PEDI Social	> 5 times a week	21.64±17.38	25.98±16.89	28.92±16.72	0.13
	≤ 5 times a week	19.81±14.53	23.25±15.07	26.25±15.97	

GMFM, Gross Motor Function Measure; PEDI, Pediatric Evaluation of Disability Inventory; GMFCS, Gross Motor Function Classification System

Correlation between SELSI and Bayley according to gestational age and brain abnormalities.

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Objective

Both the Bayley Scales of Infant Development (BSID) and the Sequenced Language Scale for Infants (SELSI) are for screening high-risk infant populations after premature birth or perinatal insults. BSID can be helpful in identifying infants and young children who are at risk for developmental delays by evaluating both cognitive and physical functions. On the other hand, SELSI can assess only language function in infants from the ages of 4 to 35 months. However, there are no previous studies about correlation of subcategories between these two tests according to gestational age(GA) and brain image. So, this study is aimed to find any significant correlations of two tests in infants with premature gestational age and different brain images.

Subjects and Method

We reviewed recordings of 24 infants who have visited our hospital and performed both Bayley Scales of Infant Development-II (BSID-II) and SELSI. BSID-II is subdivided into three subcategories including cognition, motor, and behavior scales. And SELSI is also subdivided into two subcategories including receptive and expressive language abilities. We calculated quotient scores by dividing estimated age by corrected age and multiplying it by 100. First, we compared quotient scores of each group and then, analyzed the correlation of these scores between cognition scale of BSID-II and two subcategories of SELSI. We applied the same method after dividing subjects into two groups according to GA (<32 weeks, ≥32 weeks) and the presence of abnormalities (normal, abnormal: cyst, PVL, hemorrhage, ischemia) in brain image.

Result

Infants with less than 32 weeks of GA showed significantly higher quotient scores than infants with more than 32 weeks of GA in cognition scale of BSID-II and expressive language abilities of SELSI (Table1). Also, the correlations of quotient scores between receptive language abilities of SELSI and cognition scale of BSID-II ($r=0.64$, $p<0.01$), between expressive language abilities of SELSI and cognition scale of BSID-II ($r=0.73$, $p<0.01$) were statistically significant. And these correlations were more prominent in infants with more than 32 weeks of GA (receptive: $r=0.93$, $p<0.01$; expressive: $r=0.75$, $p<0.05$) than in infants with less than 32 weeks of GA (receptive: $r=0.54$, $p<0.05$; expressive: $r=0.69$, $p<0.01$). Also, infants with abnormal brain images showed higher correlation (receptive: $r=0.89$, $p<0.01$; expressive: $r=0.83$, $p<0.05$) than infants with normal brain images (receptive: $r=0.54$, $p<0.05$; expressive: $r=0.69$, $p<0.01$) (Table 2).

Conclusion

This study shows that infants with more than 32 weeks of GA performed low scores on BSID-II and SELSI. So, we should carefully consider BSID and SELSI to infants with even higher GA. Also, correlations between language abilities of SELSI and cognition scale of BSID-II were statistically significant and this correlations were more prominent in infants with more than 32 weeks of GA and with abnormal brain images.

Table 1. Difference between quotient scores between each groups

	Gestational Age			Brain Image		
	<32 Weeks (n=14)	≥32 Weeks (n=10)	p-value	Normal (n=17)	Abnormal (n=7)	p-value
Cognition scale of BSID-II	15.4	8.5	0.02*	13.6	9.9	0.26
Receptive Language Abilities of SELSI	14.4	9.6	0.12	13.5	10.0	0.29
Expressive Language Abilities of SELSI	14.9	9.2	0.04*	13.9	9.2	0.15

Values are mean rank.

BSID-II: Bayley Scales of Infant Development

SELSI: Sequenced Language Scale for Infants

* $p < .05$ ** $p < .01$

Table 2. Correlation of quotient scores between SELSI and Bayley subcategories

Cognition scale of BSID-II SELSI	Total	Gestation Age		Brain Image	
		<32 Weeks (n=14)	≥32 Weeks (n=10)	Normal (n=17)	Abnormal (n=7)
Receptive Language Abilities	0.64**	0.54*	0.93**	0.54*	0.89**
Expressive Language Abilities	0.73**	0.69**	0.75*	0.69**	0.83*

Values are correlation coefficients.

BSID-II: Bayley Scales of Infant Development

SELSI: Sequenced Language Scale for Infants

* $p < .05$ ** $p < .01$

Correlation between IQ of K-WPPSI-IV and previous result of developmental test in young children

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Objective

We aimed to compare correlation between Korean Wechsler Preschool and Intelligence Infant Test-IV(K-WPPSI-IV) and previous results of developmental test and find out early predictable factor of intellectual ability in young children.

Subjects and Methods

We retrospectively reviewed the medical records of 227 patients who performed K-WPPSI-IV and 32 patients who previously underwent Korean Infant and Child Development Test (KICDT) and Korean Bayley Scale of Infant Development-II(K-BSID-II) were included. Pearson chi-square test was used to analyze correlation between Full Scale Intelligence Quotient (FSIQ) of K-WPPSI-IV and developmental quotient (DQ) of subscales of KICDT such as gross motor, fine motor, language, personal-social, and cognitive-adaptive and also between FSIQ of K-WPPSI-IV and psychomotor developmental index (PDI) and mental developmental index (MDI) of K-BSID-II.

Result

Mean age of initial developmental tests was 30.03±9.13 months and mean age of K-WPPSI-IV was 48.88±8.69 months. DQ of KICDT was respectively 75.47±22.14, 77.65±17.46, 68.44±24.58, 75.62±19.25, and 79.63±22.67 for gross motor, fine motor, language, personal-social and cognitive-adaptive. FSIQ of K-WPPSI-IV was 75.06±22.22. There was significant correlation between FSIQ of K-WPPSI-IV and fine motor, personal-social, language, cognitive-adaptive DQ of the KICDT and also MDI of the K-BSID-II. But, gross motor DQ of KICDT and PDI of K-BSID-II were not significantly correlated with FSIQ of K-WPPSI-IV.

Conclusion

This study shows that developmental tests which is conducted in infancy and young childhood, especially fine motor, personal social, language and cognitive-adaptive DQ in KICDT and MDI of K-BSID-II may be useful in predicting future cognitive development in children.

The risk factor associated with clavicle fracture in infants with congenital muscular torticollis

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Objective

Congenital muscular torticollis (CMT) has known to be able to occur along with several conditions, such as brachial plexus injury (BPI) or clavicle fracture. Among them, there has been little study about the risk factor of clavicle fracture combined with CMT, although clavicle fracture is the most common fracture in newborns. Therefore, the aim of this study is to investigate the relationship between demographic factors and clavicle fracture combined with CMT.

Material and method

The medical records of 449 subjects who complained of abnormal posture of head and neck were reviewed. Exclusion criteria were (1) no specific finding on ultrasonography; (2) diagnosed as postural torticollis; (3) no plain radiograph of cervical spine and/or clavicles. And 134 patients of CMT were included. Therefore, we retrospectively reviewed the medical records of 134 patients with CMT. Clavicle fracture was confirmed when fracture line and/or callus were detected on the plain radiography. Demographic data, such as body weight, maternal age, gender, gestational age, delivery method, sternocleidomastoid (SCM) thickness of ipsilateral side, and its ratio between ipsilateral and contralateral side, and first visit date after the birth were collected by reviewing medical record. To find the difference of the demographic data between CMT patients with and those without clavicle fracture, an independent T-test, Fisher's exact test, or chi-square test were performed. In addition, multivariate logistic analysis was then performed on the demographic factors with a p-value less than 0.05 in independent t-test, Fisher's exact test, or chi-square test.

Results

Clavicle fracture was found in 15 of 134 patients with CMT, with the concurrent rate being 11.19%. In comparison of the demographic data between CMT patients with and those without clavicle fracture, there was a significant difference in delivery mode (P-value <0.05). There was a significant difference in body weight between CMT patients with and those without clavicle fracture (P-value <0.05). However, there was no significant difference in other demographic factors. In multivariate logistic analysis, the body weight was the only significant parameter for predicting clavicle fracture in patients with CMT (p-value <0.05). In patients with CMT, the area under the ROC curve of the body weight for predicting clavicle fracture was 0.659 (95% CI, 0.564-0.745.; p<0.05). The optimal cut-off value obtained from the maximum Youden index J was 3470g (sensitivity:

57.14%, specificity: 75.76%), and the odd ratio of clavicle fracture in patients with CMT increased by 1.244 times at every 100g of body weight.

Conclusion

Body weight at birth can be a clinical predictor of clavicle fracture in patients with CMT. Therefore, care should be taken to detect clavicle fracture when the body weight at birth is more than 3470g in patients with CMT.

P 1-41

Does SCM muscle size affect upper trapezius muscle thickness in patient with congenital torticollis?

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Purpose

To study the upper trapezius muscle thickness (UTMT) using ultrasound (US) in patients with congenital muscular torticollis (CMT) and correlation among sternocleidomastoid muscle thickness (SCMT), accessory nerve (AN) and UTMT in CMT.

Method

The study recruited 17 infants with the difference of the thickness of the SCM muscle on both sides greater than 2 mm on ultrasonography (group 1-CMT) and 21 infants with the difference of the thickness of the SCM muscle on both sides less than 2 mm (group 2-postural torticollis (PS)). A physiatrist performed B-mode US measured the SCMT, UTMT, and calculated the cross-sectional area (CSA) of the AN in both groups (Figure 1). We calculated SCMT, UTMT, and AN ratio (affected/unaffected thickness) in both groups. We also evaluated the correlation among sternocleidomastoid muscle thickness (SCMT), CSA of AN and UTMT in both groups.

Result

SCMT, UTMT, and CSA of the AN in affected side in group 1 was significantly greater than that in group 2 (Table 1). SCMT, UTMT, and CSA of the AN in affected side was significantly greater than that in unaffected side in group 1. However, there was no significant differences in group 2 (Table 2). CSA of the AN in affected side in group 1 was positively correlated with UTMT ($r=0.55$, Table 3) and not with SCMT. There was no correlation among SCMT, UTMT, and CSA of the AN in affected side in group 2.

Conclusion

This study demonstrated SCM size affect upper trapezius muscle thickness via accessory nerve in patients with congenital torticollis.

table1. SCM, Sternocleidomastoid muscle; UT, Upper trapezius muscle; CSA, Cross sectional area. * P<.05 statistically significant differences obtained in independent T test between group 1 and group 2.

Parameter	Group 1 (n=17)	Group 2 (n=21)	<i>P</i>
SCM thickness, mm	11.83±3.2	6.74±1.41	0.001*
UT thickness, mm	5.1±1.2	3.12±0.41	0.000*
Accessory nerve CSA, mm2	1.26±0.55	0.47±0.23	0.033*

table2. SCM, Sternocleidomastoid muscle; UT, Upper trapezius muscle; CSA, Cross sectional area. * P<.05 statistically significant differences obtained in paired T test.

Parameter	Affected side	Unaffected side	<i>P</i>
Group 1			
SCM thickness, mm	11.83±3.2	5.79±0.73	0.000*
UT thickness, mm	5.1±1.2	2.56±0.44	0.000*
Accessory nerve CSA, mm2	1.26±0.55	0.41±0.15	0.000*
Group 2			
SCM thickness, mm	6.74±1.41	6.52±1.33	0.081
UT thickness, mm	3.12±0.41	3.09±0.5	0.569
Accessory nerve CSA, mm2	0.47±0.23	0.48±0.21	0.76

Values are Mean±SD

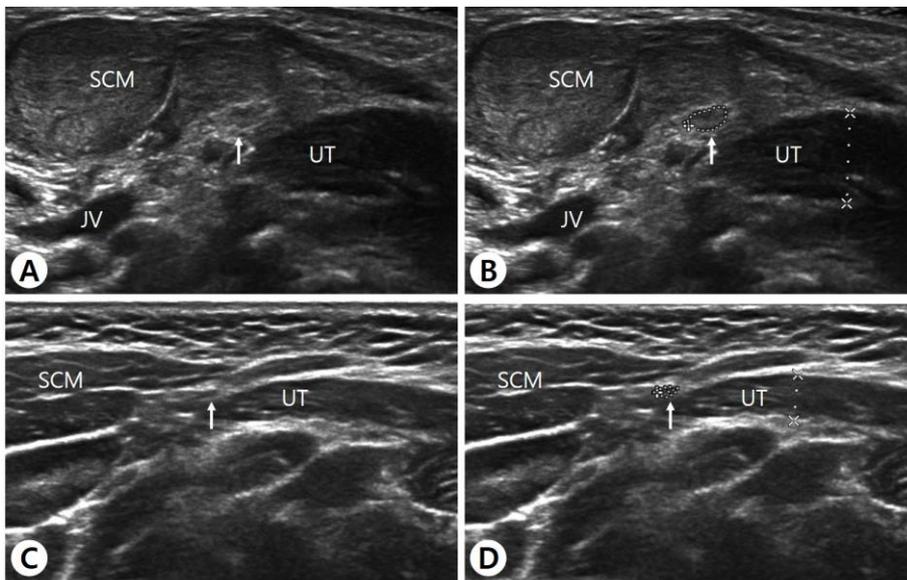


fig1. Representative transverse ultrasound image of sternocleidomastoid muscle, accessory nerve and upper trapezius in group 1(A-B) and group 2(C-D). (A, B) B-mode image showed fibrosis of sternocleidomastoid muscle with enlarged accessory nerve (Arrow) in group 1. (C, D) In group 2, cross sectional area of accessory nerve and diameter of upper trapezius were measured. SCM, Sternocleidomastoid muscle; UT, Upper trapezius muscle; JV, Juglar vein.

Feasibility of Robot-assisted Gait Training with End-effector Type in Children with Cerebral palsy

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Introduction

One of the most disabling mobility problems in CP is gait impairment, clinically characterized by reduced speed and endurance, as well as reduced step, stride length, and toe clearance during gait. Robotic-assisted gait training (RAGT) has become an increasingly common rehabilitation tool over the last decade to improve the gait pattern of people with neurological impairment. While there is a growing body of evidence on the effectiveness of RAGT in adults, evidence for pediatric population is not so clear. There are two main categories of automated gait machines: exoskeletons and end-effectors. Morning Walk[®] is the only end-effector commercially available in Korea. It has two foot plates that simulate locomotor activity with saddle support for body weight. The purpose of this study is to investigate the feasibility of Morning Walk[®] in Children with Cerebral palsy.

Materials and Methods

This study is fulfilled from April 2014 to May 2018. Children under 120 cm of height and over 120 kg of weight were excluded considering specification of the device. Two sizes of saddles were applied according to the heights of the patients. RAGT was done for 30 minutes per each session and 1 or 2 times per week. Completed therapy consisted of 24 consecutive sessions. If weight support greater than 70% and ground reaction force less than 20% of the body weight remained unchanged, the patient was excluded from RAGT. A session of RAGT was stopped in the following cases: 1) if an experienced therapist judged there would be a potential musculoskeletal injury; 2) if there was a request to stop from the patient; or 3) if the patient was not cooperative to the treatment.

Results

Total 31 children with cerebral palsy were included in this study (mean age 13.5 ± 3.54 yrs), and the distribution of CP was diverse (Table 1). 15 of them performed the GMFM test and 28 children performed occupational evaluation (Table 2). Among these population, Twenty-five patients had cognitive dysfunction and 10 children could not complete RAGT therapy, because of poor cooperation and hip joint pain (Table 3).

Conclusion

The present study demonstrated that automated gait machine with end-effector is feasible and safe for children with cerebral palsy. Further research, such as a randomized controlled trial including the follow-up periods after the training, is needed to provide

conclusive evidence of the efficacy of Morning Walk[®] compared with conventional rehabilitation or intervention with other devices.

table1. Type and Distribution of Cerebral Palsy

Type of Cerebral Palsy		
Quadriplegia	11	(35.48 %)
Hemiplegia	3	(9.68%)
Triplegia	3	(9.68%)
Diplegia	14	(45.16%)
GMFCS level		
I	4	(12.90%)
II	10	(32.26%)
III	7	(22.58%)
IV	9	(29.03%)
V	1	(3.23%)

table2. Physical and occupational evaluation of Cerebral Palsy

	Number of Patient (% of total patient)	Result
MBI total	15 (48.39 %)	48.80 ± 29.20
MBI stair climbing		3.00 ± 3.55
MBI ambulation		4.33 ± 5.08
GMFM	15 (48.39 %)	
GMFM C (Crawling & Kneeling)		67.62 ± 31.50
GMFM D (Standing)		43.58 ± 30.81
GMFM E (Walking, Running, Jumping)		35.63 ± 31.62

table3. Reasons of Discontinuation of Cerebral Palsy

Reasons of Discontinuation [↵]		Number of Patient [↵] (% of total patient) [↵]
Severe cognitive dysfunction [↵]	GMFCS I [↵]	2 (6.45 %) [↵]
	GMFCS IV [↵]	6 (19.35 %) [↵]
Severe motor dysfunction [↵]	GMFCS V [↵]	1 (3.23 %) [↵]
Pain at hip joint [↵]	GMFCS I [↵]	1 (3.23 %) [↵]

Association of stress signals with developmental outcome at 10 months in premature infants

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BACKGROUND

The aim of this study was to investigate if uncoordinated sucking, swallowing, and respiration (SSR) during the preterm period, which results in stress signals during bottle-feeding, is indicative of developmental outcomes when evaluated at 10 months of corrected age.

Methods

We retrospectively reviewed the medical records of premature infants born between January 2014 and December 2016 at * National University Hospital (*NUH). At least two minutes of video-recording was conducted for all referred infants, which was then reviewed for assessment using the Neonatal Oral-Motor Assessment Scale (NOMAS). A total of 71 premature infants were assigned a NOMAS score at the preterm period and a Bayley score at 10 months of corrected age (CA). Of these, 70 premature infants exhibited a disorganized sucking pattern according to the NOMAS. The disorganized sucking pattern was divided into two groups according to incoordination findings (Table 1). The incoordination-positive group included cases exhibiting stress signals (i.e., head bobbing, extraneous movements of the body or limbs during sucking, choking, gagging, coughing, yelping, and grunting) and defined as cluster 4. The incoordination-negative group included clusters 2 and 3 and included cases exhibiting no stress signals.

Results

Of the premature infants belonging to the incoordination-positive group (cluster 4, n=22), 4 (18.18%) had a Bayley-III cognitive composite score of less than 85 at 10 months of CA. The Bayley-III cognitive composite score was significantly lower ($p=0.004$ by Mann-Whitney U test) in the incoordination-positive group (cluster 4) than in the incoordination-negative group (cluster 2, 3). In univariate analysis, moderate-to-severe bronchopulmonary dysplasia (BPD), presence of stress signals (incoordination positive group= cluster 4), Grades 3 or 4 germinal matrix hemorrhage-intraventricular hemorrhage (GMH-IVH), total parenteral nutrition duration, and birth weight were considered predictive of cognitive development at 10 months. Meanwhile, a multiple linear regression analysis indicated that the presence of stress signals, Grades 3 or 4 GMH-IVH, and moderate-to-severe BPD were predictive of cognitive development at 10 months.

Conclusions

There is a need for periodic follow-up and early intervention for developmental delay when incoordination that results in stress signals in NOMAS is observed before 40 weeks post-menstrual age.

TABLE 1 | Scoring instructions and interpretation for each Neonatal Oral-Motor Assessment Scale cluster.

Cluster	Interpretation	Scoring instruction
1	Normal sucking pattern	
2	Disorganized sucking pattern	Only an arrhythmical sucking pattern, without the observation of "unable to sustain" or "incoordination of suck/swallow and respiration" sucking patterns
3	Disorganized sucking pattern	An arrhythmical and "unable to sustain" suckle pattern The "unable to sustain" suckle pattern includes the following: 1. The infant ceases sucking completely during the first 2 min of nutritive sucking, or 2. The pauses are longer than the burst, or 3. The bursts are shorter than three sucking phases
4	Disorganized sucking pattern	An arrhythmical and "incoordination of suck/swallow and respiration" sucking patterns that cause stress signals; the "unable to sustain" suckle pattern may or may not be present "Incoordination of suck/swallow and respiration" includes all the following stress signals: nasal flaring, head turning, head bobbing, extraneous movements of the body or limbs, gagging, choking, coughing, yelping, and grunting
5	Dysfunctional sucking pattern	The interruption of sucking activity owing to abnormal movements of the tongue and jaw which includes the following: 1. Excessively wide excursions of the jaw or 2. Minimal excursions: clenching or 3. Flaccid tongue with absent tongue groove or 4. Retracted tongue with posterior humping

Table 2. Multiple regression analysis for Bayley-III cognitive composite score at 10 months of corrected age

Variable	B	95% CI for B	Beta	t	P value
Presence of stress signals (Incoordination-positive vs. negative group on NOMAS)	-8.926	-15.118 to -2.734	-0.306	-2.880	0.005
Grades 3 or 4 GMH-IVH	-21.714	-33.525 to -9.902	-0.373	-3.670	0.001
Moderate-to-severe BPD	-6.213	-12.355 to -0.072	-0.216	-2.020	0.048

NOMAS, Neonatal Oral-Motor Assessment Scale; TPN, total parenteral nutrition; BPD, bronchopulmonary dysplasia

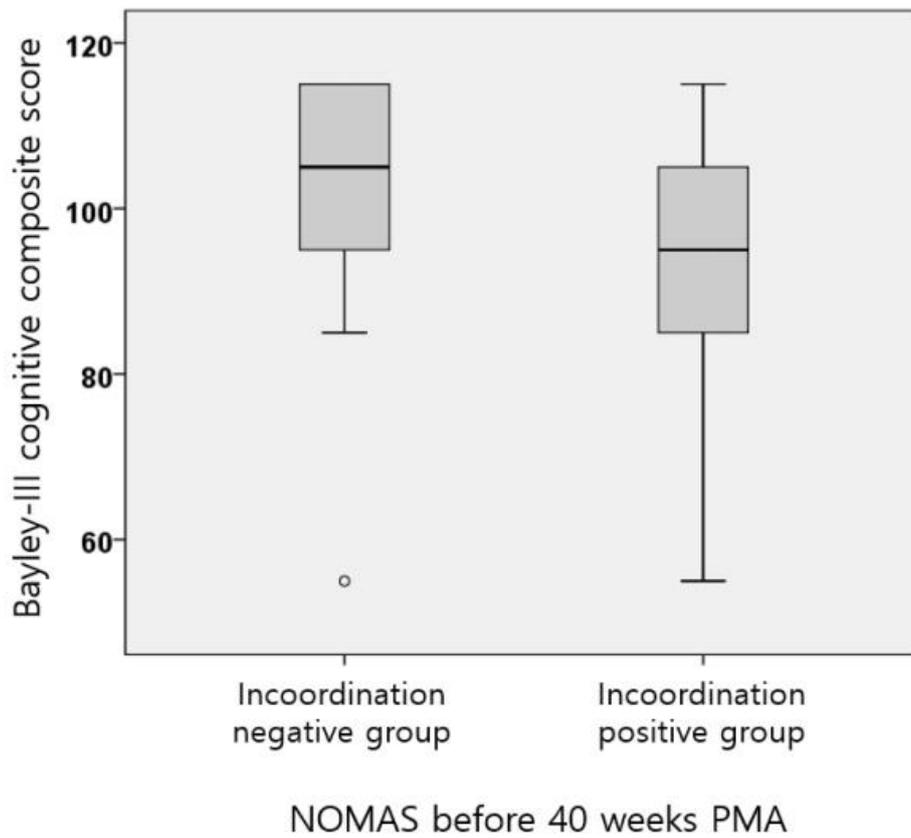


Figure 1. Bayley-III cognitive composite score at corrected age 10 months based on incoordination findings in Neonatal Oral-Motor Assessment Scale

Correlation between psychologic tests for assessing cognitive development in young children

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Objective

We aimed to find out correlation between psychologic tests for assessing cognitive development in children using Kaufman Assessment Battery for Children (KABC), Korean-Wechsler Preschool and Intelligence Infant Test-IV(K-WPPSI-IV) and Visual-Motor Integration (VMI).

Subjects and Methods

We performed K-WPPSI-IV, KABC and VMI at same time for 10 young children who referred for cognitive function evaluation and analyzed the correlation among the Full Scale Intelligence Quotient (FSIQ) of K-WPPSI-IV, cognitive processing score of KABC and calculated IQ of VMI using Pearson chi-square test.

Result

Mean age of subjects was 57.40 ± 10.18 months (7 males and 3 females). The mean FSIQ score of K-WPPSI-IV was 90.30 ± 12.67 , cognitive processing score of KABC was 103.20 ± 12.84 and calculated IQ from VMI was 102.09 ± 10.33 . There was significant correlation between FSIQ of K-WPPSI-IV and Cognitive processing score of KABC. But there was no significant correlation between calculated IQ of VMI and FSIQ of K-WPPSI-IV and also between calculated IQ of VMI and Cognitive processing score of KABC.

Conclusion

This study shows that not all cognitive assessments are correlated even though the subject number is small. Therefore, it is suggested that caution should be exercised in using only one tool to assess the cognitive development of young children.

Motion and heart rate during horse riding and horse riding simulator in children with cerebral palsy

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The evidence of efficacy of therapeutic horse riding in children with cerebral palsy is increasing. However, there are limitations in applying it because of scarce of experts for hippotherapy and the hassle of going to the place for horse riding. Therefore, some people apply the horse riding simulator instead of horse riding for the therapeutic purpose. The study aimed to determine the difference between the movement and heart rate response on the actual horse and the device. The participants were 12 children with cerebral palsy (GMFCS level I-III) aged 5-12 years recruited from university rehabilitation hospital. Five were boys, and eight were bilaterally involved. The body movement was monitored by accelerometer wearing at the waist during the beginner mode of the simulator and the horse riding. And heart rate was monitored by wireless heart rate monitor equipment. Movement of 3 axes, x, y, z, and monitored heart rate was analyzed by Data Analysis Software. The movement of the y-axis was significantly less during the horse riding simulator compared to real horse riding, 300.27 ± 277.22 and 210.71 ± 243.70 , respectively ($P < 0.05$). However, movement of x- and z-axes significantly more during the simulator. The axis x movement were 649.89 ± 337.24 and 1050.44 ± 379.00 , and axis z movement were 840.66 ± 406.85 and 1147.95 ± 414.10 during horse riding and simulator exercise, respectively ($P < 0.05$). The motion tracked in three axes is presented in Figure 1 and 2. The variability of heart rate on equipment was significantly less than the real horse riding ($P = 0.001$) (Figure 3). On a horse, there is a rhythmical up and down movement while the horse is walking. However, on the simulator equipment, the movement of the y-axis was less, but the movement of x- and z-axes was significantly more than the horse riding. Although total vector magnitude of movement was more on the simulator, the variability of heart rate was significantly more during the real horse riding. Data comparing the horse riding and horse riding simulator is scarce. In addition to movements, we tracked variations of heart rate but, further study about the simulator's effect on postural reaction and gross motor function is needed.

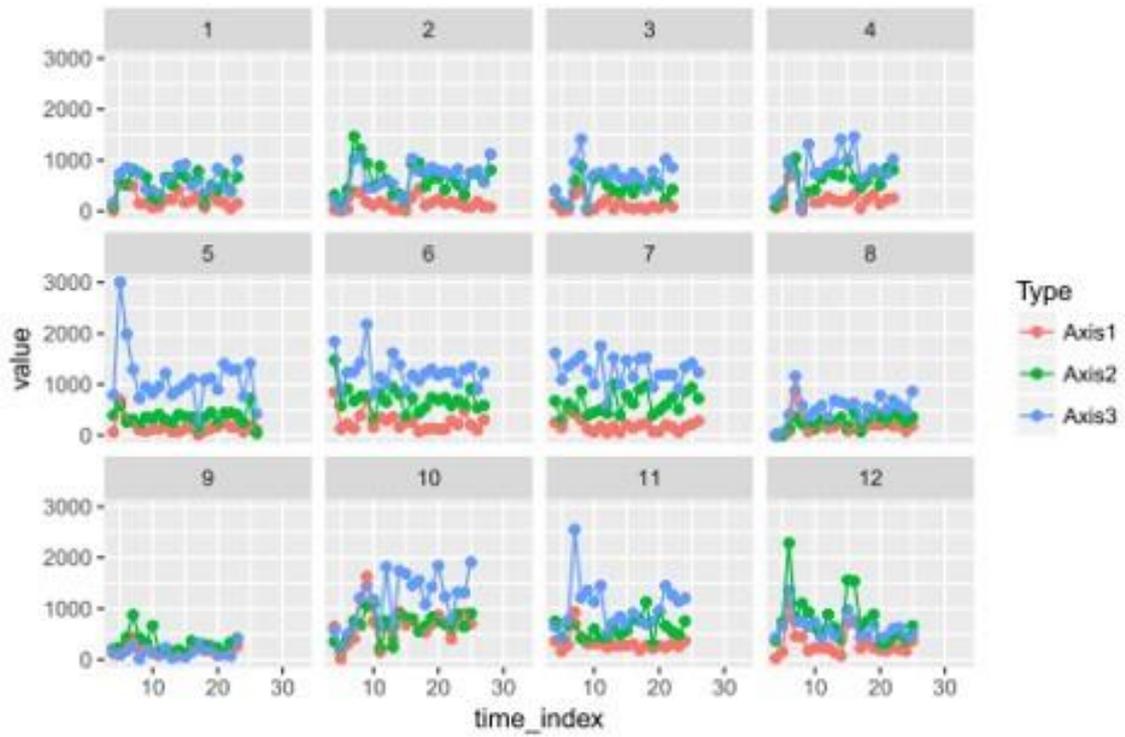


fig1. Movements according to x-, y-, z-axes (axis 2, axis 1, axis 3) during real horse riding.

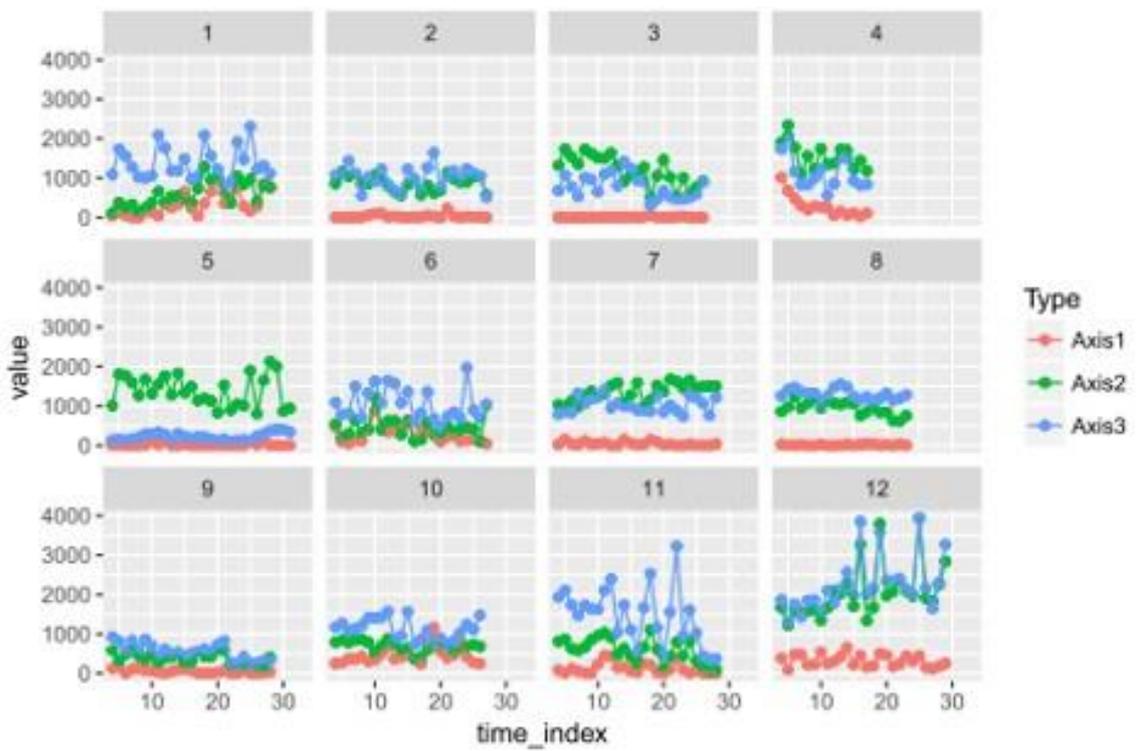


fig2. Movements according to x-, y-, z-axes (axis 2, axis 1, axis 3) on a horse riding simulator.

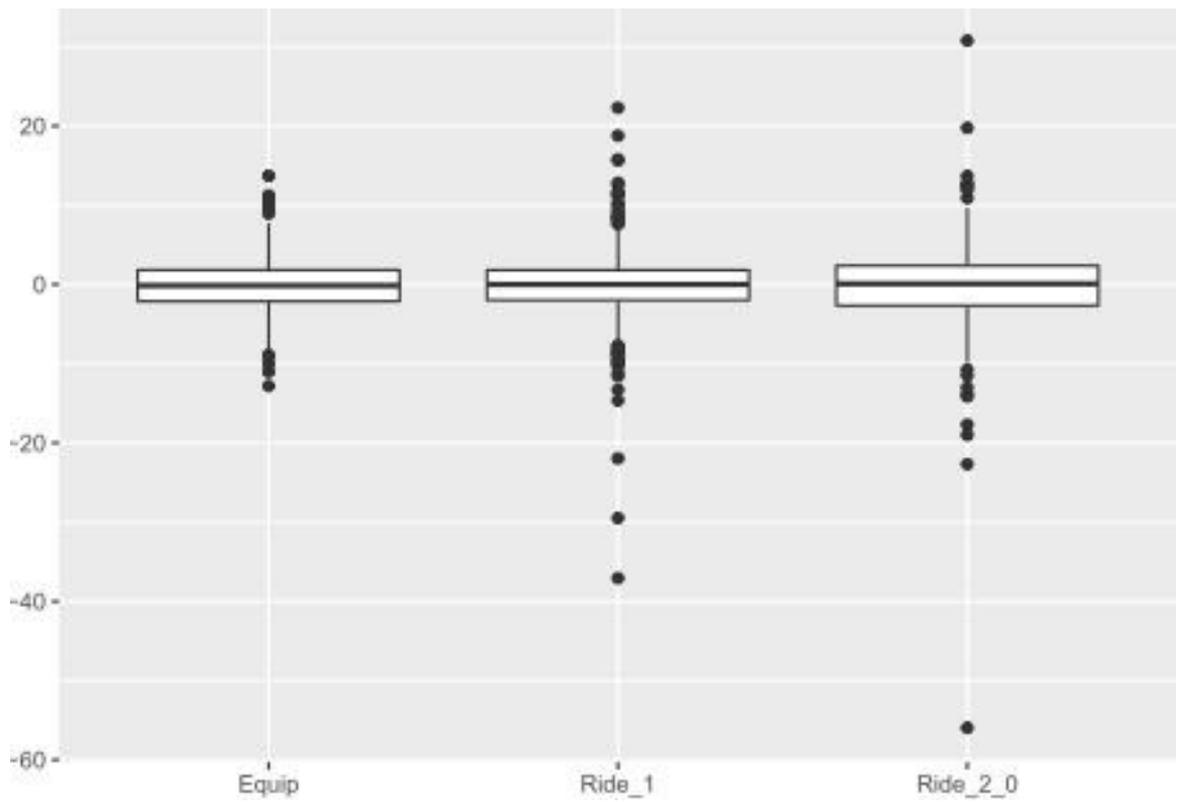


fig3. Heart rate variability during the horse riding and exercise on horse riding simulator

Trajectory of change in the swallowing status in spinal muscular atrophy type I

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Aim

Spinal muscular atrophy (SMA), an autosomal recessive genetic disorder, is characterized by progressive muscle weakness and atrophy. An objective description of swallowing difficulty in patients with SMA type I is currently lacking making the management of patients with such conditions rather challenging. This study aimed to describe the change in progressive swallowing dysfunction in 11 subjects with SMA type I from birth to 2 years of age using the Neuromuscular Disease Swallowing Status Scale (NdSSS) and videofluoroscopic swallowing study (VFSS).

Methods

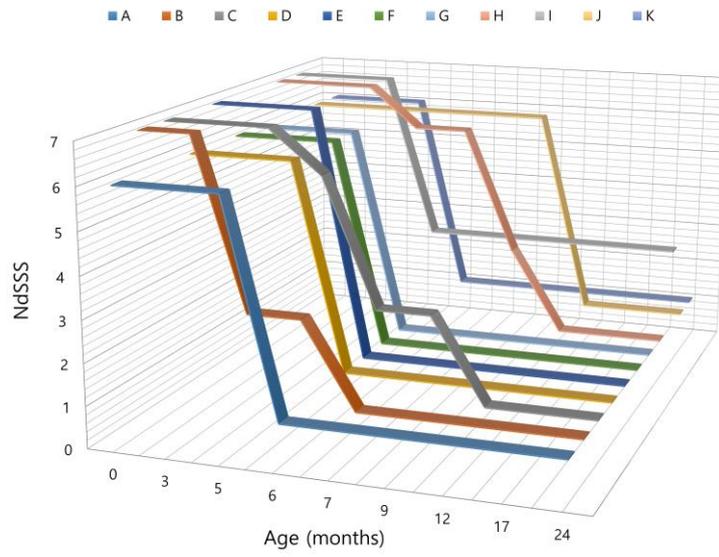
Retrospective chart reviews were performed. The NdSSS was used to describe the actual swallowing situation in patients with SMA type I and VFSS was used to assess swallowing function in an objective manner.

Results

Upon analysis, we found that the swallowing function generally deteriorated in patients with SMA type I at approximately 6 months of age, and the average age at which tube feeding was initiated was approximately 6.8 ± 2.0 months. However, there was wide variation in the period when the main route of feeding was changed from totally oral to tube feeding (from 5 months to 12 months). Five subjects with SMA type I had VFSS data. In some cases, the evidence of laryngeal aspiration was obtained via the VFSS at very early stages of the disease. Conversely, there were some cases in which mainly oral feeding was maintained up to 12 months and evidence of aspiration was not observed in the VFSS.

Conclusion

An individualized approach is essential, as the timeline of deterioration in swallowing function varies widely in patients with spinal muscular atrophy type I.



Trajectory graph of NdSSS in patients with type I SMA according to age.

Comparison of body movement characteristics between EAAT and walking in children with cerebral palsy

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Purpose

Equine-associated activities and therapy (EAAT) are known to be one of exercise interventions to improve postural control in children with cerebral palsy (CP). However, there is little research on the mechanism of action to improve postural control. The purpose of this study was to compare of the body movement characteristics between EAAT and walking in children with CP using tri-axial accelerometer,

Subjects and Method

Twelve children (age, 8.3±2.0; height, 128.5±7.3; weight, 27.7±4.6) with CP (Gross Motor Function Classification System level I -III) participated in this study. Tri-axial body movements were measured with ActiGraph model GT3X accelerometer (Health One Technology, Fort Walton Beach, FL) on the waist during EAAT and walking. Changes of heart rate were also measured with Polar heart rate monitor (Polar Inc., Oulu, Finland) on the chest during EAAT and walking. The 40-minute EAAT programs were offered, which included stretching, strengthening, dynamic balance, postural control, and basic riding skills while walking and trotting. Times for mounting and unmounting activities were excluded in the analysis. Six minute walk tests (6MWT) were performed at least two days apart from the measurement during EAAT. Children received the same verbal instructions to assist in the pace of walking. Tri-axial raw acceleration data (counts per minute) obtained were analyzed with ActiLife 6.0 software (Health One Technology, FL, USA). Then the coefficients of variation (CV, ratio of the standard deviation to the mean) of tri-axial raw acceleration were calculated. The metabolic equivalent rate (MET) of each child was calculated using Freedson equations for children (2005); $2.757 + (0.0015 * \text{Counts per minute}) - (0.08957 * \text{Age}) - (0.000038 * \text{Counts per minute} * \text{Age})$.

Results

Tri-axial raw acceleration (anteroposterior, mediolateral and vertical) were all significantly lower during EAAT than walking ($p < .01$). However, the coefficients of variation in all tri-axis were significantly higher in EAAT than walking ($p < .01$). The highest acceleration was noted in the vertical axis during walking, anteroposterior axis during EAAT, respectively. MET and HR was significantly lower during EAAT than walking ($p < .01$). However, the coefficients of variation in MET was significantly higher in EAAT than walking ($p < .01$).

Conclusion

Body movements in all tri-axis were decreased in spite of continuous postural challenge. However, contents of the EAAT program seem more complex and variable than those of walking (higher CV). This implies automatism has not been completed during EAAT. Then these results support EAAT is a context focused therapy to improve postural control in children with CP.

Table 1. The value of tri-accelerometry, MET and HR during EAAT and walking^u

Value ^o	Walking(6min) ^o	EAAT(30min) ^o	p ^o
Vertical Axis (counts/min) ^o	3247.41±1307.79 ^o	558.35±231.57 ^o	.002* ^o
Mediolateral Axis (counts/min) ^o	2270.49±790.52 ^o	654.77±258.72 ^o	.002* ^o
Anteroposterior Axis (counts/min) ^o	2324.15±629.95 ^o	1036.44±462.79 ^o	.002* ^o
MET ^o	5.81±1.31 ^o	2.54±.35 ^o	.002* ^o
Heart Rate (beats/min) ^o	143.15±14.16 ^o	105.66±10.17 ^o	.002* ^o

NOTE. MET, Metabolic Equivalent rate; EAAT, Equine-associated activities and therapy; * significantly difference between walking and EAAT (p<.01). ^u

Table 2. The Coefficient of variation of tri-accelerometry, MET and HR during EAAT and walking^u

Coefficient of variation ^o	Walking(6min) ^o	EAAT(30min) ^o	p ^o
Vertical Axis (counts/min) ^o	.140±.117 ^o	.906±.227 ^o	.002* ^o
Mediolateral Axis (counts/min) ^o	.129±.099 ^o	.586±.144 ^o	.002* ^o
Anteroposterior Axis (counts/min) ^o	.140±.142 ^o	.571±.141 ^o	.002* ^o
MET ^o	.162±.071 ^o	.309±.063 ^o	.002* ^o
Heart Rate (beats/min) ^o	.098±.056 ^o	.069±.025 ^o	.117 ^o

NOTE. MET, Metabolic Equivalent rate; EAAT, Equine-associated activities and therapy; * significantly difference between walking and EAAT (p<.01). ^u

Effect of Equine-assisted activities and therapy on aerobic capacity and endurance in children with cerebral palsy: A Pilot study

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Purpose

Equine-Assisted Activities and Therapy (EAAT) are known to give beneficial effects on gaits in children with cerebral palsy (CP). This may lead to improvement in exercise tolerance in children with CP. There has been little evidence of effects of EAAT on aerobic capacity and endurance so far. Therefore the purpose of this study was to evaluate the effect of EAAT on aerobic capacity and endurance in children with CP

Subjects and Method

Twelve children (age, 8.9±1.9; height, 131.7±8.6; weight, 27.9±4.8) with CP (Gross Motor Function Classification System level I-III) participated in this study. Six minute walk tests (6MWT) measured using ActiGraph model GT3X accelerometer (Health One Technology, Fort Walton Beach, FL, USA) on the waist, and polar heart rate sensor (Polar Inc., Oulu, Finland) on the chest. Children received the same verbal instructions to assist in the pace of walking. Temporospatial gait parameters before and after the EAAT were obtained and analyzed with ActiLife 6.0 software (Health One Technology, FL, USA). The metabolic equivalent rate (MET) of each child was calculated using Freedson equations for children (2005); $2.757 + (0.0015 * \text{Counts per minute}) - (0.08957 * \text{Age}) - (0.000038 * \text{Counts per minute} * \text{Age})$. EAAT program The 40-minute EAAT program was offered twice a week for 16 weeks. The EAAT contents included stretching, strengthening, dynamic balance, postural control, and basic riding skills while walking and trotting.

Results

Walking speed, walking distance in 6MWTs were significantly improved after the 16-week-EAAT program compared with the control group. MET was significantly increased EAAT group after the program.

Conclusion

This pilot study showed beneficial effects of EAAT on aerobic capacity and endurance in children with CP.

Table 1. Change of HR, MET, and gait parameters[↵]

Variables [↵]		Pre [↵]	Post [↵]	P [↵]	Different value [↵]	p [↵]
HR [↵] (beats/min) [↵]	CON [↵]	147.71±19.00 [↵]	151.17±18.85 [↵]	.225 [↵]	5.79±6.43 [↵]	.629 [↵]
	EAAT [↵]	151.81±23.07 [↵]	161.79±23.37 [↵]	.068 [↵]	3.46±7.79 [↵]	
MET [↵]	CON [↵]	5.34±1.32 [↵]	4.98±1.60 [↵]	.686 [↵]	-.37±.65 [↵]	.109 [↵]
	EAAT [↵]	6.54±1.10 [↵]	5.60±0.82 [↵]	.028* [↵]	-.94±.56 [↵]	
Steps [↵] (counts/min) [↵]	CON [↵]	109.63±16.07 [↵]	94.14±23.55 [↵]	.225 [↵]	-15.50±23.19 [↵]	.631 [↵]
	EAAT [↵]	118.11±13.15 [↵]	103.58±12.94 [↵]	.075 [↵]	-14.54±19.84 [↵]	
Stride length [↵] (m) [↵]	CON [↵]	.80±.12 [↵]	.80±.14 [↵]	.917 [↵]	-.003±.042 [↵]	.394 [↵]
	EAAT [↵]	.83±.24 [↵]	.90±.18 [↵]	.345 [↵]	.067±.148 [↵]	
Walking speed [↵] (m/min) [↵]	CON [↵]	54.17±18.35 [↵]	56.08±21.16 [↵]	.293 [↵]	1.92±5.33 [↵]	.003 † [↵]
	EAAT [↵]	62.92±13.64 [↵]	72.50±13.69 [↵]	.024* [↵]	9.58±4.01 [↵]	
Walking distance [↵] (m) [↵]	CON [↵]	325.00±110.09 [↵]	336.50±126.99 [↵]	.293 [↵]	11.50±3.20 [↵]	.003 † [↵]
	EAAT [↵]	377.50±81.84 [↵]	435.00±82.16 [↵]	.024* [↵]	57.50±24.03 [↵]	

NOTE. MET: Metabolic Equivalent rate. * Statistically significant difference between pre and post EAAT program (p<.05).

† Statistically significant difference between EAAT and control group (p<.01).

Responses to cord blood therapy in global developmental delay: improvement of autistic features

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Introduction

Global developmental delay (GDD) is defined as a significant delay in two or more developmental domains. The prevalence of GDD is estimated to be 1% to 3% in children younger than 5 years. As most GDD patients have limited improvements with conventional treatments, stem cell therapy targeting neuro-regeneration is an emerging therapeutic option. Administration of umbilical cord blood mononuclear cells (UCB) has demonstrated clinical improvements without safety issues in autism patients. Considering poor performance across all developmental domains in GDD patient, the effect of UCB was studied in association with available results of developmental assessments. Changes of autistic features and cognitive improvement after UCB injection were also included.

Materials and methods

This study is a retrospective review of GDD patients who received autologous UCB between April 2010 and June 2016. Erythropoietin was administered together to potentiate UCB effects. Inclusion criteria were 1) diagnosis of GDD, 2) received autologous UCB, 3) available results of functional assessments before and after UCB administration. Exclusion criterion was the history of other previous stem cell therapy. A telephone survey was conducted to find any adverse events and the level of satisfaction in the developmental domains. Psychological measures including Childhood Autism Rating Scale (CARS) score in association with changes in other domains of development were observed. This study was approved by the institutional review board of ethics.

Results

The demographics of 31 eligible patients are described in Table 1. Eighteen patients responded to the telephone survey. No adverse events were reported with the longest follow-up duration of 13.4 years and the level of satisfaction for gross motor, fine motor, cognition, language, and social interaction domains were favorable to UCB therapy in most patients (Figure 1). Procedural content scored the highest followed by overall satisfaction in the survey. Gross Motor Function Measures was changed significantly after UCB injection in total and all subcategories except for Rolling. Three among seven patients with documented autistic features (CARS > 30) improved substantially at follow-up CARS assessment after UCB therapy (Figure 2).

Conclusion

In this retrospective review, autologous UCB potentiated with EPO in children with GDD was proved to be safe for over a decade. This study demonstrated a potential benefit of

UCB injection especially in GDD children with autistic features. Subsequent studies utilizing various psychomotor evaluations will be able to help identify the effective population of UCB therapy.

Table 1. Demographics of GDD patients with autologous cord blood cell transplantation

Characteristics	Mean \pm SD
Sex (male / female, n)	21/10
Gestational age (weeks)	38.7 \pm 1.6
Mode of delivery (NVSD/C/S, n)	19/12
Birth weight (kg)	3.18 \pm 0.5
Age of UCB injection (months)	55.0 \pm 27.1
Follow-up duration after UCB injection (months)	21.6 \pm 28.9
GMFCS level I/II/III/IV/V, n	22/4/1/2/2
Brain MRI findings, n (%)	
Normal	20 (64.5)
Mild ventricular dilatation	6 (19.4)
Partial agenesis of corpus callosum	2 (0.6)
Diffuse brain atrophy	2 (0.6)
Non-specific bilateral parietal T2 high signal intensities	1 (0.3)

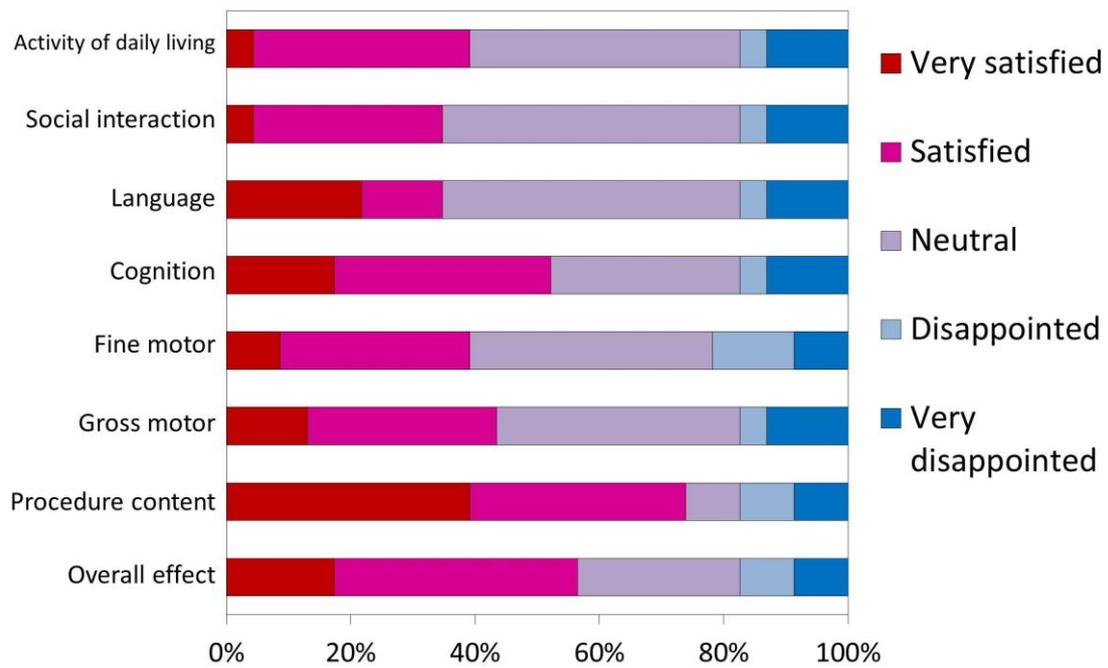


Figure 1. Satisfaction survey results Caregivers of 18 patients responded to the telephone survey on satisfaction of UCB injection for each developmental domain including gross motor, fine motor, language, cognition, social interaction and activities of daily living. The procedural content and overall effect were also questioned.

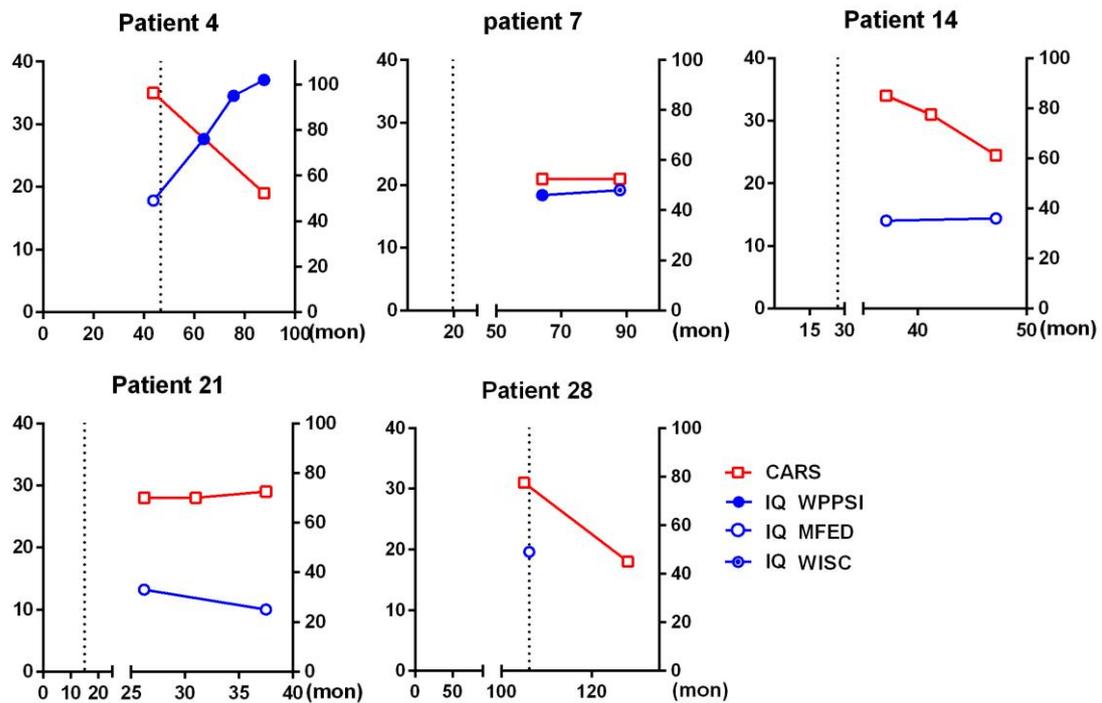


Figure 2. Psychological changes of autistic features after UCB injection Left Y axis stands for CARS scores while right Y axis stands for IQ scores. The dotted vertical lines indicate the time of UCB injection in each patient. IQ scores are based on Munich Functional Developmental Diagnostics (MFED) unless otherwise marked. CARS, Childhood Autism Rating Scale; IQ, Intelligence Quotient; WPPSI, Wechsler Preschool and Primary Scale of Intelligence Korean version; WISC, Wechsler Intelligence Scale for Children Korean version; mon, months

Pain related goal achievement after SEMLC (single-event multi-level chemoneurolysis) of the limb using botulinum toxin-A and/or alcohol in adult patient with cerebral palsy.

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Retrospective chart review was done at a multidisciplinary cerebral palsy clinic of a university hospital. 60 adult patients older than 18 years old, 102 cases were enrolled for the study of goal achievement after SEMLC (single-event multi-level chemoneurolysis) of the limb using botulinum toxin-A and/or alcohol. They received on average 1.7 treatment (range 1-4) during the 2-year-old study period. Time-based realistic goals were set before treatment and self or parents reported goal achievements were recorded at the first visit after SEMLC. Overall 215 goals were categorized using the ICF (International Classification of Functioning, Disability, and Health) model. 55 cases (53.9% of 102 cases) reported ongoing pain before the procedure. The most frequent site is leg (27.5%) and back (20.6%). Pain related treatment goals was pain (b280, 37.3%), post-op pain (b2802, 2%), discomfort (b279, 13%), tightness (b7800, 9.8%) and spasm (b7801, 2.9%). And the percent of achieved goal was in pain (86.8%), post-op pain (50.0%), discomfort (84.6%), spasm (100%), tightness (80%). Among 2 post-op pain cases, one was missing for follow up visit and regarded as the goal was not met. We analyzed only goals of sensory function (b250-b279) and pain (b280-289) based on ICF model. This result signified that overall good positive effect of multi-level chemoneurolysis using botulinum toxin-A and/or alcohol for uncomfortable sensation and pain of adult cerebral palsy patients.

Neurodevelopmental Delay According to Severity in Children with Deformational Plagiocephaly

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Objective

The purpose of this study was to investigate the incidence of neurodevelopmental delay among deformational plagiocephaly (DP) children, and to confirm relationship between neurodevelopmental delay and severity of DP.

Material and methods

This study is retrospective study. Figure 1 shows flow charts of this study. Five hundred thirteen children who visited for abnormal head shape through outpatient department were recruited. To identify the children with neurodevelopmental delay among the 513 children with DP, Denver Development Screening Test (DDST) was performed in 38 children who suspected of neurodevelopmental delay. Demographic data of 38 children including risk factor for DP was collected. Cranial vault asymmetry (CVA) was measured by using caliper, and cranial vault asymmetry index (CVAI) was calculated. Thirty eight children with DP who conducted DDST were divided into two groups according to the degree of CVA; group 1 included 21 children with CVA under 10 mm, and group 2 included 17 children with CVA over 10 mm. Chi-square test and independent t-test were used for statistical analysis.

Results

There was no significant difference in demographic data between group 1 and group 2 (Table 1). Mean CVA and CVAI (5.90 ± 2.21 mm, 4.20 ± 1.51 %) in group 1 was smaller than that in group 2 (12.71 ± 3.22 mm, 8.83 ± 2.18 %), respectively ($p < .05$, Table 1). There was a significant difference in number of neurodevelopmental delay between group 1 and group 2, with 7 children of group 1 and 14 children of group 2 ($p < .05$, Table 2). CVAI in neurodevelopmental delay group (7.39 ± 3.24 %) was significantly larger than that in non-neurodevelopmental delay group (4.89 ± 1.84 %) ($p < .05$).

Conclusion

This study showed that incidence of neurodevelopmental delay was 21 (4.09%) out of 513 children with DP, which was affected by the severity of CVA. Our results suggest that children with DP should be screened and monitored for developmental delays.

Table 1. Demographic Characteristics of group 1 and group 2

Variable	Group 1 (n = 21) (CVA<10mm)	Group 2 (n = 17) (CVA≥10mm)
Age (months)	5.33 ± 6.43	5.35 ± 2.44
Gender (boy:girl)	11:10	13:4
Side (Rt.:Lt.)	14:7	8:9
Risk factors		
-Oligohydroamnios	1	1
-Breech delivery	2	3
-Twin baby	3	3
CVA (mm)	5.90 ± 2.21*	12.71 ± 3.22*
CVAI (%)	4.20 ± 1.51*	8.83 ± 2.18*

Values are presented as mean±standard deviation or number.

*The difference was significant by independent t-test (p<.05).

Group 1, Children less than 10mm in CVA; Group 2, Children over 10mm in CVA

CVA, Cranial Vault Asymmetry; CVAI, Cranial Vault Asymmetry Index

Table 2. Prevalence of neurodevelopmental delay between group 1 and group 2

	Group 1 (n = 21) (CVA<10mm)	Group 2 (n = 17) (CVA≥10mm)	P-value
Neurodevelopmental delay (+)	7	14	0.003*
Neurodevelopmental delay (-)	14	3	

Values are presented as number.

*The difference was significant by chi-square test (p<.05)

Group 1, Children less than 10mm in CVA; Group 2, Children over 10mm in CVA

CVA, Cranial Vault Asymmetry

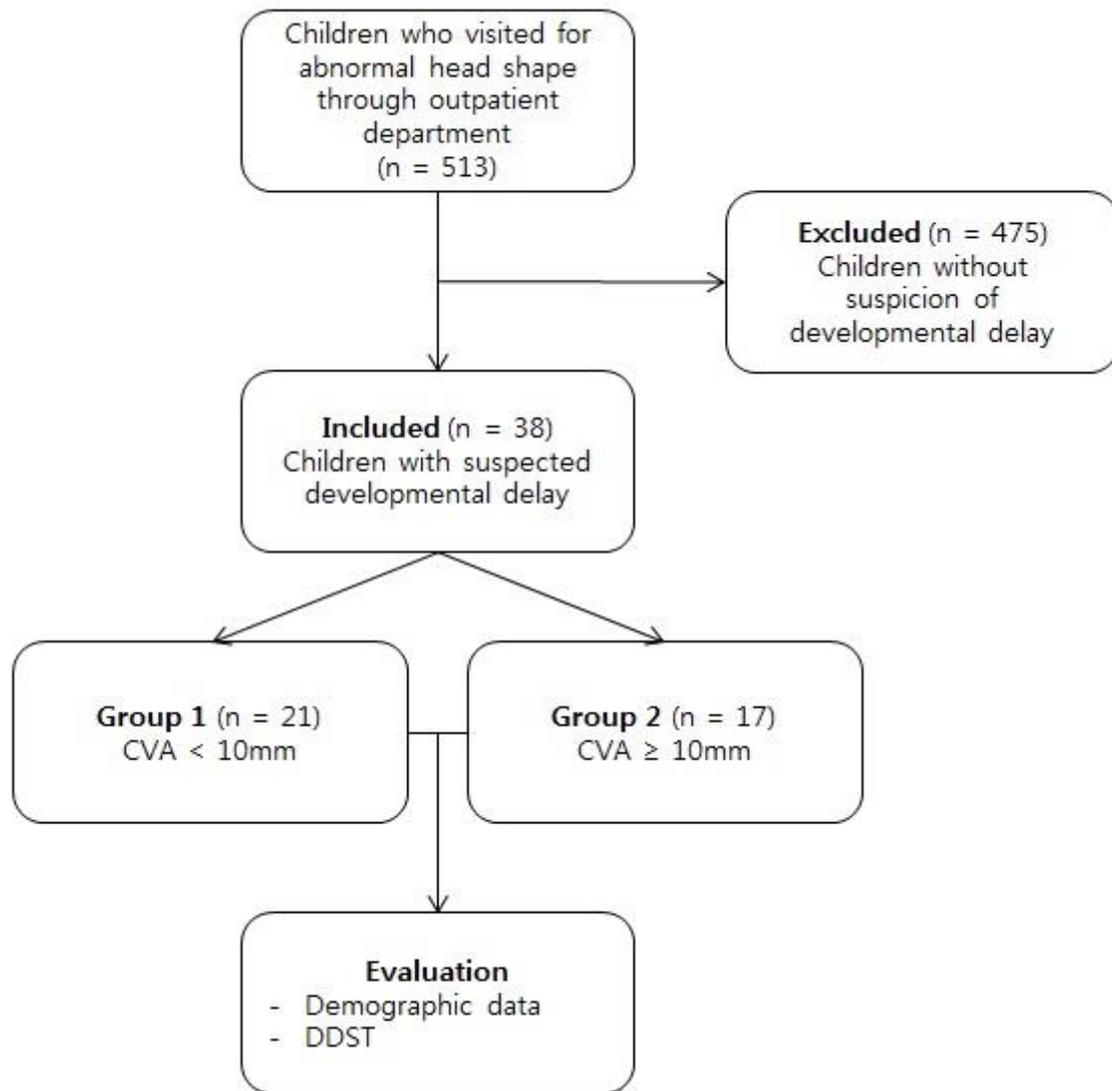


Figure 1. Study flowchart. CVA, Cranial Vault Asymmetry; DDST, Denver development screening test.

Lower body weight and less skeletal muscle mass in children with disabilities

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Introduction

Identifying the nutritional status of children with disabilities and correcting malnutrition is very important issue, and some researches have been conducted on body composition index for understanding this issue. However, there are few studies about the nutritional and growth status in children with disabilities in Korea. The purpose of this study is to measure and compare body composition indexes between typically developing children and those with disabilities in Korea for understanding the nutritional and growth status.

Method

Typically developing 355 children(183 boys and 172 girls) in the 5th and the 6th grades from two schools (A and B), and 73 children with disabilities(50 boys and 23 girls) from one special school which includes from elementary school students to high school students were participated. The clinical characteristics of all subjects are listed in Table 1. Inbody 770 and Inbody S10, body composition analyzers, were used to measure the body composition index of the subjects. They have an Asian population-based standard range of body composition index that fit the subject's height through several studies. Body weight(BW), Fat Mass(FM), Fat-Free Mass(FFM), Skeletal Muscle Mass(SMM), Body Mass Index(BMI), and Percentage Body Fat(PBF) were measured. We calculated mean and standard deviation(SD) of measured body composition index. And we calculated the rate of "under range", "within range" and "over range" which depends upon each index belonging to the standard range as mentioned above. Data from 5th and 6th grades of the special school were used to compare the mean difference with typically developing children. And data from all students of the special school were used to compare the rate of "under range", "within range" and "over range" with typically developing children.

Result

The results of comparing the mean difference of body composition index were shown in Table 2. The SMM was significantly higher in typically developing children compared to children with disabilities in 5th and 6th grades. The results of comparing the rate of "under range", "within range" and "over range" shown in figure 1. As shown in Figure 1, BW showed the significant difference in the rate of "under range", "within range" and "over range" between typically developing children and children with disabilities.

Conclusion

In this study, we measured and analyzed the body composition index of typically developing children and children with disabilities in Korea. We found that the rate of “under range” in BW was significantly higher in children with neurodevelopmental disabilities than typically developing children. And SMM was significantly lower in children with disabilities. The results of this study suggest that children with disabilities have lower body weight with less skeletal muscle mass. This highlights that the importance of physical activity in children with disabilities.

Table 1. The clinical characteristics of typically developing children and children with disabilities.

Typically developing children	Clinical Characteristics	No. of patients(%)
	Male/Female	183(51.5) / 172(48.5)
	School A/School B	195(54.9) / 160(45.1)
	5th grade/6th grade	180(50.7) / 175(49.3)
Children with disabilities	Clinical Characteristics	No. of patients(%)
	Male/Female	50(68.5) / 23(31.5)
	Ambulation/Non-Ambulation	64(87.7) / 9(12.3)
	5th grade/6th grade	9(12.3) / 7(9.6)
	Type of disability	No. of patients(%)
	Intellectual disability	55(75.3)
	Cerebral palsy	16(21.9)
	Autism spectrum disorder	14(19.2)
	Epilepsy	2(2.7)
	Language disorder	1(1.4)
Hearing impairment	3(4.1)	

Table 2. The mean difference of body composition indexes between typically developing children and children with disabilities(5th and 6th grade).

	Typically developing children	Children with disabilities (5th and 6th Grade)	P value
Height(cm)	148.54 ± 7.54	145.32 ± 7.81	0.097
BW(kg)	45.49 ± 12.06	39.59 ± 8.54	0.054
FM(kg)	13.35 ± 7.48	10.34 ± 5.12	0.113
FFM(kg)	32.14 ± 5.82	29.24 ± 5.18	0.051
SMM(kg)	16.92 ± 3.48	15.13 ± 3.09	0.043*
BMI(kg/m²)	20.39 ± 4.12	18.74 ± 3.79	0.114
PBF(%)	27.63 ± 8.83	25.41 ± 8.64	0.325

* Mean value was significantly different between compared group(P<0.05)

BW : Body weight, FM : Fat mass, FFM : Fat Free Mass, SMM : Skeletal Muscle Mass
 BMI : Body Mass Index, PBF : Percentage Body Fat

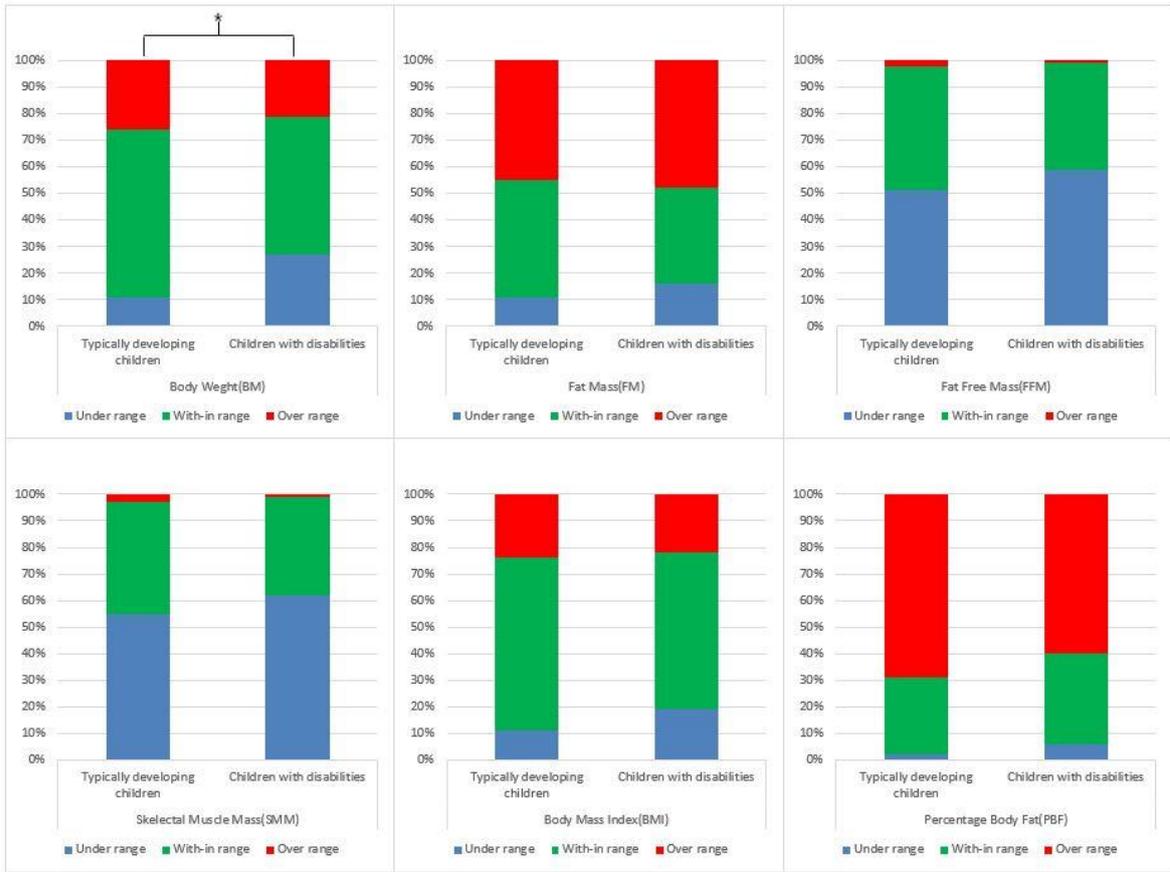


Figure 1. Comparison in the rate of “under range”, “within range” and “over range” between typically developing children and children with disabilities.

Body Composition Indexes in Children with 5th and 6th Grade Students of Elementary School.

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Introduction

Growth and development is an important issue in children, and some researches have been conducted on body composition index for understanding of these problems. However, there are few studies to analyze the nutritional and growth status of children by analyzing these body composition index in Korea. Therefore, the purpose of this study was to measure and analyze the growth and body composition index of typically developing children in Korea.

Method

Typically developing 355 children(183 boys and 172 girls) in the 5th and the 6th grades from two schools (A and B) were participated. The clinical characteristics of the subjects are listed in Table 1. Inbody 770, a body composition analyzer, was used to measure the body composition index of the subjects. It has an Asian population-based standard range of body composition indicators that fit the subject's height through several studies. Body weight(BW), Fat Mass(FM), Fat-Free Mass(FFM), Skeletal Muscle Mass(SMM), Body Mass Index(BMI), and Percentage Body Fat(PBF) was measured. We calculated mean and standard deviation(SD) of measured body composition index. And we calculated the rate of "under range", "within range" and "over range" which depends upon each index belonging to the standard range as mentioned above.

Result

Mean and SD of body composition index in all subjects are listed in Table 1. The results of comparing the mean difference of body composition index between each group were shown in table 2. As shown in table 2, BW, BFM, FFM, SMM, and BMI were significantly higher in 6th grade compared to 5th grade. SMM and BMI were significantly higher in male compared to female and there was no significant difference between A and B schools. When divided by sex in 5th and 6th grade, BW, FFM, SMM, BMI were significantly higher in male compared to female in students of the 5th grade and PBF were significantly higher in female compared to male in the students of the 6th grade. The results of comparing the difference between the rate of "under range", "within range" and "over range" in each group were shown in figure 1. As shown in figure 1, BW, FM, BMI showed the significant difference in the rate of "under range", "within range" and "over range" according to the sex. And, SMM showed the significant difference in the rate of "under range", "within range" and "over range" according to grade.

Conclusion

In this study, we measured and analyzed the body composition index of Korean school-aged children. We found that the rates of “within range” in BW and FM were significantly higher in female than in male and the rate of “within range” in SMM were significantly higher in 6th grade than in 5th grade. The results of this study are expected to serve as a theoretical basis for the expansion of national health data and guidelines for therapeutic approaches to growth and developmental problems of children with disabilities.

Table 1. The clinical characteristics and body composition indexes(Mean±SD) in all subjects.

Clinical Characteristics	No. of patients(%)
Male/Female	183(51.5) / 172(48.5)
School A/School B	195(54.9) / 160(45.1)
5th grade/6th grade	180(50.7) / 175(49.3)
Body composition index(Mean ± SD)	
Height(cm)	148.54 ± 7.54
Body Weight(kg)	45.49 ± 12.06
Fat Mass(kg)	13.35 ± 7.48
Fat Free Mass(kg)	32.14 ± 5.82
Skeletal Muscle Mass(kg)	16.92 ± 3.48
Body Mass Index(kg/m ²)	20.40 ± 4.12
Percentage Body Fat(%)	27.63 ± 8.83

Table 2. The mean difference of body composition indexes according to sex, grade and School.

	School			Grade			Sex			Sex(5th Grade)			Sex(6th Grade)		
	A school	B school	P value	5th Grade	6th Grade	P value	Male	Female	P value	Male	Female	P value	Male	Female	P value
BW(kg)	45.62 ± 12.31	45.32 ± 11.78	0.818	42.50 ± 11.34	48.56 ± 12.03	<0.01*	46.19 ± 12.69	44.74 ± 11.34	0.258	44.09 ± 12.38	40.57 ± 9.65	0.038*	48.68 ± 12.67	48.46 ± 11.49	0.907
FM(kg)	13.50 ± 7.56	13.16 ± 7.41	0.673	12.41 ± 7.17	14.32 ± 7.69	0.016*	13.48 ± 8.00	13.21 ± 6.91	0.728	13.23 ± 7.88	11.40 ± 6.08	0.089	13.79 ± 8.17	14.82 ± 7.24	0.381
FFM(kg)	32.12 ± 5.82	33.16 ± 5.83	0.948	30.09 ± 5.19	34.24 ± 5.69	<0.01*	32.71 ± 6.20	31.53 ± 5.33	0.057	30.86 ± 5.52	29.16 ± 4.63	0.029*	34.89 ± 6.28	33.65 ± 5.04	0.153
SMM(kg)	16.91 ± 3.47	16.94 ± 3.50	0.935	15.71 ± 3.11	18.17 ± 3.40	<0.01*	17.30 ± 3.70	16.51 ± 3.19	0.031*	16.20 ± 3.30	15.10 ± 2.76	0.017*	18.60 ± 3.74	17.76 ± 3.02	0.104
BMI(kg/m ²)	20.50 ± 4.09	20.28 ± 4.16	0.616	19.88 ± 4.18	20.92 ± 4.00	0.017*	20.81 ± 4.34	19.96 ± 3.83	0.049*	20.54 ± 4.50	19.08 ± 3.60	0.019*	21.13 ± 4.15	20.74 ± 3.87	0.512
PBF(%)	27.80 ± 8.72	27.43 ± 8.98	0.688	27.29 ± 9.09	27.98 ± 8.56	0.454	27.28 ± 9.69	28.01 ± 7.81	0.437	27.92 ± 9.45	26.51 ± 8.62	0.3	26.53 ± 9.98	29.34 ± 6.78	0.032*

* Mean value was significantly different between compared group(P<0.05)

BW : Body weight, FM : Fat mass, FFM : Fat Free Mass, SMM : Skeletal Muscle Mass, BMI : Body Mass Index, PBF : Percentage Body Fat

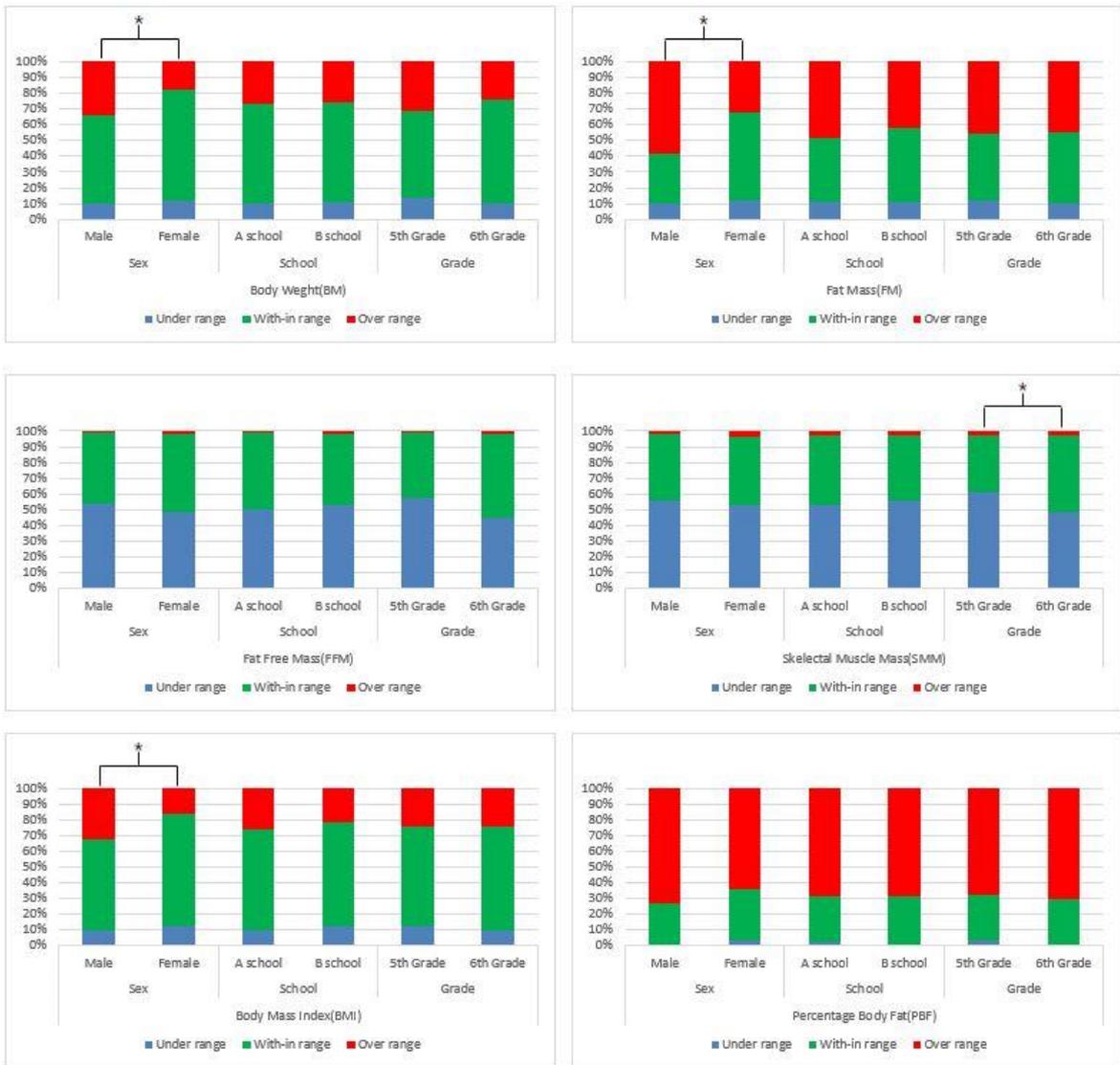


Figure 1. The difference between the rate of “under range”, “within range” and “over range” according to sex, grade and School

P 1-54

Efficacy of intensive therapy program using therasuit method for pediatric rehabilitation patients

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Introduction

Pediatric patients with CP or other brain injuries demonstrate problems with body functions and structures, such as altered balance control, poor alignment, reduced muscle strength, and limited joint range of motion. Intensive therapy program using therasuit method (ITP) is a stretching and strengthening program based on individual`s level and need, during which the patient wears therasuit. Use of therasuit may able to modify joint alignment and reinforce certain muscle groups. However, evidence indicating functional benefit from participation in ITP is limited. In this study, the authors compared changes in gross motor function, balance parameters, and activities of daily living in pediatric patients with CP and other brain injuries who received ITP and conventional in-patient NDT therapy.

Method

Five patients participated in the pilot study. All patients had no history of newly developed neurological problems, musculoskeletal disorders, or botulinum toxin injections in the previous 6 months. Three patients were diagnosed with cerebral palsy, two patients were diagnosed brain tumor and intracranial hemorrhage, respectively. Each patient received in-patient NDT therapy for a period of 12 weeks, 5 times per week, in three half hour sessions per day. After a period of time, same patients admitted again and underwent ITP for a period of 8weeks, 5 times per week, in a one and half hour session per day. ITP included multiple movements combined with the wearing of a fitted suit, which provided resistance during activity. In addition, Each patient`s therapeutic program was individualized with the goal of advancing the patient to the next level of function or physical activity. Two major differences between ITP and in-patient NDT therapy were as follows: (1) one continuous session versus three intermittent sessions, (2) using therasuit and universe exercise unit versus no additional device. Outcome measures were gross motor function measure (GMFM-88), pediatric balance scale (PBS), functional independent measure (FIM). Outcome measures were assessed at admission and before discharge. Changes on the GMFM, PBS, FIM were compared between ITP and in-patient NDT therapy.

Results

Demographic characteristics of the five patients were provided in table 1. Duration of ITP was shorter than that of in-patient NDT therapy (48 days versus 92.4 days). All outcome measures improved in both therapies. Changes of GMFM score were 6.86% after ITP,

5.59% after in-patient NDT therapy. Changes of PBS score were 7.4 after ITP, 4.0 after in-patient NDT therapy. Changes of FIM were 4.8 after ITP, -0.6 in in-patient NDT therapy (Table 2).

Conclusion

This pilot study shows that the effect of ITP outweighs those of in-patient NDT therapy, especially on balance function. Follow-up study should be performed to demonstrate statistically significant difference between the therapies.

Table 1. Demographic data of five patients

	Sex	Age	Diagnosis	Duration of disease (Days)	GMFCS (Level)
Patient 1	Male	11	Athetoid CP		2
Patient 2	Female	6	Ataxic CP		1
Patient 3	Male	11	Brain tumor	902	
Patient 4	Female	7	ICH	207	
Patient 5	Male	6	Diplegic CP		1

Table 2. Data of outcome measures

	ITP	in-patient physical therapy
GMFM_pre	79.5%	77.1%
GMFM_post	86.4%	82.7%
PBS_pre	32.8	33.3
PBS_post	40.2	37.3
FIM_pre	83.0	77.6
FIM_post	87.8	77.0

Protocol of robot-assisted gait training in children with cerebral palsy

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BACKGROUND

Mobility and walking ability are the most important areas of rehabilitation in children with cerebral palsy. Therefore, many rehabilitative interventions focus on walking ability. Partial weight support gait training is known to be effective therapy. Likewise, robot-assisted gait training enables children to have effective gait training as it partially supports the body weight and to walk longer. Robot-assisted gait training is established as treatment option, but the clinical evidence on the neurologic recovery or musculoskeletal system is rare. So, in this study, we will assess the impact of robot-assisted gait training on neurologic recovery, cardiopulmonary function, and body composition in children with cerebral palsy by comparing functional change of usual care period and robotic therapy period.

Methods/Design

The study design is single-blinded, pragmatic, randomized, cross-over trial. Children with cerebral palsy will be recruited and randomized into two groups ; Group 1 (Robotic Training – Usual Care), Group 2 (Usual Care – Robotic training-Usual Care). Each period is 6 week. The patient will receive robotic therapy 3 days per week for 6 weeks in robotic training period in addition to the usual care. The inclusion criteria are like as follow; Children (1) diagnosed with spastic cerebral palsy(3~12 years-old); (2) gross motor function classification system Level II~IV ; (3) height of 98 ~ 160 centimeter ; (4) follow the instructions and communicate if they feel pain or discomfort (weeFIM score: more than 11 points in communication, social cognition domain); We excluded patients with any of the following ; (1) cognitive impairment so that each assessment can not be performed properly ; (2) history of neurosurgery or orthopedic surgery operated on limbs ; (3) severe joint contracture (knee joint : more than 20 degrees flexion contracture, hip joint more than 40 degree contracture). We will measure gross motor function measure (GMFM), functional independence measure (WeeFIM), manual muscle test (MMT), range of motion (ROM), modified ashworth scale (MAS) before and after each treatment periods. The motor evoked potential, balance test, cardiopulmonary exercise test, body composition analysis will be assessed before and after robotic therapy period. Treatment effects and follow up effects will be analyzed.

Discussion

This study would provide an important evidence on impact of robot-assisted gait training not only on the neurologic recovery but also on cardiopulmonary function, and body composition in children with cerebral palsy.

Table 1. Assessment Protocol

Assessment	Assessment 1		Assessment 2		Assessment 3		Assessment 4	
	RT-UC	UT-RT	RT-UC	UT-RT	RT-UC	UT-RT	RT-UC	UT-RT
GMFM, C, D, E (dimension)	○	○	○	○	○	○		○
MMT	○	○	○	○	○	○		○
Modified Ashworth scale	○	○	○	○	○	○		○
Balance test	○		○	○		○		
Gait analysis	○		○	○		○		
MEP	○		○	○		○		
Body composition analysis	○		○	○		○		
CPET	○		○	○		○		
COPM	○	○	○	○	○	○		○

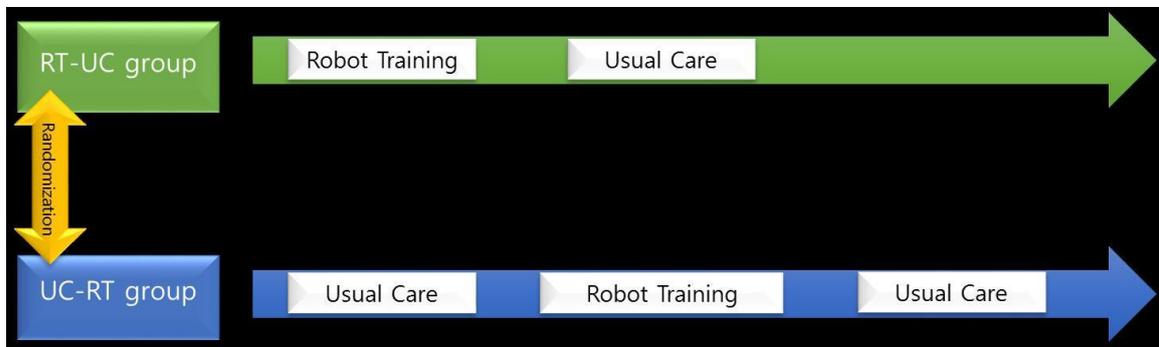


Fig 1. Study protocol of 2 groups

Alexander Disease mimicking Cerebral Palsy : A Case report

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Chungnam National University, School of Medicine, Department of Rehabilitation Medicine¹

Introduction

Alexander disease is a rare degenerative disorder and leukodystrophy caused by dominant missense mutations in the gene encoding the glial fibrillary acidic protein. The characteristic signs of Alexander disease are developmental delay, megalencephaly, seizures, spasticity and psychomotor deterioration. Four types can be distinguished based on the age at clinical presentation: neonatal, infantile, juvenile, and adult. Especially, the juvenile type, with an onset in childhood, shows a variable clinical course; slowly progressive paresis, bulbar signs, and brisk reflexes, but often with an intact mental state. This is a case in which an adolescent presented with developmental delay, history of seizures, and progressive paresis.

Case presentation

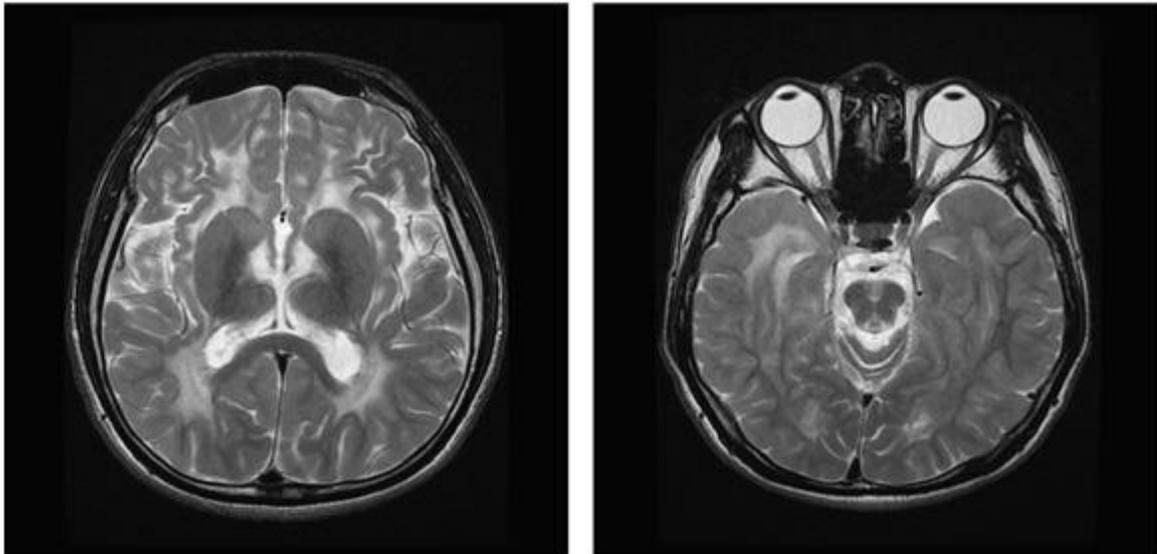
A 17-years old boy visited our outpatient clinic with a history of progressive paresis. The boy was born with a full-term pregnancy. Postnatally, he showed global developmental delay and was able to walk at about 24 months. He was diagnosed as cerebral palsy and intellectual disability. He had crouched gait but was able to stair up and down. But, He began to fall down when he was fifteen and has been unable to walk at all since the slip down injury of August 2017 even if he had no evidence of fracture. He seemed to have a progressive paresis and was not able to even sit to stand alone. Based on the progressive paresis, neurodegenerative disease, cerebral infarction, leukodystrophy, etc. were considered. We did several diagnostic evaluation. Brain MRI showed bilateral confluent T2 high signal intensity in periventricular and subcortical white matter of bilateral cerebral hemispheres and central white matter of cerebellum which. The exome sequencing test showed mutation of the gene encoding glial fibrillary acidic protein (GFAP) which is known to be the cause of Alexander disease. In the exon 1 of the GFAP gene (17q21.3) mutation was found in which the 79th amino acid, arginine, was substituted with cysteine. Gene study about parents and siblings were all negative, so the patient was concluded to have de novo mutation of GFAP gene.

Discussion

Alexander disease is a slowly progressing neurodegenerative disease. Children with infantile form do not survive past the age of 6, and the juvenile onset do not live until child-bearing age and do not reproduce, indicating that the majority of cases are sporadic. In this case, the boy was incorrectly assumed as cerebral palsy until the 17 years-old. So It is inevitable to get the regular follow-up in children with developmental delay of unknown origin and the accurate diagnosis will be helpful to give appropriate palliative care.

Table1. Exome sequencing report

Gene	Mutation	Mutation effect	Hetero/Homo	HGMD/OMIM	Inheritance	Classification
GFAP	c.235C>T [p.Arg79Cys]	Missense	Hetero	ALXDRD	AD	Pathogenic
Reference sequence : NM_002055.4						
Abbreviations : ALXDRD [Alexander disease], AD [Autosomal dominant]						



[Figure 1. Bilateral confluent T2 high signal in periventricular and subcortical white matter]

Botulinum Toxin Injection for Functional Assistance in Cerebral Palsy with Swan-neck Deformity Hand

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National Health Insurance Service Ilsan Hospital, Department of Physical Medicine and Rehabilitation¹

Introduction

Swan-neck deformities are defined by the hyperextension of the PIP joints and the flexion of the distal interphalangeal (DIP) joints. In cerebral palsy, patients can present with swan-neck deformity of 2 different etiologies—intrinsic or extrinsic. The intrinsic type of swan-neck deformity is caused by spastic contraction of the intrinsic muscles of the hand while the extrinsic type is caused by excessive tension of the long extensors due to wrist flexion contractures; these forces lead to weakening of the volar plate of the PIP joint. Stretching of the volar plate ultimately results in severe hyperextension of the PIP joint that persists after correction of the wrist flexion contractures. Because of these spastic forces, patients with cerebral palsy often present with advanced swan-neck deformities. In this study, we tried to provide functional assist to their swan neck deformity through botulinum toxin injection.

Case series

The first patient was 8-year-old female, who was born at 35 weeks and 5 days of gestation via cesarean section with 1.91 kg (March 3, 2009). IVH was found on brain sonography immediately after birth, and bilateral IVH grades 3 and 4 were observed on brain MRI (2009.9). Neurologic examination revealed spasticity in Rt upper extremity and both lower extremities. The caregiver's wish was that she would be able to make the finger flexion movement more natural when she was trying to use her Rt hand. Before the injection treatment, her right hand showed swan neck deformity in 2-4th fingers, supination limitation, and thumb in palm pattern. Swan neck pattern was more severe with wrist drop when she tried to grasp. Therefore, we injected botulinum toxin into her Rt EDC 30u, PT 30u, AP 15u, PI 25 (total 100 unit). After the injection, the swan neck pattern has been improved so that she can grasp with more natural movements as she tries to use her hands. The second patient was a 17-year-old Rt hemiplegic CP male patient. When we first examined him, his Rt. wrist flexor spasticity was G1, supinator spasticity G1 with thumb up limitation and 2-4th finger swan neck deformity was observed. He also complained about the inconvenience of finger movement in using buttons when changing clothes alone. So we injected botulinum toxin into his Rt EDC 20u, PT 30u, PI 30 (total 80 unit). After 2 weeks of injection, he was examined again and his DIP hyperflexion, PIP hyperextension was improved. And we saw him grasp and move his hands more finely and comfortably.

Conclusion

The results of this study suggest that botulinum toxin injections safely and effectively decrease muscle tone and increase range of motion. Because some functional improvements were seen after injections, regular follow up through global functional assessment method may be necessary. Further studies with large sample size will provide more insight into clinical utilization of botulinum toxin injection for swan neck deformity of cerebral palsy.

An unusual, intermediate sized lesion type, motor organization in schizencephaly

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Introduction

Schizencephalies are abnormal clefts of the cerebral hemispheres that **result** from abnormal late neuronal migration and cortical organization. As schizencephaly occurs during the early phases of gestation, this type of brain lesion is likely to be associated with an effective organization of the sensorimotor cortex.

Case

Two patients were presented to our department with the symptom of left hemiparesis. The patient 1 was 25 years-old male and the patient 2 was 23 years-old female. Brain MRI showed closed lip schizencephalic cleft in the right hemisphere and nonschizencephalic focal cortical dysplasia in the left hemisphere. The extent and involvement of schizencephalic cleft in the left hemisphere is wider in patient 2, and the cortical dysplasia in the right hemisphere is more severe in patient 1. Diffusion tensor imaging suggests that in patient 2, polymicrogyria in the left frontal lobe may have a possibility to affect the corticospinal projection. Motor evoked potentials of the first dorsal interosseous muscles of both hands were recorded simultaneously. In patient 1, there have been contralateral MEPS from the more severely affected hemisphere with schizencephalic cleft, in the paretic hand. In patient 2, no MEP was evoked from the affected hemisphere even when the stimulation intensity was increased to 100% of maximal output.

Conclusion

We report two different types of unusual motor organization of patients with schizencephalic cleft in the right hemisphere and polymicrogyria in the opposite one. Despite the similar brain pathology affecting the sensorimotor cortex, two patients showed the different types of motor organization. In both patients, ipsilateral corticospinal projections to their paretic hands were observed by TMS of the less affected hemisphere with polymicrogyria. However, a crossed corticospinal tract to the paretic hand from the more severely affected hemisphere with schizencephalic cleft in a patient was observed and this type of motor organization in schizencephalic patient has not been reported before. It suggests that motor organization after early brain injury may be affected by the interhemispheric competition of the corticospinal system and bilateral brain lesions manifestate unilateral hemiparesis.

Rapid recovery in Miller-Fisher syndrome in a child with poor prognostic factors: A Case report

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Introduction

Guillain Barre Syndrome (GBS) is known to be a syndrome with several variant forms. Of those variant, Miller Fisher Syndrome (MFS) is not common in children and characterized by double vision, loss of balance and deep tendon reflexes. We present a child who had MFS with abrupt onset of profound weakness with multiple conduction blocks with good prognosis.

Case report

A 6-year-old male patient came to the emergency room. He complained of abrupt gait disturbance and left side weakness, difficulty in left lateral gaze, intermittent dysarthria and presented diplopia. Initial chest X-ray showed pneumonia and two days later, high fever up to 39.9°C was checked. Intravenous immunoglobulin therapy started, but his symptoms gradually worsened and five days later, the patient became tetraplegia and fell into respiratory failure, so ventilator care was started. Steroid pulse therapy was started just before the EMG, that is, 8 days after the onset. Muscle strength was generally trace grade according to the manual muscle test. Deep tendon reflex of upper limb and bilateral knee jerk were hypoactive, and ankle jerk was absent. Nerve conduction study (NCS) and electromyographic (EMG) examination were performed 9 days after symptom onset. Sensory NCS showed decreased amplitudes of sensory nerve action potential (SNAP) in bilateral sural and right ulnar nerves. Motor NCS presented drop in amplitudes of compound muscle action potential (CMAP) in right median, peroneal and bilateral tibial nerves, delayed conduction velocities in right median and bilateral tibial nerves (Table 1). Needle EMG and facial ENoG showed no definite abnormality. And there was no response of F wave in all sampled nerves. Above electrodiagnostic findings are compatible with inflammatory demyelinating polyneuropathy (AIDP). Comprehensive rehabilitation therapy including gait training, fine motor training and balance training was continued. After a month, the patient was able to walk independently. Still, mild impairment of balance and fine motor in upper extremities was remained, but he participated nearly all activities of daily living including running.

Conclusion

Early diagnosis of AIDP is crucial because it sometimes is life-threatening, but several treatments could lessen the disease severity and improve outcome. Generally, the prognosis of AIDP in children is better than adults. However, outcomes may be less favorable those with some risk factors. Such as child younger than 2 years, limb paralysis within 10 days, very weak at presentation, unevoked motor nerves on NCS, the

involvement of cranial nerves, and requiring ventilator support. In this case, despite the patient presented several risk factors for poor prognosis, the patient gradually recovered satisfactorily over a few weeks. This recovery was probably due to early diagnosis and rapid treatment.

table1. The results of needle EMG and F-wave studies

EMG Summary Table									
Muscle	Spontaneous					MUAP			Recruitment
	IA	Fib	PSV	Fasc	CRD	Amp	Dur	PPP	Pattern
R. Biceps brachii	N	None	None	None	None	N	N	N	N
R. Vastus medialis	N	None	None	None	None	N	N	N	N
R. Gastrocnemius (medial)	N	None	None	None	None	N	N	N	N

F-wave	
Nerve	F min (ms)
R Median - APB	No Response
R Median - APB	No Response
L Tibial - AH	No Response



Magnetic resonance imaging of thoracic and lumbar spine. A. Normal conus medullaris at D12-L1 was observed B. Diffuse enhancement of cauda equine was present and definite nodularity or enlargement was not observed.

Sensory NCS					
Nerve / Sites	Onset Lat ms	Peak Lat ms	Pk Amp µV	Distance mm	Velocity m/s
R Median - Digit III					
Palm	1.20	1.82	17.5	70	58
R Ulnar - Digit V					
Wrist	1.51	2.29	11.1		
R Sural - Ankle (Calf)					
Calf	1.82	2.71	7.5	90	49
L Sural - Ankle (Calf)					
Calf	1.72	2.80	5.8	90	50
R Superficial peroneal - Ankle					
Lat leg	1.77	2.71	9.5	90	48
L Superficial peroneal - Ankle					
Lat leg	2.08	3.02	9.4	90	43
Motor NCS					
Nerve / Sites	Latency ms	Amplitude mV	Duration ms	Distance mm	Velocity m/s
R Median - APB					
Wrist	2.19	6.6	4.90		
Elbow	6.67	1.4	9.48	155	35
R Ulnar - ADM					
Wrist	1.93	5.9	5.68		
B.Elbow	4.43	4.0	5.73	125	50
R Peroneal - EDB					
Ankle	5.05	1.7	10.83		
Fib head	8.18	0.9	14.90	190	61
L Peroneal - EDB					
Ankle	4.22	2.8	8.13	70	
Fib head	8.13	2.7	9.08	200	51
R Tibial - AH					
Ankle	3.02	11.1	8.44	80	
Pop fossa	24.11	0.1	2.81	250	12
L Tibial - AH					
Ankle	3.44	10.2	8.28	80	
Pop fossa	12.76	0.3	6.58	250	27
ENoG					
Nerve / Sites	Onset Lat (ms)	Pk Amp (mV)	Duration (ms)	Area (mVms)	
R Facial - Fonralis,Orb Oculi, Nasalis,Orb Oris					
Frontalis	5.68	0.4	8.65	1.6	
Oculi	2.66	0.7	7.08	2.6	
Nasalis	3.33	0.5	7.40	2.0	
Oris	3.44	0.8	19.95	5.8	
L Facial - Fonralis,Orb Oculi, Nasalis,Orb Oris					
Frontalis	5.63	0.5	15.63	2.9	
Oculi	2.66	0.9	7.08	2.8	
Nasalis	3.23	0.9	8.07	2.9	
Oris	3.70	0.8	12.55	3.5	

The results of sensory, motor and facial nerve conduction studies

Pediatric transverse myelitis with root involvement which mimic GBS : a Case report

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Samsung Medical Center, Department of Rehabilitation Medicine¹

BACKGROUND

Transverse myelitis(TM) is a rare demyelinating CNS disorder characterized by acute or subacute onset of motor, sensory, and autonomic dysfunction. Children account for 20% of total cases of TM. The extent of demyelination varies among patients so there is a variety of presentations. High-dose intravenous steroids and/or plasma exchange have been used with variable outcomes. Following immunotherapy, pain is the first symptom to resolve, followed by an improvement in motor deficits. Bladder function and sensory deficits may take longest to improve. In general, children with TM have a better outcome than adults.

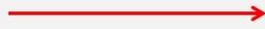
Case presentation

A previous healthy 6 year-old korean girl presented in january 2018 with urinary retention and acute paraparesis. She was treated with pharyngitis a week ago. On initial presentation, she was noted to have severe flaccid weakness in both of her lower extremities with decresed DTR at her patellars and ankles bilaterally. Sensation was preserved. She had an MRI of her spinal cord that showed cord swelling and contrast enhancement in the ventral roots of the cauda equina. Nerve conduction study showed both peroneal axonal motor neuropathy. She was presumptively treated with intravenous immunoglobulin (IVIG) owing to initial concern for motor variant of Guillain-Barré syndrome. After failure to improve, she was transferred to our facility. At february 2018, upper motor neuron sign emerged at her lower extremity. She recieved intravenous methylprednisolone(mPD) for transverse myelitis. After treatment, she was able to improve substantially with strength in her right lower extremity (at least 3/5 in all muscle groups) and more severe weakness in her left lower extremity (generally 2/5). She currently is able to ambulate with minimal assit. In follow up spine MRI, contrast enhancement in the ventral roots of the cauda equina disappeared. However her voiding dysfunction present on initial admission had not improved. She received laparoscopic ureteroneocystostomy in May 2018 for her vesicoureteral reflux.

Conclusion

We described a special case of pediatric transverse myelitis mimic GBS that has concomitant root involvement. Similar cases may be missed and could account for patients diagnosed with GBS who are labeled as poor responders to IVIG. We insists that transverse myelitis should be considered in all cases of acute flaccid paralysis and spinal cord imaging with regular follow-up is essential for them.

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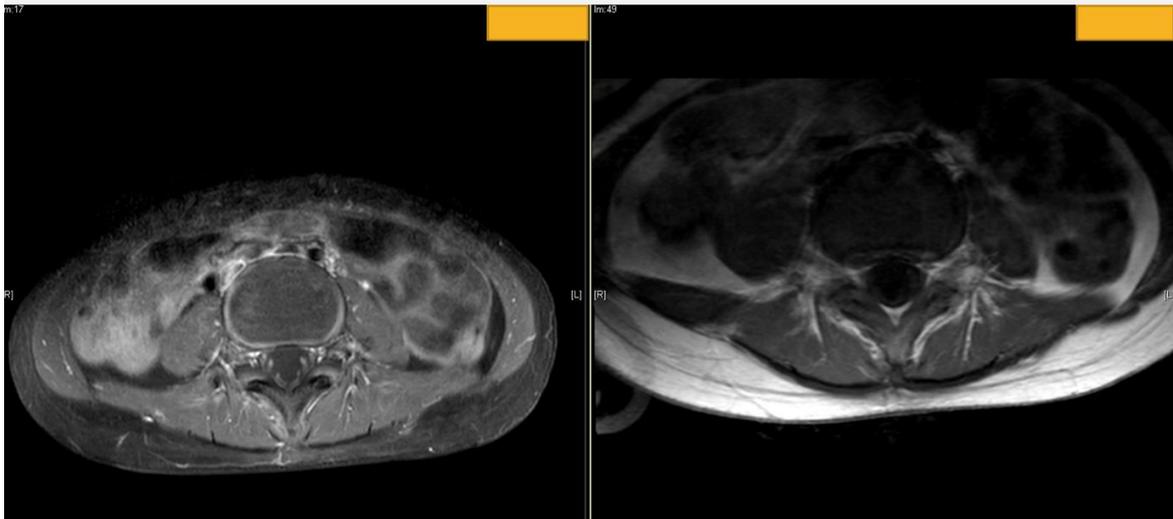


cauda equina 의 root enhancement 를 보이는 MRI 와 methyprednisolone 치료 후 enhancement 가 사라진 MRI

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cauda equina 의 root enhancement 를 보이는 MRI 와 methyprednisolone 치료 후 enhancement 가 사라진 MRI

Allan-Herndon-Dudley Syndrome with New SLC16A2 Mutation : A Case report

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Introduction

Allan-Herndon-Dudley syndrome (AHDS) is a disease that prevents absorption of thyroid hormone and leads to developmental disorder of the brain due to the problem of MCT8 expression process caused by mutation of SLC16A2 (Monocarboxylate transporter 8; MCT8) gene of X-chromosome. Clinical findings include motor weakness, muscle atrophy, hypertelorism and mental retardation. Laboratory findings include increased T3, decreased T4 and borderline or increased TSH levels. We report a case of new mutations in Allan-Herndon-Dudley syndrome.

Case report

The 26-month-old boy admitted the department of rehabilitation medicine for evaluation due to developmental delay. He was the first child of healthy parent and born in the 40th week of gestation after an uncomplicated pregnancy; birth weight was 3500g (50-75th centile). At birth, mother and father were 34 and 39 years old, respectively. He could not head control at 4 months, and developmental delay with progressive muscle weakness was seen from 8 months. On physical examination at the age of 26 month, height was 100cm (>97th centile), weight 12kg (25th centile) and occipital-frontal circumference was 47cm (5th centile). He had hypertelorism, ptosis, a broad and flat nasal bridge. Both upper and lower extremities strength was grossly grade 3 by manual muscle test and showed muscular hypotonia. He still could not head control. Further investigations, routine laboratory tests, brain magnetic resonance imaging, electroencephalogram, chromosomal microarray, spinal muscular atrophy test and joint x-rays did not reveal abnormality. Thyroid function test were T3 1.67(0.87~1.78)ng/dL, free T4 0.45(0.58~1.64)ng/dL, TSH 5.44(0.34~5.6)U/mL. T3 showed a result on the high borderline of the normal range, low on the freeT4, and high on the borderline of the normal range of TSH. The NGS (Next generation sequencing) panel test, a genetic test, found NM_006517.4(SLC16A2):c.455G>A, p.(Gly152Asp), hemizygote, a rare mutation in the SLC16A2 gene. The result is an X-linked recessive disorder of chromosome Xq13.2, located in the mutated hot span region of exon 2, and the mutation was not previously reported. Family NGS Panel Test showed that the father was negative, and the mother was a heterozygote mutant of SLC16A2 and was a carrier without clinical symptoms. (Fig. 1)

Conclusion

This is a case of AHDS diagnosed by a new SLC16A2 mutation through genetic testing in patients with developmental delay and muscular hypotonia. Psychiatrists are likely to be

the first to encounter with these patients, so careful physical examination with gathering detailed information on family history and appropriate genetic analysis should be considered in patients with unexplained developmental delay or muscular hypotonia to ensure a correct diagnosis.

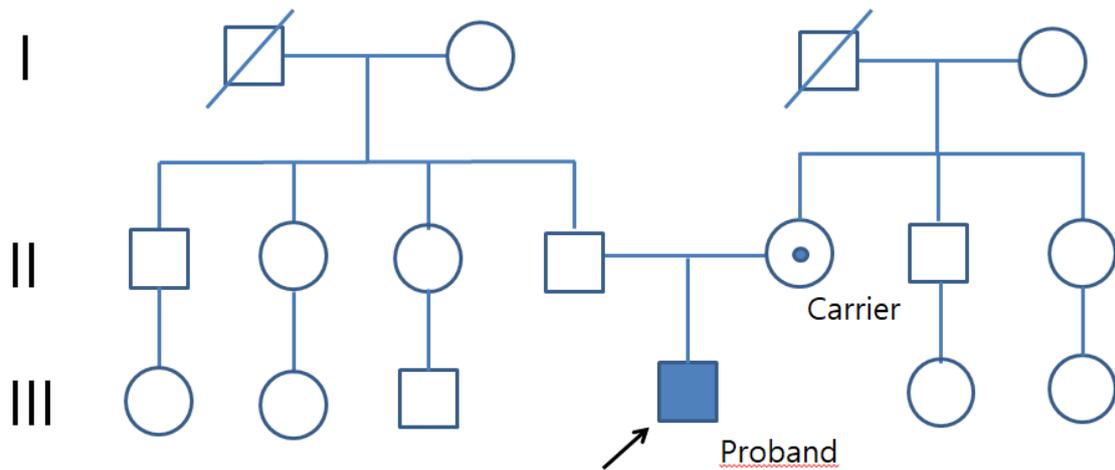


Figure 1. Three generation pedigree of the patient's family. Filled symbols represent affected members, open symbols represent unaffected members. Circles and squares represent females and males, respectively.

Partial trisomy 1q32.1 to 1q44 case improved in developmental delay with rehabilitation

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BACKGROUND

Partial trisomy 1q is a rare chromosomal abnormality and these cases have been reported as either pure trisomy or unbalanced translocations. Among these, pure partial duplications of chromosome 1q mostly involve duplications of 1q32qter region. Most of these cases are known to still born or die in the early of life, even if one lives, they have extreme psychomotor and mental retardation. We report that a patient, who had a pure partial duplication of the 1q32-44 segment, was alive and improved developmental status with rehabilitation.

Case report

The neonate was born at 37 weeks 5 days of gestation by caesarean section, and Apgar score was 4 at 1 minute, 6 at 5 minute. His weight was 3.458 kg (75-90p), head circumference 38cm (>90p), and length 48 cm (50-75p). Polydactyly of the right thumb, thin long fingers and toes, micrognathia, microphthalmia, macrocephaly and low set ear were seen, and heart murmur was auscultated. In echocardiography, it showed patent ductus arteriosus, atrial septal defect and ventricular septal defect. Ductus arteriosus did not closed and was sustained cardiomegaly, PDA ligation was done at PCA 39 weeks 4 days. In brain MRI, Diffuse subdual fluid collection in left cerebral and cerebellar convexity, dilated left temporal horn and choroid plexus cysts in lateral ventricle were seen. And enlarged ventricular system, both lateral and 3rd ventricle were seen. Chromosomal study of patient showed 46,XY,rec(1)dup(1q)inv(1)(p36.3q32.1)pat (Fig. 3 C). And in paternal chromosomal study, 46,XY,inv(1)(p36.3q32.1) was confirmed since maternal chromosomal study was normal. Breast feeding progresses smoothly without heart failure and liver failure, and weight gains well, so follow-up observation after discharge from the hospital. After discharge, follow-up echocardiography was performed. Enalapril was discontinued at 5 months of age. The patient underwent VSD operation at 7 months of age. His first evaluation for devilmnt was done when he was 12 months old with Bayley Scales of infant and Toddler Development. All subtests showed extremely low level. To know his gross motor function more precisely, we performed Gross Motor Function Measure (GMFM), and he earned 58.8 % score on Lying & Rolling dimension, which meant he could roll over and partially lift his head on prone position. We continued proper rehabilitation program, and second evaluation was done when he was 18 months old. Patient can reach to object, and hold up his head. Patient is currently undergoing rehabilitation medicine and pediatric department follow-up.

Discussion

The reported cases, prenatally diagnosed as partial trisomy 1q, were mostly terminated. Postnatally diagnosed cases were died as respiratory or hepatic failure. Even if one lives, they have severe psychomotor and mental retardation. However, treatment of retardation or developmental delay has not been reported. Our case continued proper rehabilitation program, so showed improvement.



General appearance: micrognathia, microphthalmia, macrocephaly, polydactyly, long fingers, long toes

Effect of Vestibular Rehabilitation on Vestibular Dysfunction with deafness and Cognitive Impairment

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Introduction

In children, vestibular function plays an important role in the gross motor development and postural control. Children with congenital deafness commonly suffer from vestibular dysfunction in bilateral ears and difficulty of postural control. There have been very few studies which have investigated balance in these children. Furthermore there has been no study about the postural control in patients who have vestibular dysfunction with hearing impairment and cognitive impairment . We report a case of vestibular rehabilitation on a patient with cognitive impairment and mixed hearing loss who has bilateral vestibular dysfunction.

Case report

The patient was a 34-month-old boy who had congenital vestibular abnormality with deafness. He was diagnosed mixed hearing loss and underwent left cochlear implant when he was 29 months old (Pure Tone Audiometry (PTA) > 60dB). And he had hypoxic brain injury when he was 23 months old due to respiratory arrest. He had cognitive impairment (Denver Developmental Screening Test : personal-social domain : 13 months, language domain: 3 months) and impaired at obey commands . He was hospitalized at pediatric rehabilitation center, and had vestibular rehabilitation with Bobath therapy, occupational therapy and cognitive rehabilitation during 6 weeks. At first, his Berg balance scale (BBS) score was zero. 3 weeks later, BBS score improved to 5. After 6-week training, BBS score improved to 19.

Discussion

Vestibular rehabilitation with comprehensive rehabilitation therapy is effective in vestibular dysfunction patients with cognitive impairment and hearing loss.

Identification of C.430C>T Mutation Leading to Diagnosis of Alstrom Syndrome via Genetic Analysis

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Introduction

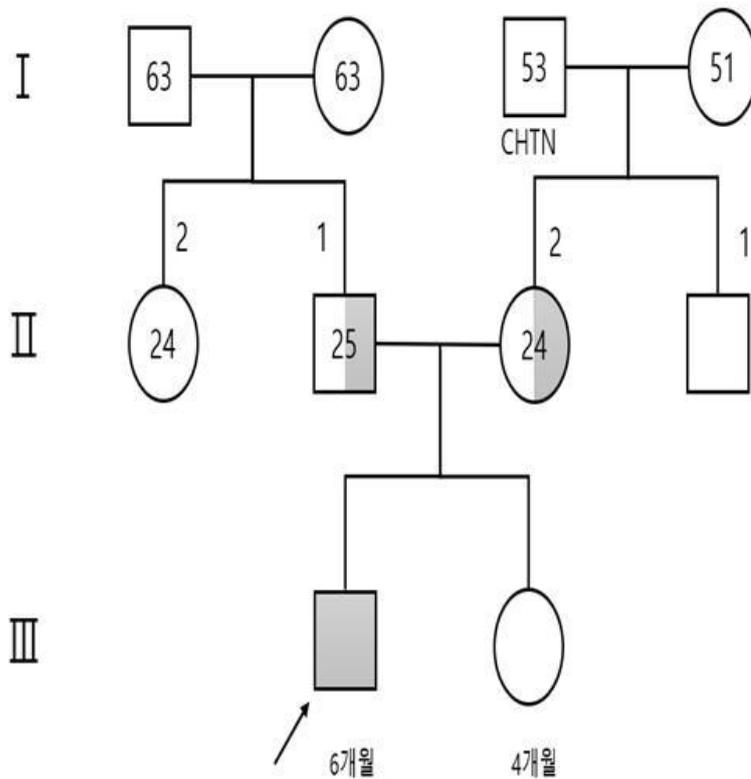
Alstrom syndrome (ALMS1) is a rare autosomal recessive disease associated with ALMS1 gene mutation located at Chromosome 2 (2p13). Patients with Alstrom syndrome usually become blinded due to progressive visual cell atrophy and sometimes sensorineural hearing loss occurs. By the age of 10 type 2 DM occurs accompanied child obese. During the period from infant to adolescent 70% patients occurs with dilated myocarditis. Also, abnormalities in renal, pulmonary, urinary function are common and progressive systemic fibrosis occurs. Here we present a case of Alstrom syndrome early diagnosed via genetic analysis.

Case report

The male patient was referred from pediatrics to rehabilitation medicine and medical genetics due to facial deformity at 6 months. Patient's mother was diagnosed in poly hydramnios and gestational diabetes. He was delivered by C-Sec at 34 weeks 5 days. Patient's weight was 2400g at the time of delivery and patient is preterm and low-birth weight baby. Because of dyspnea and cyanosis with chest retraction in neonatal room, the patient was moved to intensive care unit and received ventilator care. Echocardiography revealed Patent Ductus Arteriosus(PDA), Atrial Septal Defect(ASD), Mitral Regurgitation(MR), Tricuspid Regurgitation(TR) in this patient. However, PDA and ASD were closed spontaneously and MR and TR showed improvement in follow up Echocardiography. There was no abnormality in ophthalmic examination for retinopathy of prematurity. On physical examination, height and weight were below 25th percentile and occipital-frontal circumference was below 3rd percentile. On oral examination, the patient had high arched palate and capillary hemangioma in cervical area. Also, microretrognathia and simian line were showed. Given the family history and physical examination, we arranged a chromosomal microarray for the patient that yielded a normal result. Diagnostic exom sequencing (DES) was performed on the subject identified c.430C>T and c.12155_12158delinsACAT mutation in ALMS1 gene. So, we performed the genetic study including patient's parents and sister. We found c.12155_12158delinsACAT mutation from father and c.430C>T mutation from mother. We could not find any mutation for his sister. There was no abnormality in hearing test to evaluate sensorineural hearing loss observed commonly in Alstrom syndrome. So, we recommended regular check up and educated neuromuscular stimulation exercise.

Conclusion

The patient was referred to us due to facial deformity, microencephaly and microretrognathia and diagnosed as Alstrom syndrome at 9 months earlier than the average age of diagnosis (> 2 years). The patient showed c.430C>T and c.12155_12158delinsACAT mutation simultaneously in ALMS1 gene. We thought that parents had a individual different allele mutation and the patient was inherited indivisually. To the best of our knowledge, c.430C>T mutation is the first molecular genetic analysis of Alstrom patient.



Three generation pedigree of the patient's family. Filled symbols represent affected members, open symbols represent unaffected members. Circles and squares represent females and males, respectively.

A Case of Charcot-Marie-Tooth Disease with Recurrent Guillain-Barré Syndrome

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Guillain-Barré (GB) syndrome is clinically characterized by symmetrical weakness of the limbs as well as hyporeflexia or areflexia; it progresses to the serious condition within 4 weeks and causes acute flaccid paralysis. Charcot-Marie-Tooth (CMT) disease is a genetic disorder; patients with CMT disease present with a progression of chronic motor and sensory neuropathy. The lifetime prevalence of CMT disease is reported as 40/100,000 in worldwide. The case of CMT disease with recurrent GB syndrome is rare. A 29-month-old girl was referred to our clinic for further evaluation and treatment of muscle weakness. On history taking, the patient had no past history of trauma, but being diagnosed with CMT disease in 2009 and GB syndrome in 2011 at other hospitals. Despite a lack of duplication of the peripheral myelin protein 22 (PMP22) gene, the patient showed findings that are indicative of peripheral motor and sensory polyneuropathy on electromyography (EMG). Furthermore, the patient also showed abnormal thyroid functions. After 2 injections of immunoglobulins in January and March, the patient achieved improvements in symptoms. In 2013, the patient developed general paresis accompanied by changes in respiration and voice formation as well as fever, for which a 5-day-course of immunoglobulins was administered. In the first week of July of 2013, the patient developed paralysis of both arms, thus being treated with immunoglobulins. Then, the patient received a decreased dose of prednisolone from 25 mg to 20 mg. In December of 2013, the patient developed general paresis involving the neck. The currently, the patient was taking prednisolone 20 mg in August of 2017, the patient was treated with immunoglobulins again, but showed no notable findings in the muscle weakness. At our institution, the patient presented with a delayed milestone, dysphonia, dysarthria, and EMG findings that are suggestive of peripheral motor and sensory polyneuropathy. On urological examination, the patient had urinary frequency, which is indicative of GB syndrome. Currently, the dose of prednisolone was maintained at 20 mg. According to a review of the literature, there is a relationship between primary hypothyroidism and GB syndrome; gangliosides are abundantly present in thyrocytes and neuronal cells. This may lead to the formation of auto-antibodies involved in the pathogenesis of GB syndrome. Moreover, it has also been reported that patients with CMT disease would be vulnerable to worsening of clinical and neurophysiological findings if they have comorbidities, such as diabetes, hypothyroidism, exposure to toxins and obesity. In conclusion, our case indicates that physicians should consider the possibility of thyroid dysfunction in patients with signs and symptoms that are suggestive of CMT disease and GB syndrome.

The Development of Virtual Reality-based Cognitive Therapy in Children with Brain Lesions

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Objective

Existing cognitive therapy such as paper and pencil tasks and computerized cognitive training for children with brain lesions has limitation with the use of pencils, keyboards, or unrealistic scenes. The purpose of this study is to develop and apply a virtual reality (VR)-based cognitive therapy with realistic scenes, simple operations, and adequate difficulty level for children with brain lesions.

Methods

VR-based cognitive therapy was developed to enable use with simple reaching gestures to perform cognitive tasks. The hardware of VR-based cognitive therapy uses motion sensors(Kinect[®]) and physical user interface(PUI) to detect children behavior and provide sensory feedback based on the outcome and concentration of the training(Fig 1). The program of cognitive therapy was developed in the three categories(visualization and reasoning, attention and memory, and activity of daily life) and 13 sub-items. The level of difficulty in the program is from 1 to 5, which is divided by the changes in the number, characteristics and location of objects and time limit. To evaluate the efficacy of the therapy, 2 patients had conventional therapy using paper and pencil task(control group) and 2 patients had VR-based therapy(experimental group). The therapy consists of total 20 session, 30 minutes/session/day in both groups(Table 1). In order to compare the effects before and after therapy, motor-free visual perception test(MVPT) or developmental test of visual perception(DTVP), attention diagnostic system(ADS), pediatric volitional questionnaire(PVQ) and verbal cue frequency of the therapist were evaluated.

Result

In the control group, visual perception test score decreased after cognitive therapy, but in the experimental group, visual perception score increased. Also, in comparison with the control group, the impulsiveness in ADS and verbal cue of the therapist decreased and the participation of therapy in PVQ increased in the experimental group(Table 2).

Conclusion

VR-based cognitive therapy showed more improvement in the visual perception function and participation of the children than the conventional therapy. So, VR-based cognitive therapy will be helpful for children with brain lesion who have impaired hand function and decreased participation of therapy.

Table 1. Characteristics of patients

Group	Patients	Gender / Age	Diagnosis
Control	1	Male/11	CP
	2	Male/13	CP
Experimental	3	Male/9	CP
	4	Male/6	CP

CP, Cerebral palsy

Table 2. Comparison of visual perception assessment and degree of the participation of patients before and after therapy

Group	Patients	Treatment	Visual perception	Inattention ^{a)}	Impulsiveness ^{b)}	PVQ	Frequency of verbal cue
Control	1	Before	29*	246/132	78/100	17	70
		After	23*	327/149	76/45	29	81
	2	Before	33*	165/121	153/83	16	51
		After	22*	232/110	99/105	22	55
Experimental	3	Before	32*	294/87	39/75	38	21
		After	33*	235/128	41/42	47	12
	4	Before	33**	78/67	119/79	28	32
		After	40**	254/74	40/72	42	25

*Motor-free visual perception test(MVPT), **DTVP(Developmental test of visual perception);

^{a)}Inattention in ADS(visual/auditory), ^{b)}Impulsiveness in ADS(visual/auditory);

PVQ, pediatric volitional questionnaire



Fig 1. PUI and software image of VR-based program

Concomitant Guillain-Barre syndrome and acute transverse myelitis: Case report

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Guillain-Barre syndrome is acute inflammatory peripheral polyneuropathy with rapid onset of weakness, changes in sensation and pain, caused by the immune system damaging the peripheral nerves. Acute transverse myelitis is a rare acquired neuro-immune demyelinating disorder that can present with the rapid onset of weakness, sensory alterations, and bowel or bladder dysfunction. Concurrency of demyelinating diseases of central and peripheral nervous system are rare, but we present a case of dual diagnosis following viral pharyngitis. A 6-year-old girl complaining pelvic, abdominal pain and gait disturbance, was admitted to hospital. The patient had a history of influenza vaccination 1 or 2 months ago and prescription of medication for acute pharyngitis 5 days ago. She presented to the hospital with severe motor weakness on bilateral lower limbs(grade 0~1), hyporeflexia, urinary retention with abdominal pain and distension, but no sensory change. At admission, she did not show any upper motor neuron sign and there was no remarkable finding shown in Brain and Whole Spine MRI. Serological studies for Campylobacter Jejuni Ab, Mycoplasma pneumonia IgM and Anti-Herpes simples IgM were positive. And cerebrospinal fluid tests showed increased WBC and protein. The patient received IVIG 1g/kg/day for 2days, antibiotics and acyclovir for 2 weeks, but motor weakness was not improved and Babinski sign, ankle clonus revealed. Follow up Spine MRI showed that high contrast enhancement in nerve fascicle of conus medullaris area without spinal cord signal change or focal lesion. Thus we concluded conus medullaris inflammation due to GBS concurrent with ATM, we started IV steroid pulse therapy for 3 days followed by oral methylprednisolone 1mg/kg/d for 11 days. 2 weeks later, GI function and lower limbs muscle strength was improved(grade 2). In neurophysiologic study, both peroneal motor amplitudes were lowered and F wave latencies showed delayed responses, which were consistent with acute motor axonal neuropathy(AMAN). And both tibial somatosensory evoked potential(SEP) studies revealed delayed responses suggesting abnormality of somatosensory pathway. The patient's muscle strength on both lower limbs was improved(Rt: grade 3, Lt: grade 1) after receiving physical therapy including muscle strength exercise. At discharge, muscle strength was more improved(Rt: grade 4, Lt: grade 2),and she could ambulate with minimal assist. We report a case of pediatric Guillain-Barre syndrome concomitant with acute transverse myelitis who underwent IVIG and steroid pulse therapy. In particular, this case showed the conus medullaris inflammation in spinal MRI. Although it is rare, it may be triggered by both central and peripheral nervous system demyelination through

impaired immune system. Recognizing dual diagnosis is important to predict prognosis and recovery. So we should consider pediatric GBS combined ATM through precise clinical history and physical examination.



Fig 1. sT2 mDixon SAG water MRI images of the spine, showing prominent hyper-intense lesions in conus medullaris. (A)



Fig 2. In T1-weighted images (B), same lesions showed low signal intensity.

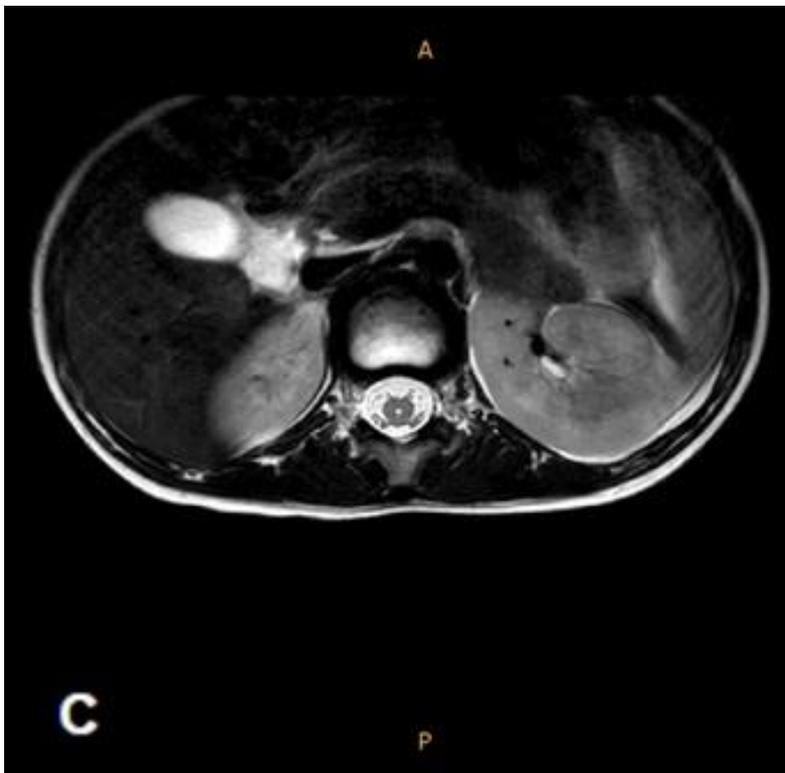


Fig 3. T2 TSE Axial image of L1 level also shows hyper-intense lesions. (C)

Transverse Myelitis Plus Syndrome : A Case report

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Introduction

Transverse myelitis plus syndrome is a subset of transverse myelitis which has features of peripheral nerve involvement, such as diffuse cauda equina enhancement. It should be distinguished from Guillain-Barre syndrome.

Case presentation

A 6-month-old boy presented with weak voice and both lower extremities weakness that progressed over 24 hours. He had upper respiratory infection and diarrhea 1 weeks ago, and these symptoms disappeared when he visited at hospital. He had flaccid paralysis on bilateral lower extremities noted as trace to poor grade, however, no weakness on the upper extremities. Response to painful stimulation decreased on bilateral lower extremities and hypoactive deep tendon reflexes on bilateral lower extremities were also noted. Assessment including blood test, image studies of brain and lumbar spine magnetic resonance image (MRI), cerebrospinal fluid analysis, and electrodiagnostic study were to reveal neurological diseases such as Guillain-Barre syndrome, transverse myelitis and encephalopathy. L-spine MRI showed long segmental path enhancement with subtle T2 hyperintensity of 1st to 5th thoracic spinal cord, which was a feature of transverse myelitis. In addition, there was contrast enhancement with thickening of the cauda equina and nerve roots, which could be suggestive of Guillain-Barre syndrome. Brain MRI and cerebrospinal fluid analysis showed no abnormalities. At 14th hospital day, electrodiagnostic study was performed and it showed preganglionic lesion below cervical level. Initially, he was suggestive of Guillain-Barre syndrome and intravenous immunoglobulin was given immediately from 1st to 5th hospital day. After L-spine MRI and electrodiagnostic study were done, he was diagnosed of transverse myelitis plus syndrome, and steroid pulse therapy from 6th to 10th hospital day and tapering was done. During hospital course, physical therapy including neurodevelopmental treatment and electrical stimulation were done simultaneously. At 1 month after onset of symptom, hypoactive deep tendon reflex on bilateral knee and ankle improved. Muscle power of bilateral lower extremities improved slightly as poor grade and he could not perform antigravity movement. Response to painful stimulation on bilateral lower extremities improved also slightly.

Discussion

Transverse myelitis plus syndrome is atypical form of transverse myelitis which distinguishes from transverse myelitis with pure central nervous system involvement. We report this case of transverse myelitis plus syndrome, which has unique features of transverse myelitis with peripheral involvement.

Bilateral Stress Fracture of Femur Neck, Fatigue type of Non-Athletic Young Adult: A Case Study

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Introduction

Stress fractures of femur neck have been reported primarily in the older adult population and in military personnel. Bilateral femur neck stress fractures of non-athletic young adult population are even more rare. We now report rare case, bilateral femoral neck fractures of non-athletic young adult.

Case report

A 35 year-old man, previously healthy visited emergency department for the right inguinal pain. Recently, about 3 weeks ago he started personal training and had been working out hardly, including daily Buffy test, squatting, treadmill, hip abduction strengthening exercise, for every day, for two weeks. A week ago, while he was running, he felt sudden right inguinal pain. Pain lasted for 5~10 minute and gone. The next day, the pain was on his right posterolateral hip. Pain was aggravated as weight bearing was on his hip, and relieved at rest. The pain was most severe while he was running. Two days ago, he visited orthopedic clinic, and was diagnosed as sub-gluteal bursitis. Triamcinolone injection was done for right hip sub-gluteal bursa but there was no improvement. So he visited emergency department. On physical examination, tenderness was on right posterior aspect of hip, on gluteus maximus, medius level. Patrick sign was positive on right hip joint. There was no physical abnormalities on left lower extremity. He ambulated with an antalgic gait on the right side. Standard AP radiographs of the pelvis shows right basilar femoral neck stress fracture. The MRI showed linear fracture in the both femoral neck with marrow edema, and small amount of effusion in the right hip joint. The result of blood test including hormone studies was normal, except bone ALP, C-telopeptide, 25(OH)-Vitamin D.

Result

This patient was diagnosed as bilateral femoral fatigue fracture. He had closed reduction and internal fixation for both femur neck fracture. After surgery, he was discharged. He ambulated with wheel chair at discharge. 4 weeks later he visited outpatient clinic for follow up, he used crutches and gait as partial weight bearing.

Conclusion

Bilateral femoral neck stress fractures in a young non-athletic, non-military adult with no particular medical history has not been reported before. Excessive exercise can cause

fatigue fracture of femur on healthy young adult and further investigation should be done for which exercise causes fatigue fracture of femur neck.

The importance of physical function in patients with multiple myeloma for improving quality of life

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Purpose

To find out the relation between physical function and quality of life in multiple myeloma patients.

Method

This is retrospective cross-sectional study. Patient's data (N=58) with multiple myeloma who were consulted to the department of rehabilitation medicine from October 2017 to May 2018 were reviewed. Physical function was evaluated with Mini-Balance Evaluation Systems Test (Mini-BESTest). For evaluation of quality of life, EORTC QLQ-C30 and QLQ-MY20 were assessed by patient. Fatigue severity score and Beck Depression Index were collected to evaluate symptom and psychological status. Compare to normative value of mini-BESTest based on previous study, patients were divided into two groups. Thirty-two patients (Group 1) were in normal value and twenty-five patients (Group 2) were below. Clinical features were reviewed to find out the contributing factors to physical function: age, sex, disease duration and stage, cancer type, duration after transplantation, and baseline and current laboratory findings.

Result

Positive correlation was present between mini-BESTest score and global health status and QoL score ($r=0.279$, $P=0.035$). Physical function and QoL score were decreased with lower albumin level, severe disease related symptoms, and depressed patients. The Group 2 patients showed lower hemoglobin and albumin ($P=0.024$, 0.004 respectively). The Group 2 had shorter duration after stem cell transplantation ($P=0.017$), and shorter disease duration, though not statistically significant.

Conclusion

In patients with multiple myeloma, physical function has a significant relationship with quality of life. Low albumin level, severe disease related symptoms, and depression were related to decreased physical function. Not only psychosocial status but also object medical condition affects physical function, and it consequentially affects quality of life in multiple myeloma patients.

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Change of healthcare providers' perceptions after CAncer REhabilitation (CARE) program

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Purpose

To investigate the perceptions that healthcare providers face while implementing cancer rehabilitation and to find changes after receiving CAncer REhabilitation (CARE) program.

Methods

All healthcare providers participating the CAncer of REhabilitation (CARE) program were surveyed immediately after program and invited to complete an online survey at 1 month after program. The questionnaire was developed by a focus group of physiatrists, physical therapist and public health specialist based on the National Coalition of Cancer Survivorship (NCCS)'s Quality Cancer Care—Declaration of Principles. The survey covered the following domains: experience of receiving educational program of cancer rehabilitation, importance and knowledges about specific rehabilitation services, usability & applicability of program and activation plan. On the second survey, change of knowledge and confidence about cancer rehabilitation, usability & applicability and causes of limitation of application were included.

Results

A Total of 52 healthcare providers (men 14.9%) in Korea completed the survey. Of these, 53.8% reported they did not provide rehabilitation services to cancer patients because of limitation of knowledge and information (40.4%), manpower (25.5%), guideline (19.1%), financial support (12.8%) and lack of time (2.1%). Healthcare providers with employment history longer than 5 years perceived more importance and knowledge of cancer rehabilitation compared to those less than 5 years. Respondents reported the prior activation plans might be policy of certified licensing professionals in cancer rehabilitation (19.5%), improvement of educational standards (16.2%), communication with other experts about cancer survivorship (16.2%). After 1 month, the confidence of knowledge about cancer rehabilitation significantly improved. The main cause of limitation of application was that they had no cancer patient referred by oncologists.

Conclusions

Healthcare providers in the field of cancer rehabilitation suggested the policy of certified licensing professionals in cancer rehabilitation, development of standards and manual for education, communication with other experts about cancer survivorship for activating cancer rehabilitation program.

Long-term effects of breast cancer treatments on scoliosis

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Introduction

Breast cancer is the second most common cancer in Korean women. The patients with breast cancer are in a risk condition of scoliosis due to a combination of asymmetrical body mass distribution by surgical procedure and increased risk of osteoporosis by systemic therapies such as chemotherapy or hormone therapy. Since most women are likely to be long-term survivors after breast cancer treatments, we have to attention to the association between breast cancer treatments and scoliosis. A few research has been carried out regarding the effect of breast cancer surgery on the postural changes using DEXA scan, chest radiographs or photogrammetry. The purpose of this paper is to identify the prevalence of scoliosis in breast cancer survivors and to investigate the long-term impact of breast cancer surgery on scoliosis with whole spine anteroposterior standing radiographic assessment to look at the alignment of the entire spine.

Methods

This retrospective study was carried out from April 2014 to July 2018. Inclusion criteria are as follows: 1) patients who diagnosed with breast cancer and treated with surgical procedure (Breast conserving surgery(BCS), mastectomy(MA) with or without immediate breast reconstruction(IBR)); 2) patients who underwent whole spine anteroposterior standing radiography within 60days after breast cancer surgery and repeated radiography at least 300days later. Exclusion criteria were 1) bilateral breast cancer operation; 2) spine operation in the past; 3) previous chemotherapy, hormone or radiation treatment for other cancer; 4) bone metastasis; 5) recurrent breast cancer; 6) delayed breast reconstruction surgery. The curvature of the spine was measured by using the Cobb method.

Result

Total 130 women met the criteria. The demographic characteristics in the three groups are shown in table 1. Women in MA with IBR group were younger than those in the BCS or MA without IBR group ($p=0.002$). The mean time between operation and the initial X-ray assessment was 21.81 ± 9.86 days and the total duration of X-ray follow up was 617.64 ± 253.97 days. At initial assessment, 13 out of our 130 women (10.77%) showed scoliosis. 3 more women had scoliosis during the whole follow-up and scoliosis was present in total 17 out of 130 women, at a prevalence rate of 13.08%. However, there were no significant differences among the three groups for the prevalence of scoliosis. The mean Cobb angle at initial and follow-up assessment was 4.84 ± 4.17 and 5.20 ± 4.15 . The difference over time was statistically significant by paired t-test ($p=0.041$) and change

in Cobb angle was 1.50 ± 1.36 . However, when comparing three groups, there was no significant time and time \times group interaction effect.

Conclusion

In the overall patients with breast cancer, the prevalence of scoliosis and Cobb angle showed a tendency to increase over time. Proceeding from this result, we have to observe the developing and progression of scoliosis in breast cancer survivors.

Table1. Demographic characteristics in the three groups (n=130)

	BCS (n=70)	Mastectomy without reconstruction (n=30)	Mastectomy with reconstruction (n=30)	p-value
Age (yr)	50.80 \pm 9.82	51.67 \pm 9.75	45.63 \pm 8.00	0.002
Time between initial and follow-up X-ray (days)	573.59 \pm 235.65	662.70 \pm 262.85	675.37 \pm 274.72	0.100
Scoliosis prevalence at initial assessment	9 (12.86%)	2 (6.67%)	3 (10.00%)	0.650
Scoliosis prevalence at follow-up assessment	10 (14.29%)	2 (6.67%)	5 (16.67%)	0.469
Initial Cobb Angle	4.87 \pm 4.17	4.66 \pm 4.86	4.96 \pm 3.49	0.960
Follow up Cobb Angle	5.43 \pm 4.21	4.85 \pm 4.17	5.02 \pm 4.06	0.789
Difference of Cobb angle	1.52 \pm 1.32	1.31 \pm 1.47	1.65 \pm 1.37	0.623
APEX				0.194
- Thoracic (T1-T11)	24	17	9	
- Thoracolumbar (T12-L1)	19	4	9	
- lumbar (L1-L5)	27	9	12	
Height (cm)	157.25 \pm 4.78	156.87 \pm 4.08	159.00 \pm 6.41	0.210
Weight (kg)	57.48 \pm 7.22	57.50 \pm 8.08	56.17 \pm 7.47	0.710
BMI	22.79 \pm 2.68	22.90 \pm 2.80	21.83 \pm 3.03	0.240
Osteoporosis (n)	29	11	7	0.204
Chemotherapy (n)	50	24	23	
Neoadjuvant chemotherapy (n)	5	10	10	
Radiation therapy (n)	62	13	11	
Hormone therapy (n)				
- Tamoxifen	44	16	22	
- AI	7	5	1	
- Mixed	3	0	1	

By one-way ANOVA for parametric data and Chi-square test for nominal data

Lymphedema index ratio as Predictive Factor in Patients with Breast Cancer Related Lymphedema

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Introduction

Bioimpedance analysis (BA) is known to be useful diagnostic and monitoring tool in patients with breast cancer related lymphedema (BCRL). In previous studies, they measured the amount of extracellular fluid (ECF) and bilateral arm circumference before and after treatment in patients with BCRL and found that ECF is useful prognostic factor of treatment in patients with BCRL. The purpose of this study is to determine the useful prognostic factors related BA in patients with BCRL.

Material and methods

This study was targeted at female patients with BCRL admitted to perform Complex decongestive therapy (CDT) in physical medicine and rehabilitation department of XX Hospital from August 2016 to March 2018. The subjects were older than 18-year-old who underwent surgery because of breast cancer. The patients were diagnosed as BCRL with lymphoscintigraphy. Patients with recent metastasis, conditions such as lymphatic inflammation, trauma, and surgical history of the affected arm were excluded. CDT was performed for 10 days (5 days per week) for 30 minutes a day. CDT consisted of manual lymphatic drainage, compressive bandaging, exercise to promote lymphatic drainage, and patient education. Before and after 2 weeks of CDT, we conducted the BA using Inbody S10[®]. The volume of bilateral upper extremities was measured from the fingertips to the proximal portion of 33 cm using the water displacement method.

Result

A total of 68 patients were enrolled. Lymphedema index ratio (LIR) at pre-CDT and post-CDT were 1.264 ± 0.234 and 1.149 ± 0.156 , respectively. The volume differences between bilateral upper extremities at pre-CDT and post-CDT were 326.27 ± 275.54 (ml) and 197.78 ± 172.72 (ml). During CDT, the change of LIR and volume differences in bilateral upper extremities were statistically significant with the t-value of 8.399 and 8.535 at the $p < 0.005$ level respectively. The correlation coefficient between the pre-CDT LIR and the volume difference between bilateral upper extremities was 0.731, which was statistically significant at the level of $p < 0.001$ (Figure 1). The correlation coefficient between pre-CDT LIR and change of volume difference in bilateral upper extremity before and after CDT was 0.561, which was statistically significant at the level of $p < 0.001$ (Figure 2). The pre-CDT LIR and duration of disease were statistically significant at the level of $p < 0.001$ and the ratio of ratio bilateral ECF volume, age, skeletal muscle mass, body mass index, and body fat percentage were not statistically significant in multivariate linear regression (Table 1).

Conclusion

In this study, it was found that LIR by BA is useful monitoring tool of treatment outcome and the pre-CDT LIR was statistically significant factor for predicting effects of treatment in patients with BCRL. We suggest continuous BA is required to use the LIR as a follow-up and predictive factor of treatment in patients with BCRL.

Table 1. Factors associated with volume change before and after CDT by multivariate linear regression analysis

Independent Predictor	Standardized β	<i>p</i> -value	Adjusted R ²
LIR at admission	0.576	<0.005*	
Age	0.134	0.216	
Skeletal muscle mass	0.213	0.242	
BMI	- 0.177	0.522	0.510
Body fat percentage	0.245	0.245	
Extracellular fluid	-0.182	0.787	

CDT, Complex decongestive therapy; LIR, Lymphedema index ratio; BMI, Body mass index

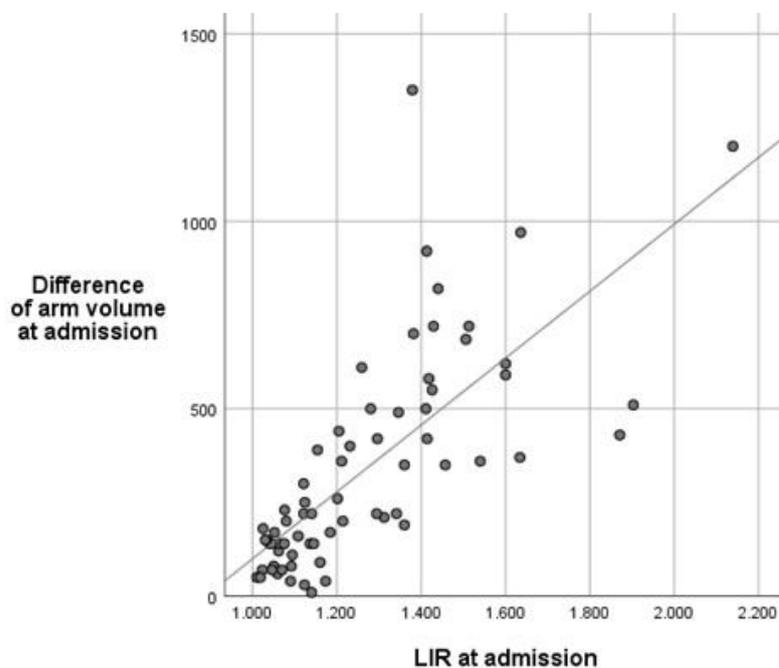


Fig 1. Correlation between LIR and volume difference between both arms at admission

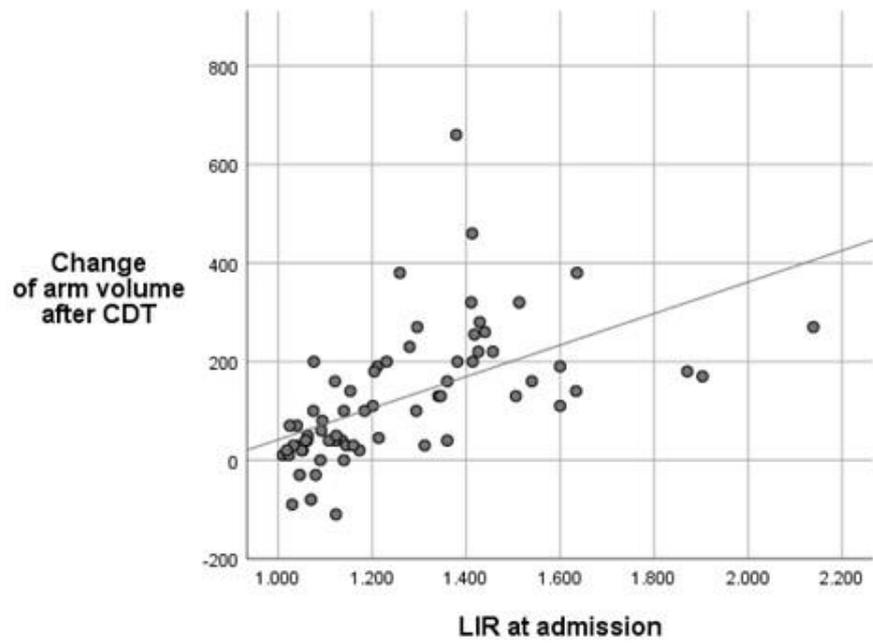


Fig 2. Correlation between LIR at admission and change of affected arm volume after CDT

The change in muscle properties of upper limb in breast cancer patients under radiation therapy

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Purpose

Radiation therapy is a fundamental part of cancer treatment but it occurs the onset of late adverse effects in the normal tissue, especially radiation-induced fibrosis. But, It is difficult to objectively assess the muscle properties. In order to understand and treat muscle tightness of breast cancer patients under radiation therapy, detailed information on the clinical course and muscle properties of upper limb is required. The aim of the current prospective study was to investigate the changes of muscle properties of upper trapezius (UTZ), sternoclavicular muscle (SCM), and pectoralis major (PM) in breast cancer patient under radiation therapy by serial follow-up (before, after radiation therapy and 4 months after end of radiation therapy) using a hand-held myotonometer.

Methods

The breast cancer patients who underwent surgery and scheduled radiation therapy were included. We measured muscle properties and subjective stiffness. Muscle properties were measured using Myoton, a noninvasive and small hand-held device expressed on a continuous scale. Subjective stiffness score is a 5-point scale, 1 means 'feel no stiffness', and 5 means 'feel very stiff'. Three measurements were taken before and after the radiation therapy, and four months after the end of the radiation therapy.

Results

The stiffness of PM was significantly higher in the affected side before radiation therapy. There were no statistically significant changes in other muscles. After radiation therapy, the tone of affected side PM was higher the elasticity was lower, and the stiffness was increased than the unaffected side. This pattern was similar 4 month after end of radiation therapy. Other muscles showed no significant difference. In the PM of the affected side, the tone gradually increased, the elasticity decreased, and the stiffness increased. All these values were statistically significant. The UTz of the affected side showed a similar pattern with the PM, but only stiffness was statistically significant. And there was no meaningful change in this scale and no correlation with the objective values on the subjective stiffness score.

Conclusion

In this study, there was no significant change in the properties of the SCM muscle. There was a significant difference in stiffness of the PM between affected and unaffected side

before radiation therapy. And it seems an effect of surgery. After radiotherapy, in PM muscle, the tone was increased, the elasticity was decreased, and the stiffness was increased. This change was significant and is thought to be the effect of radiation therapy. In affected side, the pattern of UTz was similar to that of the PM, which is presumed to be due to posture when receiving radiation therapy. There was no significant change in the subjective stiffness score and no correlation with the objective values. The study is considered to be an important resource in the rehabilitation for breast cancer patients after radiation therapy.

Long-term predictive factors of response to complete decompressive treatment in patients with BCRL

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OBJECTIVE

In some previous study reported the benefits of complete decompressive treatment (CDT) in patients with breast cancer related lymphedema (BCRL). However, there were few studies about predictive factors on response to CDT as well as published descriptions of the long-term predictive factor. The aim of this study is to determine the long-term (2 years) predictive factors of response to CDT in patient with BCRL.

METHODS

We retrospectively reviewed patients who had visited the rehabilitation medicine outpatient clinic from September, 2015 to December, 2015 who have undergone CDT. The examined factors include the following: patients age, BMI, marital status, side of diseased limb, type of diagnosis, type of surgery, removed lymph node, metastatic lymph node, type of chemotherapy, agent of chemotherapy, radiotherapy and the length of days from operation to the beginning of CDT. Furthermore, excess circumference ratio $[(CL-CH)/CH \times 100]$ were measured prior to treatment, at the end of CDT and 2 years after CDT. The treatment response group was divided into three groups (treatment free, maintain with compression, aggravation) according to the change of excess circumference ratio between 2 years after CDT and prior to treatment, and at the end of CDT. Moreover, we considered whether the follow-up treatment was necessary 2 years after.

RESULTS

A total 81 patients were reported, including patients of 43 treatment free (53.09%), 28 maintain with compression (34.57%), and 10 aggravation (12.34%). There was a significant difference in removed lymph node, type of chemotherapy and agent of chemotherapy between treatment response groups ($p < .05$) (Table 1). There were excess circumference ratio trends among each group of treatment response. The initial, observed excess circumference ratio was greater in the aggravation group (Fig 1). In the logistic regression analysis between non-aggravation group (treatment free and maintain with compression) and aggravation group, there was an only significant difference in type of chemotherapy (Table 2).

CONCLUSION

Our results suggest that removed lymph nodes, types of chemotherapy and agents of chemotherapy could be long-term (2 years) predictive factors of response to CDT between treatment response groups (treatment free, maintain with compression and

aggravation). Also, the initial excess circumference ratio may be considered as a long-term predictive factor. In the logistic regression analysis between non-aggravation group (treatment free and maintain with compression) and aggravation group, there was an only significant difference in type of chemotherapy. A larger sample size is required to confirm our findings.

Table 1. Clinical characteristics according to each group of treatment response

	Treatment free (n=43)	Maintain with compression (n=28)	Aggravation (n=10)	Total (n=81)	p-value
Mean Age	52.4± 9.4	52.9 ± 10.6	47.4 ± 7.0	52.0 ± 9.7	.28 [#]
BMI on diagnosed BCRL	23.5 ± 2.8	23.4 ± 2.7	23.1± 2.6	23.4 ± 2.7	.89 [#]
Marital status, n (%)					.73 ⁺
Married	38 (88.4)	25 (89.3)	8 (80.0)	71 (87.7)	
Unmarried, divorced	5 (11.6)	3 (10.7)	2 (20.0)	10 (12.3)	
Side of diseased limb, n(%)					.79 ⁺
Right	18 (41.9)	12 (42.9)	5 (50.0)	35 (43.2)	
Left	25 (58.1)	14 (50.0)	3 (30.0)	42 (51.9)	
Bilateral	0	2 (7.1)	2 (20.0)	4 (4.9)	
Type of diagnosis, n (%)					.53 ⁺
Carcinoma in situ (DCIS, LCIS)	4 (9.3)	0	1 (10.0)	5 (6.2)	
Invasive ductal carcinoma	38 (88.4)	27 (96.4)	9 (90.0)	74 (91.4)	
Metastatic cancer	1 (2.3)	1 (3.57)	0	2 (2.5)	
Type of Surgery, n (%)					.30 ⁺
Modified radical mastectomy	7 (16.3)	9 (32.1)	5 (50.0)	21 (25.9)	
Quadrantectomy	4 (9.3)	3 (10.7)	1 (10.0)	8 (9.9)	
Skin sparing mastectomy	9 (20.9)	7 (25.0)	2 (20.0)	18 (22.2)	
Lumpectomy	23 (53.5)	9 (32.2)	2 (20.0)	34 (42.0)	
Removed lymph node					.00 ⁺
=10	29 (67.4)	11 (39.3)	2 (20.0)	42 (51.9)	
>10	14 (32.6)	7 (60.7)	8 (80.0)	39 (48.1)	
Metastatic lymph node					.36 ⁺
=5	36 (83.7)	25 (89.3)	7 (70.0)	68 (84.0)	
>5	7 (16.3)	3 (10.7)	3 (30.0)	13 (16.0)	
Type of Chemotherapy, n(%)					.04 ⁺
Neoadjuvant	16 (37.2)	15 (53.6)	8 (80.0)	39 (48.2)	
Adjuvant	27 (62.8)	13 (46.4)	2 (20.0)	42 (51.9)	
Agent of Chemotherapy, n(%)					.00 ⁺
Taxene	26 (60.5)	27 (96.4)	10 (100.0)	63 (77.8)	
No taxene	17 (39.5)	1 (3.6)	0	18 (22.2)	
Radiotherapy, n(%)					.60 ⁺
Yes	37 (86.1)	22 (78.6)	9 (90.0)	68 (83.9)	
No	6 (13.9)	6 (21.4)	1 (10.0)	13 (16.1)	
Length of day from operation to CDT start, n(%)	224.6 ± 170.7	204.5 ± 189.9	130.2 ± 117.2	206.0 ± 173.0	.30 [#]

Values are expressed as the mean ± standard deviation or as numbers (%).

CDT complete decompressive treatment

p values were calculated using the χ^2 -test[†] or the ANOVA[#], p< .05 was considered to be statistically significant.

p-value was comparison of age groups treatment response groups

Table 2. Odds ratio for response 2 years after complete decompressive therapy between non-aggravation group and aggravation group

	OR	95% CI	<i>p</i> -value
Removed lymph node	1.95	0.34-11.31	.46
Metastatic lymph node	2.28	0.40-12.89	.35
Type of Chemotherapy	12.30	1.48-102.67	.02*
Agent of Chemotherapy	0.86	0.06-12.53	.90
Radiotherapy	0.36	0.05-2.79	.33

p values were calculated using the logistic regression analysis, *p* < .05 was considered to be statistically significant. non-aggravation groups was treatment free and maintain with compression

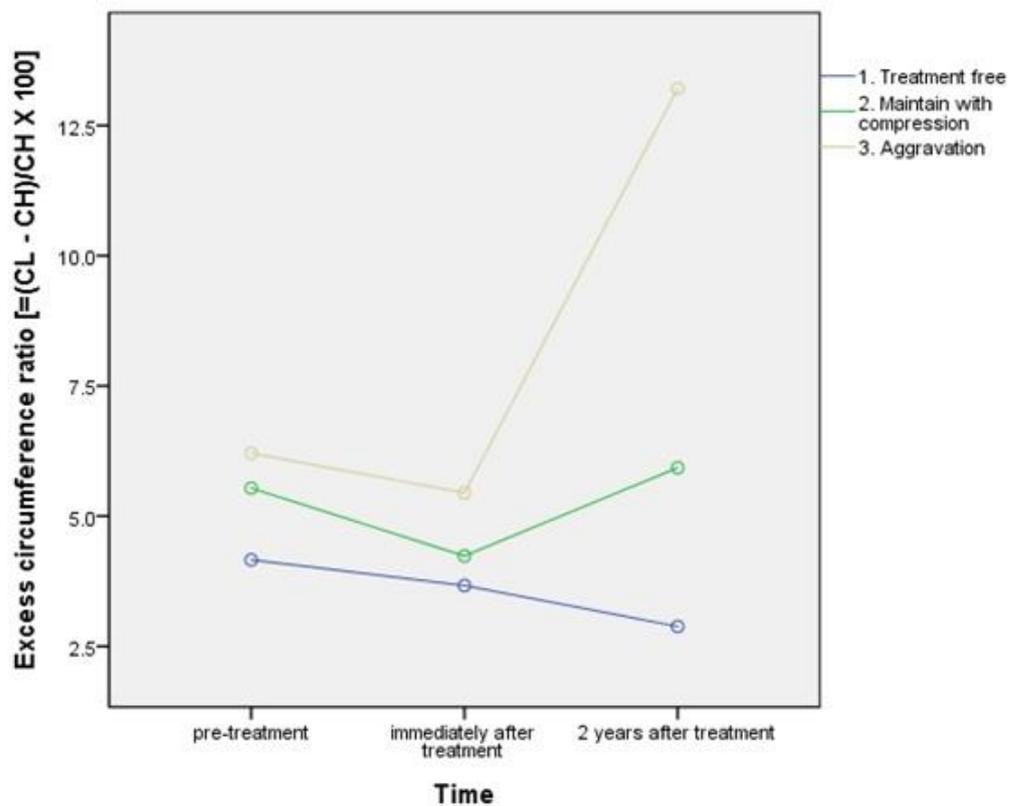


Fig 1. Excess circumference ratio trend among each group of treatment response

P 1-76

Correlation with cognitive function and chemotherapy in breast cancer: preliminary study

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Objectives

To investigate the effect of chemotherapy on cognitive function, cardiorespiratory fitness and physical activity in breast cancer patient.

Methods

From June 2017 to April 2018, patients between the ages of 40-70 who underwent surgery due to breast cancer in the department of the breast and thyroid surgery were enrolled. A total 10 patients were recruited and divided into two groups. Patients treated with chemotherapy are chemotherapy group (n=5), and patients who did not receive chemotherapy are non-chemotherapy group (n=5). Age, types of breast cancer surgery, history of chemotherapy and radiotherapy, education level, Korean version of the Mini-Mental State Exam (K-MMSE), Beck depression inventory (BDI) were collected as demographic data. In addition, we performed the Korean version of Montreal cognitive assessment (MOCA-K), Computerized Neuro-cognitive Function Test (CNT) for cognitive function evaluation and evaluated the International Physical Activity Questionnaire (IPAQ) to measure physical activity level. We also performed cardiopulmonary exercise test using modified Bruce protocol to evaluate cardiorespiratory fitness. All outcomes were measured after surgery (T0, baseline) and immediately after the anti-cancer therapy (T1).

Results

Among the chemotherapy group, the mean age was 56.2 ± 8.1 , and 48.8 ± 4.3 in the non-chemotherapy group. In chemotherapy group, breast cancer stage 2 and 3 were more frequent, and mastectomy was performed more frequently. Education level, K-MMSE, BDI scores did not showed significant differences between two groups (Table 1). No significant differences were found between two groups in the cognitive function outcomes at T0. There was also no significant change in cognitive function outcomes between T0 and T1 in both groups when compared within each group. In IPAQ, there was no significant difference between the two groups, but the ratio of Category 2 at T1 was increased in both groups (Table 2). Similarly, there was no significant difference between the two groups in the cardiorespiratory fitness parameters at T0. However, anaerobic threshold (AT) was significantly lower in the chemotherapy group than in the non-chemotherapy group at T1 (18.38 and 24.66 respectively, $p < 0.05$) (Table 3).

Conclusions

Chemotherapy did not significantly affect cognitive function, cardiorespiratory fitness, and physical activity at the time immediately after chemotherapy in breast cancer

patients. However, further evaluation of the effect of chemotherapy on these parameters over time will be needed in future through a long-term follow up evaluation.

Table 1. Baseline characteristics of the subjects.

Parameters	Chemotherapy group (n=5)	Non-chemotherapy group (n=5)	p-value
Age (year)	56.2 ± 8.1	48.8 ± 4.3	0.095
Breast cancer stage			
I	0 (0)	5 (100)	0.008*
II	3 (60)	0 (0)	
III	2 (40)	0 (0)	
Surgery type			
Breast-conserving surgery+radiotherapy	1 (20)	5 (100)	0.048*
Mastectomy	4 (80)	0 (0)	
Neoadjuvant chemotherapy only	0 (0)	0 (0)	
Chemotherapy			
TC	2 (40)		
AC	0 (0)	N/A	
TC+AC	3 (60)		
Radiotherapy	3 (60)	5 (100)	0.444
Education level			
Elementary school	1 (20)	0 (0)	0.357
Middle school	0 (0)	3 (60)	
High school	2 (40)	1 (20)	
University	2 (40)	1 (20)	
K-MMSE	28.0 ± 1.2	28.0 ± 0.8	0.421
BDI	11.4 ± 5.3	13.4 ± 10.1	0.841

Values are presented as mean ± standard deviation or number (%).

TC, Doxitaxel, cyclophosphamide; AC, Doxorubicin, cyclophosphamide; K-MMSE, Korean version of the Mini-Mental State Exam; BDI, Beck Depression Inventory.

* $p < 0.05$

Table 2. Comparison of cognitive function, physical activity between two groups at baseline, post anti-cancer therapy

Variables	Group	T0	T1	<i>p</i> -value
K-MMSE	Chemotherapy	28.00 ± 1.22	28.4 ± 1.1	0.310
	Non-chemotherapy	28.80 ± 0.84	29.2 ± 0.8	
MOCA-K	Chemotherapy	25.60 ± 2.97	26.8 ± 2.4	0.841
	Non-chemotherapy	25.80 ± 2.77	27.2 ± 0.4	
CNT-D	Chemotherapy	45.90 ± 18.70	46.7 ± 18.6	1.000
	Non-chemotherapy	47.30 ± 18.09	47.7 ± 17.5	
CNT-V	Chemotherapy	37.50 ± 6.89	40.3 ± 6.7	0.548
	Non-chemotherapy	44.90 ± 5.99	42.6 ± 7.8	
CNT-T	Chemotherapy	39.00 ± 8.85	42.1 ± 10.4	0.690
	Non-chemotherapy	39.60 ± 8.60	40.4 ± 8.1	
CNT-W	Chemotherapy	36.88 ± 7.61	36.7 ± 6.5	0.690
	Non-chemotherapy	40.04 ± 10.75	40.0 ± 9.9	
BDI	Chemotherapy	11.40 ± 5.32	8.8 ± 4.8	0.095
	Non-chemotherapy	13.40 ± 10.14	13.4 ± 2.5	
IPAQ (Continuous score)	Chemotherapy	481.80 ± 336.21	863.00 ± 470.40	0.310
	Non-chemotherapy	431.80 ± 316.72	647.70 ± 505.34	
IPAQ (Categorical score)	Chemotherapy	C1	3 (60)	1.000
		C2	2 (40)	
	Non-chemotherapy	C1	4 (80)	1.000
		C2	1 (20)	

Values are presented as mean ± standard deviation or number (%).

K-MMSE, Korean version of the Mini-Mental State Exam; MOCA-K, Korean version of Montreal cognitive assessment; CNT-D, Computerized Neuro-cognitive Function Test-Digit span; CNT-V, Computerized Neuro-cognitive Function Test-Visual span; CNT-T, Computerized Neuro-cognitive Function Test-Trail making; CNT-W, Computerized Neuro-cognitive Function Test-Word color test; BDI, Beck Depression Inventory; IPAQ, International Physical Activity Questionnaire; C1, Category 1; C2, Category 2.

**p*<0.05

Table 3. Comparison of cardiorespiratory fitness between the two groups at baseline, post anti-cancer therapy

Variables	Group	T0	T1	<i>p</i> -value
VO ₂ max (ml/kg/min)	Chemotherapy	22.36 ± 4.55	21.54 ± 2.06	0.222
	Non-chemotherapy	27.80 ± 2.96	26.98 ± 5.50	
METs	Chemotherapy	6.40 ± 1.32	6.14 ± 0.59	0.222
	Non-chemotherapy	7.94 ± 0.85	7.70 ± 1.58	
RER	Chemotherapy	1.35 ± 0.17	1.37 ± 0.14	0.151
	Non-chemotherapy	1.33 ± 0.13	1.24 ± 0.15	
VE _{max} (L/min)	Chemotherapy	52.51 ± 11.88	48.50 ± 7.02	0.421
	Non-chemotherapy	49.74 ± 7.90	43.32 ± 8.93	
AT (ml/kg/min)	Chemotherapy	18.82 ± 2.98	18.38 ± 2.91	0.032*
	Non-chemotherapy	23.88 ± 4.85	24.66 ± 4.31	

VO₂max, maximal oxygen consumption; METs, Metabolic equivalent tasks; RER, Respiratory exchange ratio; VE_{max}, Maximal pulmonary Ventilation; AT, Anaerobic Threshold.

**p*<0.05

P 1-77

Predicting the functional status after breast reconstruction : A prospective, longitudinal study

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Purpose

To evaluate the functional status of breast cancer patients after breast reconstruction with transverse rectus abdominis flap and to identify factors affecting functional outcomes.

Methods

A prospective longitudinal study in patients with breast cancer who visited the department of rehabilitation at 1 month (T0) and 3 months (T1) after breast reconstruction with TRAM. Manual muscle test of shoulder, abdomen by hand held dynamometer, Isometric Double Straight Leg Lowering Test (IDSLLT) and Abdominal muscle related Activities of Daily Living (ArADL) using questionnaires were used to functional status. Personal and cancer-related factors were recorded. Univariable and multivariable analyses were used to identify factors associated with changes in physical function.

Results

A total of 53 patients (mean age; 48.1 ± 5.8 yrs) were enrolled from March 2017 to June 2018. Functional status such as abdominal strength, shoulder strength, LDSLLT and ADL scores were improved from T0 to T1 (3.2 ± 0.8 vs 4.0 ± 0.6 , $p < 0.001$; 2.5 ± 1.1 vs 3.6 ± 0.8 , $p < 0.001$; 5.5 ± 5.0 vs 16.1 ± 9.9 , $p < 0.001$; 46.0 ± 3.0 vs 49.4 ± 2.4 , $p < 0.001$, respectively). Abdominal muscle strength at T0 (less than 3) were significantly associated with IDSLLT ($\beta = 8.307$, 95% CI, 1.539 to 15.075) and ADL ($\beta = -1.684$, 95% CI, -3.353 to -0.015) at T1.

Conclusions

Breast cancer patients with poor abdominal muscle strength at 1 month after reconstruction with TRAM are likely to show lower ArADL level at 3 months after surgery. Rehabilitation program with abdominal strengthening exercise should be prioritised for breast cancer patients with poor abdominal muscle at 1 month after TRAM for better activities of daily living.

```
. regress ADL_RA_Function_Score_2 i.abmmt1
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Source	SS	df	MS	Number of obs	=	53
Model	23.0002633	1	23.0002633	F(1, 51)	=	4.10
Residual	286.018605	51	5.60820793	Prob > F	=	0.0481
				R-squared	=	0.0744
				Adj R-squared	=	0.0563
Total	309.018868	52	5.94267054	Root MSE	=	2.3682

ADL_RA_Fun~2	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
1.abmmt1	-1.683721	.831411	-2.03	0.048	-3.352848 - .0145937
_cons	50.8	.7488797	67.83	0.000	49.29656 52.30344

Association between abdominal muscle strength at 1 months and ADL scores at 3 months after breast reconstruction

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. regress IDSLLT_2 i. abmmt1
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Source	SS	df	MS	Number of obs	=	53
Model	559.858885	1	559.858885	F(1, 51)	=	6.07
Residual	4702.02791	51	92.1966256	Prob > F	=	0.0171
				R-squared	=	0.1064
				Adj R-squared	=	0.0889
Total	5261.88679	52	101.190131	Root MSE	=	9.6019

IDSLLT_2	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
1.abmmt1	8.306977	3.371019	2.46	0.017	1.539373 15.07458
_cons	9.6	3.03639	3.16	0.003	3.504193 15.69581

Association between abdominal muscle strength at 1 months and Isometric Double Straight Leg Lowering Test (IDSLLT) at 3 months after breast reconstruction

Comparison of Characteristic and Complications According to Gastrostomy type

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Introduction

Gastrostomy is divided into percutaneous endoscopic gastrostomy (PEG) using endoscopy and percutaneous radiological gastrostomy (PRG) using radiation. Although there have been comparative studies on the risk of complications of PEG and PRG groups, there were no studies comparing PEG and PRG groups by disease group. This study is a comparative study of the characteristics, complications, and prognosis between PEG and PRG on various patient groups using various parameters.

Material and methods

The subjects were patients who underwent gastrostomy through outpatient or hospitalization from december, 2010 to april, 2018. We investigated the sex, age, cause of the dysphagia, date and type of gastrostomy, complications. We retrospectively reviewed the medical records.

Result

A total of 187 patients were enrolled in this study. Of these, 5 of patients were excluded from the study because they were replaced by PRG after PEG. As a result, 48 patients with PEG and 129 patients with PRG were recruited. The patient's underlying disease in each PEG and PRG group was described in Table 1. Complications occurred in 63 patients (total 68 patients). The types and incidence of complications in each group were described in Table 2. The risk of complications according to gastrostomy type was examined, the risk of complication was higher in the PEG group than in the PRG group and the odds ratio was 5.528(Table 3). And the correlation between age, sex and complication was examined in the PEG and PRG groups, there was no significant difference between the groups in which the complication occurred and the group in which no complication occurred(Table 4, 5). In this study, age and gender did not affect the outcome of complication in PEG and PRG groups. The preference for procedural type showed that PEG was preferred for Cerebral vascular disease and traumatic brain injury patients. PRG was preferred in patients with head and neck cancer. Complication was more common in the PEG group than in the PRG group. In particular, inadvertent remove, pneumonia, and wound infection were significantly higher in the PEG group than in the PRG group

Conclusion

The purpose of this study was to compare PEG and PRG, which are frequently used in gastrostomy, and to evaluate the preference of PEG and PRG for each disease in

gastrostomy. There were differences in the incidence of complications, especially There were also differences in the types of complications that could occur. Further study is needed to determine the causes of the complication differences between PEG group and PRG group in this study.

Table 1. Generic characteristics of patients

Vairables	PEG	PRG	p-value
Total	48	129	
Age(mean)	65.83	63.05	0.232
Male(female)	31(17)	98(31)	0.155
Head & Neck caner(n)	4	88	0.000*
Cerebrovascular disease(n)	22	10	0.000*
Traumatic brain injury(n)	11	6	0.006*
Brain tumor(n)	1	2	0.929
Motor neuron disease(n)	3	2	0.209
Parkinsonism(n)	2	3	0.302
Etc.(n)	4	18	0.270

* etc : pneumonia, cervical vertebral tumor, GI track cancer, DM neuropathy

Table 2. Kind of complication according to gastrostomy type

Complication	PEG(n)	PRG(n)	p-value
Total	36	32	0.000*
Buried bumper syndrome	2	2	0.298
Electrolyte imbalance	3	2	0.093
Fever	0	2	
GI symptomes	2	9	0.491
Inadvertent remove	6	3	0.006*
Peritonitis	1	2	0.807
Pneumonia	5	1	0.002*
Wound Infection	13	8	0.000*
Etc.	4	3	0.068

* Etc. : LFT elevation, leakage, hypoglycemia

Table 3. Relative risk of complication according to gastrostomy type

	Value	95% Confidence interval	
		Lower	Upper
Odds Ratio for Findings (PEG/PRG)	5.528	2.707	11.286
Complication group	2.604	1.805	3.755
Control group	0.471	0.317	0.699
N of valid cases	177		

Table 4. Comparison of age according to occurrence of complications

	Complication(age)	Control(age)	p-value
PEG	67.42	62.94	0.290
PRG	65.64	62.13	0.105

Table 5. Relative risk of complication according to gender in PEG group

PEG goup	Value	95% Confidence interval	
		Lower	Upper
Odds Ratio for Findings (Male/Female)	2.173	0.636	7.420
Disease group	1.341	0.812	2.214
Control group	0.617	0.292	1.301
N of valid cases	48		
PRG goup	Value	95% Confidence interval	
		Lower	Upper
Odds Ratio for Findings (Male/Female)	0.932	0.369	2.356
Disease group	0.949	0.476	1.893
Control group	1.018	0.804	1.289
N of valid cases	129		

Prognostic Factors of Lymphoscintigraphic Findings in Patients with Breast Cancer-Related Lymphedema

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OBJECTIVE

Lymphedema is a chronic disabling disease that can occur in breast cancer patients after the treatment. Early diagnosis and treatment would be important for lymphedema. Lymphoscintigraphy (LSG), which using mainly qualitative factor analysis, is a useful tool for lymphedema diagnosis and severity assessment. Not only its usage for diagnosis of lymphedema, we purposed to evaluate its role as prediction of effects of complete decongestive therapy (CDT) in lymphedema after breast cancer treatment. ,

METHODS

Of the patients who visited our clinic from January 2017 to April 2018, patients diagnosed as clinical lymphedema after breast cancer surgery (sentinel node biopsy or axillary lymphnode dissection) were screened. Among them, patients who underwent LSG within 3 months before and after 2 weeks of initial CDT were included. Arm circumference was measured at 4cm intervals from hand dorsum before and after treatment with CDT and summated as whole arm volume. Percentage excess volume (PEV) and percentage reduction in excess volume (PREV) were calculated. Using LSG, we calculated ratio of the affected to unaffected side of upper extremity uptake and axillary node uptake at 1 hour and 2 hour after the injection of Tc-99m Phytate in 2nd interdigital space. Those who has uptake in supraclavicular lymph node were analyzed including this area additionally.

RESULTS

A total of 18 patients who met the inclusion criteria were included and average age of them was 55.3 ± 9.2 years old. Average time from surgery to CDT were and 25.6 ± 46.4 months. Initial PEV showed positive correlation with ratio of upper extremity uptake at 2 hour and negative correlation with ratio of axillary node uptake and axillary plus supraclavicular nodes uptake (Fig 1.). PREV showed positive correlation with ratio of axillary node uptake at 2 hours after injection (Fig 2.). When we divided the patients into 4 groups according to lymph node uptake in axillary and/or supraclavicular area, PREV was highest in the group having only the axillary lymph node uptake without any statistically significant difference between the groups (Fig 3.).

CONCLUSION

Quantitative and qualitative analysis of LSG are useful for predicting the prognosis after CDT as well as assessment of severity of lymphedema in breast cancer patients.

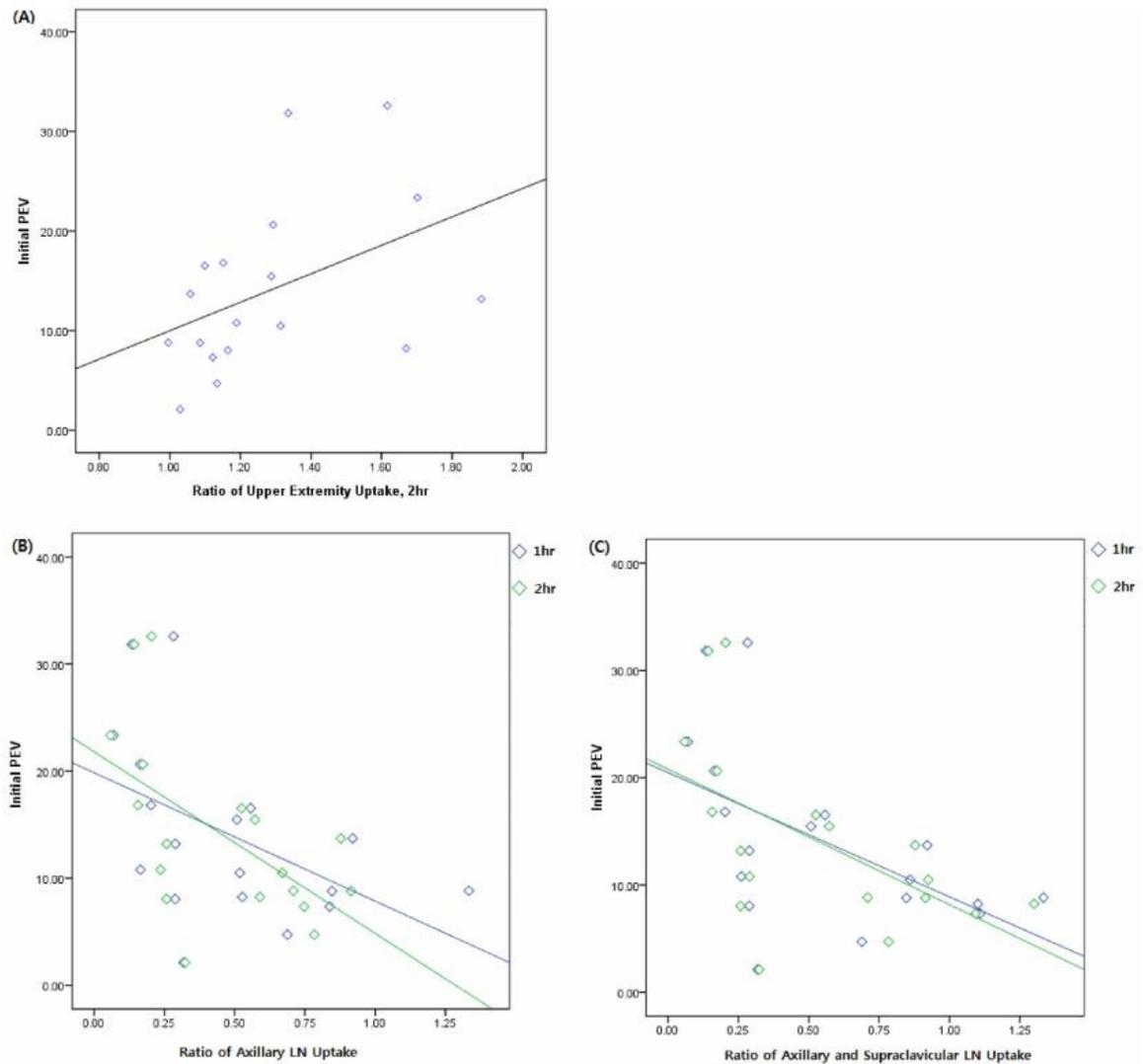


Fig 1. Quantitative factors of LSG and initial PEV (Percentage excess volume). Analysis was done by Kendall tau rank correlation. (A) The ratio of upper extremity uptake at 2 hour and the initial PEV showed positive correlation ($\tau\text{-}b=0.359$, $p\text{-}value=0.037$). (B) The ratio of axillary LN uptake at 1, 2 hour were inversely correlated with initial PEV ($\tau\text{-}b=-0.386$, $p\text{-}value=0.025$ at 1 hour, $\tau\text{-}b=-0.477$, $p\text{-}value=0.006$ at 2 hour). (C) The ratio of axillary and supraclavicular LN uptake at 1-, 2- hour were inversely correlated with initial PEV showing more statistically significant correlation than axillary LN uptake ($\tau\text{-}b=-0.438$, $p\text{-}value=0.011$ at 1 hour, $\tau\text{-}b=-0.490$, $p\text{-}value=0.004$ at 2 hour).

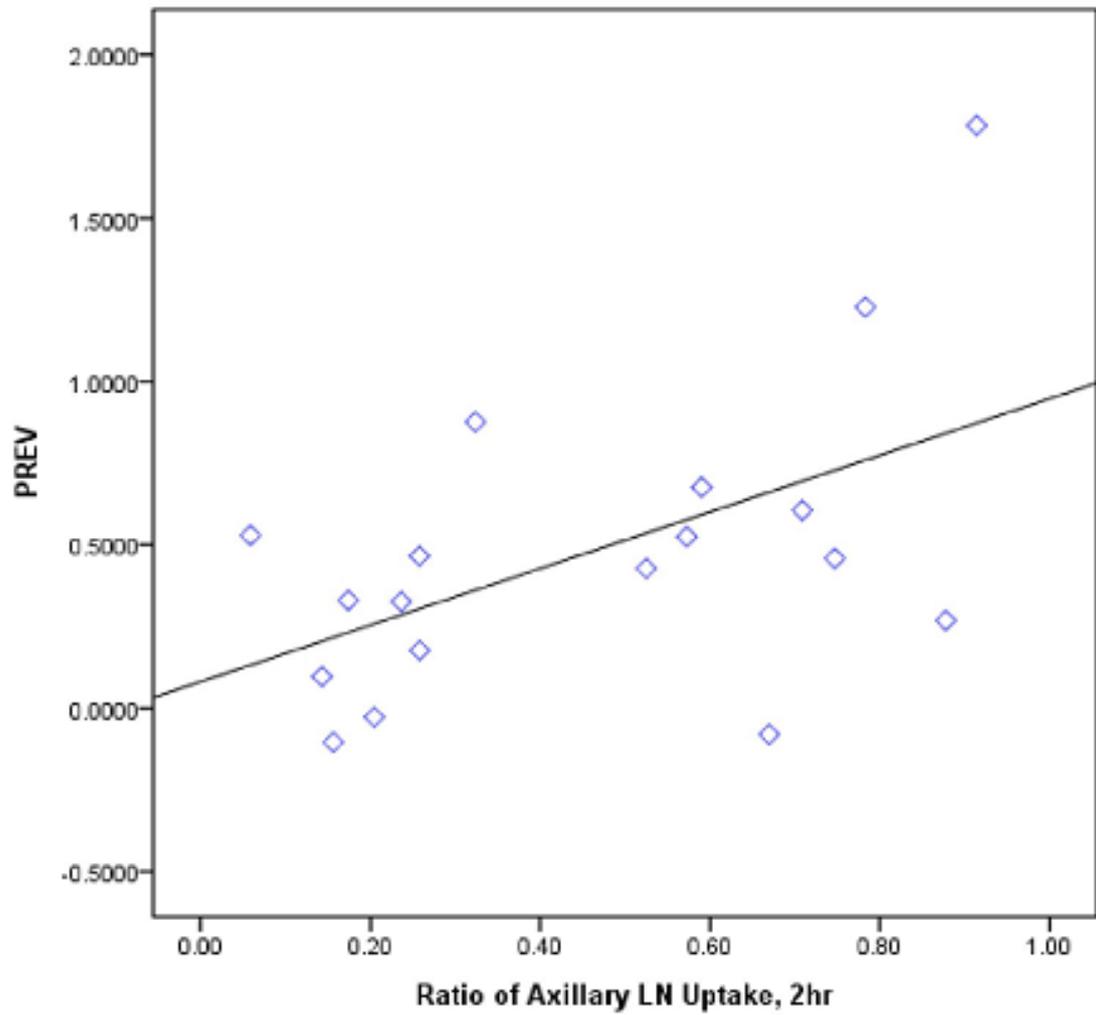


Fig 2. Quantitative factors of LSG and initial PREV (Percentage reduction in excess volume). Analysis was done by Kendall tau rank correlation. PREV showed positive correlation with the ratio of axillary node uptake at 2 hours after injection. ($\tau\text{-}b=0.346$, $p\text{-}value=0.045$).

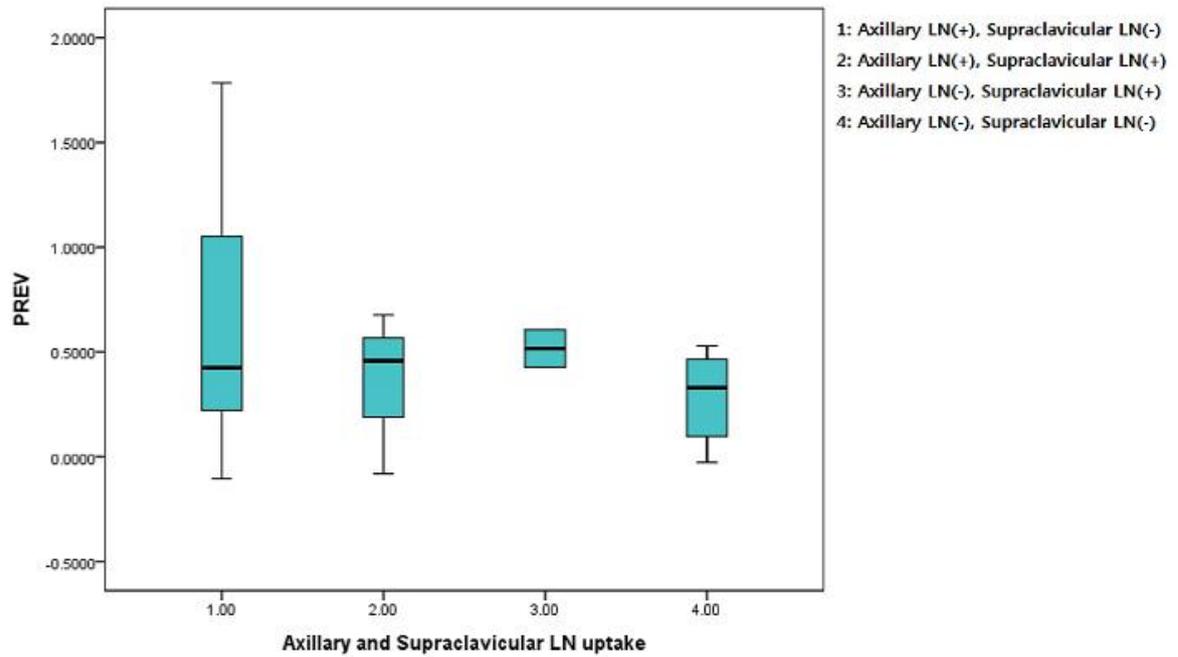


Fig 3. PREV differences according to regional LN uptake. Average of PREV was highest in group 1 and lowest in group 4, though these differences between groups were not statistically significant. Mean±SD of each group was estimated as follows; Group 1: 0.63±0.22, Group 2: 0.35±0.22, Group 3: 0.51±0.89, Group 4: 0.27±0.11. The line in the box indicates the median value of each group.

A man with dysphagia after cervical esophagogastrostomy

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Introduction

Dysphagia based on the functional gastric outlet obstruction is rarely reported. The natural course of functional gastric outlet obstruction is not uncovered, yet. We report the case of a patient with dysphagia with functional gastric outlet obstruction after cervical esophagogastrostomy.

Case Presentation

A 62-year-old man referred to our outpatient clinic with one-month history of dysphagia and discomfort, from the department of cardiac & thoracic surgery. Dysphagia was non-selective for liquids or solid foods during meal time. He underwent surgery for esophageal cancer cT2N0M0, as transhiatal esophagectomy & cervical esophagogastrostomy, one months ago. Chest CT revealed no evidence of metastasis of cancer recurrence. Physical examination or endoscopic examination of the patient did not show any positive findings. The videofluoroscopic study(VFSS) with barium, which was performed to evaluate the dysphagia, showed a mild increase of post-swallow remnants. The VFSS for esophageal phase with the anteroposterior view, revealed delayed emptying of lower esophagus as functional gastric outlet obstruction at diaphragm. Delayed chest x-ray (ten minutes after VFSS) showed delayed emptying of the esophagus (Figure 1). His surgeon decided observation without intervention for 1 month. After then, following VFSS for esophageal phase with the anteroposterior view, revealed more aggravated functional gastric outlet obstruction at diaphragm. Delayed chest x-ray showed aggravated delayed emptying of the esophagus (Figure 2). Physiatriest recommended the surgical intervention of functional gastric outlet obstruction to patient's cardiothoracic surgeon.

Conclusion

The cervical esophagogastrostomy for early esophageal cancer would be one of a functional etiology of functional gastric outlet obstruction, prespresenting dysphagia and discomfort during the meal. The physician would concern the dysphagia and functional changes of the esophagus in patients with cervical esophagogastrostomy.



Fig. 1. Delayed chest x-ray (ten minutes after videofluoroscopic study) showed that most of the barium were disappeared and was suggested for delayed emptying of the esophagus.

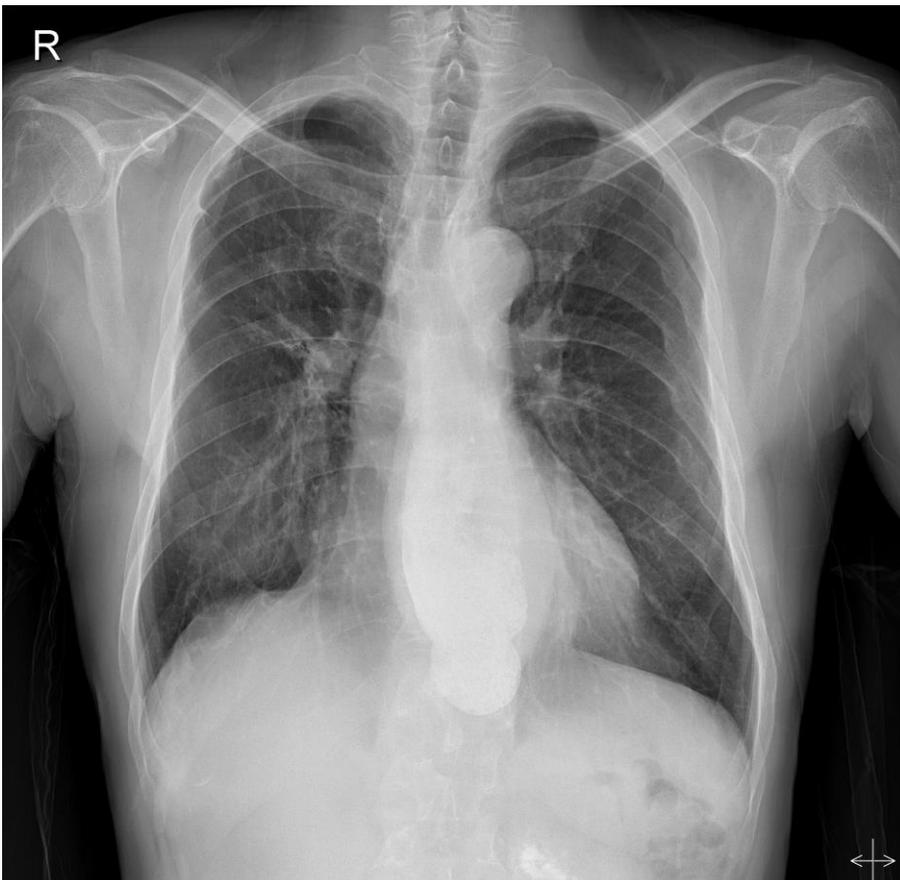


Fig. 2. Delayed chest x-ray (ten minutes after videofluoroscopic study) showed that most of the barium was remained of the lower esophagus and was suggested of functional gastric outlet obstruction.

Bilateral Thalamic Glioma in 17-Year-Old Female Patient: A Case report

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Introduction

Bilateral thalamic glioma is one of the rarest tumors among brain tumors. Of the total brain tumors, primary thalamic gliomas account for about 1-1.5% and bilateral thalamic glioma is even rarer. Most patients are found in adults and only 25% of them are under the age of 15. Bilateral thalamic gliomas differ clinically and radiologically from other gliomas. Personality changes, mental decline, memory impairment, emotional lability, cognitive and behavioral impairments are shown. Radiotherapy is the main treatment option rather than the surgical intervention, which is limited to a role of biopsy, because of the deep location of the lesion and the complexity of the structure. We report a 17-year-old female patient with bilateral thalamic glioma, who has cognitive dysfunction and personality change.

Case

In September 2017, A 17-year-old female presented with bradykinesia, daytime somnolence, apathy and insidious personality change for a few months. Two weeks later, she began to show dysarthria and decreased verbal fluency. On the neurological examination, disorientation, recent memory impairment, and dyscalculia were noted. The manual muscle test was Medical Research Council(MRC) grade III on both upper and lower extremities. Magnetic resonance imaging (MRI) of the brain showed enlarged bilateral thalamus with iso-signal intensity lesion on a T1-weighted image and with hyper-signal intensity lesion on a T2-weighted image. MRI examination revealed the involvement of both thalami, hypothalamus, right midbrain, both frontal lobes without hydrocephalus. Brain computed tomography (CT) scan was performed for localization, however, there was no contrast enhancement associated with the brain lesion. MR spectroscopy of both thalami showed increased Choline(Cho)/Creatinine(Cr) ratio with decreased N-acetyl aspartate(NAA) peak. The patient underwent stereotactic biopsy of the right frontal lesion. Histopathological examination revealed high-grade Glioma, WHO grade III, and the patient was referred for radiotherapy of 1000cGy, 4 fractions and 4000cGy, 20 fractions and later on for chemotherapy. After that, she was transferred to our department for intensive rehabilitation. During the five-month of the clinical follow-up period, the patient was stable without significant change in the clinical status except for right visual disturbance and left hearing impairment. Chemotherapy and intensive rehabilitation are ongoing and follow-up brain MRI is planned.

Conclusion

Clinical and radiologic features of bilateral thalamic glioma differ from those of unilateral thalamic tumors. Although bilateral thalamic glioma is extremely rare, it is important to

differentiate the patients with personality change, memory impairment from others. MRI is essential in the diagnosis a hypo-intense to an isointense lesion in T1-weighted images and a homogeneous hyper-intense lesion in T2 images.

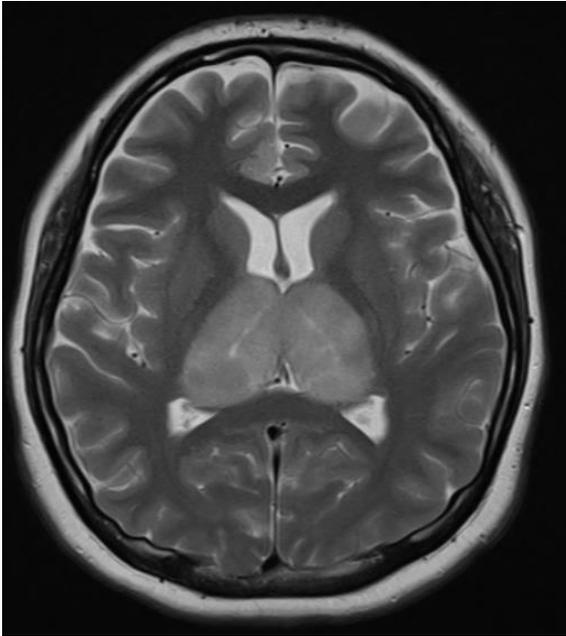


Figure 1A. T2-weighted MRI sequence shows hyperintensity of both thalami.

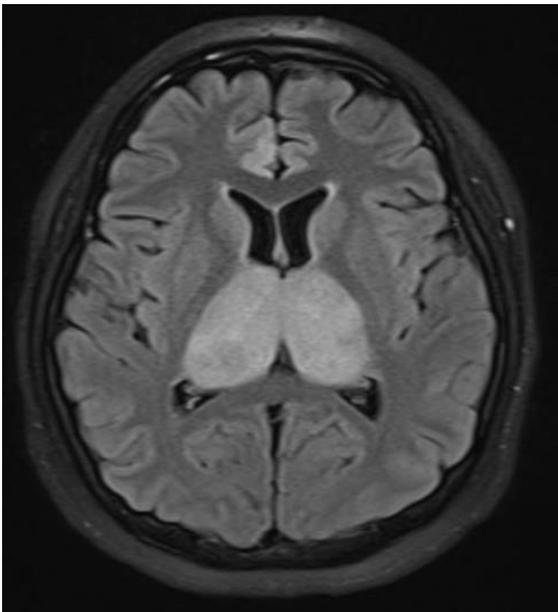


Figure 1B. Axial FLAIR sequence shows prominent bilateral hyperintense thalami.

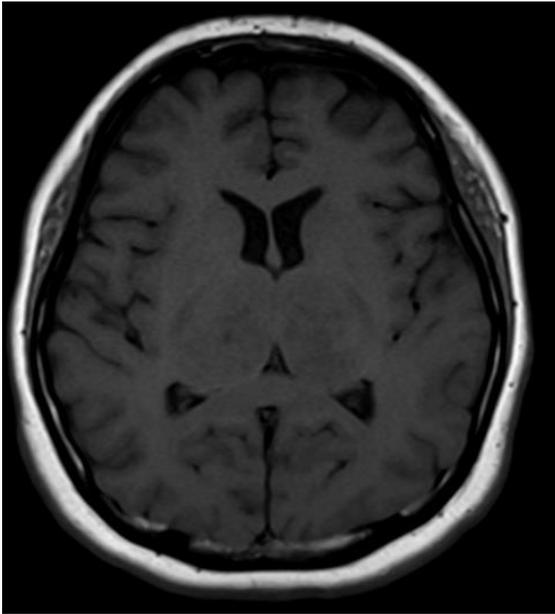


Figure 1C. T1-weighted image shows isointensity of both enlarged thalami.

Effect of a Robotic Orthosis on gait in a child with incomplete paraplegia due to spina bifida

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Objectives

Gait function is important for the ability to perform activities of daily living in disabled persons. Recently, many research institutions and companies have developed various exoskeleton robots for enhancing gait function in persons with gait impairments and have reported several positive outcomes of exoskeleton robots assisting gait in adults with gait disabilities. However, there is limited evidence demonstrating the effect of exoskeleton robots on gait function in children with motor disability in lower extremities. Therefore, the aim of this study was to determine whether the robotic exoskeleton, a newly developed for assisting gait of children, improved gait function in a child with incomplete paraplegia caused by spina bifida.

Subjects

A 12-year-old girl with incomplete paraplegia caused by spina bifida who can walk shortly on the level floor only with solid AFO participated in this study.

Methods

The gait function of a participant was assessed during walking on the level floor for 6 minutes with a wheeled walker under two conditions; robotic exoskeleton gait (REG) and gait with AFO (AFO). The robotic exoskeleton provided powered hip and knee assistance in the form of extension torque assistance during stance phase and flexion torque assistance during swing phase rather than position-controlled limb guidance according to a determined joint trajectory. While a participant walked under each condition, the oxygen consumption and the heart rate were measured using a portable cardiopulmonary metabolic system (Cosmed K4b2, Rome, Italy) and a wearable heart rate monitor (Wahoo Fitness, Atlanta, USA), respectively. In addition, kinematic data of hip and knee joints was measured by encoders built into the joints of robotic exoskeleton under the REG condition and by 3D motion analysis system (Vicon T10s, Oxford, UK) under the AFO condition.

Results

During over-ground walking for 6 minutes, the mean of oxygen consumption per unit mass was 14.56 ml/min/kg under the REG condition and was 14.17 ml/min/kg under the AFO condition. The oxygen consumption in two conditions was not significantly different. The kinematic data showed that the range of motion of the hip joints were 32 degrees in

average under the AFO condition and 48 degrees under the REG condition. The range of motion of the knee joints under AFO and REG conditions were 33 degrees and 46 degrees, respectively. The kinematic pattern of hip and knee joints on sagittal plane improved under REG condition compared to AFO condition.

Conclusions

This study demonstrated that the newly-developed robotic exoskeleton for a child can enhance gait function by assistive torque generation. Although the oxygen consumptions of the REG condition did not show significant change, the kinematics of gait improved only by torque assistance at hip and knee joints, not by joint position control.

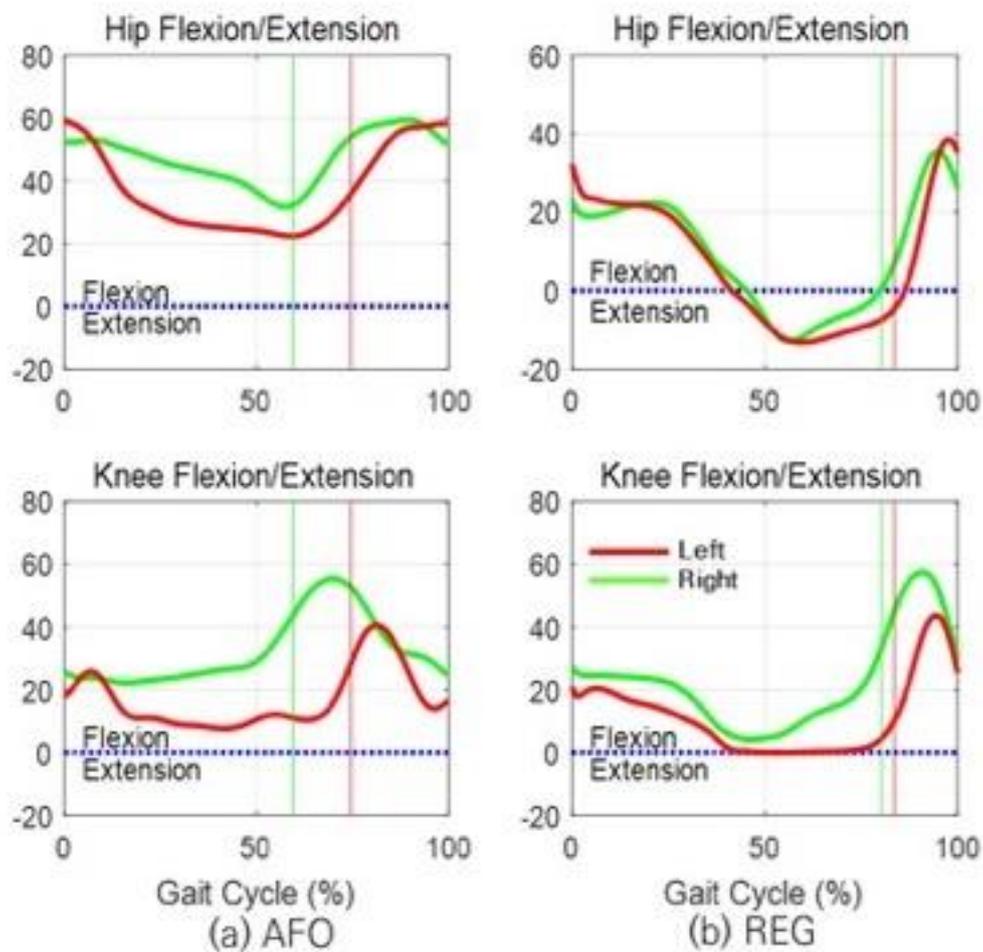


Fig 1. The kinematic pattern of hip and knee joints on sagittal plane of (a) AFO gait and (b) robotic exoskeleton gait(REG).

Effect of posterior cervical spine tool on neck alignment for the adults with anterior head posture

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Objectives

With the popularity of computers, the frequency of the appeals to the neck, shoulder, and musculoskeletal abnormalities has been increased in students and professionals who frequently use the computers. The anterior head posture (turtle neck syndrome), which frequently occurs in long-term computer working group, is a cause of diverse musculoskeletal, nerve and vascular disorders because the head moves in front of the gravitational center line and becomes chronic. It is difficult for the general people to know whether the intervention methods so far are a correct cervical posterior motion of the cervical deep muscle. Analogue methods are mostly used, and there are digital devices only for the prevention of the head posture. So we decided to develop a digitized head anterior rehabilitation tool.

Methods

When the subject is placed in a lying position and presses the pillow after the posterior cervical spine, the target receives inputs of position, value and degree of bending through Arduino Bluetooth module via FSR•FLEX sensors. After receiving the above information, the application executes the conditional statement operation (exercise method), and the vibration is output when the event processing is completed (Fig. 1). In the right posture, the patient puts pressure on the pointing part to take necessary positions for rehabilitation treatment. The patients will output vibration or sound when the internal event processing is completed within the app. Then, they enter the position, value of the pressure point and the degree of bending, and send sensor value to Bluetooth. The specialist identifies the progress of the treatment by sending a graph of data. They perform the conditional operation according to sensor value in application.

Results

If the patients apply this posterior cervical spine tool to a person with a anterior head posture as a steady exercise, the neck adjustment is returned to the normal range and the symptoms of the anterior head posture and musculoskeletal symptoms will be alleviated considerably.

Conclusions

We suggested it is meaningful that this is designed to induce the correct operation and make it easier to use than the existing equipment for Turtle neck syndrome. In addition, if the exercise information is used in the medical field, it will be more helpful to understand patient's physical condition.

Keywords

Forward head position (FHP), Turtle neck syndrome, Rehabilitation exercise, FSR•FLEX sensor.

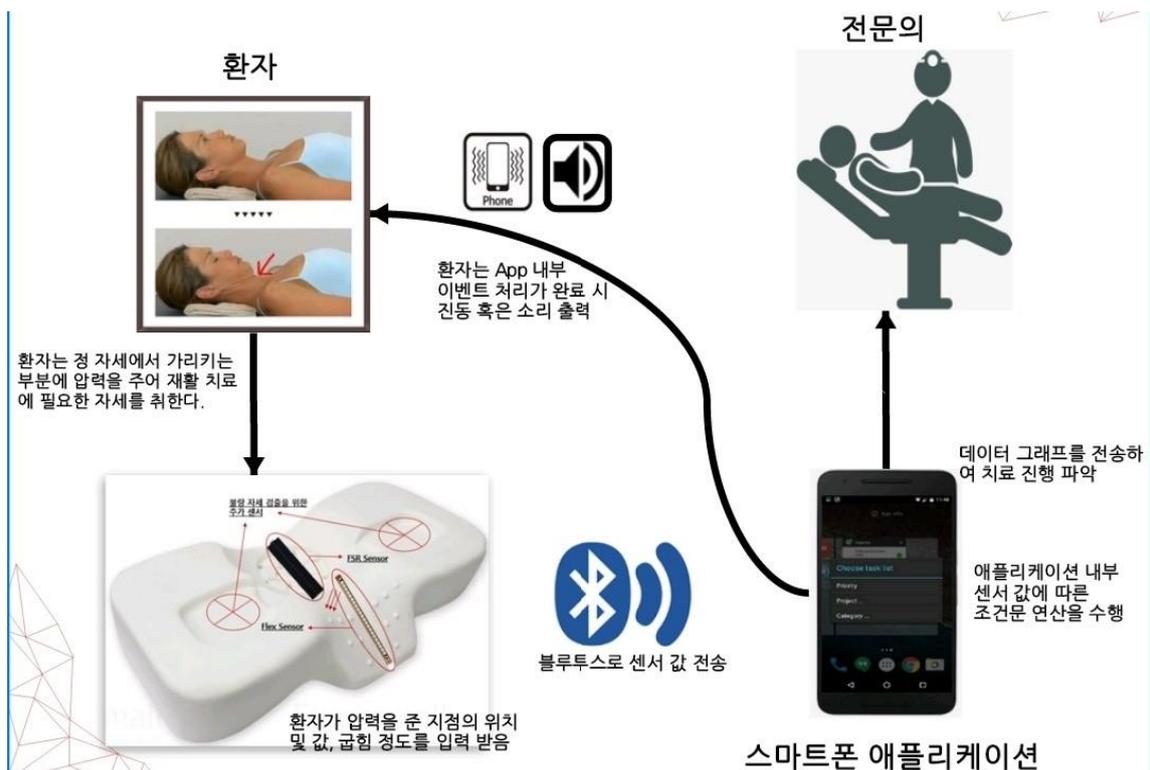


Figure 1. Process of neck posture control device.

A Study on the relationship between reaction time and cognitive perceptual function

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Background and aims

The ability to safely drive depends on reaction time and cognition. The aim of this study was to investigate the relationship between the perceptual aspect of cognitive functions and reaction time in automobile drivers.

Method

96 drivers aged 20~82 (mean: 45.30) participated in this study. Cognitive perceptual functions were assessed by CPAD (Cognitive Perceptual Assessment Driving) consisting of 8 sub-tests (Depth perception, Sustain attention, Divided attention, Stroop test, Digit span, Field dependency, Trail making test A, Trail making test B and Weight total score). The DTS (Drive test station) was used to test the reaction times of pedal and left and right hand controllers by measuring time to reach the break threshold when a red light signal was given. The pedal and hand controller acceleration thresholds were set at 4 kg, 3.1 kg respectively and the break thresholds of those were set at 20 kg and 8 kg.

Result

The pedal reaction time was negatively correlated with Depth perception($r=-.523$), Sustain attention($r=-.532$), Divided attention($r=-.377$), Stroop test($r=-.425$), Digit span($r=-.527$), Field dependency($r=-.368$), Trail making test A($r=-.642$), Trail making test B($r=-.653$) and Weighted total score($r=-.670$). The left and right hand controller reaction times were negatively correlated with Depth perception($r=-.456$, $-.536$), Sustain attention($r=-.440$, $-.387$), Divided attention($r=-.402$, $-.274$), Stroop test($r=-.380$, $-.347$), Digit span($r=-.442$, $-.357$), Field dependency($r=-.345$, $-.285$), Trail making test A($r=-.533$, $-.465$), Trail making test B($r=-.530$, $-.455$) and Weighted total score($r=-.564$, $-.467$).

Conclusion

The present study demonstrated that the perceptual aspects of cognitive functions influenced reaction times in automobile drivers; therefore, perceptual cognitive tests are necessary for driver's safety

Upper extremity rehabilitation using SMART Board system among patient with stroke.

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National Rehabilitation Center, Department of Rehabilitation Medicine¹, Chonbuk National University Hospital, Department of Rehabilitation Medicine², National Rehabilitation Center, Department of Neurorehabilitation³

Objective

Virtual reality based rehabilitation has been increasingly used for upper limb recovery in stroke survivors. This study was designed to find out the clinical applicability of the newly developed virtual reality based rehabilitation system (RAPAEL Smart Board™; SB system) among stroke survivors. Thus, we examined the therapeutic effects of SB and role of diagnostic measurements as a pilot study.

Methods

The present study was a single-blinded, randomized controlled trial. The study included 26 stroke survivors who were randomized to a SB or a conventional intervention (CON) group. In one set of session, Patient in the SB group completed 30 min session using the RAPAEL Smart Board™ and additional 30min of standard occupation therapy. On the other hand, patient in CON group completed matched amount of conventional occupation therapy. Each patient received 20 set of sessions over 4 weeks. The primary outcome was the change in the Fugl-Meyer assessment (FM) scores, and the secondary outcomes were the changes in the Wolf motor function test (WMFT), active range of motion (AROM) of upper extremities, Brunnstrom stage, modified Barthel index, and Stroke Impact Scale scores. Also, correlation between data from SB and classical outcome measures were obtained. Assessments were performed at baseline (T0), immediately after the intervention (T1), and 1 month after the intervention (T2). Comparisons between two groups were performed using RM-ANOVA and $p < .05$ was used to indicate a significant difference.

Results

Among 26 randomized patients, 25 participants (12 in the SB, 13 in the CON group) completed 4 weeks of intervention. There were no significant differences in baseline characteristics between two groups. Both groups showed improvements in the FMA (FMA-total, FMA-prox, and FMA-dist), WMFT (WMFT-sum, WMFT-time), AROM (shoulder flexor, abductor, and external rotator), and modified Barthel index ($p < .05$). AROM in shoulder internal rotator showed significant improvement only in SB group. However, statistically significant time x group interaction was not seen in all the outcomes. The data from SB were found to be significantly related to upper extremity function such as FMA-total, FMA-prox score, and Brunnstrom stage ($p < .05$).

Conclusion

SB system combined with conventional occupation therapy showed similar effects on upper limb function compared to amount-matched conventional therapy. Also, SB system could take a role of upper limb function assessment tool.

Keywords

Stroke, Upper extremity, Virtual reality, Smart Board

Effect of Personalized Wrist Orthosis for Wrist Pain with 3D Scanning and Printing Technique.

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Objective

Use of video display terminals (VDT) are increasing every year and it is linked with increasing likelihood of work-related musculoskeletal disorders (WMSDs). Wrist pain, one of the WMSDs, is caused by overuse and treated with wearing of a wrist orthosis. Mass produced, ready-made orthoses are of lower quality and are bulky, and uncomfortable to wear compared to custom-made wrist orthoses. However, custom-made wrist orthoses are more expensive than ready-made and take a long time to produce. Three-dimensional (3D) printer technology can overcome these problems by producing personalized medical products with low cost and reduced time. In this study we developed a personalized wrist orthosis using a 3D scanner and 3D printer for patients with wrist pain and compared its efficacy with ready-made conventional wrist orthosis.

Methods

Twenty-two patients with wrist pain were randomly assigned to the control and experimental groups. The control group wore a ready-made cock-up orthosis and the experimental group wore a 3D printed wrist orthosis for one week. The Patient Rated Wrist Evaluation (PRWE), Jebsen Hand Function Test (JHFT), and Orthotics and Prosthetics User Survey (OPUS) were checked before and one week after the application. A Mann-Whitney U test was performed to analyze the difference in the continuous variables between the control and experimental groups and a chi-square test for the categorical and ordinal scale variables.

Results

The PRWE showed significant pain relief in both groups. The experimental group spent significantly more time wearing the device than the control group. Two items of the 28 OPUS questions, 'Put toothpaste on brush and brush teeth' and 'Dial a touch tone phone', showed high satisfaction scores, with statistically significant difference in the experimental group (P=0.036 and 0.004).

Conclusions

The 3D printed wrist orthosis was superior to the cock-up orthosis for two items of the OPUS. Higher user satisfaction was observed in the group with the 3D printed wrist orthosis and showed longer wearing time. Moreover, the 3D printed wrist orthosis was as effective as ready-made orthosis in relieving wrist pain. Considering the same cost and

efficacy of the 3D printed wrist orthosis as the conventional wrist orthosis, our study shows the possibility of 3D printed wrist orthosis as a substitute for conventional ready-made wrist orthoses for patients with wrist pain.

The Effect of End-Effector Type Robotic Assisted Gait Training in Patients with GBS

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Introduction

Guillain-Barre syndrome (GBS), also called acute inflammatory demyelinating polyneuropathy (AIDP) is rapid-onset immune-mediated polyradiculopathy involving sensory, motor and autonomic nerves. The clinical manifestations of GBS can range from mild muscle weakness to complete muscle paralysis, which may lead to severe impairment in walking ability and cause functional deficits. Therefore, it is critical to help regain muscle strength and improve balance in GBS. Rehabilitation in GBS includes strength, endurance and gait training with graduated increases in mobility, maintenance of posture and alignment as well as joint function. To regain walking ability, various treatments were undertaken to assist gait training including robotic-assisted gait training (RAGT). RAGT has been shown to be effective in improving gait function in patients with stroke and spinal cord injury. However, no studies have reported the effect of gait training using an end-effector type robotic device in GBS patients. In this study, we report the effect of gait training using an end-effector type robotic device in GBS patients.

Subjects & Methods

Among GBS patients who had been hospitalized in our clinic from April 2016 to April 2018, 13 patients with GBS were enrolled. Among them, one participant was dropped out of the trial due to pain and discomfort around saddle area. The final sample consisted of 12 participants with 10 males and 2 females. Subjects received RAGT for 24 times (Table 1). All participants were assessed with manual muscle test, Functional Ambulation Categories (FAC), Modified Barthel Index Score (MBI) and Rivermead Mobility Index (RMI) before and after RAGT.

Results

Compared to baseline, all outcome measures were improved after RAGT (Table 2). Strength in muscles of the lower extremities significantly improved after RAGT except for hip extension. Also FAC, MBI, 2-minutes walking distances and RMI which are associated with gait function were significantly improved.

Conclusion

This study showed RAGT using end-effector type device improves walking ability in GBS patients. RAGT can be considered as one of gait training tools to recover gait function in patients with GBS. However, this study has a limitation of small sample size and lack of

control group, so further study is required to confirm the effectiveness of RAGT in GBS patients.

Table 1. Demographics of Study Group

N = 12	
Age	55.1±16.7
Gender	Male : 10 (83.3%) Female : 2 (16.7%)
Number of Treatments	24 sessions
Onset	4.0±3.9

Table 2. Outcome measures at Initial and the End of the RAGT

		Initial	End	P-value
Muscle power	Hip Flx.	3.1±0.7	3.6±0.8	0.004*
	Hip Ext.	2.7±0.8	3.3±0.5	0.317
	Knee Flx.	3.0±0.8	3.3±0.8	<0.001*
	Knee Ext.	3.2±0.8	3.4±0.7	0.001*
	Ankle Flx.	2.6±1.2	3.0±1.1	0.001*
	Ankle Ext.	2.8±1.2	3.2±0.9	0.002*
FAC		2.7±1.7	4.0±2.0	0.013*
MBI		56.9±24.5	71.2±24.0	0.002*
2-min walking		35.4±42.2	81.3±69.6	0.009*
RMI		5.5±3.7	8.1±4.5	0.005*

*p<0.05, FAC : Functional Ambulation Categories, MBI : Modified Barthel Index Score, RMI :

Rivermead Mobility Index, Flx. : Flexor, Ext. : Extensor

Single-Leg Exoskeleton Robot for Gait Training of Hemiplegic Patient – A Pilot Study

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Back ground

The walking of the human body refers to a continuous movement and form using two legs alternately to move the center of gravity of the human body from one place to another. For this, the activity of the muscles and the mobility of the joints must be well coordinated in time and mechanics. However, this coordination can be broken by various causes, which include various diseases and accidents of the central nervous system or musculoskeletal system. Stroke is the most common example of pathologic walking among these central nervous system diseases. Many therapies have been used to restore the gait of the stroke such as traditional physical therapy and functional electrical stimulation. Recently rehabilitation robot was developed to assist walking but their size is too big and can do only on treadmill. For this reason, we used single-leg type exoskeleton robot, which is relatively light and can be worn and walked anywhere without the need for additional equipment such as treadmill.

Method

From March, 2018 to May, 2018, two strokes patients were enrolled in this study. Patients were hemiplegic stroke patients who had been in stroke for more than 6 months. Patients were able to walk independently but their stability and endurance were impaired due to hemiplegia. Gait training was scheduled with twice a week for eight weeks. Each training consisted with 45 minutes walking with single-leg exoskeleton. Neurological status, functional and walking ability were evaluated before the training, after 4 weeks training and the end of the training on 8 weeks. Neurological status was measured with Korean version Fugl-Meyer Assessment lower extremity scale which used to assess functional and neurological recovery in stroke patients.

Result

Total 8-week training did not show significant improvement in neurological assessment such as Korean version Fugl-Meyer Assessment score of lower extremity, coordination, sensation, joint range of motion and pain (Table 1). On the muscle strength test using hand dynamometer there was gradual improvement in both legs muscle strength (Table 2). Gait performance using a timed up to go test, a 4m gait speed test and 6 minutes walking test also showed sequential improvement in two patients (Table 3).

Conclusion

For hemiplegic stroke patients, using single leg exoskeleton robot were useful for improving their strength and gait performance. This robot also had the advantage of being easily worn and less space occupying and portable use without space limitation. Although neurological outcomes of the patients were not changed, further studies are needed to evaluate long-term effects of single leg exoskeleton robot.

Table 1. Korean Version Fugl-Meyer Assessment Lower extremity

Category	Case 1			Case 2		
Lower extremity (.../28)	12	12	12	15	15	15
Coordination /speed (.../6)	5	5	5	5	5	5
Sensation (.../12)	2	2	2	6	6	6
Passive joint motion (.../20)	19	19	19	10	10	10
Joint pain (.../20)	20	20	20	20	20	20

Table 2. Lower leg muscle strength using hand dynamometer

Muscle strength (kg)	Joint	Muscle	Case 1			Case 2		
			Before	4 weeks	8 weeks	Before	4 weeks	8 weeks
Right	Hip	Flexor	20.1	22.5	25.2	7.4	12.2	16.9
		Extensor	19.9	24.2	24.4	14.8	15.2	17.4
	Knee	Flexor	17.3	14.5	20.9	3.5	5.8	6.1
		Extensor	21.1	22.8	25.9	14.5	17.3	17.4
	Ankle	Dorsiflexor	14.8	15.7	18.8	3.1	4.3	4.1
		Plantarflexor	16.9	20.7	21.1	12.8	13.2	14.4
Left	Hip	Flexor	11.9	22.4	17.4	17.3	21.1	17.8
		Extensor	15.3	19.5	24.2	20.7	25.2	26.1
	Knee	Flexor	1.7	1.7	1.8	17.1	20.2	18.1
		Extensor	19.9	24.4	28.3	17.3	24.4	25.7
	Ankle	Dorsiflexor	0	0	0	16.1	15.9	15.7
		Plantarflexor	4.8	10.1	15.1	18.5	18.5	18.5

Table 3. Gait performance

	Case 1			Case 2		
	Before	4 weeks	8 weeks	Before	4 weeks	8 weeks
Timed up to go test(sec)	29.62	28.27	28.31	25.69	23.52	19.01
4m gait speed test(M/sec)	0.34	0.37	0.37	0.36	0.39	0.39
6 minutes walking test(cm)	121.2	132.8	139.1	125.4	127.9	157.7

IMU-based Gait analysis for Determining proper assistive device with disabled patients : Case serial

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Gait analysis with IMU technology is effective for people who cannot walk independently in two ways. In previous study, we presented that IMU-based gait analysis allow us to evaluate gait patterns with patients, who needs handling assistive devices. Furthermore, we described its helpfulness for determining best-fitting assistive devices for rehabilitation. Recent days, we focused on utilizing IMU-based gait analysis for making decision of proper assistive device. It can provide quantitative information of gait parameters without consideration of specific environments and surroundings, so, it is useful for determining the most suitable assistive device for disabled patient. Currently, we initially evaluate gait patterns of patients on first day of their transfer, admission(in-patient) or visit(out-patient) to conclude the most affordable device in tailored way. 10 patients with several disease entities were recruited in this study. Table 1 shows baseline characteristic of patients. Testing tool was Humantrack(Figure 1.), which equipped with fusion-sensor system composed with wireless IMU sensor and Stereo camera. First, IMU sensor provided to patients' abdomen, both thigh, shank and foot dorsum(Figure 1.). And next, calibration of axis was done. Then, patients gait 6m with several assistive devices with video monitoring. During the gait, gait parameters(14 items: gait cycle time(sec), stance phase(%), swing phase(%), velocity(m/s), stride length(m), cadence(step/min), pre-swing(%), initial double support time(%), initial single support time(%), terminal double support time(%), terminal single support time(%), hip joint angle(deg), knee joint angle(deg), ankle joint angle(deg) were detected. Figure 2. shows the result of gait evaluation. The priority factors we gave significance more than others were gait cycle time, stance phase, swing phase, velocity and stride length. All patients were tolerable during 6m gait with IMU-gait evaluation. Patients were evaluated with various assistive devices for finding the fittest one, respectively. If the result showed no significant difference or better performance in superior assistive between two gait analyses, superior level handling devices was adapted. In contrast, if there was difference, inferior level handling devices was adapted. Patient 1-7 shows cases of final choice with superior level handling devices. And Patient 8 presents final choice of inferior level handling device. In addition, Patient 9-10 appears the fittest choice of assistive device among 3 or more options. Compared to previous case study, we think there are variations due to patient characteristics such as age, sex, disease entity and general condition. Therefore, there must be a consideration of these affecting factors. We shows that IMU-based gait analysis may shed light on evaluating disabled patients' gait patterns quantitatively with accuracy, ones again.

Table 1. Baseline characteristics

	Disability	Determined Assistive device
Patient 1 M/65	Right hemiplegia d/t left basal ganglia and left frontal ICH, s/p Left frontotemporal craniotomy, hematoma removal (17/3/12)	Mono-cane vs. Quad-cane -> Mono-cane
Patient 2 M/67	Gait disturbance due to a SAH(18/3/7) b. r/o frontal lobe Syndrome	Independent vs. Mono-cane ->Independent
Patient 3 F/79	Tetraplegia d/t SCI, ASIA D Spine : 1) myelopathy, C4-5 level 2) Disc extrusion, right central zone or OPLL 3) Disc protrusion, left central zone	Quad-cane vs. Walker ->Quad-cane
Patient 4 M/56	Gait disturbance d/t traumatic SDH along the falx and and bilateral tentorium(2018/4/10)	Independent vs. Mono-cane ->Independent
Patient 5 M/60	Right side weakness d/t cervical myelopathy, C4-5, s/p AIF(2017/6/20)	Independent vs. Quad-cane ->Independent
Patient 6 M/49	Right hemiplegia d/t left pons ICH (2017/4/25)	Independent vs. Quad-cane ->Independent
Patient 7 F/76	General deconditioning d/t Gallbladder stone with cholecystitis s/p laparoscopic cholecystectomy(18/2/13)	Mono-cane vs. Walker -> Mono-cane
Patient 8 F/60	Gait disturbance d/t r/o radiculopathy, L3/4	Quad-cane vs. Walker ->Walker
Patient 9 M/11	Gait disturbance d/t cauda equina syndrome(2018/3/5)	Compared Independent, unilateral Mono-cane, bilateral Mono-cane and Forearm crutch ->Independent
Patient 10 M/85	Gait disturbance d/t Chronic SDH at left cerebral convexity(2018/1/28) 2) R/O recent infarction at right side pons	Compared Mono-cane, Quad-cane and walker ->Q-cane

table 3-12. Gait parameters, Patient 1-10

	Mono-cane				Quad-cane					Independent				Mono-cane				Walker			
	U	R	L	R	U	R	L	R		U	R	L	R	U	R	L	R	U	R	L	R
gait cycle time(sec)	2.3	2.3	2.3	2.6	2.3	2.3	2.3	2.6	1.7	1.8	1.7	1.7	2.4	2.3	2.4	2.3	2.4	2.3	2.4	2.3	
stance phase(%)	58.0	56.6	57.2	48.9	58.1	56.7	57.4	49.1	58.1	56.7	57.4	49.1	61.3	60.3	60.8	59.8	61.3	60.3	60.8	59.8	
swing phase(%)	42.0	44.4	42.8	50.1	41.9	43.3	42.6	50.9	41.9	43.3	42.6	50.9	38.7	39.7	39.2	40.2	38.7	39.7	39.2	40.2	
velocity(m/s)	0.9	0.6	1	0.5	0.9	0.6	1	0.5	0.7	0.5	0.4	0.5	0.4	0.4	0.6	0.6	0.2	0.3	0.5	0.5	
stride Length(m)	0.7	0.5	0.7	0.3	0.7	0.5	0.7	0.3	0.5	0.5	0.4	0.3	0.2	0.3	0.5	0.5	0.2	0.3	0.5	0.5	
cadence (step/min)	58.0	56.6	57.2	48.9	58.1	56.7	57.4	49.1	58.1	56.7	57.4	49.1	61.3	60.3	60.8	59.8	61.3	60.3	60.8	59.8	
pre-swing(%)	19.4	19	19.2	12.3	19.4	19	19.2	12.3	19.4	19	19.2	12.3	19.4	19	19.2	12.3	19.4	19	19.2	12.3	
initial double support time(%)	36.2	38	36.2	34.2	36.2	38	36.2	34.2	36.2	38	36.2	34.2	36.2	38	36.2	34.2	36.2	38	36.2	34.2	
terminal double support time(%)	2.8	36.4	3.3	28.2	2.8	36.4	3.3	28.2	2.8	36.4	3.3	28.2	2.8	36.4	3.3	28.2	2.8	36.4	3.3	28.2	
terminal single support time(%)	41.5	40.3	40.4	56.9	41.5	40.3	40.4	56.9	41.5	40.3	40.4	56.9	41.5	40.3	40.4	56.9	41.5	40.3	40.4	56.9	
hip joint angle(deg)	27.7	27.1	26.8	23.7	27.7	27.1	26.8	23.7	27.7	27.1	26.8	23.7	27.7	27.1	26.8	23.7	27.7	27.1	26.8	23.7	
knee joint angle(deg)	47.7	47.1	46.8	14.6	47.7	47.1	46.8	14.6	47.7	47.1	46.8	14.6	47.7	47.1	46.8	14.6	47.7	47.1	46.8	14.6	
ankle joint angle(deg)	39.4	40.7	39.8	38.9	39.4	40.7	39.8	38.9	39.4	40.7	39.8	38.9	39.4	40.7	39.8	38.9	39.4	40.7	39.8	38.9	

Table 3 Gait parameters, Patient 1 -> similar, choice : mono-cane

Table 4 Gait parameters, Patient 4 -> similar, choice : no assist

Table 5 Gait parameters, Patient 7 -> better in mono-cane gait, choice : mono-cane

	Independent				Mono-cane			
	U	R	L	R	U	R	L	R
gait cycle time(sec)	1.4	1.5	1.6	1.6	1.4	1.5	1.6	1.6
stance phase(%)	54.5	53.1	57.1	60.6	54.5	53.1	57.1	60.6
swing phase(%)	45.4	46.7	42.7	39.4	45.4	46.7	42.7	39.4
velocity(m/s)	1	0.8	0.8	0.7	1	0.8	0.8	0.7
stride Length(m)	0.6	0.6	0.6	0.4	0.6	0.6	0.6	0.4
cadence (step/min)	54.5	53.1	57.1	60.6	54.5	53.1	57.1	60.6
pre-swing(%)	8.7	6.8	6.4	10.1	8.7	6.8	6.4	10.1
initial double support time(%)	38.3	41.4	38.4	40.4	38.3	41.4	38.4	40.4
terminal double support time(%)	6.8	8.7	10.1	8.4	6.8	8.7	10.1	8.4
terminal single support time(%)	46.2	41	40.1	41	46.2	41	40.1	41
hip joint angle(deg)	25	26	22	27.9	25	26	22	27.9
knee joint angle(deg)	32.6	31.1	30.6	32.7	32.6	31.1	30.6	32.7
ankle joint angle(deg)	45.6	51	42.1	41	45.6	51	42.1	41

Table 6 Gait parameters, Patient 2 -> better in independent gait, choice : no assist

	Independent				Quad-cane			
	U	R	L	R	U	R	L	R
gait cycle time(sec)	1.9	1	2.4	2.3	1.9	1	2.4	2.3
stance phase(%)	61	60.7	60.3	51.1	61	60.7	60.3	51.1
swing phase(%)	39	44.2	39.7	47.9	39	44.2	39.7	47.9
velocity(m/s)	0.5	0.3	0.3	0.3	0.5	0.3	0.3	0.3
stride Length(m)	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1
cadence (step/min)	61	60.7	60.3	51.1	61	60.7	60.3	51.1
pre-swing(%)	13.8	8.8	9.8	2.5	13.8	8.8	9.8	2.5
initial double support time(%)	29.7	30.1	29.9	32.2	29.7	30.1	29.9	32.2
terminal double support time(%)	18.7	14.2	15	24.8	18.7	14.2	15	24.8
terminal single support time(%)	39.5	43.1	39.2	39.5	39.5	43.1	39.2	39.5
hip joint angle(deg)	22.1	14.4	14.4	19	22.1	14.4	14.4	19
knee joint angle(deg)	33	19.8	19.7	19.8	33	19.8	19.7	19.8
ankle joint angle(deg)	16.5	12.3	11.2	10.1	16.5	12.3	11.2	10.1

Table 7 Gait parameters, Patient 5 -> better in independent gait, choice : no assist

	Quad-cane				Walker			
	U	R	L	R	U	R	L	R
gait cycle time(sec)	2.4	2.3	2.4	2.3	2.4	2.3	2.4	2.3
stance phase(%)	61.3	60.3	60.8	59.8	61.3	60.3	60.8	59.8
swing phase(%)	38.7	39.7	39.2	40.2	38.7	39.7	39.2	40.2
velocity(m/s)	0.4	0.4	0.6	0.6	0.4	0.4	0.6	0.6
stride Length(m)	0.2	0.3	0.5	0.5	0.2	0.3	0.5	0.5
cadence (step/min)	61.3	60.3	60.8	59.8	61.3	60.3	60.8	59.8
pre-swing(%)	18.1	19	16.1	15.2	18.1	19	16.1	15.2
initial double support time(%)	37.1	39.5	42.8	45.1	37.1	39.5	42.8	45.1
terminal double support time(%)	3.9	10.1	12	8.1	3.9	10.1	12	8.1
terminal single support time(%)	40.9	38.8	45.9	43.6	40.9	38.8	45.9	43.6
hip joint angle(deg)	25.9	31.1	30.3	31.6	25.9	31.1	30.3	31.6
knee joint angle(deg)	35.1	40.7	39.3	42.1	35.1	40.7	39.3	42.1
ankle joint angle(deg)	52.4	42.9	40.5	43	52.4	42.9	40.5	43

Table 8 Gait parameters, Patient 8 -> better in walker, choice : walker

	Independent				Unilateral mono-cane				Bilateral mono-cane				Bilateral forearm crutch			
	U	R	L	R	U	R	L	R	U	R	L	R	U	R	L	R
gait cycle time(sec)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
stance phase(%)	52.9	54.7	54.4	55	52.9	54.7	54.4	55	52.9	54.7	54.4	55	52.9	54.7	54.4	55
swing phase(%)	47.1	45.3	45.6	45	47.1	45.3	45.6	45	47.1	45.3	45.6	45	47.1	45.3	45.6	45
velocity(m/s)	0.9	1	1	0.7	0.9	1	1	0.7	0.9	1	1	0.7	0.9	1	1	0.7
stride Length(m)	0.8	0.8	0.8	0.5	0.8	0.8	0.8	0.5	0.8	0.8	0.8	0.5	0.8	0.8	0.8	0.5
cadence (step/min)	52.9	54.7	54.4	55	52.9	54.7	54.4	55	52.9	54.7	54.4	55	52.9	54.7	54.4	55
pre-swing(%)	9.3	7.4	5.7	4.2	9.3	7.4	5.7	4.2	9.3	7.4	5.7	4.2	9.3	7.4	5.7	4.2
initial double support time(%)	32.4	37.4	34.2	36.1	32.4	37.4	34.2	36.1	32.4	37.4	34.2	36.1	32.4	37.4	34.2	36.1
terminal double support time(%)	7.4	8.3	10.4	5.7	7.4	8.3	10.4	5.7	7.4	8.3	10.4	5.7	7.4	8.3	10.4	5.7
terminal single support time(%)	48.9	45.9	47.7	45.6	48.9	45.9	47.7	45.6	48.9	45.9	47.7	45.6	48.9	45.9	47.7	45.6
hip joint angle(deg)	35.9	38.3	38.5	39.9	35.9	38.3	38.5	39.9	35.9	38.3	38.5	39.9	35.9	38.3	38.5	39.9
knee joint angle(deg)	40.4	37.2	39.5	34	40.4	37.2	39.5	34	40.4	37.2	39.5	34	40.4	37.2	39.5	34
ankle joint angle(deg)	12.7	18.5	18.5	15	12.7	18.5	18.5	15	12.7	18.5	18.5	15	12.7	18.5	18.5	15

Table 9 Gait parameters, Patient 10 -> best in independent gait, choice : no assist

	Quad-cane				Walker			
	U	R	L	R	U	R	L	R
gait cycle time(sec)	1.3	1.2	1.3	1.3	1.3	1.2	1.3	1.3
stance phase(%)	52.3	50.7	50.6	55.7	52.3	50.7	50.6	55.7
swing phase(%)	47.7	49.3	49.4	44.3	47.7	49.3	49.4	44.3
velocity(m/s)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
stride Length(m)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
cadence (step/min)	52.3	50.7	50.6	55.7	52.3	50.7	50.6	55.7
pre-swing(%)	14.8	14.1	14.1	14.3	14.8	14.1	14.1	14.3
initial double support time(%)	43.7	48.4	48.9	43.7	43.7	48.4	48.9	43.7
terminal double support time(%)	1.3	1.7	1.7	1.7	1.3	1.7	1.7	1.7
terminal single support time(%)	32.2	32.9	32.7	32.3	32.2	32.9	32.7	32.3
hip joint angle(deg)	39.3	34	38.7	31.8	39.3	34	38.7	31.8
knee joint angle(deg)	15.8	16.1	11.2	23.4	15.8	16.1	11.2	23.4

Table 10 Gait parameters, Patient 3 -> similar, choice : Quad-cane

	Independent				Quad-cane			
	U	R	L	R	U	R	L	R
gait cycle time(sec)	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
stance phase(%)	55.9	61	60.4	47.4	55.9	61	60.4	47.4
swing phase(%)	44.1	39.1	39.6	52.6	44.1	39.1	39.6	52.6
velocity(m/s)	1.2	1	0.4	0.7	1.2	1	0.4	0.7
stride Length(m)	1	0.8	0.2	0.5	1	0.8	0.2	0.5
cadence (step/min)	55.9	61	60.4	47.4	55.9	61	60.4	47.4
pre-swing(%)	12.8	12.8	12.8	12.8	12.8	12.8	12.8	12.8
initial double support time(%)	46.5	50.4	50.8	34.6	46.5	50.4	50.8	34

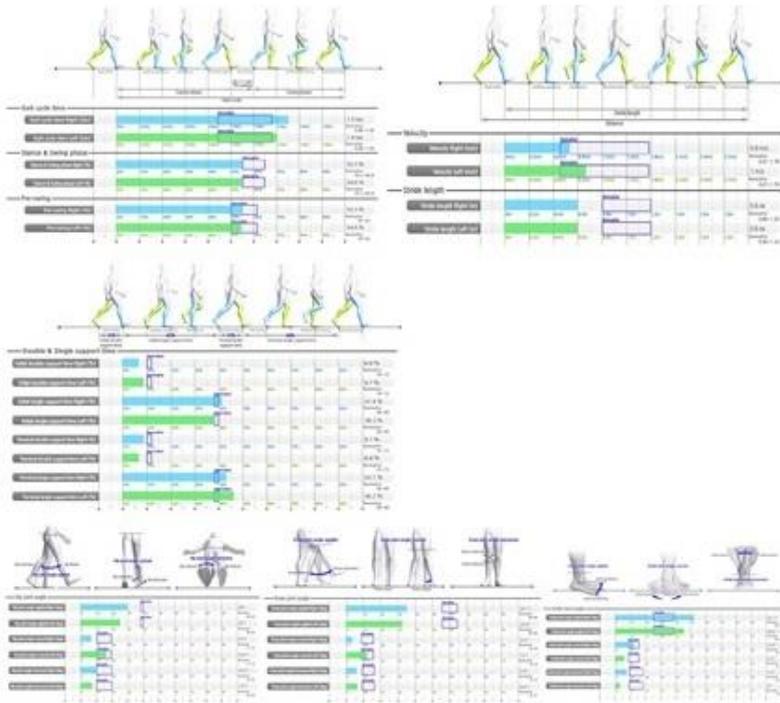


Figure 1. IMU-based gait evaluation(HumanTract)

Figure 2. Gait report(HumanTract)

Decompensation should be considered while managing AIS with bracing; a report of 2 cases

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Introduction

Reduction of Cobb's angle is the most important factor estimating the prognosis of effect using orthosis. However, decompensation, one of other factors that could affect prognosis, was emphasized mainly in the cases of surgical treatment, and not studied with cases of orthosis treatment. This report compared two patients of adolescent idiopathic scoliosis (AIS). One had decompensation primarily and the other's decompensation occurred at first wear of orthosis.

Case report

Patient 1 experienced menarche 8 months ago. Tanner stage was II, Risser stage was III and height was 155.3cm. Initial X-ray presented double curve pattern, right thoracic and left thoracolumbar. The major curve was thoracolumbar curve and it was 35° of Cobb. Vertebral rotation was +2 by Nash-Moe technique. Decompensation was measured as 20mm to the left side. After wearing Boston Brace, in-brace X-ray represented the major curve reduced by 6°. Also decompensation was improved with 12 mm decrease. A change of pad position was done to reduce decompensation by placing thoracic pad 1 level upward and lumbar pad 1 level downward. After 5 months, follow up exam showed major curve decreased by 2°. Decompensation also decreased by 1.1mm. [Figure 1]

Patient 2 did not experienced menarche yet. Tanner stage was I, Risser stage was I and height was 146.7cm. Initial X-ray presented the same pattern of curve with patient 1. The major curve was thoracic curve and it was 35° of Cobb angle. Vertebral rotation was +1 by Nash-Moe technique. Decompensation was 1.2mm to the left side. After wearing Boston Brace, in-brace X-ray showed the major curve reduced by 16.5°. However, decompensation was aggravated with 4.3mm increase. A change of pad position was done to the brace. After 5 months, major curve increased by 15.5°. Decompensation also increased by 1.8mm. [Figure 2] More modification was done and this case is still on the treatment.

Conclusion

In case of patient 1, decompensation was observed initially, but we confirmed that Cobb's angle was decreased by correction of brace modification. In case of patient 2, decompensation was not observed initially, but Cobb's angle decreased and then increased again, because the decompensation occurred after wearing brace. [Table 1] By this report, we suggest that decompensation is important factor that must be considered in the manage of AIS using the orthosis. Our findings in these cases implies that

decompensation is also an important factor in treatment with orthosis, not only in patients with surgical treatment. Following up X-ray and checking decompensation can be an important predictive factor of scoliosis progression. An early modification of decompensation also can help patient's prognosis. This study has limitation that other factors except decompensation was not controlled

Table 1. Changes in parameters before and after treatment

	patient 1				patient2			
	Before treatment	Initial in-brace	After treatment	Chang of value	Before treatment	Initial in-brace	After treatment	Chang of value
Cobb's angle (°)	35	33	27	-8	35	18.5	34	-1
Decompensation(mm)	20	8	1.4	-18.6	1.2	5.5	7.3	+6.1

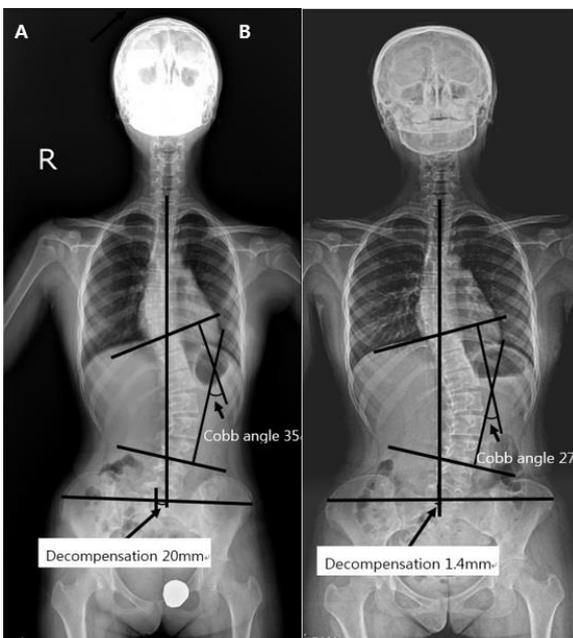


Fig 1. X-ray of patient 1. (A) Before brace (B) After 6 months Boston brace treatment

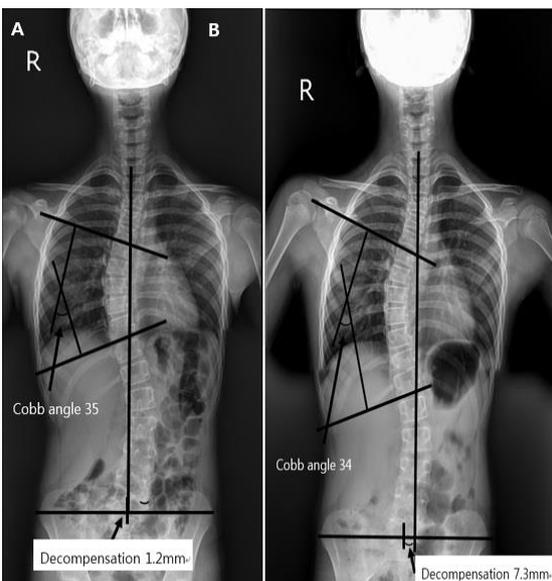


Fig 2. X-ray of patient 2. (A) Before brace (B) After 6 months Boston brace treatment

Early Standing with Prosthesis and Orthosis in a Transtibial Amputation with Other Limb Fractures

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Introduction

Lower limb amputation due to an external injury commonly accompanies fracture in the other limb, which hinders early mobilization with prosthetic fitting of the amputee side until complete healing of the fracture. Many cases often result in poor rehabilitative outcome as excessive immobilization causes muscle atrophy, joint contracture, synovial adhesions, and cartilage degeneration. This Case report reveals an exemplary good outcome of early standing training for a lower limb amputation combined with the other limb fractures.

Case report

A 75-years-old man suffered from a crush injury by a metal beam falling on October 19th, 2013. At the day of the accident, he undertook transtibial amputation on right leg and external fixator insertion for left tibial shaft open fracture. Five days later, he received open reduction and internal fixation for fractures in left medial condyle, distal radius and ulna. He was transferred to rehabilitation ward on 28th November. Prosthesis prescription took place at the same time with the evaluations for underlying cardiopulmonary function, nutrition, and psychologic status. Nine days later, partial weight bearing on amputee leg with prosthesis initiated on a tilt table twice a day. His prosthesis was composed of patellar tendon bearing socket, silicon suction typed suspension, endoskeletal shank, energy-storing ankle and dynamic response foot. On 19th December, 2013 he was discharged for improved general condition while waiting for healing of Lt. upper limb and lower leg fractures. Before 2nd admission, He did self exercises including stretching for prevention of contracture, strengthening of hip and knee muscles on the amputee side. Weight bearing exercise with prosthesis continued. After 4 months, on 9th April, 2014 he was re-admitted to rehabilitation ward for gait training. X-ray of Lt. tibiofibular fractures still showed incomplete healing but with progress of callus formation. Parallel bar walking with prosthesis and the other on KAFO was initiated from 10th April, 2014. Enough wt. bearing to promote bone union was applied without a full wt. lode to fractured side. Gait training gradually progressed to walking with monocane from 13th May and walking on ramp from 30th May. After 1 year since injury, he could walk up and down stairs while holding bar and lower leg fractures were healed.

Discussions

Combined fractures are common in lower limb amputation from trauma. There are many complications such as wound infections or non-unions, which tend to delay rehabilitation until complete healing of the fracture. In this case, early wt. bearing training with prosthesis results in good rehabilitative outcome. Here, the initial purpose of prosthesis fitting was not for gait training but for early standing. Restoring the physical condition through early standing with a proper prosthesis and orthosis may shorten rehabilitation period, promote bone healing, and finally advance functional independence.



Progression of bone union on serial X-ray of left tibiofibular fracture : post-operation status



Progression of bone union on serial X-ray of left tibiofibular fracture : at the time of transferring to rehabilitation



Progression of bone union on serial X-ray of left tibiofibular fracture : 1 year after injury

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Effects of Bone Marrow Aspirate Concentrate and Platelet-rich Plasma on Rotator Cuff Tear

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Background and purpose

We compared the clinical course of rotator cuff tears between exercise and bone marrow aspirate concentration (BMAC)-platelet rich plasma (PRP) injection to identify the therapeutic effects of BMAC-PRP on rotator cuff tears.

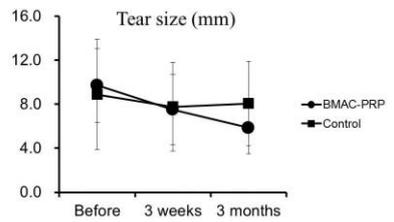
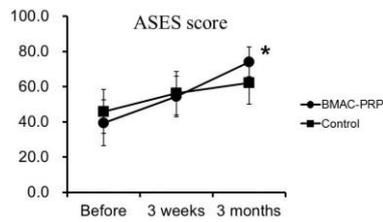
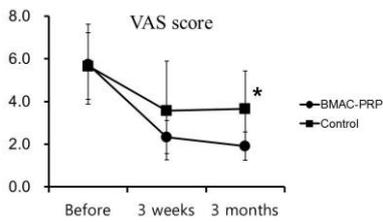
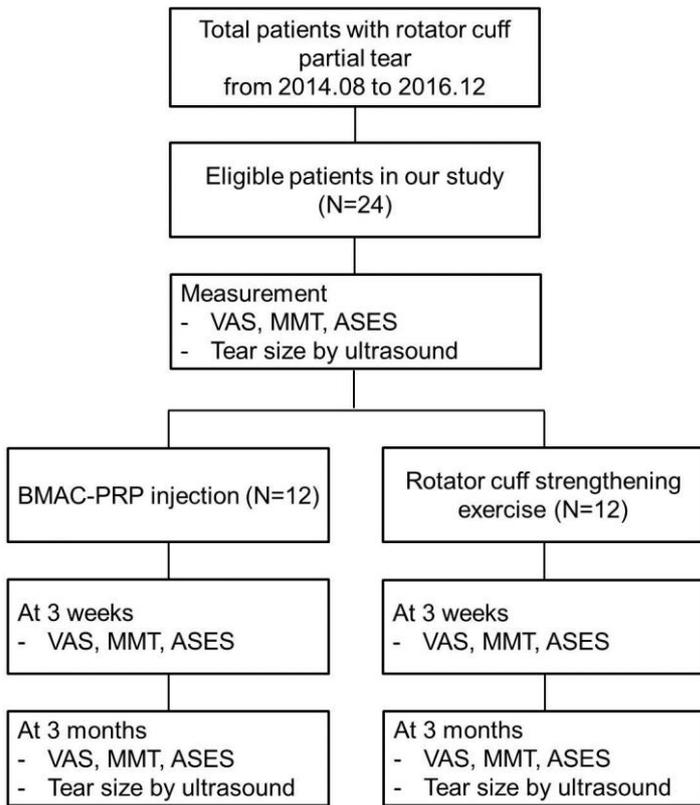
Patients and methods

Twenty-four patients with partial rotator cuff tear participated in this study. Twelve patients underwent extraction of BMACs and PRP and received the injection of BMAC-PRP at the tear site under ultrasound guidance. Twelve patients in the control group were asked to perform the rotator cuff exercise for 3 months. Visual analog scale (VAS) and manual muscle test (MMT) scores of the supraspinatus muscle were measured and the American Shoulder and Elbow Surgeons (ASES) score was recorded before, three weeks, and three months after injection. Tear size was measured by the greatest longitudinal tear length.

Results

The change in the VAS differed between groups at three months ($P = 0.039$) but not at three weeks ($P = 0.147$). The ASES scores in the BMAC-PRP group changed from 39.4 ± 13.0 to 54.5 ± 11.5 at three weeks and 74.1 ± 8.5 at three months while those in the control group changed from 45.9 ± 12.4 to 56.3 ± 12.3 at three weeks ($P = 0.712$) and 62.2 ± 12.2 at three months ($P = 0.011$). The tear size decreased at three weeks or three months after the BMAC-PRP injection but was not significantly different from that in the control group.





the treatment of radicular pain in the lower cervical spine: a retrospective comparative study

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Objective

A retrospective study compared the mid-term effects and advantages of the ultrasound (US)-guided selective nerve root block (SNRB), fluoroscopy (FL) guided cervical interlaminar epidural steroid injection (CIESI), transforaminal epidural steroid injection (CFESI) radicular pain in the lower cervical spine through assessment of pain relief and functional improvement.

Method

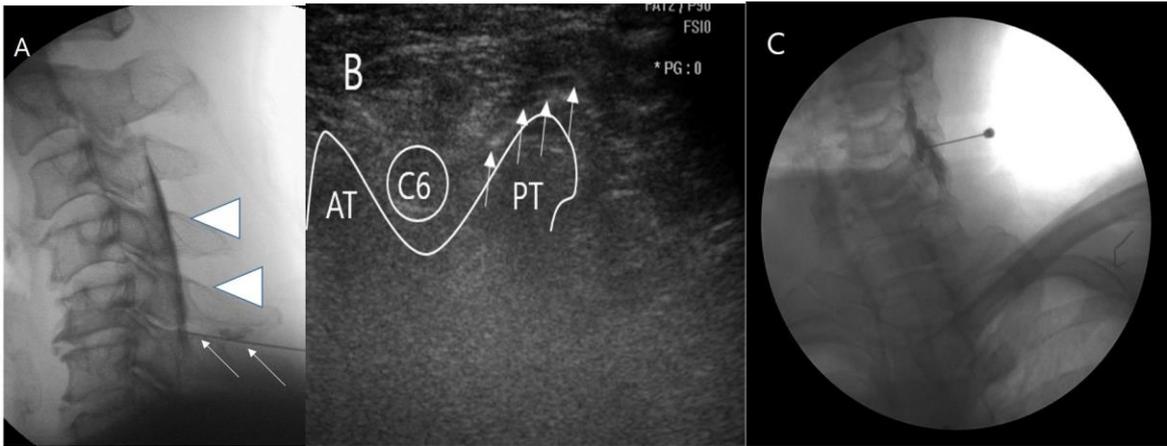
Patients with radicular pain in the lower cervical spine who received guided SNRB (n = 44) or FL-guided CIESI (n = 41) or CFESI (n=37) were included in this retrospective study. All procedures were performed using a FL or US. The complication frequencies during the procedures, adverse event, treatment effects, functional improvement were compared at 1, 3, and 6 months after the last injection

Results

Both the NDI and VNS scores showed improvements at 1, 3, and 6 months after the last injection in all groups, with no significant differences between groups ($p < 0.05$). Furthermore, the treatment success rate at all time points was not significantly different between groups. Logistic regression analysis revealed that the injection method (US- or FL-guided), sex, analgesic use, pain duration, number of injection and age were not independent predictors of treatment success. blood was aspirated before injection in 7% (n=3),14%(n=6) and 0% patients in the FL-guided CIESI, CFESI and US-guided groups, respectively. In 2 patients of FL-guided CIESI and 7 of FL-guided CFESI group, intravascular contrast spread was noted during injection.

Conclusion

Our results suggest that, compared with FL-guided CIESI and CFESI, US-guided SNRB require a shorter administration duration while providing similar pain relief and functional improvements. Therefore, US-guided SNRB can be considered as an effective alternative for the conservative management of chronic radicular pain in the lower cervical spine. .



A: fluoroscopy (FL) guided cervical interlaminar epidural steroid injection B:Ultrasound-guided selective nerve root block C: transforaminal epidural steroid injection

Slow releasing platelet derived growth factor could improve tendinitis; in vitro study.

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Objective

It has been reported that the platelet derived growth factor (PDGF) could have treatment effect in tendon or ligament injury. However, the PDGF has limitations of short half-life and low affinity to tissue. The poly(lactic-co-glycolic acid) (PLGA) polymer is a FDA-approved material for the drug delivery and the tissue engraft scaffold. The PLGA microsphere with surface modification using heparin-dopamin (hep-PMS) has an ability of slow releasing. We fabricated the slow releasing PLGA microsphere impregnated with PDGF (PDGF/Hep-PMS). We aimed to investigate whether the PDGF/Hep-PMSs could suppress the inflammatory response in lipopolysaccharide (LPS)-stimulated tenocytes in vitro.

Method

To impregnate the PDGF on Hep-PMS, the Hep-PMSs were immersed into 0.1 M MES buffer (pH 5.6) and gently shaken 30 min to active highly negative-charged heparin on Hep-PMSs. Highly positive-charged PDGF at concentration of 500 ng/mL was added to 0.1 M MES buffer (pH 5.6) containing Hep-PMSs. Tenocytes were isolated from the rotator-cuff tendon of New Zealand white rabbit. The tenocytes (1×10^5 cells/well) were seeded on 10 mg of PMSs, PDGF/PMSs, and PDGF/Hep-PMSs in 24-well tissue-culture plates and maintained in Dulbecco's modified Eagle's medium. At 1, 3, and 7 days, each sample was rinsed with PBS and CCK-8 proliferation kit reagents were added and incubated for 1 h. Reagents were transferred to 96-well plates and optical density was measured with a Flash Multimode Reader at 450 nm. To demonstrate the anti-inflammatory effects of PMSs, PDGF/PMSs, and PDGF/Hep-PMSs, pro-inflammatory cytokines on cells grown on each sample after LPS activation were measured by real-time polymerase chain reaction (PCR).

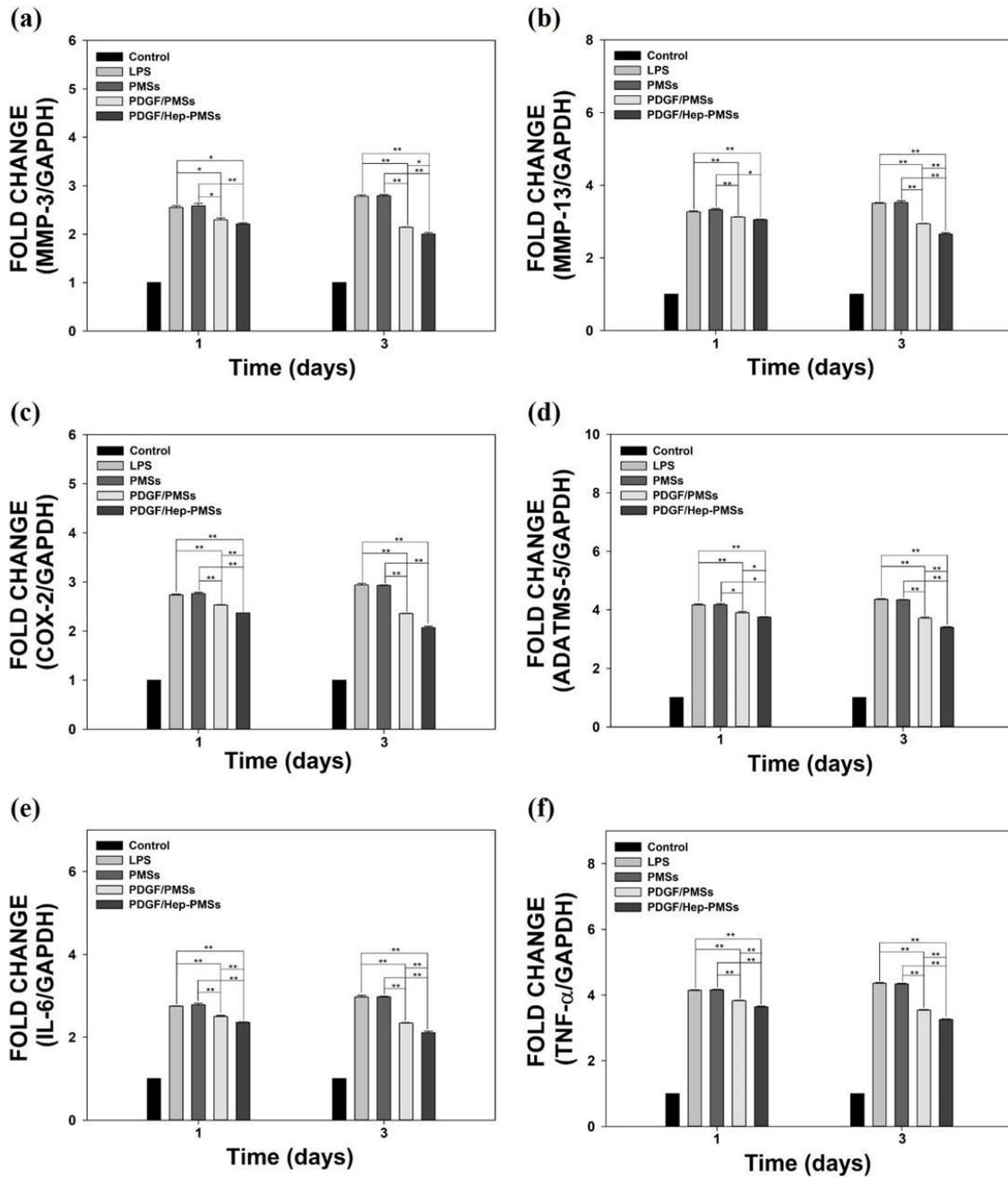
Results

There were no significant differences in cell proliferation between any groups on day 1. At 3 days, the differences in tenocyte proliferation were significant between tenocyte grown on PDGF/PMSs and PMSs and between tenocytes on PDGF/Hep-PMSs and PMSs. At 7 days, there were significant differences in tenocyte proliferation cultured on PDGF/PMSs or PDGF/Hep-PMSs compared to PMSs. No mRNA expression of pro-inflammatory cytokines was detected in LPS-stimulated cells grown on PMSs compared to in the positive control group on days 1 and 3. However, PDGF/PMSs or PDGF/Hep-PMSs showed significantly decreased MMP-3, MMP-13, COX-2, ADAMTS-5, IL-6, and TNF- α expression levels relative to in LPS-activated tenocytes on days 1 and 3. Moreover, the

mRNA levels of MMP-3, MMP-13, COX-2, ADAMTS-5, IL-6, and TNF- α in LPS-stimulated tenocytes on PDGF/Hep-PMSs were significantly decreased compared to those of all other groups.

Conclusion

The PDGF/Hep-PMSs could suppress the mRNA levels of pro-inflammatory cytokines. Localized and slow delivery of PDGF using heparinized-porous microspheres is a promising therapeutic injectable material for controlling tendinitis.



Relative mRNA levels of pro-inflammatory cytokines, including (a) MMP-3, (b) MMP-13, (c) COX-2, (d) ADAMTS-5, (e) IL-6, and (f) TNF- α in LPS-stimulated tenocytes grown on PMSs, PDGF/PMSs, and PDGF/Hep-PMSs on days 1 and 3. Data are presented as the mean \pm SD (n = 5). *P < 0.05 and **P < 0.01.

Posturography parameters in patients with the history of ankle sprain – a pilot study

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Introduction

The ankle is the most common area for a ligament injury. Previous ankle sprain is associated with a 2.3-fold greater recurrence. Chronic ankle instability is characterized by recurrent ankle sprain and leads to the sensation of “giving way” suggesting decline in balance ability. The posturography is a technique that measures balance in certain postures. In this study, we aimed to reveal the pattern of balance parameters in patients with the history of ankle sprain through the posturography.

Method

From the database of our institute between 2014 and 2018, patients who were diagnosed with ankle sprain were extracted. Among them, those who underwent the posturography test were included. Patients with known neurological disorders were excluded. Data was collected by the static posturography device Tetrax® (Sunlight Medical Ltd) in 8 standardized positions. One sample t-test was done to compare each parameters to known mean values. Statistical analysis was done with SPSS (IBM, version 21).

Results

A total of 10 patients were included for the analysis. First, by comparing the results at the basic posture (normal eyes open, NO) with known normal reference value, we found significant differences in Fourier index (FI) of frequency ranges F2, F5 and F6 (Table 1). The stability index (ST) and weight distribution index (WDI) were also significantly different from the normal mean values. The Fourier Power spectrum (Figure 1) shows the FIs of low frequency (F1) and high frequency (F7-8) are reduced compared to normal profile while FIs of the medium frequency (F2-4 and F5-6) take up more portion. When defining values less than -1 or greater than 1.5 standard deviations from the average as abnormal cases, F2-4 results were all abnormal in postures with the position change of head in 7 out of 10 patients. At head lateral tilting postures, the synchronized indices (SI) were abnormal in 27.8% of total cases. Compared to SI in other postures, SI in head tilting posture appeared to have higher sensitivity (Figure 2).

Conclusion

In this study, several posturography abnormalities were observed in patients with the history of ankle sprain. The medium-frequency FI was sensitive in assessing overall ankle instability, while SI was sensitive in assessing balance decline caused by unilateral ankle

instability. Further study with larger number of patients will be necessary to develop more accurate indicator for assessing chronic ankle instability.

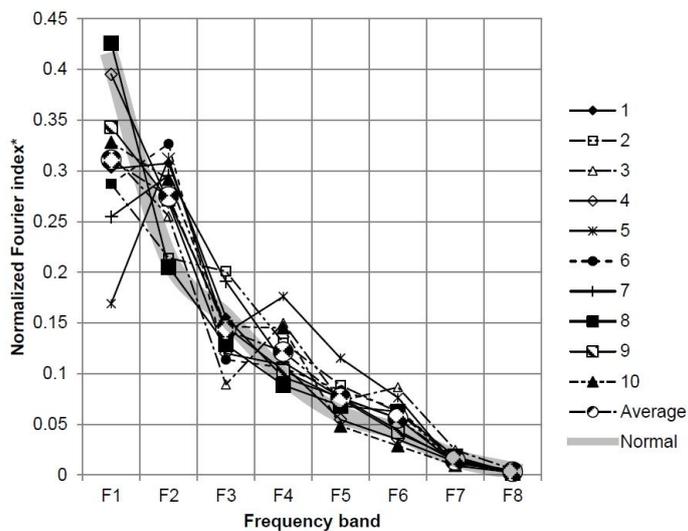
Table 1. Parameters of posturography comparing the patients and normal group in basic posture

	Total (n=10)	Reference value	p-value
ST	49.4 ± 5.0	17.4 ± 8.3	0.058
WDI	5.0 ± 2.3	9.1 ± 3.2	< 0.001*
F1	13.8 ± 5.2	17.4 ± 8.3	0.035*
F2	12.0±3.7	9.1 ± 3.2	0.035*
F3	6.4 ± 2.6	6.7 ± 2.2	0.750
F4	5.4 ± 2.0	4.2 ± 1.2	0.092
F5	3.2 ± 0.7	2.6 ± 0.8	0.014*
F6	2.3 ± 0.6	1.8 ± 0.9	0.027*
F7	0.6 ± 0.2	0.7 ± 0.3	0.079
F8	0.1 ± 0.1	0.2 ± 0.1	0.147

All parameters were measured in basic posture (normal eyes open :NO).

*p<0.05 by one sample t-test comparing the mean value of sample data with mean reference values.

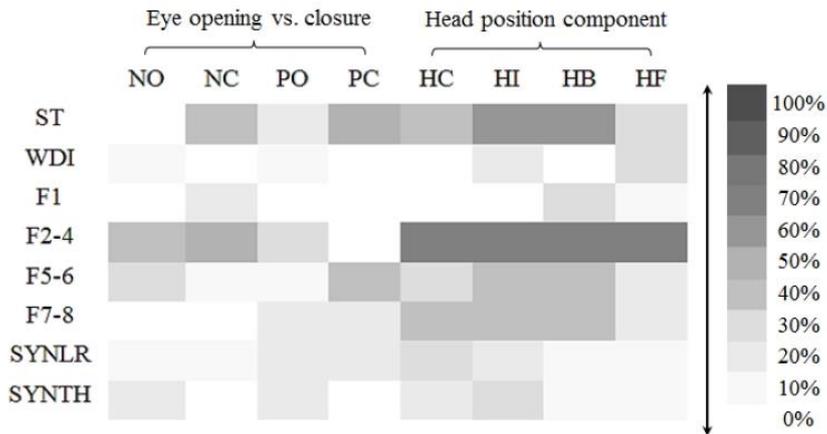
Abbreviations: ST:General stability index, WDI:Weight Distribution Index F1 - F8; Fourier indices of specific frequency range (F1: 0.01-0.1Hz, F2: 0.1-0.25Hz, F3: 0.25-0.35Hz, F4: 0.35-0.5Hz, F5: 0.5-0.75Hz, F6: 0.75-1.0Hz, F7: 1-3Hz, F8: 3Hz and above)



F1 = 0.01-0.1Hz, F2 = 0.1-0.25Hz, F3 = 0.25-0.35Hz, F4 = 0.35-0.5Hz, F5 = 0.5-0.75Hz, F6=0.75-1.0Hz, F7=1-3Hz, F8= 3Hz and above.

*Normalized FI = FI divided by summation of FI F1-F8

Figure 1. The Fourier Power spectrum of postural sway pattern (at normal eyes open position)



NO = normal eye open, NC = normal eye close PO = pillow with eye open, PC = pillow with close eye, HC = head tilt to the contralateral side of affected limb, HI = head tilt to the ipsilateral side of affected limb, HB = head back, HF = head forward, ST = stability index, WDI = weight distribution index, F1 = Fourier index(FI) of 0.01-0.1Hz, F2-4 = FI of 0.1-0.5Hz, F5-6 = FI of 0.5-1Hz, F7-8 = FI of 1Hz and above, SYNLR = synchronization index of left to right, SYNTH = synchronization index of toes to heel

Figure 2. Percentage of abnormal posturography parameters in different postures (n = 10)

Relationship between obesity and lumbar spine degeneration

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BACKGROUND

Although several studies have shown that obesity affects low back pain (LBP), the relationship between degenerative lumbar spine (LSD) and obesity has not been fully investigated. This study evaluated whether obesity is independently associated with LSD in the general population.

Methods

This cross-sectional study used public data from the Fifth Korean National Health and Nutrition Examination Survey (2010-2012). Subjects aged ≥ 50 years who had completed surveys were included (3,668 men and 4,966 women). Obesity was classified by body mass index and LSD was assessed by radiographs of the lumbar spine. The independent associations of obesity to LSD or LBP were determined using odds ratios (OR) adjusted by two regression models.

Results

The prevalence of obesity was more frequent in women than in men (38.27% vs. 33.97%, $P < 0.001$). Compared to normal-weight women, the risk of LSD was increased in overweight and obese women after adjustment (OR 1.227, 95% confidence interval [CI] 1.019–1.477 and OR 1.217, 95% CI 1.024–1.446, respectively). When obesity was subdivided, the obese II group showed higher odds for LSD in women (OR 1.797, 95% CI 1.287–2.510). However, obesity was not correlated with LSD in men. There were no significant associations between obesity and LBP in either men or women.

Conclusions

Compared to normal-weight women, the risk of LSD was increased in overweight and obese women, especially, those in the obese II subgroup. These findings suggest that maintaining normal body weight may be one of the factors preventing LSD.

Table 1. Subject characteristics

	Men (n = 3,668)	Women (n = 4,966)	P-value
Age (years)	61.1±0.2	62.8±0.2	<0.0001
Weight (kg)	67.1±0.2	57.7±0.2	<0.0001
Height (cm)	167.1±0.1	153.6±0.1	<0.0001
BMI (kg/m ²)	24.0±0.1	24.4±0.1	<0.0001
Obesity classification			
Normal weight	1,394 (36.0%)	1,751 (35.2%)	<0.0001
Overweight	1,064 (30.0%)	1,312 (26.5%)	
Obese I	1,166 (32.8%)	1,665 (33.3%)	
Obese II	44 (1.2%)	238 (5.0%)	
Lumbar spine degeneration	1,121 (26.2%)	1,824 (34.3%)	<0.0001
Low back pain	527 (13.5%)	1,645 (31.9%)	<0.0001
Current smoker	1,138 (35.6%)	176 (4.6%)	<0.0001
Alcohol drinking (biweekly or more)	1,450 (42.7%)	265 (6/1%)	<0.0001
Education			
≤Elementary school	1,156 (30.0%)	2,952 (59.2%)	<0.0001
Middle school	707 (20.9%)	785 (17.2%)	
High school	1,093 (31.3%)	920 (18.1%)	
≥ college	712 (17.8%)	309 (5.6%)	
PA			
Vigorous PA	557 (16.0%)	467 (9.4%)	<0.0001
Moderate PA	335 (9.2%)	444 (8.6%)	0.4425
Walking	1,552 (41.1%)	1,713 (34.5%)	<0.0001

Values are expressed as the mean and standard error or as numbers (%).

P-values were calculated using Student's t or χ^2 tests.

BMI, body mass index; PA, physical activity

Table 2. Odds ratios for LSD according to normal weight, overweight, obese I, and obese II categories

	Univariate analysis			Model 1 ^a			Model 2 ^b		
	OR	95% CI	P-value	OR	95% CI	P-value	OR	95% CI	P-value
Men									
Normal	Ref.			Ref.			Ref.		
Overweight	0.755	0.609–0.935	0.010	0.915	0.724–1.155	0.453	0.917	0.725–1.159	0.466
Obese I	0.817	0.661–1.009	0.061	1.009	0.805–1.265	0.937	1.018	0.809–1.283	0.877
Obese II	0.395	0.157–0.996	0.049	0.501	0.192–1.310	0.159	0.524	0.202–1.360	0.183
Women									
Normal	Ref.			Ref.			Ref.		
Overweight	1.180	0.996–1.398	0.055	1.248	1.038–1.499	0.018	1.226	1.019–1.477	0.031
Obese I	1.153	0.972–1.367	0.101	1.178	0.987–1.406	0.069	1.143	0.956–1.368	0.142
Obese II	1.826	1.321–2.522	<0.001	1.853	1.333–2.577	<0.001	1.797	1.287–2.510	<0.001

OR, odds ratio; LSD, lumbar spine degeneration; CI, confidence interval

^a Model 1 was adjusted for age group

^b Model 2 was adjusted for smoking, alcohol consumption, education, and levels of PA

Table 3. Odds ratios for LBP according to normal weight, overweight, obese I, and obese II categories

	Univariate analysis			Model 1 ^a			Model 2 ^b		
	OR	95% CI	P- value	OR	95% CI	P- value	OR	95% CI	P-value
Men									
Normal	Ref.			Ref.			Ref.		
Overweight	1.129	0.846–1.506	0.410	1.228	0.918–1.642	0.166	1.283	0.957–1.718	0.095
Obese I	0.818	0.628–1.066	0.138	0.892	0.678–1.173	0.414	0.950	0.725–1.245	0.710
Obese II	0.456	0.148–1.410	0.172	0.505	0.167–1.530	0.227	0.562	0.176–1.794	0.330
Women									
Normal	Ref.			Ref.			Ref.		
Overweight	0.880	0.724–1.070	0.199	0.882	0.722–1.077	0.218	0.857	0.697–1.054	0.144
Obese I	1.013	0.854–1.201	0.881	1.009	0.843–1.206	0.925	0.959	0.799–1.149	0.647
Obese II	1.283	0.953–1.727	0.100	1.226	0.903–1.666	0.192	1.148	0.842–1.565	0.382

OR, odds ratio; LBP, low back pain; CI, confidence interval

^a Model 1 was adjusted for age group

^b Model 2 was adjusted for smoking, alcohol consumption, education and levels of PA

P 1-97

Correlation between radiographic knee osteoarthritis and cigarette smoking in a Korean population

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Objectives

Although cigarette smoking has been known as a risk factor for degenerative arthritis, recent studies showed a negative correlation between smoking and degenerative arthritis. This study aimed to investigate the correlation of knee radiographic osteoarthritis (ROA) according to smoking amount in general population.

Materials and Methods

This cross-sectional study used public data from the Fifth and Sixth Korean National Health and Nutrition Examination Survey (2010 to 2013). Subjects included 11,638 community-dwelling adults aged ≥ 50 years. Knee ROA were defined as a Kellgren/Lawrence grade ≥ 2 on the plain radiographic study. The lifetime cigarette smoking amount was calculated as quartiles in terms of pack-year. Independent correlation of smoking on knee ROA was determined using odds ratios (OR) adjusted for age group, sex, obesity, physical activity, and household income on multivariate logistic regression analysis.

Results

Prevalence of knee ROA was 37.3% and lifetime cigarette smokers was 24.0% of the target population. Subjects with knee ROA had higher mean age, female sex ratio, and body mass index in contrast with lower physical activity (Table 1). The adjusted logistic regression model revealed that female sex (OR 2.110, 95% CI 1.895-2.349) was significantly associated knee ROA. Older age, obesity and lower household income showed positive correlations with knee ROA. Second and fourth quartile of smoker had the lower prevalence of ROA compared to never-smoker (OR 0.800, 95% CI 0.643-0.994 and OR 0.812, 95% CI 0.684-0.965) (Table 2).

Conclusion

Negative correlation with knee ROA was confirmed only in moderate to high smokers. Prospective studies will be needed to reveal the effect of smoking on knee ROA.

Table 1. Characteristics of subjects by radiographic knee osteoarthritis

		Control (n = 7294)	Radiographic knee OA (n = 4344)	P-value*
Age (years)		61.52 ± 8.60	68.36 ± 8.81	<0.001
Sex (Female %)		50.2%	69.4%	<0.001†
Region (Urban %)		76.5%	67.2	0.001†
BMI (kg/m ²)		23.62 ± 2.95	24.66 ± 3.33	<0.001
Waist circumference (cm)		82.41 ± 8.93	84.71 ± 9.28	<0.001
Obesity (%)	Low (BMI < 18.5)	3.3	1.89	<0.001†
	Normal (BMI 18.5-22.9)	38.73	28.89	
	Overweight (BMI 23-24.9)	27.73	25.19	
	Obese I (BMI 25-29.9)	28.15	38.07	
	Obese II (BMI ≥ 30)	2.13	5.96	
Household income (%)	1Q (Low)	24.75	44.07	<0.001†
	2Q (Mid-low)	26.38	24.92	
	3Q (Mid-high)	22.63	16.96	
	4Q (High)	26.25	14.04	
Physical activity (METs/week)		2121.93 ± 3336.29	1848.29 ± 3380.78	<0.001
Physical activity _quartile (%)	1Q (Low)	25.61	33.35	<0.001†
	2Q (Mid-low)	23.79	24.68	
	3Q (Mid-high)	24.46	20.20	
	4Q (High)	26.14	21.77	
Cigarette smoking (%)	Never smoker	74.02	81.94	<0.001†
	1Q (Low)	3.71	3.59	
	2Q (Mid-low)	5.45	3.42	
	3Q (Mid-high)	7.62	4.53	
	4Q (High)	9.20	6.51	

OA, osteoarthritis; BMI, body mass index; METs, metabolic equivalents

P value by *independent T-test and †Chi-square test.

Table 2. Odds Ratios of radiographic knee osteoarthritis

	N	Unadjusted OR [*] (95% CI)	P-value	Adjusted OR [†] (95% CI)	P-value
Sex					
Male	4946	1.000		1.000	
Female	6692	2.249 (2.083-2.428)	<0.001	2.110 (1.895-2.349)	<0.001
Age					
50-59	4326	1.000		1.000	
60-69	3802	2.763 (2.504-3.047)	<0.001	2.750 (2.469-3.063)	<0.001
70-79	2885	5.616 (5.065-6.227)	<0.001	5.844 (5.171-6.605)	<0.001
≥80	625	9.886 (8.304-11.769)	<0.001	11.685 (9.501-14.371)	<0.001
Obesity					
Low	314	1.000		1.000	
Normal	4044	1.288 (1.001-1.656)	0.049	2.198 (1.650-2.929)	<0.001
Overweight	3126	1.568 (1.217-2.020)	0.001	3.230 (2.415-4.320)	<0.001
Obese I	3742	2.335 (1.816-3.001)	<0.001	4.921 (3.684-6.572)	<0.001
Obese II	412	4.838 (3.545-6.602)	<0.001	9.637 (6.747-13.766)	<0.001
Physical activity					
1Q (Low)	3310	1.000		1.000	
2Q (Mid-low)	2809	0.797 (0.719-0.882)	<0.001	0.932 (0.831-1.046)	0.231
3Q (Mid-high)	2660	0.634 (0.571-0.705)	<0.001	0.849 (0.753-0.956)	0.007
4Q (High)	2859	0.640 (0.577-0.709)	<0.001	1.044 (0.928-1.175)	0.473
Household income					
1Q (Low)	3677	1.000		1.000	
2Q (Mid-low)	2999	0.531 (0.482-0.584)	<0.001	0.799 (0.715-0.892)	<0.001
3Q (Mid-high)	2407	0.421 (0.379-0.468)	<0.001	0.791 (0.699-0.895)	<0.001
4Q (High)	2555	0.300 (0.269-0.335)	<0.001	0.653 (0.574-0.742)	<0.001
Cigarette smoking					
Never smoker	8846	1.000		1.000	
1Q (Low)	449	0.875 (0.719-1.064)	0.179	1.035 (0.827-1.294)	0.764
2Q (Mid-low)	569	0.566 (0.470-0.683)	<0.001	0.800 (0.643-0.994)	0.044
3Q (Mid-high)	780	0.537 (0.457-0.632)	<0.001	0.835 (0.688-1.013)	0.068
4Q (High)	994	0.640 (0.556-0.736)	<0.001	0.812 (0.684-0.965)	0.018

OR, odds ratio; CI, confidence interval

*Unadjusted odds ratios by logistic regression analysis.

†Adjusted odds ratios by multivariate logistic regression analysis; adjusted for all other variables

Emotional well-being and Pain suffering in patients with End-Stage Renal Disease

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OBJECTIVE

End-stage renal disease (ESRD) is a chronic and life long disease which makes the patient exhausted. Furthermore, newly occurring and aggravating pain during dialysis session afflict the mood of the ESRD patients. Although the complained pain and the altered mood of the ESRD patients are well known respectively, interaction of the pain and the mood alteration in the ESRD patients is not. The aim of this study is to unveil the relationship between the dialysis associated pain and mental health in the ESRD patients.

METHODS

This study was designed as a prospective, cross-sectional study. We enrolled 94 ESRD patients and allocated them into three groups; Group 1 as those who does not have any pain; Group 2 as those who have dialysis associated pain but no pain reported in daily living; Group 3 as those who have pain not associated with dialysis session. A chart review for clinical data and demographics was conducted, and patients completed a questionnaire containing the pain characteristics and KDQOL-SFTM (Korean version of Kidney Disease Quality of Life). Demographics and clinical characteristics of the participants were analyzed and scoring of KDQOL-SF was conducted according to KDQOL manual (Table 1, 2).

RESULTS

There were no significant difference in demographics and clinical characteristics among the groups except gender, height, and comorbidities (Table 1). Pain experience in daily life showed significant difference and was the highest in the Group 3 and the lowest in the Group 1 (Table 2). New pain experience and/or pain aggravation during dialysis session also showed significant difference among the group and the Group 2 reported more than Group 1 and Group 3. Group comparison of KDQOL-SF scales showed significant difference in Pain scale category. The higher Pain scale score means the more pain free condition. Post-hoc analysis showed that the Pain scale score of Group 1 is significantly higher than that of Group 2. Emotional status affecting the Pain scale of the KDQOL-SF were described in Table 3. Emotional well-being, Role-emotion, and Energy/Fatigue scale of the KDQOL-SF showed positive correlation with the Pain scale of the KDQOL-SF and are all statistically significant. It tells us that ESRD patients in better

mood, with positive thinking on their medical condition, and with energetic life can earn less painful day.

CONCLUSIONS

Pain and altered mood in ESRD patients undergoing hemodialysis is significant matter and should not be overlooked. Maintaining positive mind affects pain perception and makes it less. Further study with large sample size should be required to clarify these tendencies.

Table1 Demographic and clinical characteristics of participants (n=94)

	Group 1 (n=19)	Group 2 (n=46)	Group 3 (n=29)	p value
Gender: male/female (n and %)	11/8 (57.9/42.1)	11/35 (23.9/76.1)	14/15 (48.3/51.7)	0.016*
Age (years, mean±SD) (range)	60.6±9 (48-76)	61.3±9.5 (37-81)	62±10.5 (46-82)	0.866
Height (cm, mean±SD) (range)	163±9.6 (145-176)	157.1±8.6 (140-180)	159.7±7 (148-174)	0.029*
Weight (kg, mean±SD) (range)	59.6±12.2 (37.7-84.3)	56.9±14.3 (34-125)	58±14.9 (38-107)	0.495
BMI (kg/m², mean±SD) (range)	22.4±32 (17.9/27.2)	23±4.3 (17.3-40.8)	22.7±5.1 (15.2-37.5)	0.874
Economic status (n and %)				0.870
NIHC	16 (84.2)	35 (76.1)	22 (75.9)	
Medical aid type 1	1 (5.3)	11 (23.9)	7 (24.1)	
Medical aid type 2	0 (0.0)	0 (0.0)	0 (0.0)	
Lower income group type 1	2 (10.5)	0 (0.0)	0 (0.0)	
Lower income group type 2	0 (0.0)	0 (0.0)	0 (0.0)	
Causes of ESRD (n and %)				0.829
Type1 DM	0 (0.0)	0 (0.0)	0 (0.0)	
Type2 DM	8 (42.1)	13 (28.3)	9 (31.0)	
PCKD	0 (0.0)	3 (6.5)	1 (3.4)	
Glomerulonephritis	0 (0.0)	2 (4.3)	1 (3.4)	
HTN	4 (21.1)	13 (28.3)	6 (20.7)	
Others	6 (31.6)	10 (21.7)	9 (31.0)	
Unknown	1 (5.3)	5 (10.9)	3 (10.3)	
Comorbidities (n and %)				
DM	10 (52.6)	16 (34.8)	15 (51.7)	0.243
HTN	15 (78.9)	29 (63.0)	25 (86.2)	0.074
Ischemic heart disease	4 (21.1)	3 (6.5)	4 (13.8)	0.235
CVD	3 (15.8)	6 (13.0)	4 (13.8)	0.959
Peripheral vessel disease	0 (0.0)	0 (0.0)	1 (3.4)	0.326
Malignancy	0 (0.0)	2 (4.3)	1 (3.4)	0.663
Others	4 (21.1)	2 (4.3)	0 (0.0)	0.011*

NIHC: National Health Insurance Corporation, ESRD: End Stage Renal Disease, PCKD: Polycystic Kidney Disease, CVD: Coronary Vessel Disease

Table2 Dialysis and Pain characteristics of participants (n=94)

	Group 1 (n=19)	Group 2 (n=46)	Group 3 (n=29)	p value
HD duration (months, mean±SD) (range)	78.8±192.8 (16-864)	82.1±127.6 (5-480)	423±109.6 (3-356)	0.185
Frequency of vascular access re-op (n and %)				0.600
0	7 (36.8)	10 (21.7)	9 (31.0)	
1	3 (15.8)	17 (40.0)	11 (38.0)	
>1	9 (47.4)	19 (41.3)	9 (31.0)	
Locations of current vascular access (n and %)				0.176
Right upper arm	1 (5.3)	4 (8.7)	6 (20.7)	
Right forearm	3 (15.8)	3 (6.5)	4 (13.8)	
Left upper arm	10 (52.6)	24 (52.2)	13 (44.8)	
Left forearm	5 (26.3)	15 (32.6)	6 (20.7)	
Experienced pain during everyday life (n and %)				<0.001**
No	18 (94.7)	25 (54.3)	3 (10.3)	
Yes	1 (5.3)	21 (45.7)	26 (89.7)	
Experienced new pain and/or aggravation of pain during HD session (n and %)				<0.001**
No	19 (100)	1 (2.2)	26 (89.7)	
Yes	0 (0.0)	45 (97.8)	3 (10.3)	
Aggravation of pain	0 (0.0)	39 (86.7)	1 (33.3)	
Same degree of pain	0 (0.0)	6 (13.3)	2 (66.7)	

Table 3. Linear Regression Analysis for the effects of emotional status on pain perception

Factor	Unstandardized β	SE	Standardized β	Adjusted R²	p value
Emotional well-being	0.646	0.117	0.497	0.239	<0.001**
Role-emotion	0.249	0.053	0.443	0.188	<0.001**
Energy/Fatigue	0.657	0.104	0.55	0.294	<0.001**

P 1-99

Cut-off value of optimal postburn duration to predict 25(OH) vitamin D deficiency in burn patients

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Objective

Burn patients constitute high risk population for vitamin D deficiency. We investigated optimal factor related to burn injury and then cut-off value of optimal burn factor according to burn types for predicting 25(OH) vitamin D deficiency in burn patients undergoing rehabilitative therapy.

Methods

This was a retrospective cross-sectional study, 524 participants of 756 inpatients undergoing rehabilitative therapy were enrolled from January 2014 to April 2017. Data were collected for 25(OH) vitamin D levels, percentage of burned body surface area (BSA), length of from injury to sampling (LOS), burn type, body mass index (BMI), smoking, intensive care unit stay history, depression, pain, and itching. 25(OH) vitamin D deficiency was defined as a plasma level of <20 ng/mL.

Results

All of flame burn (FB), electrical burn (EB) and other burn types had significantly longer LOS in 25(OH) vitamin D deficiency groups ($p<0.001$, $p<0.001$ and $p=0.024$, respectively). After adjusting for age, burned BSA and BMI, burn subjects had significantly risks of vitamin D deficiency from 1.97 to 9.12 times according to an increase in LOS quartiles (adjusted odds ratios = 1.97 to 9.12, all $p<0.05$). Cut-off values of optimal LOS to predict 25(OH) vitamin D deficiency were 42.5 days for FB, 54 days for EB and 47 days for other burns ($p<0.001$, $p<0.001$, $p=0.033$, respectively).

Conclusion

postburn duration was optimal burn factor for predicting risk of 25(OH) vitamin D deficiency. We suggest that 25(OH) vitamin D level should be tested for burn patients when postburn duration exceeds cut-off values of LOS although initially 25(OH) vitamin D level was >20ng/ml in order to prevent for post-burn complications associated with vitamin D deficiency.

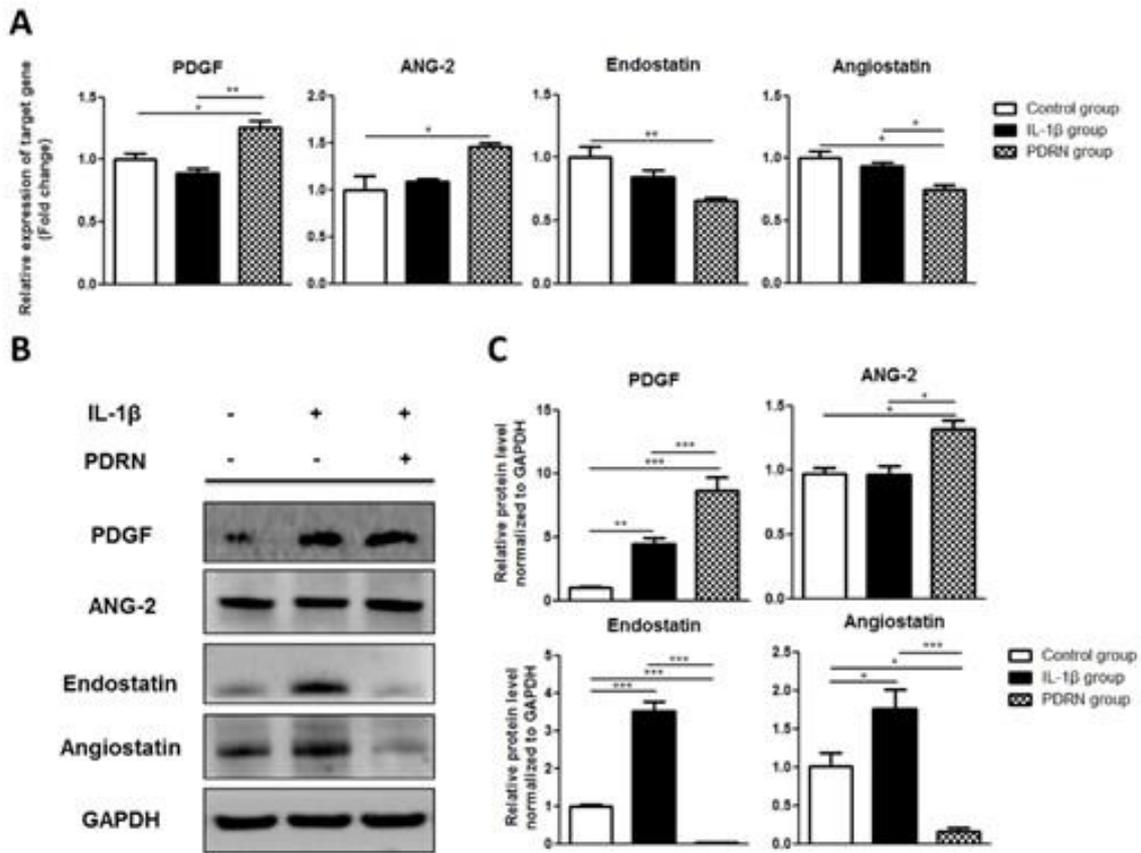
P 1-100

Angiogenesis protein expression in polydeoxyribonucleotide (PDRN) treated osteoarthritis cell model

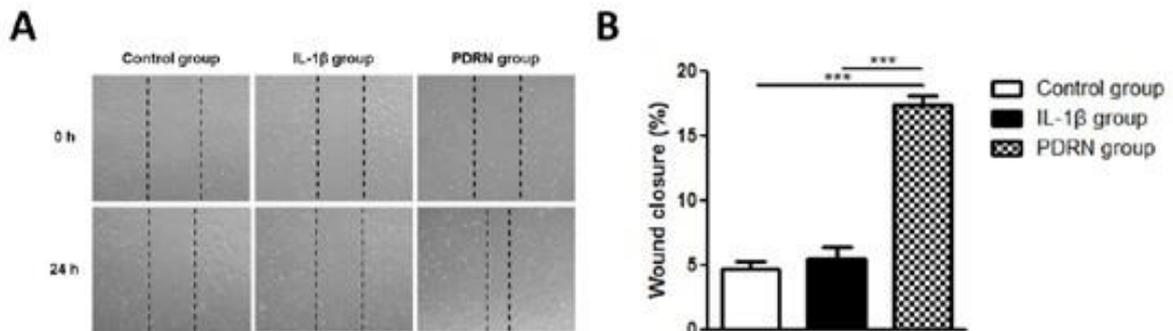
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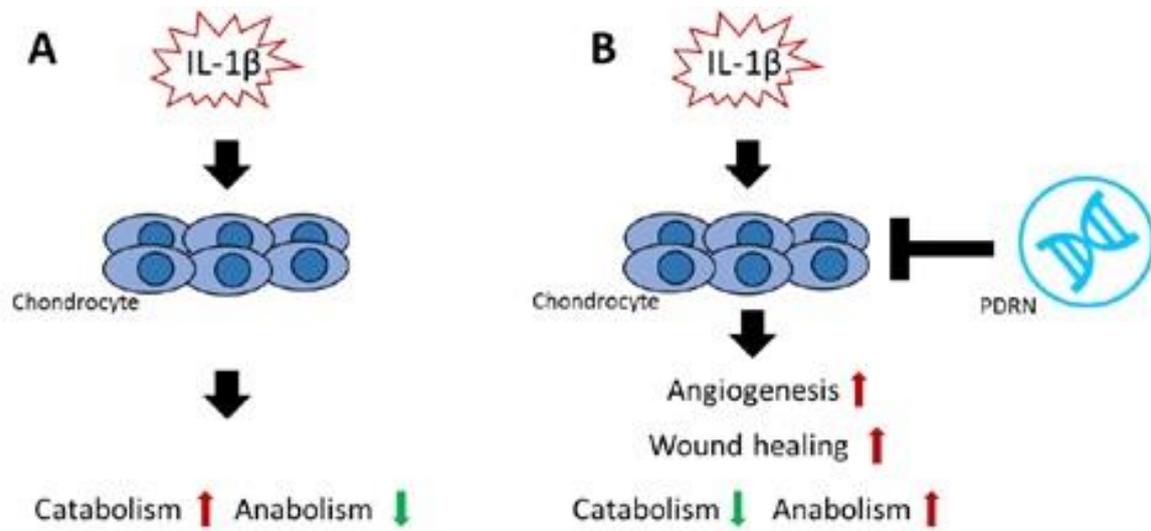
The purpose of this study was to investigate the effect of polydeoxynucleotide (PDRN) on factors associated with angiogenesis after administration of PDRN in osteoarthritis (OA) cell model. Interleukin (IL)-1 β or phosphate buffered saline (PBS) was used to treat human chondrocytic cell line in hypoxic condition for 24 h (IL-1 β group or control group). PDRN was then used to treat IL-1 β group cells for 24 h (PDRN group). Angiopoietin-2 (ANG-2), platelet-derived growth factor (PDGF) related to pro-angiogenesis and angiostatin and endostatin related to anti-angiogenesis were chosen by Label-based Human Antibody Array 1000 for further validation studies. Quantitative real-time reverse transcription polymerase chain reaction and western blot analysis validated that levels of PDGF and ANG-2 were significantly increased in the PDRN group compared to those in the control group or the IL-1 β group. However, levels of endostatin and angiostatin were significantly decreased in the PDRN group compared to those in the control group or the IL-1 β group. In in vitro scratch assay, wound closure was significantly increased in the PDRN group compared to that in the control group or the IL-1 β group. Moreover, PDRN decreased expression of MMP13 (a catabolic factor for OA) but increased expression of aggrecan (an anabolic factor for OA). These data suggest that PDRN may promote angiogenesis and wound healing via down-regulation of catabolism and up-regulation of anabolism in OA cell model.



Effects of PDRN on mRNA and protein levels of angiogenesis.



Effects of PDRN on cell migration. (A) Representative data of wound healing experiment. The beginning of the experiment is before treatment with PDRN and indicated as 0 h. After treatment with PDRN for 24 h is indicated as 24 h. (B) The area of the wound closure was quantified, and the ratio of wound closure was expressed as a percentage of recovered wound compared to the area at 0 h of each groups. All results are expressed as mean \pm SEM. * $p < 0.05$; *** $p < 0.001$.



Effects of PDRN on in vitro OA model. (A) IL-1 β induces the pathogenesis of OA in chondrocytes through up-regulation of catabolism and down-regulation of anabolism. (B) PDRN inhibit the pathogenesis of OA via up-regulation of angiogenesis and wound healing.

P 1-101

Changes in muscle architecture of GCM after nerve block in healthy

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Objective

Muscle architecture is an important determinant of muscle function. Muscle atrophy occurs due to denervation in persons with central or peripheral nerve injuries. Architectural changes of healthy muscle without any comorbid disease after denervation have not been reported so far. Therefore, this study aimed to investigate the architectural changes in gastrocnemius muscles after anesthetic tibial nerve block in healthy adults using ultrasonography (US).

Subjects

Total 19 healthy adults scheduled to undergo tibial nerve branch block to the medial head of gastrocnemius (GCM) for anesthetic calf reduction were recruited in our study. (2 males and 17 females) Subjects were excluded if they had the previous history of (a) CNS disease, (b) neuromuscular disease or (c) any surgical procedures at examined extremities (including procedure such as botulinum toxin injection, liposuction, etc.)

Method

Effect of the tibial nerve block was verified by visual observation and surface EMG analysis. US images of medial GCMs were taken by one trained physician using B-mode and real-time ultrasonography (Accuvix V10c system; Samsung Medison Co., Seoul, South Korea) with a linear-array probe (5 to 12 MHz) before nerve block, at 1wks after nerve block and at 3 months after nerve block in anatomic standing position with the feet about shoulder-width apart. Muscle thickness is a measurement of the longest distance between the fascia of the GCMs in a cross-sectional US image. Muscle fascicle length was defined as the straight-line distance between the upper muscular fascia and the lower muscular fascia parallel to the lines of the collagenous tissue visible on the image. The pennation angle was defined as the angle made between the upper fascia and the direction of the muscle fascicles.

Results

The mean age of the subjects was 28.68 ± 7.99 years. The mean body weight was 57.31 ± 7.07 kg and mean height was 162.44 ± 5.04 cm. The muscle thickness of the medial GCM was significantly reduced in both left and right sides at 3 months after the tibial nerve block ($p < 0.05$). Although the fascicle length of the medial GCM was not significantly changed, the pennation angle of the medial GCM was significantly reduced in left side at 1week and at 3 months after the tibial nerve block and in right side at 3 months after the tibial nerve block ($p < 0.05$).

Conclusion

To the best of our knowledge, this is the first report of architectural changes in healthy GCM muscle after denervation induced by tibial nerve block. Muscle thickness and the pennation angle of the muscle fascicle of the medial head of GCM were significantly reduced although fascicle length was not significantly changed.

Table 1. Changes in Sonographic parameters of muscle architecture			
	Time 1 (baseline)	Time 2 (1 week)	Time 3 (12 weeks)
Left			
Thickness(cm)	2.23±0.24(1.73-2.53)	2.12± 0.27(1.64-2.58) *	1.69±0.27(1.29-2.23) *
Fascicle length(cm)	6.64±1.06(4.83-9.34)	6.92±0.99(5.50-8.85)	6.60±1.04(5.13-8.34)
Pennation angle(degree)	20.11±2.82(15.30-27.40)	18.55±3.30(13.6-25.50)	15.08±2.78(10.60-21.00)*
Right			
Thickness(cm)	2.24±0.22(1.71-2.65)	2.17±0.30(1.53-2.60)	1.70±0.29(1.07-2.29) *
Fascicle length(cm)	6.86±0.87(5.19-8.36)	6.89±0.82(5.91-8.71)	6.55±0.85(5.28-8.06)
Pennation angle(degree)	19.37±2.43(16.50-25.20)	18.75±3.06(12.90-24.50)	14.98±2.51(10.20-18.10)*

Values are expressed as mean ± standard deviation (range).
* p<0.05 compared to Time 1 in linear mixed model

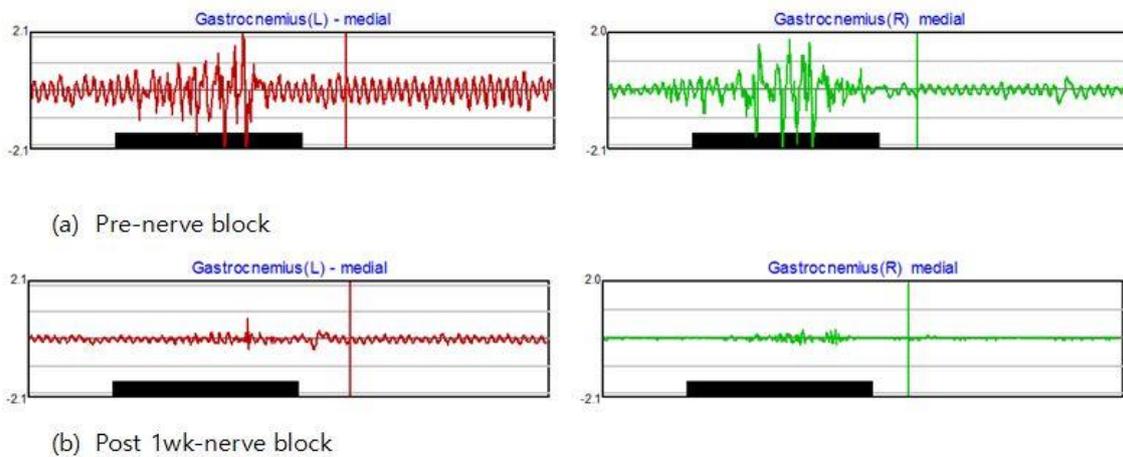


Fig 1. Surface EMG during walking in one subject. (a) pre- nerve block (b) Post 1wk-nerve block

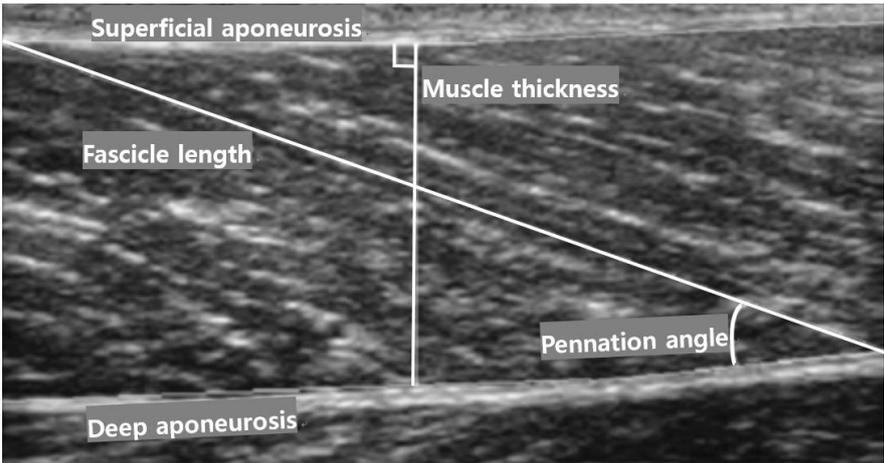


Fig 2. Ultrasound image showing muscle architecture parameters measured.

P 1-102

Distribution Patterns of Solution according to Injection Volume in Caudal Epidural Injection

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Introduction

Caudal epidural injections are commonly used to treat patients with low back pain and radiating pain to lower extremity. It has been proposed that in addition to the anti-inflammatory effects, injected material displaces the dura forward and inward, producing a stretch of the nerve roots that leads to lysis of neural adhesions. The purpose of this study was to show distribution patterns of injection solution according to injection volume and ascending level in C-arm guided caudal epidural block.

Method

The subjects are composed of 30 patients with low back pain and radicular leg pain. Needle insertion was performed through ultrasound-guiding at prone position. The level of injected solution was checked by C-arm guidance after injecting every 1ml of solution, which is a total of 20ml injection volume of dexamethasone(5mg), 9ml of 1% lidocaine and 10ml of contrast medium. The treatment effect was measured by Visual Analogue Scale (VAS) and Oswestry Disability Index (ODI). Pain was assessed using VAS and ODI at baseline, two weeks and four weeks following a single caudal epidural block.

Results

Successful needle placement occurred in all cases. Until the S1, L5, L4 level were reached, the mean sof required injection volume(ml) were 1.97 ± 1.2 , 3.87 ± 3.0 , and 6.6 ± 1.7 , respectively. Until the L3, L2, L1 level was reached, the means(ml) were 10.9 ± 3.6 , 15.1 ± 4.2 , and 14.5 ± 5.4 , respectively. Until T10, T11, T12 level was reached, required injection volume were 16, 12, 17ml in 1 case, respectively. After injecting total 20ml of solution, the ascending level were L5 in 3 cases, L4 in 3 cases, L3 in 3 cases, L2 in 15 cases, L1 in 3 cases, T10-T12 in 1 case each. In the comparison of the VAS before and 2 weeks and 4 weeks after injection, the means were 6.4 ± 1.4 , 4.5 ± 2.0 , and 4.0 ± 2.6 , respectively, which demonstrated statistically significant decrease($p < 0.05$). In the comparison of the ODI before and 2 weeks and 4 weeks after injection, the means were 17.7 ± 7.7 , 11.3 ± 6.6 , and 11.4 ± 6.9 , respectively, which also demonstrated statistically significant decrease ($p < 0.05$).

Conclusion

Caudal epidural injection could be performed more accurately in all cases under ultrasound guidance at needle insertion. Unlike previous studies, we have shown the injection dose reaching each vertebral level by confirming the spread of the contrast agent per 1 ml volume.

P 1-103

Facilitation of trunk muscles by abdominal bracing during walking in chronic low back pain patients

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Objective

The walking exercise and abdominal bracing are both recommended to chronic low back pain (LBP) patients. Trunk muscle activation pattern during walking has been investigated with surface electromyography (sEMG), and known to increase with faster walking speed. Since fast walking is difficult for patients with severe spinal stenosis or osteoarthritis, we aimed to see whether abdominal bracing combined with walking can be an alternative strategy. Therefore we designed this prospective experimental trial to quantify the activation of trunk muscles by sEMG at different walking velocities with or without abdominal bracing.

Method

Fourty eight patients with chronic LBP were recruited. In each patient, surface electrodes were placed over the multifidus of lower and upper lumbar levels, erector spinae of lower lumbar and thoracic levels, rectus abdominis, and external oblique muscles. During the walking exercise without abdominal bracing (non-braced walking), sEMG data were collected at the speed of 4 km/hr, 5km/hr, and 6 km/hr. Same protocol was repeated with the walking exercise with abdominal bracing. The amplitude of sEMG measured for quantitative evaluation of muscle activation.

Result

Activation of all measured muscles significantly increased at higher speed during non-braced walking, and same tendency was found with abdominal bracing. It showed significantly higher activation in walking with abdominal bracing than non-braced walking at muscles of multifidus (upper lumbar), erector spinae (lower lumbar, thoracic), and rectus abdominis at the speed of 4km/h. However, this difference was diminished at faster walking speed (5km/h for lower lumbar erector spinae, 6km/h for upper lumbar multifidus and thoracic erector spinae) except for rectus abdominis. The abdominal bracing in walking speed of 4km/h facilitated the same amount of muscle activation as non-braced walking of 5km/h in all muscles except rectus abdominis.

Conclusion

The walking with abdominal bracing activates trunk muscles more than non-braced walking. This effect is more prominent in lower speed so that it facilitated to the levels comparable to non-braced walking of faster speed. Therefore, patients who are unable to walk fast still can have similar training effect on lumbar trunk muscles by slow walking with abdominal bracing.

Table 1. Quantitative analysis of muscle activation during braced and non-braced walking exercise

Non-braced vs. Braced analysis (paired T test)		Surface EMG amplitude (μV)								
		LV4 (non-braced)	LV4 (braced)	p-value	LV5 (non-braced)	LV5 (braced)	p-value	LV6 (non-braced)	LV6 (braced)	p-value
Multifidus (lower lumbar)	mean	18.55±9.32	19.53±8.49	0.226	20.88±10.33	21.16±8.57	0.692	24.47±11.74	23.30±9.37	0.146
	max	36.70±21.45	38.55±22.30	0.224	42.18±24.53	43.33±23.58	0.318	48.03±26.91	47.16±25.50	0.505
Multifidus (upper lumbar)	mean	19.95±11.81	22.50±11.89	0.002	22.61±12.43	24.45±10.92	0.019	28.94±14.68	28.71±11.96	0.835
	max	38.97±15.77	43.29±18.66	0.008	44.26±17.79	48.89±18.32	0.006	59.71±30.52	59.13±25.39	0.840
Erector spinae (lower lumbar)	mean	18.30±7.98	19.60±8.14	0.016	20.79±10.02	21.48±8.64	0.387	24.93±10.63	24.87±8.86	0.942
	max	40.71±19.54	43.22±19.93	0.022	47.11±26.04	47.89±22.11	0.747	57.97±33.15	55.45±24.74	0.509
Erector spinae (thoracic)	mean	15.96±6.65	18.16±9.49	0.003	17.52±6.57	20.82±8.99	0.001	22.98±10.39	24.27±11.75	0.295
	max	33.79±12.40	38.80±18.52	0.007	39.72±13.30	45.35±16.21	0.006	53.63±27.98	51.56±21.25	0.481
Rectus abdominis	mean	15.85±6.89	22.11±13.96	<0.001	17.56±7.68	24.63±15.23	<0.001	23.57±16.21	27.59±16.91	0.003
	max	29.77±16.64	45.41±37.47	<0.001	33.93±21.01	54.31±44.50	<0.001	48.01±41.02	60.10±54.01	0.017
External oblique (abdomen)	mean	7.36±6.07	8.89±10.74	0.141	8.41±7.36	10.03±11.92	0.069	11.70±11.40	11.38±9.30	0.760
	max	13.70±14.82	17.46±26.29	0.095	17.89±19.74	20.91±35.00	0.254	26.94±35.79	24.26±26.19	0.333

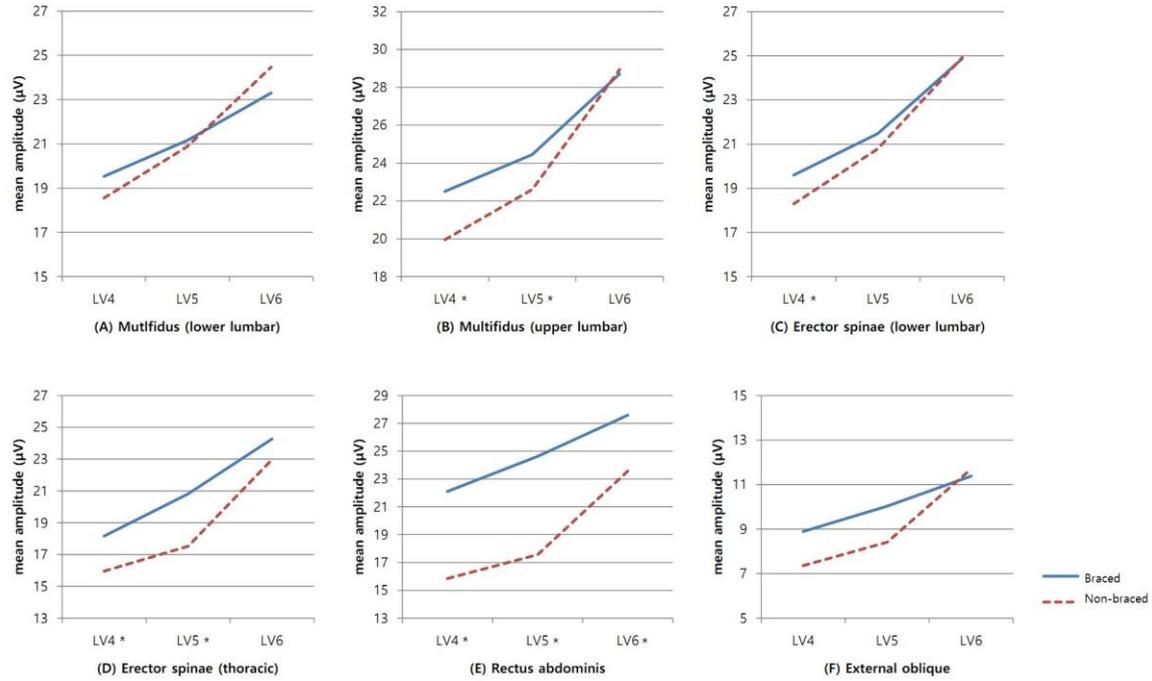


Fig 1. Quantitative data of muscle activation during braced and non-braced walking exercise. Solid line indicates braced walking and dashed line indicates non-braced walking for each muscles. Asterisk means significant difference between braced and non-braced walking. (A) Multifidus (lower lumbar) (B) Multifidus (upper lumbar) (C) Erector spinae (lower lumbar) (D) Erector spinae (thoracic) (E) Rectus abdominis (F) External oblique.

P 1-104

Intra-articular steroid injection improves pain of non-injected shoulder in both adhesive capsulitis

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Objective

To evaluate the improvement of pain and range of motion (ROM) in non-injected shoulder after intra-articular corticosteroid injection to one side in bilateral adhesive capsulitis.

Method

This is retrospective comparative study. Participants were bilateral primary adhesive capsulitis patients (n=25), who had ultrasound-guided corticosteroid injection in one shoulder. Outcome measurements were visual analogue scale (VAS) and passive ROM (①abduction, ②external rotation, ③hyperextension and internal rotation) evaluated at pre and post-injection. Wilcoxon signed rank test was performed to compare the changes of pain and passive ROM between pre and post-injection in injected and non-injected shoulder, respectively.

Result

Of the 25 patients, 8 were men, 17 were women. Mean age was 53.24±6.63. Mean value of symptom duration was 5.32±1.93months. Mean value of triamcinolone acetonide dose was 29.6±2mg. Mean value of follow-up days after injection was 18.24±4.48days. For injected shoulder, VAS and passive ROM (①abduction, ②external rotation, ③hyperextension and internal rotation) were improved with statistically significance. Interestingly, VAS and passive ROM (①external rotation) were also improved for non-injected shoulder with statistically significance (table 1).

Conclusion

This study shows intra-articular corticosteroid injection improves outcomes of non-injected shoulder. Therefore, in bilateral adhesive capsulitis, we suggest that clinicians would be better to observe the non-injected shoulder after one side injection rather than do injection both shoulders simultaneously.

Table 1. Changes of outcome measurements.

	Pre-injection	Post-injection	P
VAS score			
Injected shoulder	6.04±1.57	1.8±1.14	<.001 [†]
Non-Injected shoulder	3.96±1.13	1.78±0.99	<.001 [†]
Abduction, degree			
Injected shoulder	80±28.47	97±19.58	.004 [†]
Non-Injected shoulder	92.4±25.66	99±19.84	.101
External rotation, degree			
Injected shoulder	40.08±23.46	50.16±22.67	.001 [†]
Non-Injected shoulder	35.24±16.02	38±14.52	.038 [†]
Hyperextension and internal rotation*, cm			
Injected shoulder	43.6±13.14	36.12±12.14	.001 [†]
Non-Injected shoulder	36.68±15.47	35.52±13.28	.123

Values are expressed as mean ± standard deviation. VAS = visual analogue scale

* Length from the spinous process of C7 to tip of extended thumb

[†] Wilcoxon signed ranks test ($p < 0.05$)

P 1-105

Current Status and Unmet needs for Rehabilitation in Korean patients with CRPS

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BACKGROUND and aims

Complex regional pain syndrome (CRPS) is characterized by debilitating and refractory pain in affected limbs, associated with sensory, motor, autonomic, skin and bone abnormalities. For CRPS patients, rehabilitation aimed at improving limb function and desensitizing pain is important, however, patients cannot receive appropriate rehabilitation consistently although patients want systematic, sufficient rehabilitation treatment. The purpose of this study was to evaluate the current status of severity of pain, degree of depression, and quality of life in patients with CRPS in Korea, and assess both subjective needs and unmet needs for rehabilitation of patients in clinical care.

Method

Thirty-seven patients with CRPS who were diagnosed based on Budapest's criteria were recruited from a single medical center in Korea. As well as demographic and clinical data, structured questionnaires including brief pain inventory (BPI), world health organization disability assessment schedule-Korean II (WHODAS-K II), EuroQoL-5D (EQ-5D) for measuring quality of life were analyzed.

Results

The average value of BPI and WHODAS-K II were 7.88 ± 1.95 and $70.11 \pm 16.63\%$ in overall. EQ-5D index was 0.356 ± 0.182 . Patients' need to get more rehabilitation treatment is high in all domains: Pain 97.3%, Recovery of physical performance(RPP) 86.5%, Fatigue 81.1%, Bodyache 78.4%, Depressive mood 75.7%, Weight management 64.9%, Memory 64.9%, and ADL 58.8% in a decreasing order. For fatigue, weight management, and memory impairment domains, patients stated that they did not receive proper rehabilitation treatment.

Conclusions

In Korea, patients with CRPS are not given adequate rehabilitation treatment for them to feel satisfied by medical care. More structured and individualized rehabilitation treatment to manage each domain related to chronic pain as well as provision of care guidelines are needed in comprehensive rehabilitation setting for CRPS.

Table 1. Characteristic factors of the CRPS patients

	Value
Age of the questionnaire	38.41 ± 12.22
Age of onset of CRPS (yrs)	35.65 ± 12.57
Gender	
Male	16 (43.2)
Female	21 (56.8)
Marital status	
Married	17 (45.9)
Living without spouse	20 (54.1)
Religion	
With	24 (64.9)
Without religious beliefs	13 (35.1)
Residence	
Metropolitan area	17 (45.9)
City or country	20 (54.1)
Level of education	
Middle school or less	1 (2.7)
High school or more	36 (97.3)
Employment status	
With	3 (8.1)
Without a job	34 (91.9)
Family history	1 (2.7)
Disability judgement	8 (21.6)
Legal action	8 (21.6)
Limbs involved	
Right upper limb	5 (13.5)
Left upper limbs	1 (2.7)
Right lower limb	14 (37.8)
Left lower limbs	17 (45.9)
Severity score of CRPS – Self reported	
Allodynia	33 (89.2)
Temperature	35 (94.6)
Skin color	31 (83.8)
Sweating	32 (86.5)
Edema	33 (89.2)
Trophic changes	24 (64.9)
Motor changes	36 (97.3)
Decreased active ROM	37 (100)

NOTE. Values are expressed as number (%), and age was as mean ± SD.

Table 2. Pain characteristics and Quality of life

	Mean (SD)
Pain severity	
Worst pain	8.51 (1.52)
Least pain	4.65 (2.07)
Average pain	6.43 (1.65)
Pain now	5.92 (2.06)
Improvement after therapy(24hrs)	30.81 (20.77) %
Pain interference (BPI)	
Activity	7.69 (2.15)
Mood	7.96 (2.26)
Walk	7.34 (2.98)
Work	8.35 (1.81)
Relate	7.05 (2.97)
Sleep	8.20 (2.82)
Enjoy	8.57 (2.02)
Overall	7.88 (1.95)
EQ-5D index	0.356 (0.182)
WHO-DAS II dimensions (%)	
Overall	70.11 (16.63)
Understanding and communicating	60.54 (19.56)
Getting around	75.35 (21.36)
Self-care	63.19 (19.61)
Getting along with people	64.43 (27.31)
Life activities	79.03 (18.25)
Participation in society	70.11 (16.63)

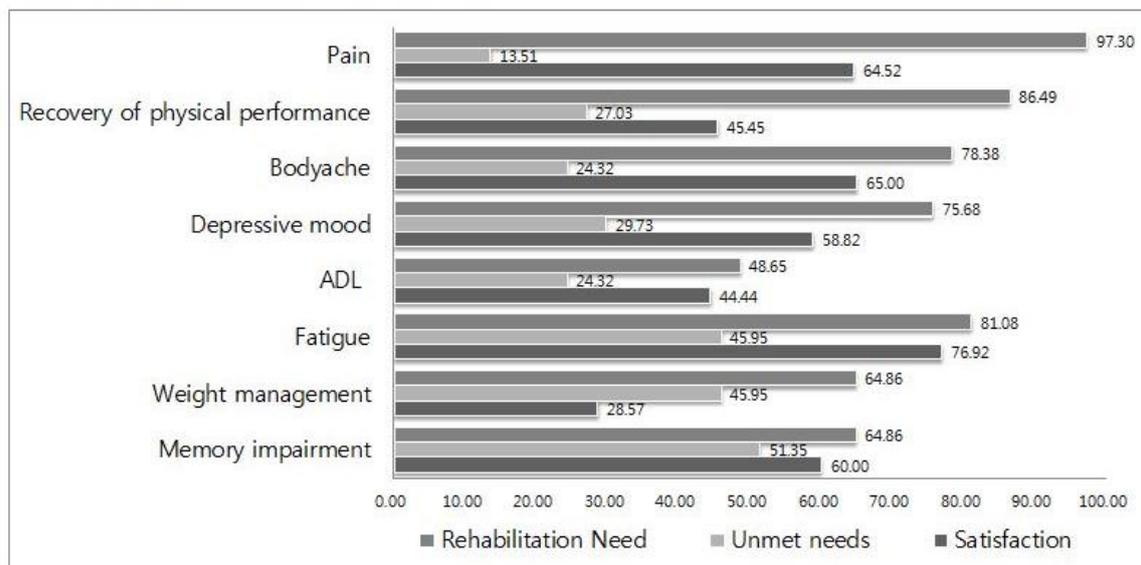


Fig1. Rehabilitation needs, unmet needs and satisfaction

P 1-106

Effect of pulsed radiofrequency therapy on chronic refractory atlanto-occipital joint pain

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OBJECTIVE

Despite several methods of conservative management, many patients with atlanto-occipital (AO) joint pain complain of persistent pain. In the current study, the authors investigated the clinical efficacy of intra-articular pulsed radiofrequency (PRF) therapy for the management of refractory chronic AO joint pain.

METHODS

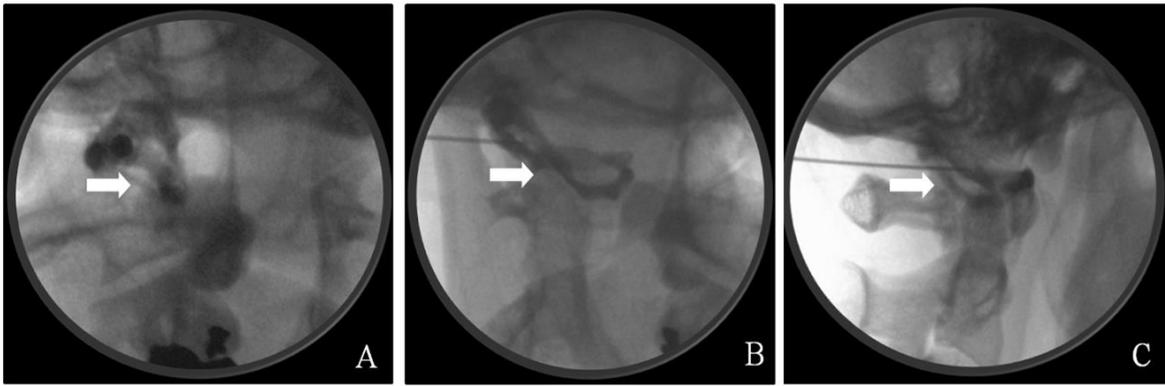
Twenty patients with refractory AO joint pain were recruited, and each received intra-articular AO joint PRF stimulation. Pain reduction after PRF therapy was measured using a numerical rating scale (NRS) before, and at 1 and 3 months, after treatment. Successful pain relief was defined as $\geq 50\%$ reduction in the NRS score compared with the pretreatment score. At 3 months after treatment, patient satisfaction levels were also examined. Patients reporting very good (score = 7) or good (score = 6) results were considered to be satisfied with the procedure.

RESULTS

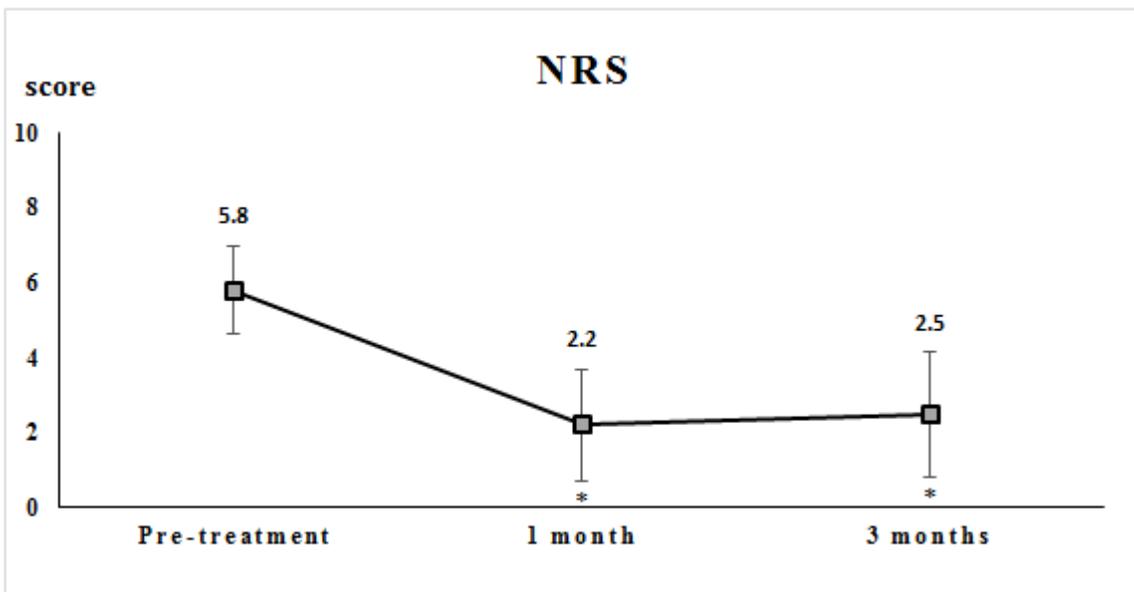
The NRS scores changed significantly over time. At 1 and 3 months after PRF therapy, the NRS scores were significantly reduced compared with pretreatment scores. Sixteen of the 20 (80%) patients reported pain relief and were satisfied with treatment results 3 months after PRF. No adverse effects were reported.

CONCLUSIONS

Intra-articular PRF therapy is a beneficial treatment tool for managing refractory chronic AO joint pain.



Fluoroscopy-guided pulsed radiofrequency on the atlanto-occipital joint. A: Ipsilateral side oblique view; a 25-gauge curved tip needle is inserted into the atlanto-occipital joint.



Average numerical rating scale (NRS) scores for atlanto-occipital joint pain. Pain was reduced significantly from 5.8 ± 1.2 at pretreatment to 2.2 ± 1.5 at 1 month and 2.5 ± 1.7 at 3 months after pulsed radiofrequency stimulation. *Indicates a statistically significant result (i.e., $p < 0.05$).

P 1-107

Efficacy of Single-Session Focused Extracorporeal Shock Wave Therapy on Lateral Epicondylitis

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BACKGROUND

Lateral epicondylitis (LE) is the most common cause of elbow pain in adult population. Recently, many researchers have demonstrated the effects of focused extracorporeal shock wave therapy (fESWT) on LE which has previously been resistant to conservative treatment. There are several papers have reported the mechanism and effects of fESWT on LE but no treatment protocol for fESWT has been established. Particularly, many controversies exist regarding the proper amount of session to be applied to the affected tissue. Patient compliance can affect the success of treatment. Reducing the repetition session of applied fESWT may affect compliance and lead to successful treatment. Thus, we developed a single-session fESWT for LE and compared the efficacy of the treatment with conservative therapy. The aim of this study is to investigate the therapeutic effects of single-session fESWT on LE.

Method

We enrolled patients who were diagnosed as LE by physicians through clinical symptoms and physical examination. All patients were randomly divided into the study group and the control group. The study group received one session of fESWT (10min 1 time for 4 weeks, total 1 session). fESWT was applied on common extensor origin of the affected elbow. One session of the treatment consisted of 2,000 impulses of shockwave at 0.06-0.12 mJ/mm². The control group received modalities including hot pack, ultrasound therapy and stretching exercise of the extensor carpi radialis muscle (20min 1 times per week for 4 weeks, total 4 sessions). All patients were educated to refrain from using extensor muscles on their wrist and were instructed how to care by themselves. All patients did not receive any other medication for pain or management during the study period. Before and at 1 month after the treatment, Patients were evaluated using Patient-related Tennis Elbow Evaluation (PRTEE), Mayo elbow Performance Index (MAPI) and Visual Analogue Scale (VAS) of pain perception. VAS was evaluated during resting, cozen test and lifting a chair

Results

Seven patients were recruited in each group. There were no significant differences in the baseline characteristics and initial measurements between two groups (Table 1). One month after the treatment, all groups showed significant improvement in PRTEE and MAPI. However, significant improvement in VAS were observed only in the study group (Table 2). When changes of measurement were compared between two groups, the study group showed more significant improvement than control group on PRTEE, MAPI and VAS during lifting a chair (Table 3).

Conclusion

In this study, we found the therapeutic effectiveness of single-session fESWT on LE. This protocol could save time and increase the compliance of patients, so it can be easily applied in the clinical setting. Thus, the single-session fESWT could be useful method for LE treatment.

Table 1. Baseline characteristics of two groups

	Study group (n=7)	Control group (n=7)	p-value
Age	49.4±6.2	54.6±8.4	0.258
BMI	24.5±2.9	26.1±0.9	0.421
Side of involvement			
Rt.	3	3	
Lt.	2	2	
Duration (month)	12.0±4.2	13.2±2.7	0.690
PRTEE	64.6±19.1	77.0±12.1	0.310
MAPI	78.0±9.8	66.0±17.1	0.222
VAS			
Resting	3.8±1.1	4.2±1.1	0.690
Cozen test	3.8±1.1	4.6±1.7	0.548
Chair lifting	4.8±0.5	5.5±1.8	0.820

Values are presented as mean±standard deviation.

BMI, Body Mass Index; PRTEE, Patient-related Tennis Elbow Evaluation; MAPI, Mayo elbow

Performance Index; VAS, Visual Analogue Scale

Table 2.Change of measurements after treatment

	Study group(n=7)			Control group (n=7)		
	Pre	Post	p-value	Pre	Post	p-value
PRTEE	64.6±19.1	44.2±21.4	0.042*	77.0±12.1	68.0±15.7	0.039*
MAPI	78.0±9.8	94.0±8.2	0.034*	66.0±17.1	77.0±11.5	0.042*
VAS						
Resting	3.8±1.1	1.6±0.9	0.034*	4.2±1.1	3.0±1.2	0.063
Cozen test	3.8±1.1	1.6±0.9	0.034*	4.6±1.7	3.4±0.9	0.083
Chair lifting	4.8±0.5	2.6±1.5	0.049*	5.5±1.8	3.8±1.8	0.180

Values are presented as mean±standard deviation.

PRTEE, Patient-related Tennis Elbow Evaluation; MAPI, Mayo elbow Performance Index; VAS, Visual Analogue Scale

*p<0.05 by Wilcoxon signed rank test.

Table 3. Changes of Measurements between two groups

	Study group (n=7)	Control group (n=7)	p-value
Δ PRTEE	-20.4±3.7	-12.5±6.1	0.032*
Δ MAPI	17.0±2.2	10.5±5.6	0.040*
Δ VAS			
Resting	-2.2±0.5	-1.2±0.8	0.095
Cozen test	-2.2±0.5	-1.2±1.1	0.093
Chair lifting	-2.4±1.3	-1.3±1.1	0.048*

Values are presented as mean±standard deviation.

PRTEE, Patient-related Tennis Elbow Evaluation; MAPI, Mayo elbow Performance Index; VAS, Visual Analogue Scale

*p<0.05 by Wilcoxon signed rank test.

Characteristics of Patients with Infectious Spondylitis: 7-year Experience

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Introduction

Infectious spondylitis involves various location of the vertebrae and elicits many kinds of clinical features. Treatment takes a long time antibiotics and sometimes surgical debridement, if the treatment fails, the patient may be fatal. We analyzed our experiences for the patients with infectious spondylitis who had admitted our hospital using medical records and report it.

Methods

We investigated inpatients medical records to find patients with disease name of "infectious spondylitis" using KCD-10 code from M46.2 to M46.9 from 2011 to 2017. Among these patients, we confirm infectious spondylitis reviewing the medical records and radiologic images. Then, we looked into the information of departments, surgical debridement, location and extents of infections, suggested etiology and identified pathogens. We also investigated neurological features such as sensory change, motor weakness and recovery of neurological deficit. Statistical analyses were done using Microsoft EXCEL 2017.

Results

177 cases were found at the first review. Subducing overlapped cases, 127 patients were recruited. Some records gave us poor information about location and extent of the infection. Thus we excluded. Finally 106 patients were included, 60 males and 46 females. Mean age was 68.5-year old. (Table 1) The localized pain was the most frequent initial symptom. (72%) The average number of infected vertebral segments was 1.75. The most frequently involved sited was lumbosacral region. 36 patients took surgical debridements. (34%) The most suggested etiology was systemic infection, (62.6%) followed by procedure-related infections. (16.8%) Among procedure-related spondylitis, the most frequent cause was epidural steroid injections. (44.4%) In case of identification of the pathogen, Staphylococcus was the most frequent. (71.4%) (Table 2)

Conclusion

We reported 7-year experiences about infectious spondylitis. Further prospective study with analyses of cause and prognosis may be required.

Table 1. Demographics

	No (%)
Sex	
Male	60 (56.6%)
Female	46 (43.4%)
Total	106
Age (year-old)	68.54 (\pm 12.75)
Department of admission	
Infectious Disease	44 (41.1%)
Neurosurgery	30 (28%)
Orthopedics	23 (21.5%)
Rehabilitation Medicine	9 (8.4%)
Consultation for Rehabilitation	43 (40.6%)

Table 2. Characteristics of Infectious Spondylitis

	No (%)		No (%)
First symptoms		Suggested etiology of infection	
Localized pain	77 (72%)	Pyogenic (unknown)	5 (4.7%)
Fever	13 (12.2%)	Systemic infection	67 (62.6%)
Weakness	8 (7.5%)	Tuberculosis	13 (12.2%)
Others	8 (7.5%)	Procedure-related	18 (16.8%)
		Immunocompromised	3 (2.8%)
Involved vertebral segments	1.75 (\pm 1.45)		
Involved vertebral level		Identified pathogen	
Cervical	4 (3.8%)	Staphylococcus	15 (71.4%)
Lower cervical to thoracic	0	Escherichia coli	4 (19.1%)
Thoracic only	10 (9.4%)	Mycobacterium	1 (4.8%)
Lower thoracic to upper lumbar	9 (8.5%)	Corynebacterium	1 (4.8%)
Lumbar or lumbosacral	71 (67%)		
Widespread or multiple	12 (11.3%)		
Sensory symptoms	15 (51.7%)	Suggested procedures related infection	
Motor weakness	40 (90.9%)	Operation-related	5 (22.8%)
Recovery from neurological deficits	11 (68.8%)	Epidural steroid injection	8 (44.4%)
		Percutaneous vertebroplasty	3 (16.7%)
Treatment		Acupuncture	2 (11.1%)
Conservative treatment	70 (66%)		
Combined surgical debridement	36 (34%)		

P 1-109

Translational Study of Low-end Shoulder Joint Rehabilitation Robot Device : Study protocol

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Background

Due to the aging, changes in lifestyle, and the increase in sports activities, the number of patients with various shoulder disorder are increasing. As the interest in shoulder rehabilitation increases, various rehabilitation robots have been developed to treat effectively and to replace the physical training effort of a therapist. The purpose of this study is to validate the tracking performance of newly developed shoulder joint rehabilitation robot device through clinical trials and to find the optimal damping value. And we will carry out a follow-up study to upgrade the product in consideration of the service environment and user experience analysis for commercialization and application in clinical practice.

Methods/Design

In the conventional continuous passive motion (CPM), because the axis of CPM is fixed, it cannot follow the natural movement of the shoulder axis. Therefore, we have developed a prototype of the low-end shoulder joint rehabilitation robot device (Rafael smart shoulder[®], Fig. 1). It has improved tracking mechanism and alignment by using the passive shoulder joint tracker and the actuator. The passive shoulder joint tracker consists of an XY table-shaped horizontal tracker and single-degree of freedom (DOF) vertical tracker with gravity compensation mechanism (Fig. 2). Ten patients who are suffering from shoulder joint disorder by stroke (n=5) or adhesive capsulitis (n=5) will be enrolled in this study. Subjects will be tested in three exercise modes (Fig. 3). In passive joint stretching mode, we will measure the differences between conventional CPM and Rafael smart shoulder[®] about tracking error, forces applied to the robot, and comparison between the joint angle of the device and of the subject during flexion, abduction, external rotation, and internal rotation. In isometric exercise and isokinetic exercise mode, it will be only tested in Rafael smart shoulder[®]. In isometric exercise mode, the forces applied to the robot and the external sensors are measured, and the degree of postural change will be measured during flexion, abduction, and extension in neutral position. In isokinetic exercise mode, tracking error, forces applied to the robot, and the difference between the joint angle of the robot and subject will be measured in two angular velocities (120 deg/s and 60 deg/s) and four motions (flexion/extension, abduction/adduction). Before the measurement, patient was informed about various shoulder joint movements.

Discussion

Rafael smart shoulder[®] allows various rotational, transitional movements of the shoulder joint using one active actuator, and we have confirmed the possibility of effectively responding to various symptoms of shoulder joint disorders. Completion of this study will contribute to achieving optimal performance of Rafael smart shoulder[®]. And, if it is commercialized, it is expected to be more cost effective, lighter, less bulky and widely available than conventional CPM.



Fig. 1. Low-end rehabilitation robot system

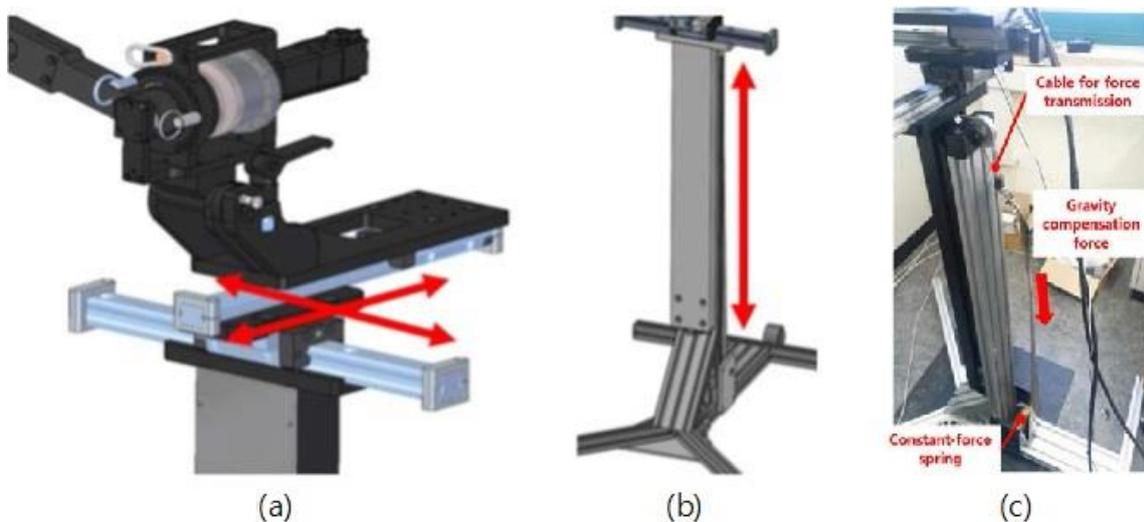


Fig. 2. Passive shoulder joint tracker with gravity compensation mechanism: (a) Horizontal tracker (b) Single-DOF vertical tracker (c) Gravity compensation mechanism

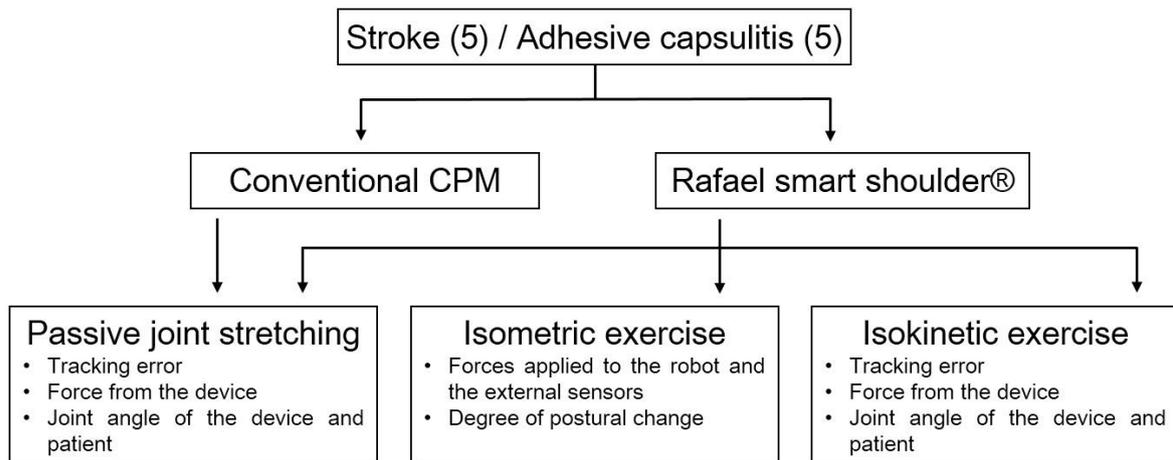


Fig. 3. Flow-chart of patients included with stroke or adhesive capsulitis with shoulder joint disorder.

P 1-110

The Effects of Antigravity Treadmill on Pain, Function, and Muscle Strength in Spine disease patients

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Jeju National University Hospital, Department of Rehabilitation Medicine¹

Objective

The lower-body positive pressure (LBPP) treadmill exercise (AlterG Anti-Gravity Treadmill) is designed to allow normal treadmill walking with reduced lower extremity weight bearing. It has recognized value during rehabilitation of lower extremity injuries, such as anterior cruciate ligament reconstruction, microfracture, total knee arthroplasty. Therefore, we aimed to report to determine the effects of an anti-gravity treadmill exercise program on pain, function, and lower limb muscle strength in spine disease patients.

Methods

We assessed spine disease patients referred for rehabilitation after either operation or conservative treatment at orthopedics department. Patients received strengthening lower extremity and gait training using a lower-body positive pressure (LBPP) treadmill (AlterG Anti-Gravity Treadmill). Before and at 3 weeks after rehabilitation, back pain (visual analog scale(VAS)), functional ambulation categories (FAC), 6-minute walk test (6MWT), 10 meter walk test (10MWT), Berg balance scale (BBS), timed up-and-go test (TUG), and one repetitive maximum (1RM) of leg press incline, leg press, leg extension, leg curl, hip abduction and hip adduction were conducted.

Results

Twenty patients (8 male/12 female, mean age 68.80 ± 14.45) were included. The Results shows significant improvements in VAS ($p < 0.001$), FAC ($p < 0.001$), 6MWT ($p < 0.001$), 10MWT ($p = 0.002$), BBS ($p < 0.001$) and TUG ($p < 0.001$) after treatment. Also, 1 RM of leg press incline ($p = 0.001$), 1 RM of right leg press ($p = 0.004$), 1 RM of left leg press ($p = 0.006$), 1 RM of right leg extension ($p = 0.001$), 1 RM of left leg extension ($p < 0.001$), 1 RM of right leg curl ($p < 0.001$), 1 RM of left leg curl ($p = 0.007$), 1 RM of hip abduction ($p = 0.001$) and 1 RM of hip adduction ($p = 0.001$) increased significantly after treatment. All participants completed the training and testing, and there were no serious adverse events during the study period.

Conclusion

This Results suggest that 3 weeks of an anti-gravity treadmill exercise program is safe, and leads to significant improvements in pain, function, and lower limb muscle strength in spine disease patients. These findings have important implications for the development of treatment strategies that can be used in the management of spine disease. Further randomized controlled trials are needed to confirm these findings.

Table 1. Demographic and Disease-Related Characteristics of the Subjects (N=20)

variable	Value (%)
Age (years)	68.8 ± 14.5
Gender	
Male	8 (40)
Female	12 (60)
Height (cm)	158.6 ± 7.5
Weight (kg)	60.7 ± 13.9
BMI (kg/m²)	24.0 ± 4.5
Comorbidities	
Hypertension	12 (60.0)
Diabetes mellitus	5 (25.0)
Osteoporosis	8 (40.0)

Values represent mean ± standard deviation or number (%) of cases

Abbreviations: BMI, body mass index;

Table 2. Disease Characteristics of the Patients (N=20)

variable	Value (%)
Diagnosis	
Compression fracture	11 (55.0)
HIVD	1 (5.0)
Spinal stenosis	6 (30.0)
Spondylolisthesis	2 (10.0)
Operation	
Yes	14 (70.0)
No	6 (30.0)
Level	
Thoracic spine	2 (10.0)
Lumbar spine	18 (90.0)

Values represent mean ± standard deviation

HIVD, Herniated Intervertebral Disk;

Table 3. Changes in Pain, Function, Muscle Strength, before and after treatment

variable	Before	After	P-value
VAS	4.4 ± 1.0	2.2 ± 0.8	<0.001
FAC	1.1 ± 0.3	2.4 ± 0.7	<0.001
6MWT (m)	135.4 ± 62.9	205.1 ± 85.7	<0.001
10MWT (sec)	38.6 ± 25.9	28.1 ± 21.0	0.002
BBS	28.7 ± 11.2	36.2 ± 10.3	0.001
TUG (sec)	45.1 ± 27.2	31.9 ± 21.8	<0.001
Strength parameters			
MVIC of leg incline (Nm)	205.3 ± 96.3	262.2 ± 113.3	0.001
Rt. MVIC of leg press (Nm)	132.5 ± 63.4	166.9 ± 65.1	0.004
Lt. MVIC of leg press (Nm)	139.4 ± 70.8	171.0 ± 73.2	0.006
Rt. MVIC of leg extension (Nm)	33.6 ± 16.5	42.4 ± 20.8	0.001
Lt. MVIC of leg extension (Nm)	31.4 ± 18.9	43.0 ± 23.2	<0.001
Rt. MVIC of leg curl (Nm)	11.7 ± 6.1	16.8 ± 8.3	<0.001
Lt. MVIC of leg curl (Nm)	13.4 ± 5.4	16.3 ± 5.2	0.007
MVIC of leg abduction (Nm)	34.1 ± 16.6	43.9 ± 20.1	0.001
MVIC of leg adduction (Nm)	42.3 ± 13.2	55.5 ± 24.4	0.002

Values represent mean ± standard deviation

VAS, visual analog scale; FAC, functional ambulation category ; 6MWT, 6 minutes walk test; 10MWT, 10 meters walk test; BBS, berg balance scale; TUG, timed up and go; MVIC, maximum voluntary isometric contraction;

P 1-111

The effectiveness of ETOIMS in improving gait speed in patient with spastic paraplegia:A pilot study

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Object

Patients with a lesion below the spinal cord T1 level can develop spastic paraplegia and show reduced gait speed due to spasticity as well as weakness. In this study, we applied electrical twitch obtaining intramuscular stimulation (ETOIMS) to the spastic paraplegic patients with gait disturbance. The ETOIMS is a Method to alleviate pain and achieve muscle relaxation by eliciting muscle twitching with electrical stimulus to the deep motor end-plate zone (MEPZ) by a monopolar needle. We present paraplegia patients who underwent ETOIMS alongside conventional stretching, strengthening exercises, and gait training, and showed improved gait speed and pattern due to muscle relaxation.

Method

We enrolled previously diagnosed spastic paraplegic patients who visited the department of rehabilitation medicine of a tertiary hospital with a complaint of gait disturbance between March 2017 and March 2018. Electrical stimulation was delivered by a monopolar needle electrode with 2-mA intensity, 0.2-ms pulse duration, and 1-Hz frequency with unipolar negative waves for 10 seconds at each stimulation point, which induced muscle twitching. The target muscles were the bilateral quadratus lumborum, multifidus originating from L4 and L5 spinous process, and gluteus medius. The participants underwent a 50-m gait test before and after ETOIMS. The gait speeds, subjective symptom changes, and gait patterns were compared before and after the interventions.

Result

Total 5 patients were enrolled and basic characteristics of the patients are shown in Table 1. The diagnoses were as follows; cervical myelitis (n=1), hereditary spastic paraplegia (NIPA1 mutation) (n=1), spinal cord tumor (n=2) and spinal cord injury (n=1). The ages were ranged from 26 to 70 years. The ambulatory motor index varied from 18 to 30. The walking aids and the antispasmodic agents in use are listed in Table 1. Tables 2 and 3 show the changes of gait parameters, stiffness and muscular pain after the ETOIMS. All patients subjectively reported the reduced stiffness during walking, and the alleviated muscular pain. After the 1st ETOIMS, the patient 1~4 showed 57%, 29%, 33%, 6% improvement in gait speed respectively. The patient 1 showed a cumulative effect in gait

speed by following two interventions, showing total 167% improvement. During gait, increased pelvic dissociation was observed. None reported any complication except for mild soreness at the stimulated sites, relieved within 2 days.

Conclusion

The ETOIMS is effective in improving gait speed and stability via relaxing the muscles or alleviating the pain in the lower back and gluteus in patient with spastic paraplegia. It is a promising minimally invasive intervention because it is easy to be performed without anesthesia, needs no injectate and the side effects are very minor. As this study is a pilot study without a control group, further controlled study is needed.

Table 1. Basic characteristics of the patients

Patient Number	Age	Sex	Height (cm)	Weight (kg)	Diagnosis	The period of diagnosis to ETOIMS	AMI	MAS		Assistive device	Medication
								Hip adductor	Knee extensor		
1	70	M	166	66	Paraplegia due to myelitis	20 months	20	G1+/G1+	G1+/G1+	Bilateral monocane	Baclofen 30mg
2	59	M	176	76	Hereditary spastic paraplegia	7 months	20	G2/G2	G2/G2	None (Independent gait)	Baclofen 5mg
3	54	M	172	72	Paraplegia due to spinal cord tumor	2 months	30	G0/G0	G1/G1	None (Independent gait)	Baclofen 30mg
4	57	M	160	64	Paraplegia due to L3/L3(s) SCI ASIA-C (Traffic Accident)	33 months	18	G1/G1	G1/G1	Bilateral quadcane	None
5	26	F	162	60	Paraplegia due to spinal cord tumor	21 months	30	G0/G0	G0/G1	None (Independent gait)	Tizanidine 1mg

ETOIMS, electrical twitch obtaining intramuscular stimulation; AMI, Ambulatory Motor Index; MAS, Modified Ashworth Scale; SCI, spinal cord injury.

Table 2. ETOIMS effects for spastic gait

Pt.		1 st ETOIMS		2 nd ETOIMS		3 rd ETOIMS	
		Pre	Post	Pre	Post	Pre	Post
Pt.1	50m gait (sec)	160	122	121	104	83	60
	50m gait (m/min)	18.75	29.51	24.79	28.85	36.14	50
	Patient's report	Legs feel heavy and stiff	Legs feel lighter Decreased stiffness	Decreased knee stiffness	Reduced low back pain		Reduced low back pain
	Gait pattern	Short stride length Decreased pelvic dissociation Decreased knee flexion Steppage gait Thoracic kyphotic posture	hip adductor, knee extensor		Decreased stiffness in hip adductor, knee extensor; improved anterior tilting		Decreased stiffness in hip adductor, knee extensor; improved pelvic dissociation Longer stride length
Pt.2		1 st ETOIMS		1 st ETOIMS		1 st ETOIMS	
	50m gait (sec)	Pre		Pre		Post	
	50m gait (m/min)	81		37.04		63	
	Patient's report	47.62		Walking much smoother; decreased low back pain		Decreased stiffness in hip adductor, knee extensor	
Pt.3		1 st ETOIMS		1 st ETOIMS		1 st ETOIMS	
	50m gait (sec)	Pre		Pre		Post	
	50m gait (m/min)	44		68.18		33	
	Patient's report	68.18		Legs feel heavy, low back pain		90.90	
Pt.4		1 st ETOIMS		1 st ETOIMS		1 st ETOIMS	
	50m gait (sec)	Pre		Pre		Post	
	50m gait (m/min)	398		7.54		377	
	Patient's report	7.54		Legs feel heavy, low back pain		7.96	
Pt.5		1 st ETOIMS		1 st ETOIMS		1 st ETOIMS	
	50m gait (sec)	Pre		Pre		Post	
	50m gait (m/min)	37		81.08		38	
	Patient's report	81.08		Feeling of muscle stiffness		78.95	
Gait pattern		Hip hiking as compensation for Lt. knee spasticity; decreased weight bearing		Decreased knee extensor stiffness with decreased quadratus lumborum pain			

Abbreviations: Pt., Patient; VM, vastus medialis; VL, vastus lateralis; GMed, gluteus medius; QL, quadratus lumborum; TFL, tensor fasciae latae

Table 3. Gait patterns and patient's symptom reports before and after ETOIMS

Pt.	ETOIMS	50 m walking test		Patient's symptom report	Gait pattern	
		Duration (sec)	Speed (m/min)			
1	1 st	pre	160	18.75	Heavy and stiff legs Low back pain Frequently likely to fall	Hip: Decreased pelvic dissociation and hip flexion Knee: Decreased knee flexion during swing phase Ankle: Decreased ankle dorsiflexion at initial heel contact (steppage gait)
		post	122	29.51	Lighter and less stiff legs Decreased low back pain	
	2 nd	pre	121	24.79	Leg stiffness improved	
		post	104	28.85	More improved stiffness Decreased low back pain	
	3 rd	pre	83	36.14	Leg stiffness improved	
		post	60	50.00	More improved stiffness Decreased low back pain Less likely to fall	Hip: Improved pelvic dissociation and hip flexion Knee: Increased knee flexion during swing phase Ankle: Increased ankle dorsiflexion at initial heel contact
2	1 st	pre	81	37.04	Heavy and stiff legs Instability in lower trunk-pelvis Frequently likely to fall	Hip: Decreased pelvic dissociation, hip flexion and extension, hip hiking, scissoring Knee: Decreased knee flexion during swing phase Ankle: Decreased ankle dorsiflexion at initial heel contact (steppage gait)
		post	63	47.62	More stability in lower trunk-pelvis Much smoother walking	Hip: Improved pelvic dissociation and hip flexion, decreased scissoring Knee: Increased knee flexion during swing phase Ankle: Increased ankle dorsiflexion at initial heel contact
3	1 st	pre	44	68.18	Heavy legs and stiff knee Low back pain	Hip: Posteriorly tilted pelvis with sway-back posture, decreased pelvic dissociation Knee: Decreased knee flexion during swing phase Ankle: Decreased right ankle dorsiflexion at initial heel contact (steppage gait)
		post	33	90.90	Lighter and less stiff legs Decreased low back pain	Hip: Improved pelvic dissociation with less sway-back posture Knee: Increased knee flexion during swing phase Ankle: Increased right ankle dorsiflexion at initial heel contact
4	1 st	pre	398	7.54	Heavy and stiff legs Frequently likely to fall back	Hip: Decreased pelvic dissociation, hip flexion and extension, scissoring Hip: external rotated during swing phase Knee: Decreased knee flexion during swing phase Ankle: Decreased ankle dorsiflexion at initial heel contact, foot drag during swing phase
		post	377	7.96	Less stiff leg Smoother walking	Hip: Improved pelvic dissociation with decreased scissoring frequency Knee: Not improved significantly Ankle: Not improved significantly
5	1 st	pre	37	81.08	Stiff knee Left low back pain	Hip: Decreased pelvic dissociation Knee: Intentionally flex left knee more than right side to prevent dragging Ankle: No specific finding
		post	36	78.95	Smoother and lighter walking Decreased low back pain	Hip: Improved pelvic dissociation Knee: Still intentionally flex left knee more than right side to prevent dragging Ankle: No specific finding

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Effect of Extracorporeal Shock Wave Therapy for Consistent Knee Pain after Total Knee arthroplasty

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Objective

The aim of this study is to investigate the effect of Extracorporeal Shock Wave Therapy (ESWT) on severity of symptoms and physical functions in patient with consistent knee pain after Total Knee arthroplasty.

Subjects and Method

This study was designed by single-blind and controlled study. All twenty patients who have consistent knee pain more than 1year after total knee arthroplasty were enrolled. The subject were classified into 2 groups by randomization. Group I was treated by conventional therapy and Group II was treated by conventional therapy and ESWT. Conventional therapy included medication or physical modalities. ESWT treatment (1000 shock wave, low energy level of 0.04 mJ/mm²) was performed once a week for 3 weeks. The shockwave probe was held stationary on a tenderness area around the knee or at the patellofemoral and tibiofemoral borders of the target knee, avoiding direct placement on the peroneal nerve or vessel. VAS (Visual analogue scale), WOMAC (Western Ontario and McMaster Universities arthritis Index), OKS (Oxford knee score) were used to evaluate severity of symptoms and physical functions. These scales measured before intervention, and at 4 weeks, 8 weeks later.

Results

There are no significant differences in the baseline characteristics (Gender, Age, height, weight, duration) and initial severity of symptoms and physical functions between two groups. Significant improvements in VAS (Visual analogue scale), WOMAC (Western Ontario and McMaster Universities arthritis Index), OKS (Oxford knee score) were observed in the group II at 4 and 8 weeks later, when compared with Group I.

Conclusion

In this study, ESWT showed significantly more improvement in pain and physical functional outcome. Generally consistent knee pain after the Total Knee arthroplasty patients hard to do re-operation and injection therapy such as hyaluronic acid injection for treatment. Therefore, ESWT can be another useful treatment option for them.

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Effect of the work hardening program on work capacity in the industrial accident patients

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Purpose

The purpose of this study is to analyze the effect of the work hardening program on work capacity in the industrial accident patients.

Methods

Subjects was selected the 40 industrial accident patients undergoing work hardening program in Industrial accident hospital. Subjects were conducted the work hardening program for 2 hours per day, 5 days a week and 12 weeks. We was investigated the evaluation of bilateral carry 10Ft, cart push, cart pull, knee extension, knee flexion, job performance possibility and floor to waist lift with Eval-Tech at before and after work hardening program (Figure 1). Data analysis was used the Wilcoxon signed-rank test.

Results

Of the 40 participants in the study, 33 were males (82.5%) and 7 (17.5%) were females. There were 49.42 years of mean age, 1550.83 days of onset duration, and 351.7 days of treatment duration. The injured area was 60.0% of upper limb, 32.5% of lower limb, 5 % of head and 2.5% of spine. All variables of work capacity were significantly improved before and after the work hardening program (Table 1). 30 patients (75.0%) were returning to work, and 25% (25.0%) were not returning.

Conclusions

Therefore, it was confirmed that the work hardening program improved the work capacity in the industrial accident patients. However, further studies will be needed to confirm the effectiveness of the work hardening program in various patients.

Table 1. Changed the work capacity before and after work hardening program

Variable	Before	After	<i>z</i>	<i>P</i>
Bilateral carry 10Ft	17.23 ± 6.99	29.03 ± 8.33	-4.888	.000
Cart push	24.43 ± 7.83	29.40 ± 9.10	-4.661	.000
Cart pull	23.02 ± 6.98	28.49 ± 7.86	-4.268	.000
Knee extension	22.90 ± 10.23	37.94 ± 12.05	-5.027	.000
Knee flexion	26.46 ± 13.02	40.61 ± 13.91	-4.705	.000
Job performance possibility	1.30 ± 0.47	2.53 ± 0.68	-4.681	.000
Floor to waist lift	18.74 ± 7.98	29.80 ± 8.42	-4.942	.000



Figure 1. Appearance of Eval Tech

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The Efficacy of Flexible Brace for Prevention of Progression in a Patient with Idiopathic Scoliosis

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Background

Idiopathic scoliosis is a three-dimensional deformity of the trunk and spine, and is defined as a lateral curve of at least 10°, measured on a standing radiograph using the Cobb's Method. Bracing for prevention of scoliosis progression is considered to be above 20° of Cobb's angle.

Objective

We aimed to investigate the efficacy of flexible brace (ALL LINETM) for prevention of scoliosis progression and improving lateral curvature on patient's with idiopathic scoliosis.

Methods

Eighteen patients diagnosed with idiopathic scoliosis were enrolled. The inclusion criteria were as follows: 1) idiopathic scoliosis, measured to be between 10° to 40° of Cobb's angle, demonstrated by X-ray ; 2) age between 19 and 40 years. Patients were excluded if they had any of the following: 1) serious or unstable neurological problems, 2) structural deformity of spine, pelvis, and lower extremity, and/or 3) pelvic subluxation above 1cm between both side. All participants trained 12hrs/day for 12 weeks. Height, Cobb's angle, length of spine from L5 to C7, pelvic and shoulder subluxation angle, thoracic and lumbar distance from central sacral vertical line (CSVL), visual analogue scale (VAS), and Oswestry disability index (ODI) were measured before training and after training completion. The scores at each time point were statistically compared.

Results

The participants showed significant improvement of Cobb's angle ($30.74 \pm 1.89^\circ$ to $24.96 \pm 2.11^\circ$, $P < 0.001$) at 12 weeks after bracing. In addition, length of spine from L5 to C7 was increased ($41.21 \pm 0.68\text{cm}$ to $42.08 \pm 0.55\text{cm}$), and distance from CSVL of thoracic (4.40 ± 0.36 to 3.49 ± 0.31 , $P < 0.001$) and lumbar (4.40 ± 0.35 to 3.86 ± 0.33 , $P = 0.005$) were attenuated by bracing in patients with idiopathic scoliosis. VAS (3.69 ± 0.39 to 0.75 ± 0.14 , $P < 0.001$) and ODI (8.44 ± 1.22 to 2.31 ± 0.53 , $P < 0.001$) were significantly attenuated in participants.

Conclusions

Flexible brace (ALL LINETM) has beneficial effect for prevention of scoliosis progression and improvement of lateral curvature in idiopathic scoliosis.

Keywords

Scoliosis, Idiopathic, Brace, Cobb, Spine

Injectate Viscosity Correlates the Volume Needed in Lumbar Transforaminal Epidural Injection

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Radicular pain is a type of low back pain which is often caused by herniation of the intervertebral disc and the prevalence is approximately 12%. Lumbar transforaminal epidural steroid injections (L-TFESIs) can be a therapeutic option for radicular pain patients whose pain is remain after conservative care. In the procedure of L-TFESIs, medication flows from the needle tip to the dorsal root ganglion then goes medial to the pedicle and reaches into the epidural space. We expected that injectate with lower viscosity than contrast would spread farther than contrast agent. The aim of this study is to evaluate the influence of injectate viscosity on the volume needed to reach specific landmarks in L-TFEIs. The patients over 20 years of age with low back and lower extremity pain who visited in the outpatient clinic during nine months were recruited. The L-TFESI was suggested to patients with little or no improvement of pain after at least one month of conservative management. The study subjects were divided into two groups by random selection Method: raw viscosity group (RV) and low viscosity group (LV). In this study, contrast volumes were recorded as contrast flow reached specific anatomic landmarks as following: the medial aspect of the superior pedicle of the corresponding level of injection (PED), the superior aspect of the superior intervertebral disc of the corresponding level of injection (SIVD), the inferior aspect of the inferior intervertebral disc of the corresponding level of injection (IIVD), both the SIVD and IIVD (BIVD), beyond the midline, spinous process, of the contralateral spinal segment (MID). The differences in the demographic data, the types of injury, and the level of injection between two groups were not statistically significant. A multiple linear regression model was used to analyze the effect of the amount and viscosity on reach to the landmarks. The progression of the injected medicine to the specific landmark showed a positive correlation with amount of the injected medicine and negative correlation with the viscosity of the injected medicine. However, in the case of PED and MID, the influence of the viscosity of the injected medicine was not statistically significant. The epidural distribution of the contrast agent through the transforaminal approach was mostly affected by injection volume and was also affected by the viscosity of the injected medicine. The effect of the viscosity of the medicine was not significantly related to reaching to the nearest landmark of PED. However, the relationship between the possibility of reaching to SIVD and IIVD and viscosity of the injected medicine were statistically significant. Furthermore, the landmark of MID demanded relatively large amount of injected medicine to reach to the landmark, whereas the effect of viscosity on the reachability to MID was not significant.

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Correlation of US Finding and Therapeutic Outcome in Adhesive Capsulitis: Preliminary study

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Background

Adhesive capsulitis (AC) in shoulder is a common clinical condition causing pain and functional impairment. Diagnosis of AC is usually made on the basis of clinical findings and ultrasonography (US) has only been used to exclude other pathologies. Specific parameters on US such as coracohumeral ligament (CHL), axillary recess (AR) and rotator interval (RI) thickness are known to be increased in adhesive capsulitis. However, there have been few studies on the relationship with clinical findings and no study investigated the relationship between US parameters and treatment effect of intra-articular (IA) injection in glenohumeral joint.

Purpose

To investigate the correlation between US parameters in patients with AC of shoulder and clinical impairments as well as treatment effect of IA injection.

Participants

Patients with clinically diagnosed unilateral AC were recruited in Kangbuk Samsung hospital from November 2017 to June 2018. Diagnosis of adhesive capsulitis was made according to three criteria; (i) pain in unilateral shoulder, (ii) feeling of shoulder stiffness, (iii) limitation of passive and active range of motion in capsular pattern. Patients were excluded if they had any of the followings; (i) rotator cuff tear (ii) calcification in rotator cuff (iii) history of trauma or operation.

Method

Ultrasonography was performed and thickness of AR, CHL and RI were evaluated. Clinical symptom was assessed using numeric rating scale for pain (NRS) and shoulder pain and disability index (SPADI), subdivided by SPADI pain score and disability score. All patients received US-guided IA injection in glenohumeral joint with triamcinolone 20mg + normal saline 6cc. After 1 month from initial evaluation and IA injection, NRS and SPADI were reassessed and improvement in score was calculated to evaluate treatment effect of injection. We analyzed whether US findings correlated with clinical symptoms and/or treatment effect of intra-articular injection.

Results

14 patients were included. The mean age was 56.86 ± 8.51 years and fifty percent of patients were male. The mean duration of symptom was 22.29 ± 16.58 weeks. The average NRS was 6.36 ± 1.82 . The thickness of AR and CHL were significantly higher in the affected

shoulder than in the unaffected one ($p < 0.05$). None of the US parameters was correlated with initial NRS and SPADI. In analysis of correlation of US parameters and treatment effect of IA injection, AR thickness was significantly correlated with improvement in SPADI total score and SPADI disability subscale score ($p = 0.02$).

Conclusion

Based on the Result of this study, US parameters do not seem to reflect severity of clinical symptom in patients with AC. However, the AR thickness appears to be associated with treatment effect of intra-articular injection which could reflect degree of inflammation. Further investigation is needed to explore the role of US parameters as a predictor of intra-articular injection effect.

Age (year)	56.86±8.51
Sex; male (%)	50
DM (%)	42.9
HTN (%)	35.7
Thyroid disease (%)	7.1
Heart disease (%)	7.1
Symptom duration (weeks)	22.29±16.58
NRS	6.36±1.82
SPADI_pain (%)	59.36±24.74
SPADI_disability (%)	54.89±23.85
SPADI_total (%)	56.56±22.99

DM; diabetes mellitus

Demographics & clinical findings of study

	NRS		SPADI(pain)		SPADI(disability)		SPADI(total)	
	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value
Axillary recess thickness (mm)	-0.396	0.161	-0.215	0.460	-0.012	0.967	-0.098	0.739
CHL thickness (mm)	-0.271	0.370	-0.447	0.126	-0.025	0.936	-0.195	0.522
Rotator interval thickness (mm)	-0.268	0.377	-0.221	0.468	-0.108	0.726	-0.161	0.598

Correlation between US parameters and functional impairment

	NRS_Imp		SPADI(pain)_Imp		SPADI(disability)_Imp		SPADI(total)_Imp	
	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value	Spearman's rho	p-value
Axillary recess thickness (mm)	0.626	0.071	0.53	0.142	0.792	0.011	0.741	0.022
CHL thickness (mm)	0.479	0.192	-0.113	0.772	-0.398	0.288	-0.307	0.421
Rotator interval thickness (mm)	0.239	0.535	0.07	0.858	0.167	0.668	0.137	0.726

Imp; improvement

Correlation between US parameters and treatment effect of IA injection

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The Relationship Between Shoulder Movements and Pressure Pain Threshold after Breast Cancer Surgery

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Objective

This study investigated the association in pressure pain threshold (PPT) of affected upper extremity with range of motion (ROM) and numeric pain rating scale (NRS) of shoulder movements. We hypothesized the low value of PPT of affected upper extremity was associated with disability or limited ROM of shoulder joint and pain during shoulder movements.

Methods

Ten patients who visited outpatient in department of rehabilitation medicine after more than 1 month of breast cancer surgery were included. We excluded patients with shoulder pain or other neuromuscular problems in shoulder joints prior to breast cancer surgery. All patients were assessed Questionnaire about Disabilities of the Arm, Shoulder and Hand (Quick DASH) score, ROM and NRS at shoulder flexion, abduction, external rotation, internal rotation. The PPT was determined by using the Algometry (Commander®, JTECH Medical, Midvale, UT, United States) to gradually increase the pressure on both supraspinatus muscles (middle point over the fossa of the scapula), pectoralis major muscles (middle point under clavicle), biceps brachii muscles (halfway between the coracoid process and the radial head), lateral epicondyles (2cm distal to the epicondyle), masseter muscles (muscle belly of masseter), 3rd finger metacarpal (MCP) joints which were determined by reference to fibromyalgia criteria, and was obtained by measuring the mean pressure 3 times when the patients began to feel pain at first. We calculated the ratio value of PPT using following Method; unaffected side/affected side/unaffected side. The relationship between the score of Quick DASH, ROM, and NRS of shoulder and PPT was statistically analyzed using SPSS version 20.0 (IBM SPSS Inc., Armonk, NY, USA).

Results

The ROM at shoulder flexion was strong correlation with PPT of pectoralis major muscle ($r=0.893$, $p<0.01$). There was a statistically significant correlation between Quick DASH score and PPT of pectoralis major muscle ($r=0.770$, $p<0.05$). However, there was no statistically significant relationship between NRS in shoulder movements and PPT of all assessed muscles.

Conclusion

The decrease in shoulder flexion after breast cancer surgery is more severe when pectoralis major muscle is susceptible to pressure pain. Therefore, shoulder flexion exercise should be prioritized among the shoulder movements after breast cancer surgery, and it is also important to treat pain of pectoralis major muscle among the muscle around the shoulder preferentially. Further study is needed to larger sample size after breast cancer surgery.

		The ratio of pain pressure threshold					
		SSP	PM	BB	LE	Ma	MCP
Shoulder ROM	Flexion	.483	.893**	.147	-.281	-.502	.006
	Abduction	.550	.511	.433	.226	-.524	.356
	External Rotation	-.279	-.070	.222	-.044	-.564	.424
	Internal Rotation	.031	.406	.063	-.156	-.156	.219

*p<0.05, ** p<0.01

ROM=Range Of Motion; QDASH= Quick Disabilities of the Arm, Shoulder, and Hand; SSP=Supraspinatus; PM=Pectoralis Major; BB=Biceps Brachii; LE=Lateral epicondyle; Ma=Masseter; MCP=Metacarpal joint; PIP=Proximal Interphalangeal joint; DIP=Distal Interphalangeal joint

Spearman Correlation Analysis Between ROM and Decreased ratio of Pain Threshold

		Location of the points for PPT assessment					
		SSP	PM	BB	LE	Ma	MCP
Shoulder NRS	Flexion	-.417	-.239	-.027	-.082	.089	.082
	Abduction	-.343	-.200	.032	-.278	-.032	-.045
	External rotation	-.530	-.200	-.194	-.097	-.084	.045
	Internal Rotation	-.058	-.234	-.045	-.143	-.039	-.201
QDASH		.455	.770**	-.067	.055	-.152	.212

*p<0.05, ** p<0.01

NRS=Numeric pain Rating Scale; QDASH=Quick Disabilities of the Arm, Shoulder, and Hand; SSP=Supraspinatus; PM=Pectoralis Major; BB=Biceps Brachii; LE=Lateral epicondyle; Ma=Masseter; MCP=Metacarpal joint; PIP=Proximal Interphalangeal joint; DIP=Distal Interphalangeal joint

Spearman Correlation Analysis Between NRS and Decreased ratio of Pain Threshold

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Comparison of effectiveness between intra-articular PRF and ICI on cervical facet joint pain

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Comparison of effectiveness between intra-articular pulsed radiofrequency and intra-articular steroid injection on cervical facet joint pain

Objective

To compare therapeutic effect of intra-articular pulsed radiofrequency and intra-articular steroid injection on cervical facet joint pain

Methods

Patients with cervical facet joint pain who feels pain more than 5 points with Visual Analogue Scale(VAS) score and radiologically diagnosed were recruited at outpatient clinic. The patients were assessed with VAS score, radiologic evaluation, functional measurements at initial visit and therapeutic outcome was assessed using VAS score after 3rd, 6th months treatment. The Successful treatment was defined as more than 50% reduction in the VAS score at 6 months compared with the pre-treatment VAS score. * Validation : the degree of change in pain reduction (change in VAS [%] = [pretreatment score - scores at 8 months after treatment] / pretreatment score × 100)

Results

The mean age of patients was 58 years old, mean morbidity period was 13 months and mean pain symptom was evaluated VAS 6.1 (table 1) The patients were divided in two groups with randomized manner and patient group A received pulsed radiofrequency intra-articular injection and patient group B received steroid intra-articular injection three times and each injection was performed 3 months intervals. There were therapeutic improvement in both group A and B patient after 3rd month visits. VAS scores are both decreased in both group A and B. But, At 6th month visit group A patients VAS scores showed sustained decrease but patients in group B VAS and WOMAC scores were risen after 6th month assessment.

Conclusions

PRF group is as effective as ICI to improve pain symptoms and functional outcomes. PRF group showed sustained effect on hemiplegic shoulder pain on long-term follow up in our study. Table 1. General feature statistics Note : Values represent the mean ± standard deviation. Abbreviations : ICI : intra-articular corticosteroid injection; PRF : pulsed radiofrequency; HSP : Hemiplegic shoulder pain; MMT : Manual muscle test; LOM : Limitation of passive range of motion; VAS : Visual analog scale; FAC(Functional ambulationi categories), MBC(Modified brunnstorm classification) Table 2. Clinical

outcomes after 3 months, 6 months for two groups Note : Values represent the mean \pm standard deviation. Abbreviations : Int. : Internal ; Ext. : External

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Characteristics		Baseline group	P-value(ICI&PRF*)	
Total	Age, years	57.95 \pm 8.7	0.472	
	Sex(M:F)	9:11	-	
	Months from HSP* onset	13.2 \pm 2.6	0.607	
	Stroke type (infarction : hemorrhage)	9:11	-	
	Involved side, right : left	10:10	-	
	MMSE	27.5 \pm 2.6	0.533	
	MBC	2.3 \pm 0.9	0.814	
	FAC	2.4 \pm 0.5	1.0	
	MMT*	Shoulder	1.9 \pm 0.6	0.512
		Elbow	2.6 \pm 0.6	0.269
		Finger	1.6 \pm 0.9	0.677
		Hip	2.0 \pm 0.6	1.0
		Knee	2.7 \pm 0.6	0.471
		Ankle	1.6 \pm 0.8	0.280
	Initial LOM* of shoulder	41.00 \pm 25.55	-	
	Flexion	Flexion	55.3 \pm 26.4	0.100
		Abduction	58.3 \pm 26.7	0.490
		External rotation	31.5 \pm 10.9	0.297
Internal rotation		21.8 \pm 7.3	0.121	
Initial pain, VAS*	6.1 \pm 1.2	0.385		

table2. Clinical outcomes after 3 months, 6 months for two groups Note : Values represent the mean \pm standard deviation. Abbreviations : Int. : Internal ; Ext. : External

		P-Value
Difference	Δ VAS, pain	0.064
	Δ Passive ROM	
	Flexion	0.479
	Abduction	0.596
	Ext. Rotation	0.089
	Int. Rotation	0.077

P 1-119

Comparison of the Effectiveness of Triamcinolone Versus Dexamethasone on Osteoarthritis of the knee

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Objective

This study is to compare the efficacy and side effects of intra-articular injection of Dexamethasone (DEX) in comparison with Triamcinolone (TA) in the treatment of knee joint inflammation in patients with knee osteoarthritis (OA) during 12 weeks after injection.

Design

49 patients with knee OA were enrolled and randomly assigned to either the DEX (n=19) or TA (n=30) group. The treatment effects estimated as visual analog scale (VAS) and Lequesne index were compared in 2, 4 and 12 weeks after the procedures.

Results

VAS and Lequesne index improved 2, 4 and 12 weeks after the injections in both groups. Statistical differences were not observed in VNS, ODI, or in the effectiveness of the procedure between the groups except after 2 weeks. There were significant better improvement in VAS in 2, 4 weeks after injection and Lequesne index at TA group in 2 week after injection ($P < 0.05$) Logistic regression analysis demonstrated Method of injection (DEX or TA group), sex, use of analgesics, pain duration, number of injections, and age were not independent variables for successful treatment Results.

Conclusion

There were no significant difference in 12 weeks after the procedure in both groups. But, TA is a non-soluble drug that can cause many complications due to particles of TA and TA also have toxicity to chondrocyte as following recent investigates. So, we recommend use dexamethasone at intra-articular injection in patients with Knee OA

Table 1. Comparison of VAS and Lequesne index in each group (TA & DEX group) from baseline to 2, 4, and 12 weeks after the last injection.

		Baseline	2 weeks	4 weeks	12 weeks
VAS	TA	6.97 ± 1.124	3.49 ± 1.067*	2.60 ± 0.695*	2.40 ± 1.193*
	DEX	7.11 ± 1.207	4.83 ± 1.014*	3.09 ± 0.742*	2.60 ± 1.035*
Lequesne index	TA	11.51 ± 1.541	6.69 ± 1.255*	4.20 ± 1.232*	4.14 ± 1.833*
	DEX	11.94 ± 1.626	7.89 ± 1.132*	4.60 ± 1.168*	4.34 ± 1.514*

Values are presented as mean ± standard deviation for continuous data. * $p < 0.05$: Comparison of each variable at a specific time point with that of baseline. TA, triamcinolone; DEX, dexamethasone

Table 2. Multiple logistic regression analysis for possible outcome predictors of effectiveness in injection at follow-up.

Factor	OR	95% CI	p-value
DEX vs TA group	0.912	0.424-1.961	0.813
Sex	1.523	0.622-3.725	0.357
Age	1.012	0.976-1.050	0.511
NSAID	0.787	0.364-1.699	0.541
Pain duration	1.382	0.630-3.033	0.420

OR, odds ratio; CI, confidence interval; TA, triamcinolone; DEX, dexamethasone; NSAID, nonsteroidal anti-inflammatory drugs.

Table 3. Comparison of VAS and Lequesne index between TA & DEX group from baseline to 2, 4, and 12 weeks after the last injection.

TA vs Dexa (inter-group comparison)	P-value	Mean difference
VAS(baseline)	0.610	-0.143
post 2wks	0.000*	-1.343
post 4wks	0.006*	-0.486
post 12wks	0.456	-0.200
Leq score(baseline)	0.262	-0.429
post 2wks	0.000*	-1.200
post 4wks	0.168	-0.400
post 12wks	0.620	-0.200

*p < 0.05: TA group have significant better improvement as much as mean difference
TA, triamcinolone; DEX, dexamethasone

P 1-120

The Relationship Between Cervical hypo-lordosis and Scoliosis

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Introduction.

Cervical hypo-lordosis is a condition in which the normal anterior curvature shifts posteriorly from its original position, Resulting in a straightening of the spine. Cervical hypo-lordosis and scoliosis are both usually caused by incorrect posture in general. However, there were only few studies concerning about the relationship between these two conditions. Therefore, we seek to find out if patients with cervical hypo-lordosis commonly also display scoliosis.

Methods.

In this study, we reviewed the plain films of 24 patients with cervical hypo-lordosis and 12 patients with scoliosis. The degree of scoliosis was measured by the Cobb's angle, and the degree of cervical lordosis was measured using the Harrison posterior tangent Method. The relationship between hypo-lordosis and scoliosis was analyzed using linear regression and bivariate analysis.

Results.

Five of the 24 patients (21%) with cervical hypo-lordosis displayed scoliosis. 7 of the 12 patients (58%) with scoliosis accompanied cervical hypo-lordosis. Although there were no statistically significant associations, there was a tendency to have both conditions if a patient was diagnosed with any one of them.

Conclusion.

Scoliosis was found to be more prevalent in patients with cervical hypo-lordosis than in the general population. Although statistical Results were not significant due to a small sample size, our Results showed that having one condition gives a tendency to have the other and vice versa. Therefore, when treating a cervical hypo-lordosis patient, we should consider rehabilitation programs for the whole spine rather than focusing on the neck.

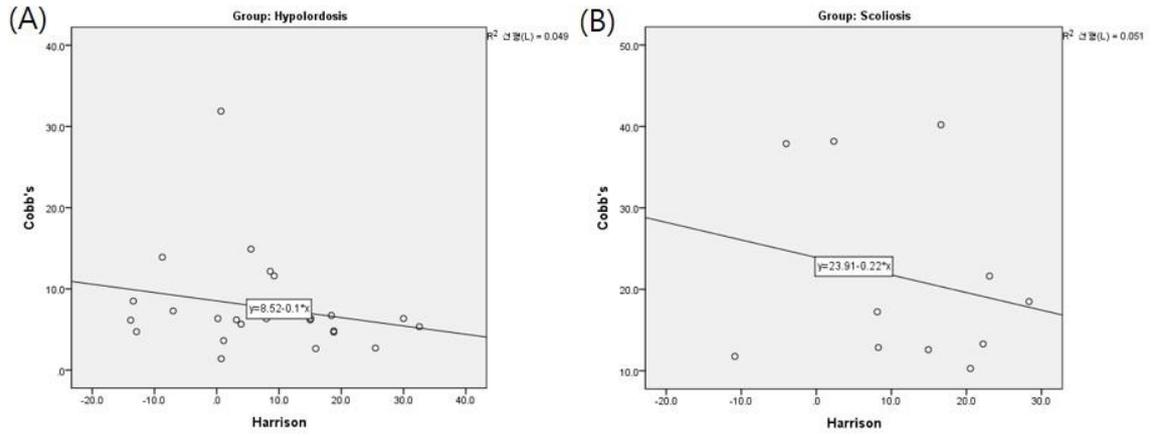


Figure 1. Scatter plot and linear regression of the Harrison posterior tangent angle versus the Cobb's angle. (A) Patients with cervical hypo-lordosis (n = 24). (B) Patients with scoliosis (n = 12).

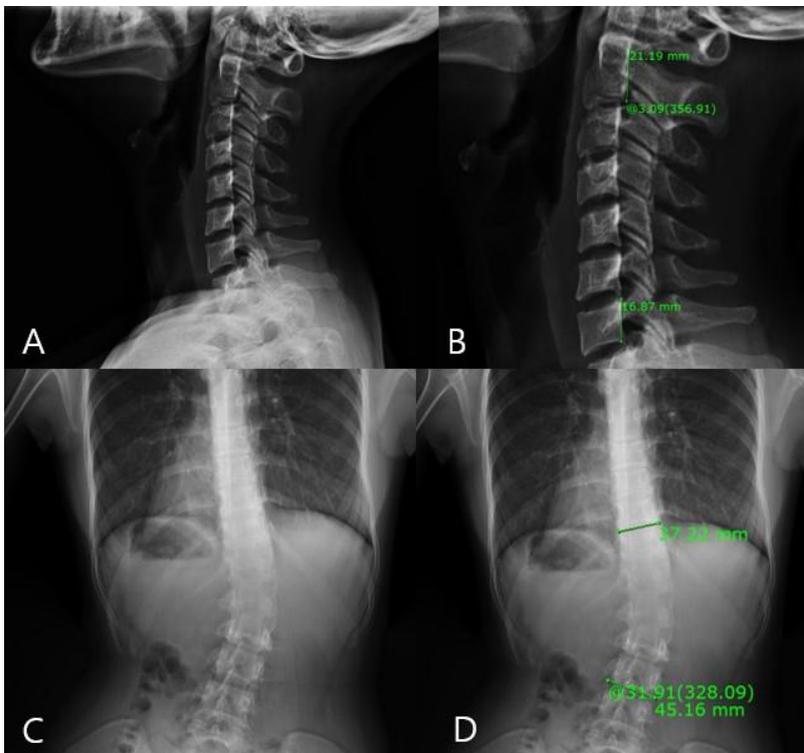


Figure 2. Cervical and thoracolumbar spine X-rays of a patient with cervical hypo-lordosis, also showing scoliosis. The Harrison posterior tangent angle and Cobb's angle are depicted in (B) and (D), respectively.

P 1-121

Correlation between functional status and psoas muscle area in patients with liver cirrhosis

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Objective

Liver cirrhosis is characterized by protein wasting, which causes muscle loss. Recently, there were many researches on the measurement of psoas muscle volume using computer tomography (CT) scan, but there was a lack of research on evaluation of functional status. We investigated the correlation between the psoas muscle area and functional status in patient with liver cirrhosis.

Methods

Among patients with liver cirrhosis who were admitted between January 2017 and July 2018, patients with no history of other diseases were included. The psoas muscle area (Figure 1) at the end plate level of L4 vertebra was measured in an abdominal axial CT scan image using Image J Fiji (Laboratory for Optical and Computational Instrumentation, University of Wisconsin-Madison, USA). Muscle strength and short physical performance battery (SPPB) were evaluated to measure functional status. Muscle strength was evaluated twice by dominant hand grip power and the average of two measurements was used. SPPB consists of three evaluation items : balance, gait speed, and endurance.

Results

Twelve subjects were included in this study and their demographic characteristics were investigated (Table 1). And psoas muscle area and functional status were evaluated (Table 2). The Pearson's correlation coefficient between psoas muscle area and dominant hand grip power was 0.858, which was statistically significant at the level of $p < 0.01$ (Figure 2). Psoas muscle area and SPPB score were statistically significant at the level of $p < 0.48$ in the Mann Whitney U-test.

Conclusion

In this study, we could find the correlation between psoas muscle area and functional status. Therefore, it is necessary to evaluate the functional status in patients with liver cirrhosis in order to recover functional status and muscle strength early.

table1. Demographic and general characteristics of the subjects

Characteristics ^o	Mean(range) or N(%) ^o
Age(yr) ^o	57.2(43-68) ^o
Sex ^o	^o
Male ^o	12(100) ^o
Female ^o	0(0) ^o
Height(m) ^o	1.68(1.56-1.74) ^o
Weight(kg) ^o	64.2(52.8-73.3) ^o
Body mass index(BMI) ^o	22.92(18.05-29.91) ^o
Child-Pugh classification ^o	^o
Class A ^o	6 ^o
Class B ^o	6 ^o
Class C ^o	0 ^o
Duration of liver cirrhosis(months) ^o	5(1-18) ^o

table2. Functional status of the subjects

Variables ^o	Mean(range) ^o
Psoas muscle area(mm ²) ^o	925.75(752-1441) ^o
Dominant hand grip power(kg) ^o	24(18-36) ^o
Short physical performance battery score ^o	9.6(9-11) ^o
Balance test score ^o	2.7(2-3) ^o
Gait speed test score ^o	3.7(3-4) ^o
Endurance test score ^o	2.9(2-4) ^o

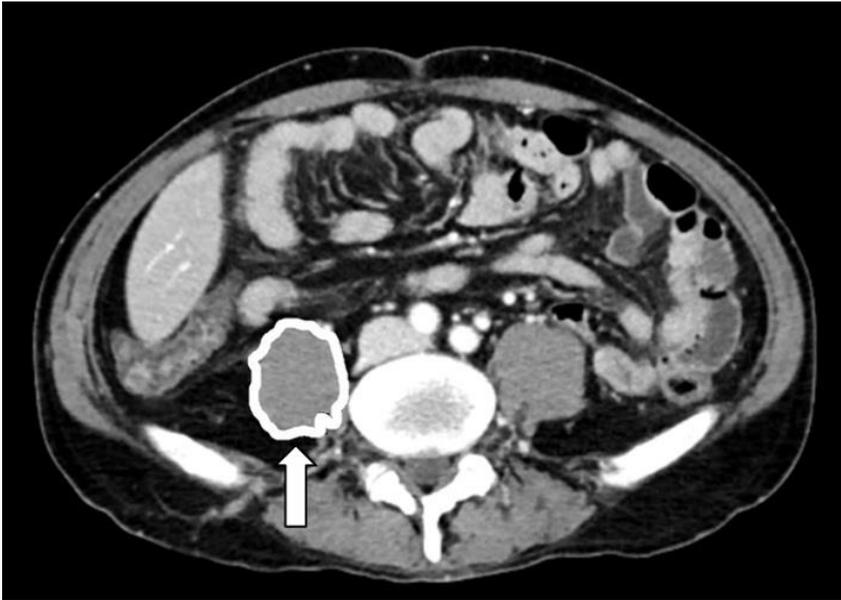


Fig. 1.

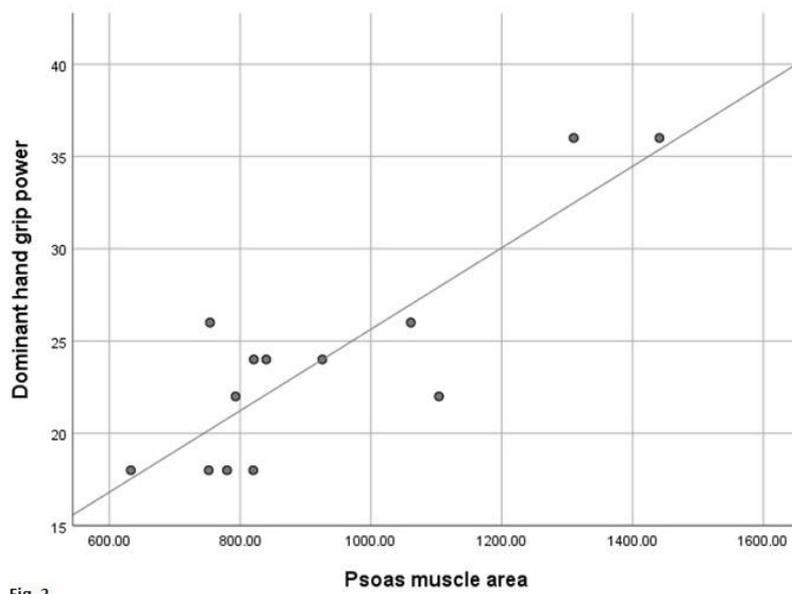


Fig. 2.

Fig 1. Measurement of psoas muscle area (arrow) at the level of endplate of L4 vertebra on an axial CT scan image using ImageJ Fiji

Fig 2. Correlation between psoas muscle area and dominant hand grip power

Clinical and USG Findings according to Steroid Injection in Patients with Epicondylitis

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Objective

Steroid injection is one of the common treatment Methods for lateral (LE) and medial epicondylitis (ME). The aim of this study is to compare the clinical and ultrasound findings of the clinical epicondylitis in the patients with LE and ME according to the previous history of steroid injection.

Materials and Methods

Two hundred and seventy-two elbows (75 men, 197 women; mean age, 52y; age range, 24–76 years) with LE (204 elbows) and ME (68 elbows) were divided into two groups; no steroid injection (143 elbows; 40 males, 103 females; mean age 51 years) and steroid injection (129 patients; 35 males, 94 females; mean age 52 years) (table 1). The clinical diagnosis of epicondylitis was based on the patient's symptoms and clinical signs in physical examination performed by a physiatrist. The criteria for epicondylitis included pain over the lateral and medial elbows that increased on palpation of the lateral and medial epicondyles and resisted extension and flexion of the wrist with the elbow extended. The number of previous steroid injection was divided into two groups (low; less than 3 times, high; more than 4 times). The clinical examination included pain during passive flexion and extension of elbow and resisted motions of wrist including flexion, extension, and radial and ulnar deviation. Visual analog scale (VAS) score was measured to determine the pain intensity of elbow. Ultrasound was performed by the other physiatrist who assessed the following abnormal ultrasound findings: the severity of tendinopathy (tendinosis, partial-thickness and full-thickness tear), cortical irregularity, increased vascularity by power Doppler signal, and intratendinous calcifications (figure 1). The Chi-square test and Mann-Whitney U test were used to evaluate the difference between two groups.

Results

The symptom duration, VAS score, painful motion score in steroid injection group (12.1+9.3 months; 6.6+1.7; 2.6+1.1) was significantly larger than that in non-injection group (5.2+8.3 months; 5.4+2.1; 2.2+1.2) ($p<.05$) (table 1). Abnormal ultrasound findings including cortical irregularity, increased vascularity, and calcifications in steroid injection group were significantly more common than those in no injection group ($p<.05$), but there is no significant difference of tendinopathy severity according steroid injection (table 2). The symptom duration in high steroid injection group was significantly longer than that in low injection group. However, there was no significant difference of other clinical and ultrasound parameters between high and low steroid injection group.

Conclusions

Our Results revealed that abnormal ultrasound findings in elbows with steroid injection were more commonly noted than those in elbows without steroid injection. Therefore, multiple steroid injections may influence negatively in echotexture of the common extensor and flexor tendons and epicondyles in patients with epicondylitis.

Table 1. Patient characteristics and clinical findings according to steroid injection in epicondylitis

	No steroid injection group (n=143)	Steroid injection group (n=129)	p value
Mean age (years)	143	129	0.660
Sex (male/female)	40/103	35/94	0.877
Affected side (right/left)	91/52	73/56	0.236
Type of epicondylitis (lateral/medial)	28/115	40/89	0.030*
Symptom duration (month)	5.17±8.3	12.11±14.2	0.000*
Number of steroid injection (≤3/≥4)		79/50	
VAS	5.4 ±2.1	6.6±1.7	0.000*
Number of painful motion	2.2±1.2	2.6±1.1	0.001*

Table 2. Ultrasound Findings according to steroid injection in patients with epicondylitis

Ultrasound finding	No steroid injection group (n=143)	Steroid injection group (n=129)	p value
Severity of tendinopathy (tendinosis/partial- or full-thickness tear)	95/47	88/42	0.817
Cortical irregularity	26	62	0.000*
Increased vascularity	31	71	0.000*
Calcification	42	71	0.000*

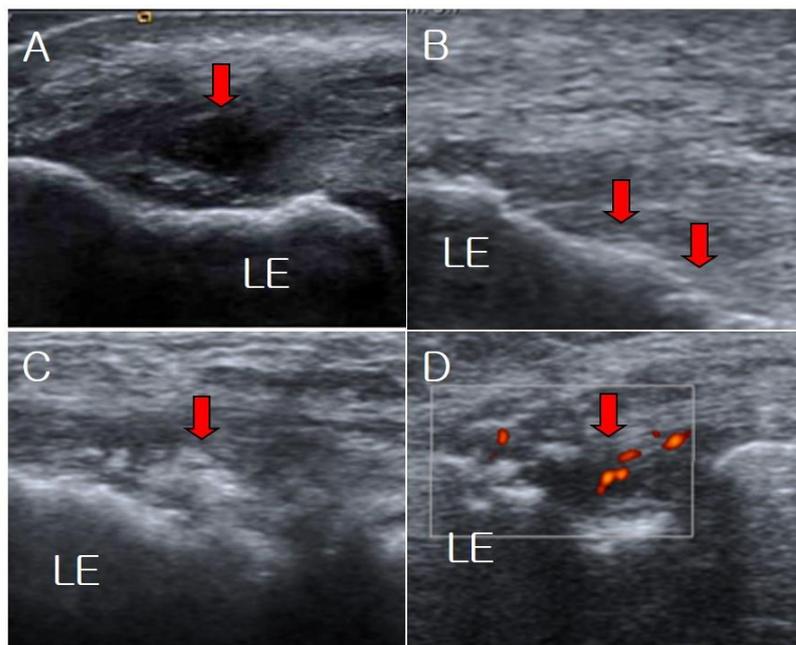


fig 1. Longitudinal ultrasound of lateral epicondyle showed partial-thickness tear of common extensor tendon (A), cortical irregularity of lateral epicondyle (LE) (B), intratendinous calcifications (C), and increased vascularity (D) of common extensor tendon on power Doppler

P 1-123

Effect of smart artificial leg on gait with transfemoral amputee

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Jeicheong Ryu⁴, Kang Hee Cho^{1,2†}

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Objective

The purpose of this study was to evaluate the gait abilities by applying a Smart artificial leg(power leg®) to the bilateral femoral amputee.

Subject & Methods

The subject was 48-year-old man who had wore Hydraulic artificial leg(3R80®, Ottobock®) with bilateral transfemoral amputation due to a industrial accident in september 2014. In this study, we compared the gait abilities with 3R80® and power leg® for one patient who has bilateral femoral amputation. The 3R80® is rotary hydraulic, Power leg® is a new Electronic artificial leg that recognizes bio-signals and walking intention through equipped sensor. He walked for 5 minutes at 1.5km/h after wearing each artificial leg. They were evaluated by using the foot pressure analyzer in the form of a treadmill(Zebris FDM®, Zebris Medical GmbH®, Germany) and respiratory gas analyzer(Cosmed K4B2®, Italy).

Results

The analysis of gait abilities showed that the power leg® had more symmetrical gait in the items of ankle rotation, step length, stance, double stance, and butterfly paragram between both limbs than the 3R80®(Table 1, Figure 1). The energy consumption analysis showed that the power leg® was superior in VO₂/kg(oxygen consumption), VCO₂/kg(carbon dioxide emission) and HR(heart rate) than the 3R80®(Table 2).

Conclusion

In this study, we analyzed the gait abilities between 3R80® and power leg®. We measured the foot pressure and energy consumption with each artificial leg. This Result showed power leg® is more symmetrical and superior in energy consumption than 3R80. We expect that this Result will be used as a data for the improvement of the artificial leg.

Table 1. Foot Pressure analysis of 3R80 and Power Leg

	Hydraulic artificial leg (3R80 [®])		Smart artificial leg (Power Leg [®])	
	Lt.	Rt.	Lt.	Rt.
Foot rotation, (degree)	-1.6 ± 0.9	5.4 ± 0.9	-0.1 ± 0.9	1.9 ± 0.8
Stride length, (cm)	77 ± 2		84 ± 2	
Step length, (cm)	31 ± 2	45 ± 1	39 ± 1	45 ± 1
Step width, (cm)	28 ± 1		27 ± 1	
Stance phase, (%)	69.1±0.8	72.2±0.5	68.4±2.0	67.9±1.4
Load response, (%)	22.7±0.6	18.6±0.7	19.3±0.6	16.9±2.4
Mid stance, (%)	27.8±0.6	30.9±0.8	32.0±1.3	31.7±2.2
Pre-Swing, (%)	18.6±0.7	22.7±0.7	17.0±2.4	19.4±0.7
Swing phase, (%)	30.9±0.8	27.8±0.5	31.6±2.0	32.1±1.4
Double stance phase, (%)	41.3±1.0		36.3±2.4	

Table 2. Energy Consumption of 3R80 and Power Leg

	Rest	3R80 [®]	Power Leg [®]	Reduction ratio
VO ₂ /Kg (ml/kg/min)	4.6	17.3	16.1	- 7%
VCO ₂ /Kg (l/min)	5.4	16.7	14.6	- 13%
HR (BPM)	92.4	127.9	121.3	- 5%

Butterfly Paramgram



Figure 1. Butterfly Paramgram of 3R80 and Power Leg

P 1-124

Short-term Walking Outcomes in Diabetic and Non-diabetic Unilateral Transtibial Amputees

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Background

The prevalence of diabetes and diabetic amputations is increasing. Patients with diabetes may have muscle atrophy, sensory deficits, depression, and cognitive impairment. Therefore, diabetes may influence walking ability after amputation.

Objective

This study compared short-term walking outcomes in diabetic amputees after prosthesis fitting to that in non-diabetic amputees.

Methods

We retrospectively investigated walking outcomes at 3 months after starting gait training with a prosthesis. Outdoor and indoor independent walking for 100 m without assistive devices was evaluated. Walking ability with a quadripod cane was also evaluated.

Results

At 3 months after gait training with a prosthesis, only 2/18 (11.1%) and 3/18 (16.7%) diabetic amputees were capable of independent outdoor and indoor walking without assistive devices, respectively. However, 21/26 (80.8%) and 24/26 (92.3%) non-diabetic amputees were capable of independent outdoor and indoor walking without assistive devices, respectively. With a quadripod cane, 7 (38.9%) and 9 (50.0%) diabetic amputees and 24 non-diabetic amputees (92.3%) were capable of outdoor and indoor walking, respectively. Outdoor/indoor walking outcomes without assistive devices or with a quadripod cane were significantly different between diabetic and non-diabetic amputees.

Conclusion

After 3 months of prosthesis training, significantly more non-diabetic amputees were capable of indoor/outdoor walking, compared with diabetic amputees.

P 1-125

Adjunctive Effect of Dynamic Balance Exercise in Patients with Knee Osteoarthritis

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Gwangju Veterans Hospital, Department of Rehabilitation Medicine¹

Objective

Patients with knee osteoarthritis have reduced balance ability and increased risk of falls associated with reduced strength of quadriceps muscles and lack of knee joint proprioception. Kinesthesia, balance and agility exercise has the purpose of improving joint stability, muscular recruitment and neuromuscular control. The purpose of the present study is to evaluate the effectiveness of balance exercise after intra-articular injection of hyaluronic acid (HA) in elderly patients with knee osteoarthritis.

Methods

30 patients with knee OA were enrolled in this study. The patients were randomly divided into two groups: Exercise after HA injection group (group A) and injection only group (group B). Both groups administered intra-articular HA injection and group A patients continued 20-session exercises for 4 weeks. The assessments were measured before injection and after 4 weeks treatment using the visual analog scale (VAS) for pain, the Western Ontario and McMaster University Osteoarthritis Index (WOMAC) for physical function, Berg balance scale (BBS), and computerized dynamic posturography using SMART Balance Master system (NeuroCom Inc., Clackamas, OR, USA) for balance function.

Results

There are no significant differences in the baseline characteristics and initial values between the two groups. In both groups, significant improvements in VAS, WOMAC and balance function were observed ($p < 0.05$). Compared between groups, exercise after HA injection group showed a significant improvement compared to HA only group in WOMAC (-11.5 ± 4.6 vs -7.3 ± 4.4 , $p < 0.05$) and computerized dynamic posturography (sensory organization test 7.0 ± 3.2 vs 3.7 ± 1.8 , $p < 0.05$; on-axis velocity left-right 0.3 ± 0.1 vs 0.1 ± 0.1 , $p < 0.05$; directional control left-right 6.0 ± 1.3 vs 3.6 ± 1.8 , $p < 0.05$).

Conclusion

It is suggested that balance exercise after intra-articular HA injection may result in improved balance function and physical function.

Effects of Smartphone Use on Craniovertebral Angle and Cranial Rotation Angle

Sang Hoon Jung^{1*}, JeeYoung Kim¹, Nami Han^{1†}, Seungjae Kang², Jaewoo Suh², Kiwon Kim², Jihwan Kim², Seoyoung Park², Kiyoon Baek², Subong Chae²

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Objective

Time to spend smartphones is increasing especially for young population who handles various kinds of tasks with smartphones. As increasing the convenience, side effects are considered with the prolonged smartphone use. The aim of this study is to find out the effects of smartphone use on posture of cervical spine and upper trunk in university students and to arouse their attention.

Methods

99 students (mean age 24.7 ± 1.6 years) who attend medical college and do not have any present illness or past history of musculoskeletal diseases were enrolled. They participated in a survey to get information about the current pattern of smartphone use. For the posture, craniovertebral angle (CVA) and cranial rotation angle (CRA) were measured in standing position (Figure 1). Pearson correlation analysis was done for the relation between time of smartphone use and posture. Participants are divided into two groups according to the hours of smartphone use (Group A, < 4 hours a day; Group B, ≥ 4 hours a day), and independent T-test was done to analyze the difference between two groups.

Results

Average hours of smartphone use was 4.23 ± 2.28 hours a day. 16% of the participants were concluded into a category of low risk and 9 % of high risk by the self diagnose scale of smartphone dependency. Hours of smartphone use had a negative correlation with CVA, on the other hand, no statistically significant correlation with CRA (Table 1). Between two groups, Group B had smaller angle of CVA than Group A with statistical significance. CRA tends to be larger in Group B, but had no significance (Table 2).

Conclusion

72.4% of the university students are using smartphones more than 4 hours a day, which is larger population compared with 54.8% in general population. It is needed to control the smartphone use because prolonged use of smartphone can lead the forward head posture, especially increase the flexion of lower cervical spine observed as decreased CVA.

Table 1. Correlation between hours of smartphone use and posture

		CVA	CRA
Hours of Smartphone use	Pearson correlation	-0.223	0.187
	p-value	0.027	0.065

CVA, Craniovertebral angle; CRA, cranial rotation angle

Table 2. Difference of Posture between Two Groups

Independent T-test	Group A (N=28)	Group B (N=70)	p-value
CVA	55.51	52.48	0.038
CRA	141.73	144.07	0.139

Group A, <4 hours a day; Group B, ≥ 4 hours a day; CVA, craniovertebral angle;
CRA, cranial rotation angle

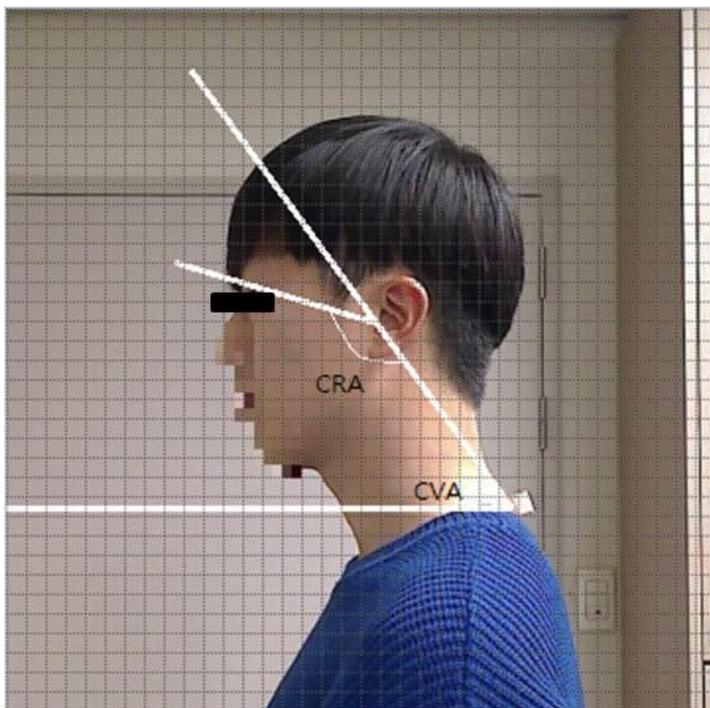


Fig 1. Craniovertebral angle (CVA) and Cranial rotation angle (CRA)

P 1-127

Relationship between grade of lumbar central canal stenosis and catheter advancement in neuroplasty

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Introduction

Percutaneous epidural neuroplasty (PEN) is a minimally invasive intervention in chronic back pain that is refractory to other conventional block. The procedure is performed with coccygeal approach or transforaminal approach. In this retrospective study, we aim to investigate whether catheter advancement can be affected by the grade of lumbar central canal stenosis in coccygeal approach.

Methods

Fourteen patients treated by PEN with coccygeal approach were enrolled in this study. We reviewed lumbar spinal magnetic resonance imaging to evaluate the grade of central canal stenosis (grade 0=none, grade 1=mild, grade 2=moderate, grade 3=severe) on every level of lumbar discs. We also reviewed fluoroscopy recordings of the procedure to confirm whether a catheter was able to be advanced up to the most stenotic lumbar level. Receiver operating characteristics curves were used to determine the cutoff values, and the area under the curve (AUC) was used to obtain the maximal degree of lumbar central canal stenosis of patients whose catheter was able to be advanced up to the most stenotic lumbar level with coccygeal approach.

Results

Each grade (i.e grade 1,2 and 3) of the most stenotic lesion was composed of 3, 4 and 7 patients, respectively. Catheter advancement was feasible in 3 patients of grade 1. Among 4 patients of grade 2, the catheter was reachable only 2 of them. Finally, among 7 patients of grade 3, the catheter was able to be advanced in only 2 patients. The cut-off value of catheter advancement was grade 2 of lumbar central canal stenosis (sensitivity=62.5%, specificity=83.3%, AUC=0.760) during PEN with coccygeal approach.

Conclusions

We found that it may be more difficult when the central canal stenosis is more severe (above grade 2). Although further study is needed, we suggest that it could be acceptable to perform PEN with transforaminal approach rather than coccygeal approach when a patient has moderate or more central canal stenosis.

Therapeutic Effect of Low-energy Extracorporeal Shock Wave Therapy on Painful Plantar Fibromatosis

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Introduction

Plantar fibromatosis is an uncommon benign, hyperproliferative disease of the superficial plantar fascia, leading to the formation of nodules. Therapeutically, conservative therapy is applied in early stage. In intractable cases, radiotherapy or surgery have been applied with substantial recurrence rates and impaired functional status. Extracorporeal shock wave therapy (ESWT) has been applied as a safe alternative treatment for intractable plantar fasciitis. Some previous studies showed ESWT could be therapeutically applied in plantar fibromatosis. The purpose of this study is to evaluate and compare the therapeutic effect of ESWT between plantar fibromatosis and plantar fasciitis confirmed by US.

Methods and Materials

Flow chart for inclusion of eligible subjects is shown in Figure 1. Medical records of 88 consecutive feet were retrospectively reviewed, who underwent ESWT for plantar fibromatosis (N= 15) and plantar fasciitis (N =73) confirmed by US. Plantar fibromatosis was confirmed when hypoechogenic echogenic nodule with elongated shape involving the superficial plantar fascia was shown on US. Plantar fasciitis was confirmed by Korean US diagnostic criteria as follows: 1. plantar fascia thickness > 3.8 mm; 2. difference of plantar fascia thickness between the symptomatic and asymptomatic foot >1.0 mm; or 3. hypoechogenicity in plantar fascia. ESWT was conducted weekly (0.06-0.12 mJ/mm²; 600-1000 shocks per session) when the Roles-Maudsley score (RMS) still showed "Poor" or "Fair" grade after conservative treatment. Subjective pain intensity was measured by Numerical Rating Scale (NRS) at immediate follow-up (one week after the last ESWT). A more than 50% reduction in the NRS score was regarded as treatment success. Statistical analysis. Repeated measured ANOVA was used to analyze the time effect on the NRS score for each group and their interaction effects. Comparisons of treatment success and failure between the two groups were achieved by chi-square test and Fisher's exact test, respectively.

Results

The basic characteristics of them were shown in Table 2. There were no significant differences between groups in baseline data. In the plantar fibromatosis group, the mean NRS score decreased from 5.4 up to 2.0 and in the plantar fasciitis, it did from 5.8 up to 3.0. Repeated measure ANOVA demonstrated that NRS significantly decreased after ESWT (time effect, $p < 0.001$) without time x group interaction effect ($p = 0.414$), indicating that ESWT equally decreased pain in both groups. Eleven feet (73.3%) in plantar

fibromatosis group and 44 feet (60.3%) in plantar fasciitis group were found to be treatment success, respectively.

Conclusion

Low-energy extracorporeal shockwave therapy reduced the subjective pain in plantar fibromatosis and its efficacy was not inferior to that of plantar fasciitis. Therefore, low-energy ESWT can be considered an alternative therapeutic Method for pain relief in plantar fibromatosis.

Table 1. Characteristics of subjects (n=88)

Characteristics	Plantar fibromatosis (n=15)	Plantar fasciitis (n=73)	p-value
Age (years)	49.4±10.4	52.9±10.9	0.252 ^{a)}
Sex			0.130 ^{c)}
Male	10	33	
Female	5	40	
Location			0.785 ^{c)}
Right foot	6	32	
Left foot	9	41	
Baseline NRS (score)	5.4±1.5	5.8±1.8	0.371 ^{a)}
Baseline RMS			0.386 ^{c)}
Poor	4	31	
Fair	11	42	
Total number of ESWT sessions	6.2±2.8	5.4±3.0	0.355 ^{a)}
Total duration of ESWT sessions (day)	68.1±35.3	55.5±36.7	0.225 ^{a)}
Duration of post-treatment soreness after first ESWT (day)	1.0 (0.0-1.0)	1.0 (0.0-3.0)	0.237 ^{b)}
Mean duration of post-treatment soreness (day)	1.4 (0.8-2.1)	1.2 (0.2-1.2)	0.889 ^{b)}
Diameter of plantar fibromatosis (mm)	7.1±3.5		
Thickness of plantar fascia (mm)		4.9±0.9	

Values are presented as mean±standard deviation or median (interquartile range).

NRS, Numeric Rating Scale; RMS, Roles-Maudsley Score; ESWT, extracorporeal shockwave therapy.

a)Student t-test, b)Mann-Whitney U-test, c)chi-sqaure test

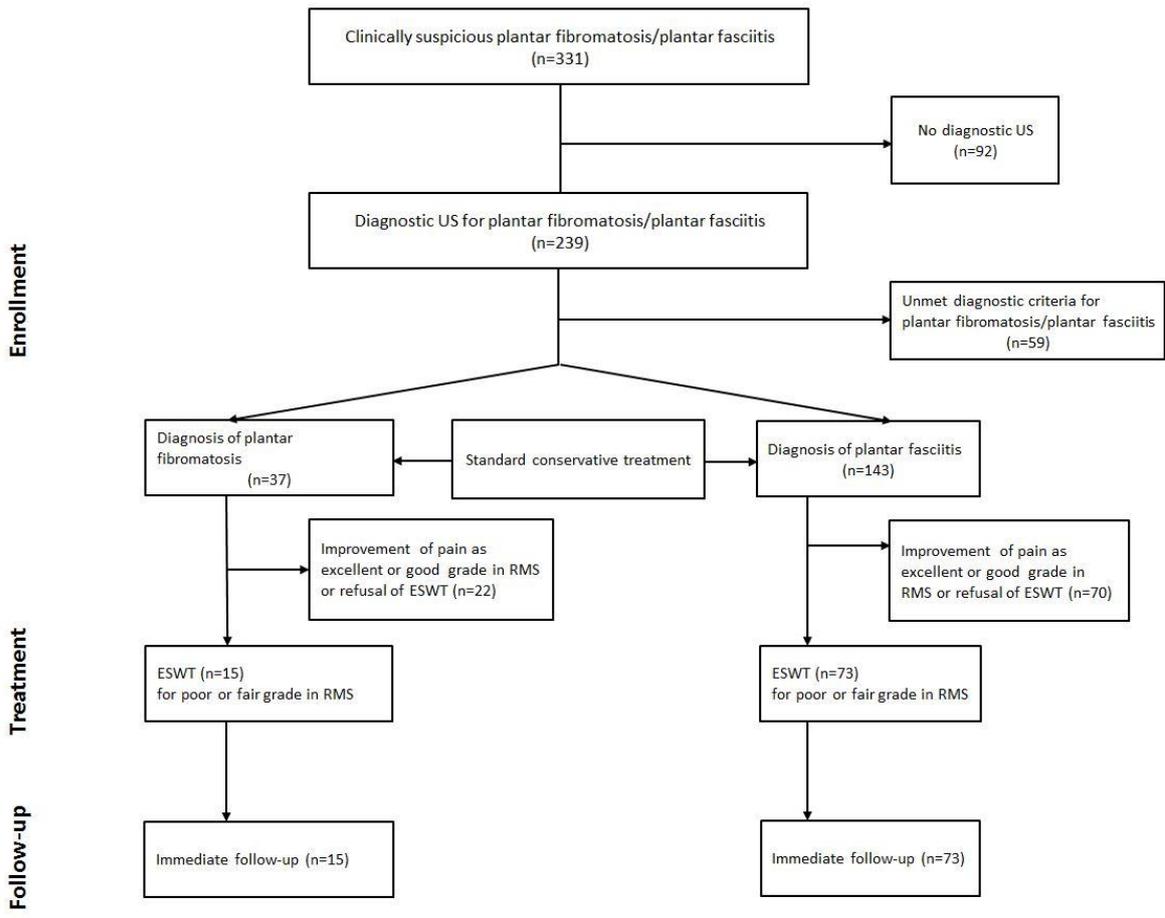


Figure1. Flow Chart for this study

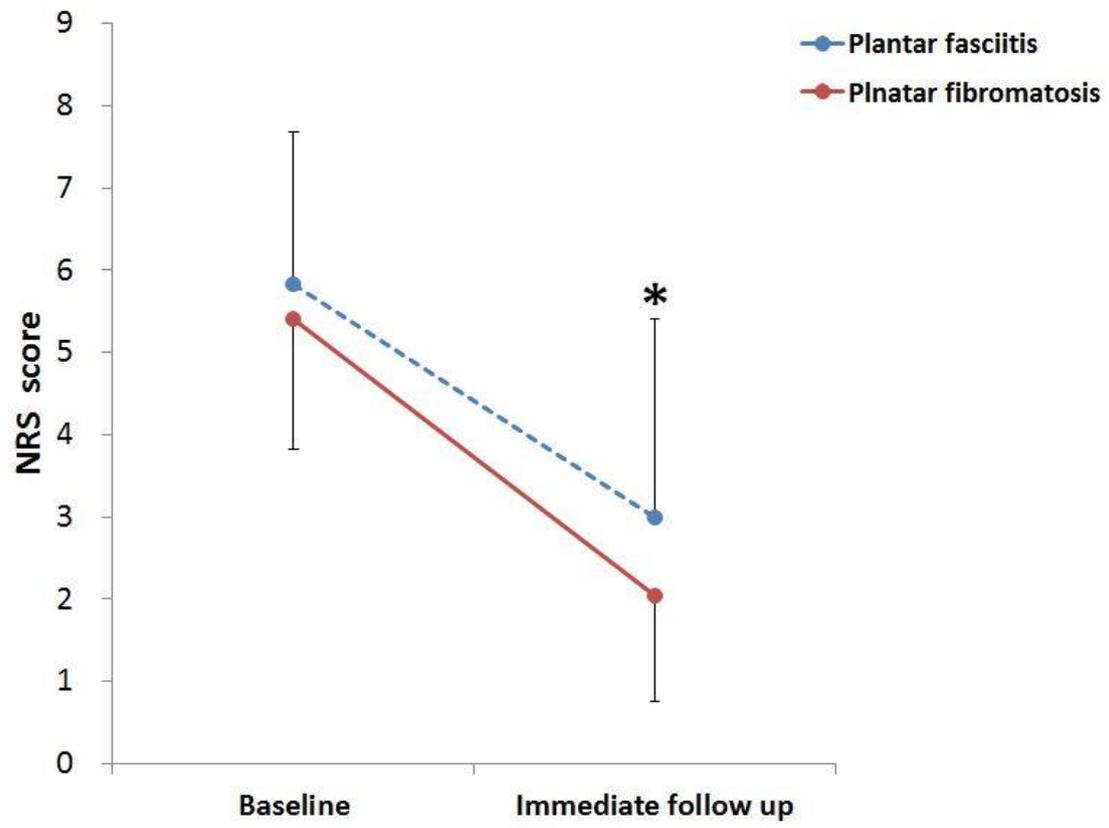


Figure2. The NRS improvement at immediate follow up as a primary outcome measure

P 1-129

Functional work capacity and sick leaves in Korean farmers

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Objective

Sickness absence is an important indicator of morbidity in occupational medicine. Functional work capacity evaluation is used as standardized tests to assess systematically a person's physical capacity to perform work tasks. We aimed to investigate physical abilities and sick leaves in Korean farmers.

Methods

A total 590 farmers were recruited. Functional work capacity including static strength, dynamic strength, and working speed were measured: static strength of hand grip and trunk flexion/extension; dynamic strength of pushing/pulling, lifting in 3 postures; working speed in 4 different tasks. Sick leaves were assessed by questionnaire phrased "Have you been absent from work during the past 1 year because of back pain?" The occupational role questionnaire (ORQ) was used to assess the impact of back in workers on productivity and satisfaction.

Results

All of functional work capacity items were negatively correlated with ORQ final score. Higher strength and fast working speed were significantly related with lower ORQ score. After adjusting for sex and age, trunk extensor strength were negatively related with sick leaves due to back pain.

Conclusion

In Korean farmer, higher functional work capacity were related with better work productivity and satisfaction. Weak trunk extensor strength was significantly related with sick leave regardless of sex and age.

Table 1. Characteristics of subjects (N=590)

	N(%)
Age group	
<50	76 (12.9)
50 to 59	230 (39)
60 or more	284 (48.1)
Sex	
Male	265 (44.9)
Female	325 (55.1)
Farming types	
Orchards	62 (10.5)
Dry fields	228 (38.6)
Rice	48 (8.1)
Greenhouses	252 (42.7)

Table 2. Functional work capacity evaluations

	Mean \pm SD
Static strength	
Hand grip strength, right (Kgf)	27.6 \pm 10.1
Hand grip strength, left (Kgf)	26.2 \pm 10.1
Hand grip strength, both (Kgf)	26.9 \pm 9.9
Hand grip strength, dominant (Kgf)	28.5 \pm 10.2
Trunk flexion strength (N)	263.2 \pm 88.4
Trunk extension strength (N)	260.9 \pm 93.3
Dynamic strength	
Pushing strength (N)	224.3 \pm 76.7
Pulling strength (N)	241.9 \pm 75.4
Lifting at floor (N)	485.7 \pm 205.9
Leg lifting (N)	415.8 \pm 228
Back lifting (N)	337.8 \pm 121.3
Mobility	
Ankle level task (Sec)	78.8 \pm 10.9
Elbow level task (Sec)	80.7 \pm 12.5
Elbow level twist task (Sec)	90 \pm 14.8
Eye level task (Sec)	82.2 \pm 14.7

Table 3. Functional work capacity and Occupational Role Questionnaire for Back Pain

	ORQ1	ORQ2	ORQ3	ORQ4	ORQ5	ORQ6	ORQ7	ORQ8	ORQ Productivity Score	ORQ Satisfaction score	ORQ Final score	SAQ1	SAQ2	SAQ3
Static strength														
Hand grip strength, right (Kgf)	-0.11 *	-0.16 **	-0.14 *	-0.19 **	-0.18 **	-0.21 **	-0.21 **	-0.17 **	-0.17 **	-0.21 **	-0.2 **	-0.1 *	-0.1 *	-0.08 *
Hand grip strength, left (Kgf)	-0.09 *	-0.12 *	-0.1 *	-0.17 **	-0.16 **	-0.18 **	-0.18 **	-0.16 **	-0.14 *	-0.19 **	-0.17 **	-0.08 *	-0.1 *	-0.07
Trunk flexion strength (N)	-0.1 *	-0.16 *	-0.14 *	-0.16 **	-0.12 *	-0.18 **	-0.15 *	-0.16 **	-0.16 **	-0.17 **	-0.17 **	-0.13 *	-0.12 *	-0.1 *
Trunk extension strength (N)	-0.16 **	-0.22 **	-0.21 **	-0.21 **	-0.18 **	-0.22 **	-0.23 **	-0.2 **	-0.23 **	-0.23 **	-0.24 **	-0.15 **	-0.03	0
Dynamic strength														
Pushing strength (N)	-0.08	-0.14 *	-0.14 *	-0.16 **	-0.15 *	-0.21 **	-0.17 **	-0.16 **	-0.15 *	-0.19 **	-0.18 **	-0.14 *	-0.06	-0.04
Pulling strength (N)	-0.06	-0.11 *	-0.12 *	-0.11 *	-0.11 *	-0.17 **	-0.14 *	-0.11 *	-0.12 *	-0.15 **	-0.14 *	-0.04	-0.07	-0.08
Lifting at floor (N)	-0.06	-0.11 *	-0.11 *	-0.11 *	-0.06	-0.17 **	-0.1 *	-0.13 *	-0.11 *	-0.13 *	-0.12 *	-0.02	-0.14 *	-0.12 *
Leg lifting (N)	-0.04	-0.09	-0.1 *	-0.09	-0.04	-0.14 *	-0.09	-0.08	-0.09	-0.1 *	-0.1 *	0.01	-0.13 *	-0.11 *
Back lifting (N)	-0.07	-0.12 *	-0.11 *	-0.11 *	-0.08	-0.13 *	-0.06	-0.07	-0.12 *	-0.09	-0.11 *	-0.04	-0.11 *	-0.07
Mobility														
Ankle level task (Sec)	0.15 *	0.14 *	0.08	0.11 *	0.13 *	0.13 *	0.14 *	0.15 *	0.14 *	0.15 *	0.15 *	0.04	0.01	-0.01
Elbow level task (Sec)	0.21 **	0.23 **	0.18 **	0.23 **	0.21 **	0.23 **	0.22 **	0.23 **	0.24 **	0.25 **	0.25 **	0.07	0.09 *	0.06
Elbow level twist task (Sec)	0.16 **	0.17 **	0.12 *	0.17 **	0.16 **	0.17 **	0.15 **	0.18 **	0.17 **	0.18 **	0.18 **	0.05	0.08 *	0.07
Eye level task (Sec)	0.18 **	0.17 **	0.15 *	0.19 **	0.18 **	0.18 **	0.18 **	0.19 **	0.19 **	0.2 **	0.2 **	0.04	0.05	0.04

* P value <0.05; ** P value <0.001

Spontaneous intraspinal hemorrhage: Three CASE REPORT

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Introduction

Spontaneous intraspinal hemorrhage is a rare condition that can be intramedullary, subarachnoid, subdural, or epidural. Because of its atypical and rarity symptoms varying from acute back pain to neurologic deficits, its prompt diagnosis is difficult. We report three cases of patients with spontaneous intraspinal hemorrhage with no traumatic injury. Case 1 A-93-year-old man experienced newly onset lower back pain with radiating pain in the L5 dermatome and no weakness. There was no history of recent trauma, and the use of anticoagulation drugs. MRI showed high signal intensity on T1WI and T2WI in the posterior subdural space at the T11-S2 level (Fig. 1). Based on these findings, a final diagnosis of spontaneous spinal subdural hematoma (SSDH) was made. Since he had no neurological deficit except pain, conservative management was chosen. At discharge, his symptoms were tolerable with pain medication. Case 2 A-81-year old man presented to the emergency department with acute onset radiating pain in the S1 sensory dermatome without history of trauma. On examination, he had a positive straight leg raise test on both side and no neurologic deficit. Lumbar spine MRI revealed a linear low to intermediate signal intensity mass, dorsal to the spinal cord, on both T1WI and T2WI at the L1-L2 level, and a fluid-fluid level of CSF space at the S1-S2 level. These lesions were enhanced (Fig. 2). As the imaging characteristics were suggestive of an idiopathic spinal subarachnoid hematoma (SSAH) and he was neurologically intact, he was treated with conservative therapies. A follow-up MR imaging study showed complete resolution of the SSAH at one month. Case 3 A-75-year old man presented with sudden onset both leg weakness and a numbness. Neurologic examination revealed motor weakness in lower limb (0-1/5 grade on both side). Impaired light touch sensation at both leg was noted. All reflexes were absent. Urinary retention was developed. Lumbar spine MRI and CT showed longitudinal epidural hematoma ranging from T11 to L2, which had clearly compressed conus medullaris (Fig. 3). Based on these findings, diagnosis of spontaneous spinal epidural hematoma (SSDH) was made. He underwent prompt surgical decompression and evacuation of the hematoma by hemi-laminectomy. Postoperatively, His proximal lower extremity strength improved (2-3/5 grade on both side).

Discussion

The clinical presentations of intraspinal hemorrhage can mimic lumbosacral radiculopathy or degenerative thoracic myelopathy. These cases highlight the need to be aware of intraspinal hemorrhage as a potential source of presenting with lumbosacral radiculopathy or degenerative thoracic myelopathy and careful MRI interpretation should be performed for proper diagnosis.

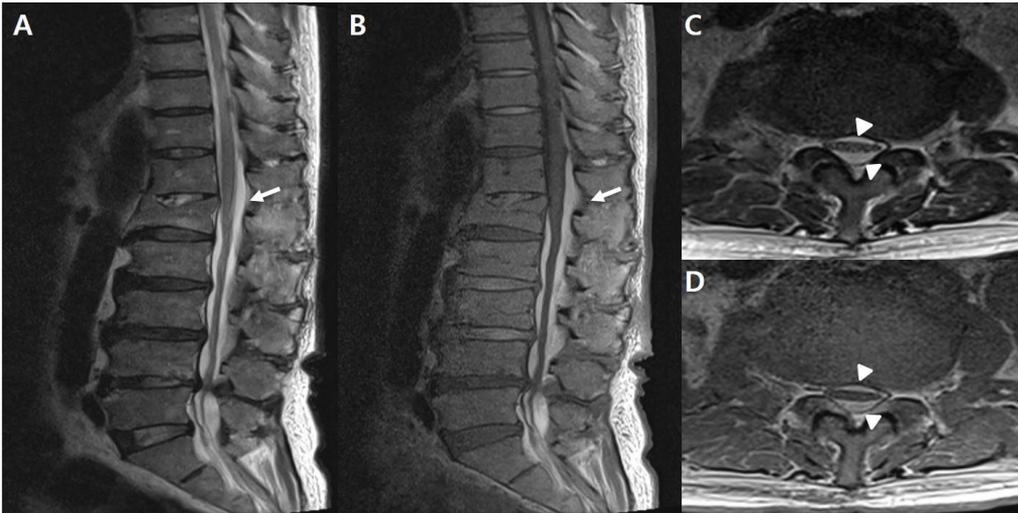


fig1. A linear high-signal intensity mass was showed in the posterior subdural space on T2-weighted (A) and T1-weighted (B) sagittal image at the T11-12 level (arrow). Axial T2WI (C) and T1WI (D) images showed high signal intensity mass (arrowhead) in ventral and dorsal to the spinal cord.



fig2. A linear low to intermediate signal intensity mass at the L1-L2 level with enhancement (arrow) and a Fluid-fluid level of CSF space at the S1-S2 level with enhancement (arrowhead) on T2-weighted (A,D) and T1-weighted (B) and enhanced T1-weighted (C,E) image.



fig3. T2-weighted (A,D) and T2-weighted images (B,E) showed longitudinal epidural hematoma ranging from T11 to L2, which had clearly compressed conus medullaris. Lumbar spine CT also demonstrated ill-defined longitudinal mass in the epidural space (black arrow)

Leiomyosarcoma of renal vein presenting as flank pain : A CASE REPORT

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Introduction

Primary vascular leiomyosarcoma is a very rare malignant neoplasm that arises from the smooth muscle tissue. Vascular leiomyosarcoma only accounts for 0.5% of all soft tissue sarcomas and the symptoms of venous leiomyosarcoma are often insidious and nonspecific because of its anatomical location and slow growth. Its low prevalence and atypical symptoms usually cause the tumors to grow large prior to detection. We report a rare case of leiomyosarcoma of the left renal vein found by an additional test while treating the flank pain.

Case presentation

A 52 year old female patient visited to our clinic with left flank and abdominal pain. The pain occurred one and half year ago and worsened from two months ago. She had a history of myomectomy 17 years ago and hysterectomy 1 year ago. Pain occurred more than 4 or 5 times a day without any special aggravating factor and it also happened at night. . It improved a little with the activity but aggravated in sitting long and resting time. The pain was a throbbing aspect, visual analog scale 6~7, and there was no tenderness at the left costovertebral angle. There were no systemic symptoms such as fever, myalgia and weight loss. In the local clinic, upper gastrointestinal endoscopy and colonoscopy were performed, but no particular findings were seen. In our clinic, left T11, T12, and L1 intercostal nerve blocks were performed three times and each injection seemed to relieved pain temporarily, but the pain became worse again and she couldn't take sleep well due to pain. Additionally, trigger point injection on left external and internal oblique abdominis muscles were performed but not effective. Abdomen-Pelvic Computed Tomography (APCT) was performed to confirm whether other problems were overlooked. APCT findings showed the diameter of the left renal vein was increased and there was a lobular enhancing mass of about 7cm extent inside. [Figure1] Intravenous leiomyomatosis was observed and leiomyosarcoma was suspected. Surgery was performed because it was considered that surgical resection was necessary under the cooperation of surgery and hematoncology department. In the surgical findings, there was about 7 cm mass adjacent to the left renal vein. Renal vein and artery were ligated after renal vein detachment and left kidney was resected. Leiomyosarcoma was identified in histologic biopsy. The patient did not complain of flank pain anymore. The chemotherapy and adjuvant radiotherapy have been performed since then.

Conclusion

Flank pain can be caused by a variety of causes. In particular, in this patient, the diagnosis was delayed because there was no suspicious symptom of systemic disease. Therefore, if there is no adequate improvement in the treatment of flank pain, it is necessary to consider other systemic disorders.



fig1. APCT findings showed dilated left renal vein (arrow head) and lobular enhancing mass in left renal vein (white arrow).

Thoracolumbar junction syndrome mimicking with renal artery stenosis: A CASE REPORT

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Flank pain is most commonly caused by one of three causes: urinary tract infection, kidney stone, and musculoskeletal problems like a muscle strain or pinched nerve. If there are abnormal image findings of genitourinary system, this will play an important role in diagnosing. However, similar pain can be sometimes caused by extraurinary abnormalities. The thoracolumbar junction syndrome, which is caused by the entrapment of anterior or posterior ramus from T10 to L2 spinal nerve, are commonly overlooked in the differential diagnosis of flank pain. We describe the case of a patient with flank pain, which was first considered as symptoms caused by renal artery stenosis but improved by the treatment of thoracolumbar junction syndrome. A 55-year-old man with left flank pain, rated as a 10/10 on the numeric rating system (NRS), for 1 week presented at the urology outpatient clinic. The patient has been taking a combination of angiotensin receptor blocker and calcium channel blocker due to hypertension for 5 years. He had an abdomen–pelvic computerized tomography (CT) for accurate diagnosis and found severe stenosis in the proximal part of left renal artery (Fig. 1). The laboratory data and plain radiograph of chest and abdomen were within normal limits. On DTPA scan, decreased function of left kidney was checked (Fig. 2). The patient was transferred to cardiology department for the intervention. Percutaneous transluminal angioplasty demonstrated proximal severe stenosis (80–90%) of left renal artery and stent was inserted. Although the pain was relieved after the stent insertion, rating as a 5/10 on NRS, the patient still felt pain on the same region. He was consulted to our department to manage the pain. On physical examination, he exhibited local hyperesthesia and pain by pinch and rolling on the skin over left flank compared with right side. Tenderness was observed in the paraspinal muscles at the thoracolumbar junction. Based on these findings, the patient was diagnosed with the thoracolumbar junction syndrome. The injections were conducted from left T9 to T12 paraspinal muscles with 0.5% lidocaine. After the injection, the patient reported an improvement in pain, rating a 2.5/10 on the NRS. He had 2nd injection again two days later and was discharged to home with improved clinical symptom. One week later, we confirmed that the flank pain completely disappeared at the outpatient clinic. In this case, the physician treated the cause of flank pain as the renal artery stenosis, but did not improve. The cause of persistent pain after stent insertion was due to thoracolumbar junction syndrome. It can be diagnosed through careful physical examination and is easy to treat simple injection therapy. There are many causes of flank pain containing intraurinary and extraurinary lesions. In diagnosing flank pain, thoracolumbar junction syndrome can mimic with other

intraurinary problem. For the accurate diagnosis, a detailed clinical examination is important.

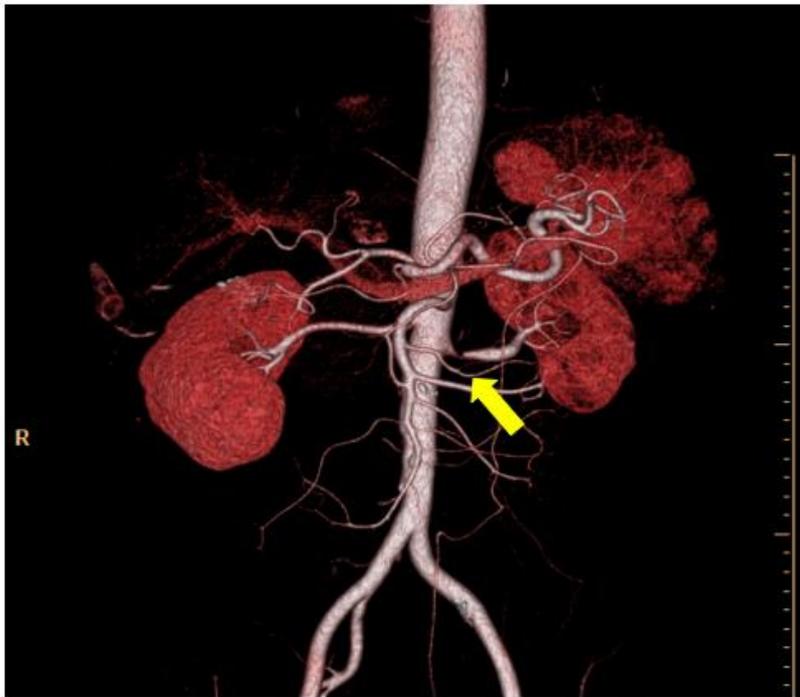


Figure 1. Abdomen renal angio CT showed focal severe stenosis in the left proximal renal artery(arrow)

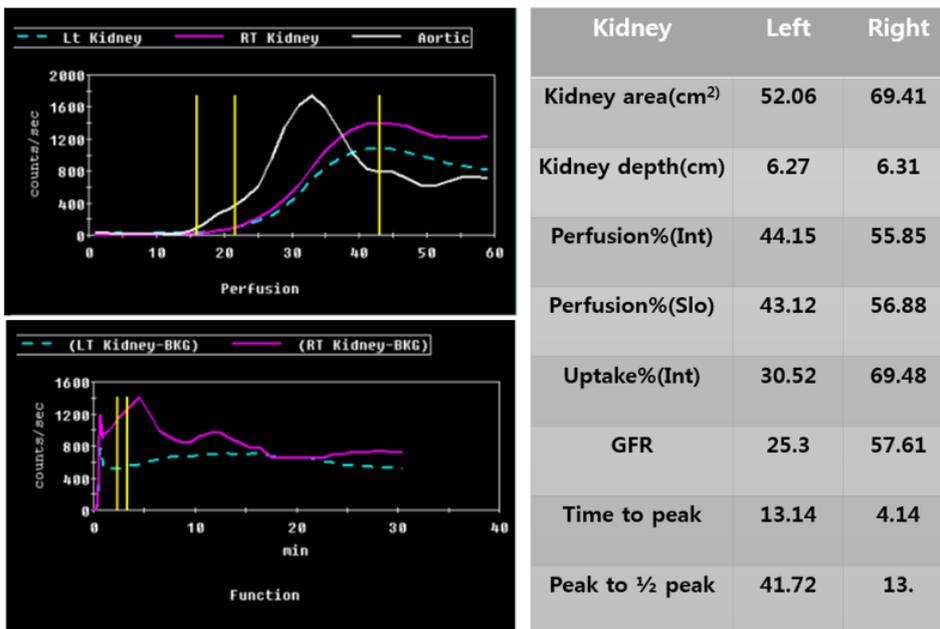


Figure 2. Tc- 99m DTPA diuretic renal scan demonstrated decreased GFR in left kidney.

CASE REPORT : May-Thurner syndrome initially presenting lymphedema without DVT

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Introduction

Unilateral leg edema can be classified into acute or chronic condition. The acute onset of unilateral leg edema is usually due to deep vein thrombosis (DVT), musculoskeletal problem or cellulitis. In this paper, we report a case of acute onset unilateral lower leg edema due to cellulitis in a young female; further work-up revealed leg edema as a clinical manifestation of venolymphatic overloading by May-Thurner syndrome (MTS) without DVT.

CASE REPORT

A 15-year-old woman visited lymphedema clinic of other hospital, presenting sudden heating sensation, swelling, redness, pain in the left thigh. There was no specific history and no drug use. The body temperature was 37.5°C and initial blood test showed a slight increase of white blood cell count and definite increase of high-sensitivity C-reactive protein. No significant stenosis/occlusion of both lower extremity arteries and DVT were observed on femoral computed tomography (CT) angiography. The femoral CT angiography revealed reduced diameter of left common iliac vein (CIV). In previous hospital, she was clinically diagnosed as cellulitis and discharged after 7 days of IV antibiotics (cefazolin + clindamycin). After 1 month of discharge, she visited our lymphedema clinic, suffering from increased left thigh edema and worsening pain of left leg. She felt pain at weight bearing of left leg. The volume of the left lower limb was 8382ml, which was 1582ml (23.26%) more than the right side. We performed duplex scan and pelvic venography. In the duplex scan, DVT was not observed and abnormal backflow from external iliac vein to internal iliac vein was detected. The pelvic venography revealed compression of left CIV by the right common iliac artery (CIA). It was a nearly complete obstruction accompanied with multiple collateral vessels around the CIV. Additionally, a 4 mmHg pressure gradient was observed between the inferior vena cava and the left CIV. Such overall findings were suggestive of MTS. Lymphoscintigraphy showed ilioinguinal lymph nodes on both inguinal area and dermal backflow at the left upper thigh. The patient underwent two weeks of complex decongestive therapy. The volume of left leg was reduced to 8018ml, which indicated volume reduction of 364ml compared to the initial measurement. Pain of left leg gradually faded, as the volume of left leg declined.

Conclusion

The MTS is a compression of extrinsic venous system by arterial system. It leads to focal stenosis at intersection of left CIV and right CIA. This syndrome is often accompanied with

DVT. But we report a case of MTS initially presenting lymphedema and cellulitis without DVT. It is meaningful in that lymphatic overloading caused by CIV obstruction damages lymphatic systems, followed by lymphedema. When treating lymphedema patients, it is necessary to consider phlebolymphe-
dema, swelling due to chronic venous insufficiency and lymphatic insufficiency.

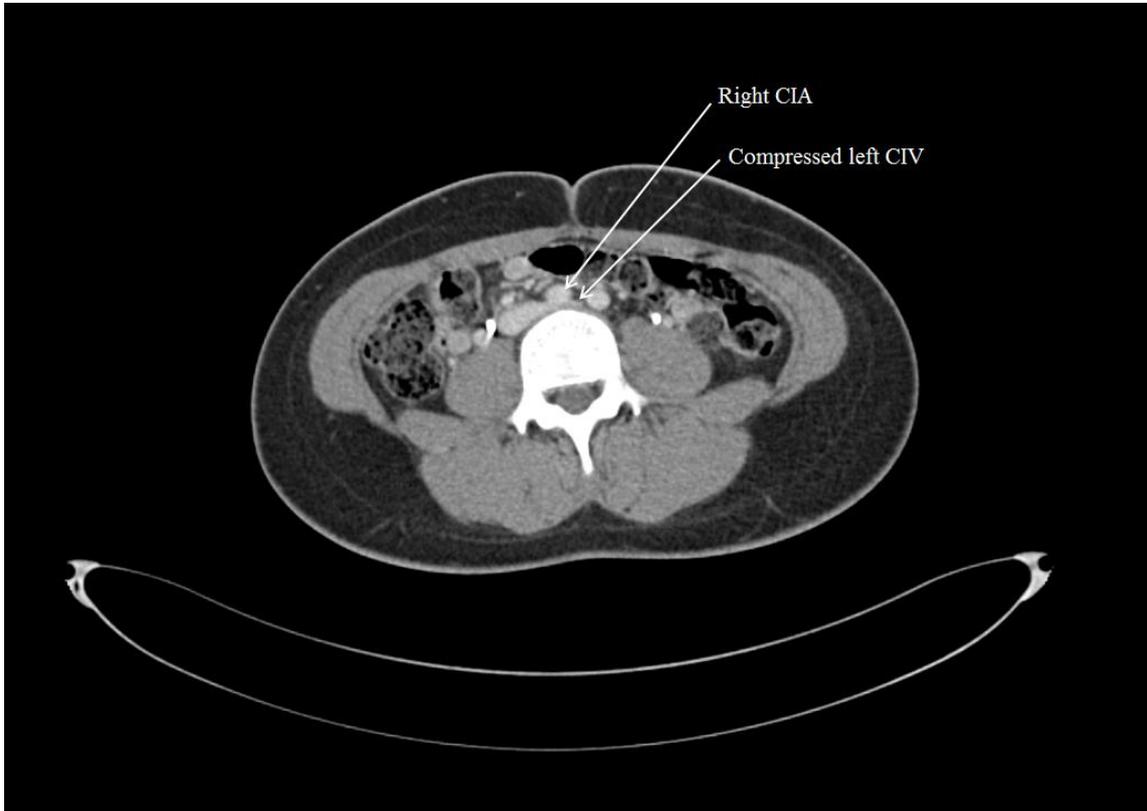
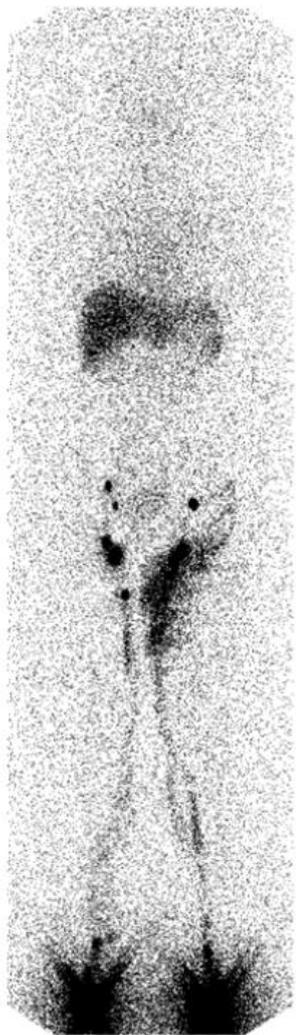
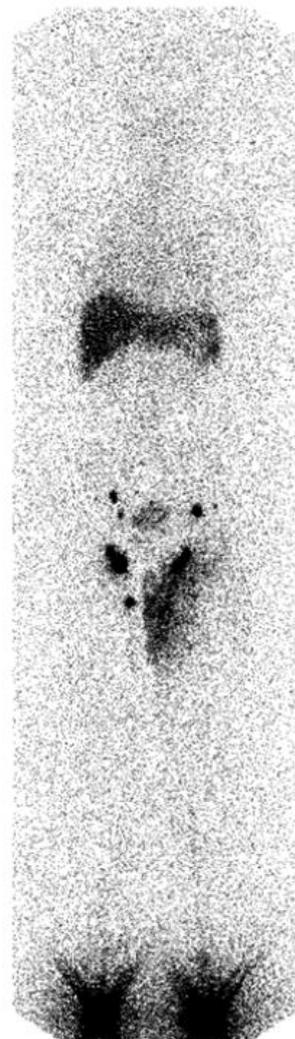


Figure 1. Diameter of left common iliac vein is reduced. Suspected of compressed by right common iliac artery. CIV : common iliac vein, CIA : common iliac artery



ANTERIOR 10MIN



ANTERIOR 60MIN

Figure 2. Dermal backflow was observed in the left upper thigh. ilioinguinal lymph nodes were observed on both sides.



Figure 3. Pelvic venography showed near complete obstruction and multiple collateral vessel development of the left common iliac vein.

Therapeutic Effect of Mental Imagery on Phantom Limb Pain in Patient with Shoulder Disarticulation

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Background

The majority of lower limb amputations are performed in cases of vascular insufficiency. However, the upper limbs amputation typically Result from traumatic injury and are characteristically sustained by young adults in good health. Phantom limb pain (PLP) are common amongst individuals with acquired upper limb amputations. Despite these rates of prevalence, there are neither recognized standard guidelines nor clear-cut pharmacologic or non-pharmacologic procedures to treat this pathologic condition and unfortunately phantom limb is often refractory to many treatments. The mental imagery or phantom exercises, are very practical, and do not require any clinical equipment. The fact that this Method could be used almost anytime and anywhere as it is a relatively simple an inexpensive Method that patients learn quickly. There has been a little reports about the therapeutic Results of mental imagery on PLP. We reported our experience that the effect of mental imagery on the PLP in patient with shoulder disarticulation.

CASE REPORT

A right-handed 24-year-old male patient underwent left shoulder disarticulation surgery secondary to traffic accident Resulting in a poor blood supply to entire left arm. The residual limb/shoulder girdle had healthy skin without scar or graft tissue. The patient was fitted a passive prosthesis with harness (Figure 1) for suspension considering his independence without prosthesis. He complained abnormal sensation on amputated arm. He did not respond to any pharmacological therapy. We planned mental imagery therapy program. The therapy program was made to reduce PLP. It had been enforced with mirror therapy & imagery treatment, six times a week and went through a 40-minute treatment period. The patient learned to concentrate on sensations from each area of the body consecutively, including the phantom arm and hand. He had a 10 minutes relaxing time before starting the therapy program (mental imagery treatment, mirror therapy) and did therapy session for 30 minutes to make a movement of amputated limb. We supplied therapy program consists of 8 movements to make various movement and offered some Objects (e.g. stacking cone, tennis ball) to the client to make grasp pattern easily (Figure 2). Daily, we checked pain intensity was assessed by Numerical rating scale (NRS): to measure intensity of pain (0 = no pain to 10 = worst pain imaginable) and also, we obtained the information about pain nature and pain site by questionnaire (Table 1). After program, the pain site was localized on the distal part of arm and pain intensity was improved from NRS 7 to 2.

Conclusion

We think that the mental imagery program is a good potential adjunct to current treatment Methods to improve the PLP in patient with shoulder disarticulation.

Table 1. The Results of pain questionnaire

Session	time	Pain site	Pain nature	Pain intensity
First session	1week	Dorsal, Palm, Forearm	Compressive, cramping sense	7
		Dorsal, Palm, Elbow(medial)		7
		Dorsal, Palm, Elbow(medial)		7
		Dorsal, Palm		6
		Dorsal, Palm, Elbow(above)		6
		Dorsal, Palm, Forearm		5
		Palm		6
Secnd session	2week	Dorsal, Palm	Compressive, cramping sense	6
		Wrist		7
		Dorsal, Palm		6
		Dorsal, Palm		5
		Dorsal, Palm, Elbow(medial)		5
		Dorsal, Palm, Wrist		5
		Dorsal, Palm		4
	3week	Palm, Wrist	Compressive, cramping sense	4
		Palm, Dorsal (thumb~index)		3
		Dorsal		3
		ulnar part(dorsal&ventral)		4
		Palm		3
		Palm, Forearm (lateral)		3
		Dorsal, Palm, Elbow(medial)		3
Last session	4week	Palm	Compressive, cramping sense	3
		fingers, radius part (medial)		3
		Palm		2
		Palm(Thumb part), Elbow(medial)		2
		Dorsal, Palm,		2
		Palm(Thumb part)		2
		Palm, Dorsal (Thumb, Little finger part)		2



Figure 1. Clinical presentation of shoulder disarticulation and passive prosthesis with harness for suspension



Figure 2. Mental imagery program on the phantom limb pain

Immune checkpoint inhibitor (ICPI)-related GBS: a CASE REPORT

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Introduction

Immune checkpoint inhibitors (ICPI) therapy provokes human natural immune system to fight cancer. In case of pembrolizumab, programmed cell death 1 (PD-1) blockade Results in reduced inhibition of peripheral regulatory T cells, which allow for self-tolerance. It frequently induces variable immune-related adverse events including neuromuscular disease such as myasthenia gravis, Guillain-Barre's Syndrome (GBS) and chronic inflammatory demyelinating polyneuropathy. We describe a case of GBS as ICPI-related adverse event.

Case presentation

A 68-year-old man with non-small cell lung cancer was started on immunotherapy after disease progression following 4 cycles of paclitaxel and carboplatin. He received pembrolizumab for 3 cycles. Two weeks after the 3rd cycle of pembrolizumab, he was referred our emergency room for fever reached 38.5 °C with elevated acute phase reactants. On the day after admission, he complained of both legs weakness and was unable to stand without assist. There was no obvious lesion or finding that could explain his progressive weakness on brain MRI. Lumbar spine MRI demonstrated linear enhancement in leptomeningeal surface of spinal cord and cauda equina without nodularity suggesting leptomeningeal seeding or GBS (Fig 1). Lumbar puncture revealed elevated protein of 771 mg/dl and cytopathology in cerebrospinal fluid identified no malignant cells. On motor nerve conduction study, amplitudes of compound muscle action potential of right median nerve and right ulnar nerve were decreased with delayed distal latency and conduction velocity, respectively. No motor nerve potential was recorded in both peroneal and both posterior tibial nerve. Also, no sensory nerve action potential was evoked in right median, right ulnar and both sural nerve as well as loss of F-waves of right ulnar, both peroneal and both posterior tibial nerve (table 1). With the above findings, we presumed GBS, immune-related adverse event secondary to pembrolizumab. He received intravenous immunoglobulin (IVIg; 0.4g/kg/day) for 5 days and oral prednisolone beginning at 2mg/kg/day followed by 4-week tapering course. At discharge 31 days after onset, he had regained antigravity strength in his proximal lower extremities, but retained weakness in distal lower extremities.

Conclusion

GBS is the second most common ICPI-related neuromuscular complication, but the exact mechanism by which ICPIs induce GBS is unclear. ICPI-related GBS follows the typical clinical presentation, course and electrophysiologic characteristics of non-ICPI associated GBS. The development of new drugs can give rise to an unexpected adverse event

although it is not common. The early participation of neuromuscular specialists able to expedite these problems will become increasingly important.

Table 1. Results of nerve conduction study

	Latency (ms)	Amplitude (uV/mV)	Conduction velocity (m/s)
SENSORY			
Median, Rt			
Finger	NR	NR	
Wrist	NR	NR	
Elbow	2.8	1.13	43
Ulnar, Rt			
Finger	NR	NR	
Wrist	NR	NR	
Elbow	3.0	3.96	41
Sural			
Rt	NR	NR	
Lt	NR	NR	
MOTOR			
Median, Rt			
Wrist	3.5	1.25	
Elbow	11.0	0.45	32
Axilla	15.1	0.35	34
Ulnar, Rt			
Wrist	3.1	0.69	
Elbow	9.5	0.41	40
Axilla	14.1	0.26	36
Peroneal, Rt	NR	NR	
Peroneal, Lt	NR	NR	
Tibial, Rt	NR	NR	
Tibial, Lt	NR	NR	



fig1. Fat Suppressed Contrast-Enhanced T1-Weighted Sagittal MRI image shows linear enhancement along the spinal cord surface including cauda equina.

Intraneural leiomyoma in radial nerve: a CASE REPORT

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Introduction

Leiomyomas arising from peripheral nerves are not common. We describe an unusual case of intraneural leiomyoma involved the radial nerve.

Case presentation

A 38-year-old man presented with extensor side weakness and pain of the right forearm for 8 months. At first, weakness of right wrist extensor occurred suddenly without trauma and 1 month later pain was accompanied by weakness. On manual muscle strength test, muscle strength of right wrist extensor was 2/5, and those of extensor digitorum communis, extensor indicis proprius, abductor pollicis longus, extensor pollicis longus were zero. There was hypesthesia in first web space of the right hand dorsum. On nerve conduction study, both sensory nerve action potential and compound muscle action potential were not recorded in right radial nerve. On needle electromyography, there were abnormal spontaneous activities in right brachioradialis, extensor carpi radialis longus, supinator, extensor digitorum communis, extensor indicis proprius, extensor carpi ulnaris. There were reduced recruitment patterns in right brachioradialis, extensor carpi radialis longus, supinator and no motor unit action potential was observed in extensor digitorum communis, extensor indicis proprius, extensor carpi ulnaris. His humerus MRI image showed T2 high signal intensity at radial nerve from right brachial plexus cord level to the posterior interosseous nerve branch and about 8mm sized intraperieural nodular lesion at midshaft level with T1/T2 isointensity (Fig. 1-A). He was referred to plastic surgeon for mass excision and nerve graft. Histologically, within the nodular area there was a lesion expanding the nerve composed of relatively circumscribed, spindle and paucicellular tissue arranged in fascicles surrounding the nerve bundles and it was consistent with leiomyoma (Fig. 2). After 1 year, there were improvements in muscle strength and hypesthesia, albeit not normal. Follow-up MRI (Fig. 1-B) and electrodiagnostic study also showed interval improvements of right radial neuropathy.

Conclusion

Despite the leiomyoma of peripheral nerve is rare, it could be considered as differential diagnosis in painful non-traumatic weakness suggesting mononeuropathy.

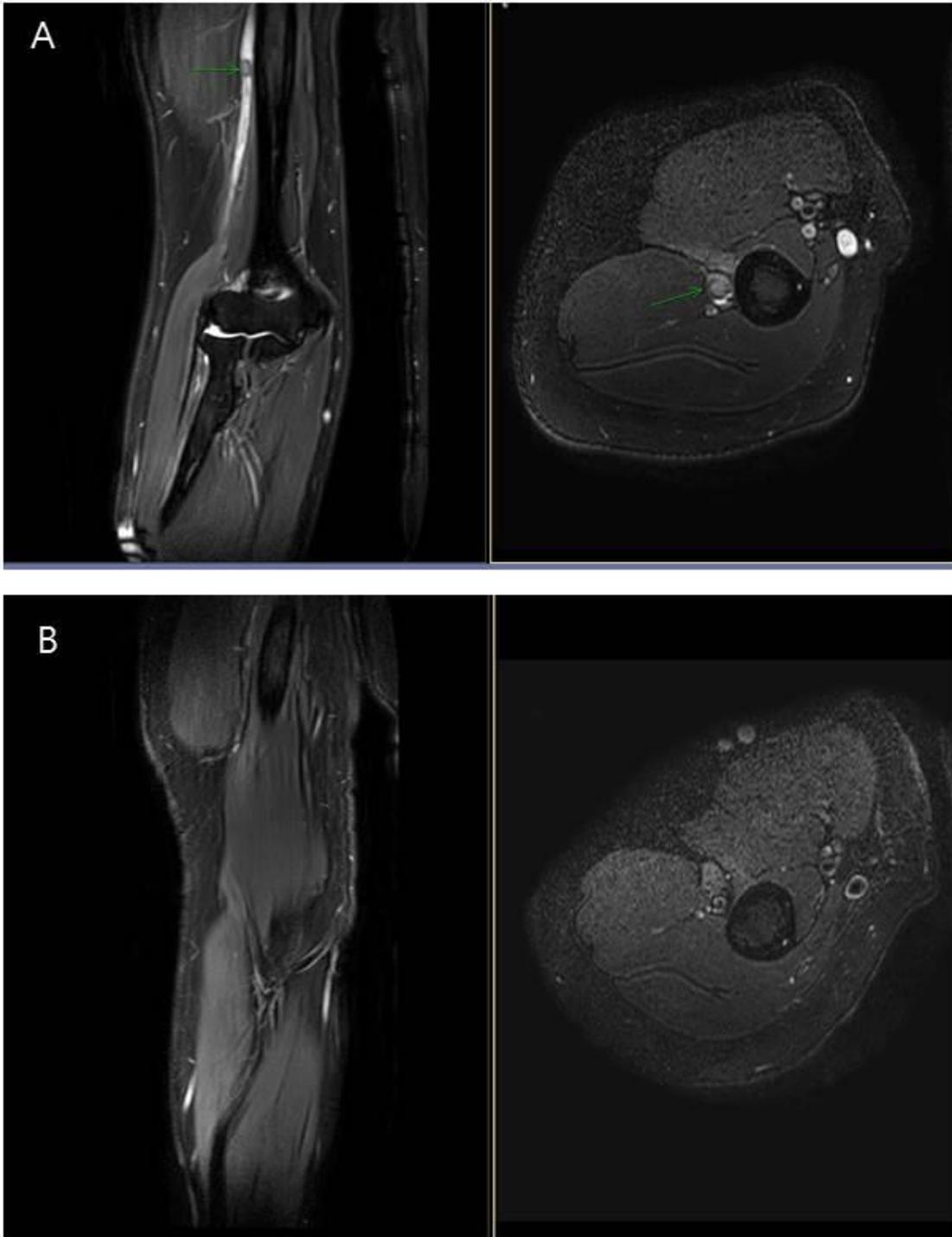


Fig1A. Initial Fat Suppressed Contrast-Enhanced T2-Weighted MRI image shows intraperineural nodule at midshaft level of right humerus with high signal intensity of radial nerve.
Fig1B. There is interval improvement of right radial neuropathy on follow-up Fat Suppressed Contrast-Enhanced T2-Weighted MRI image 1 year after surgery.

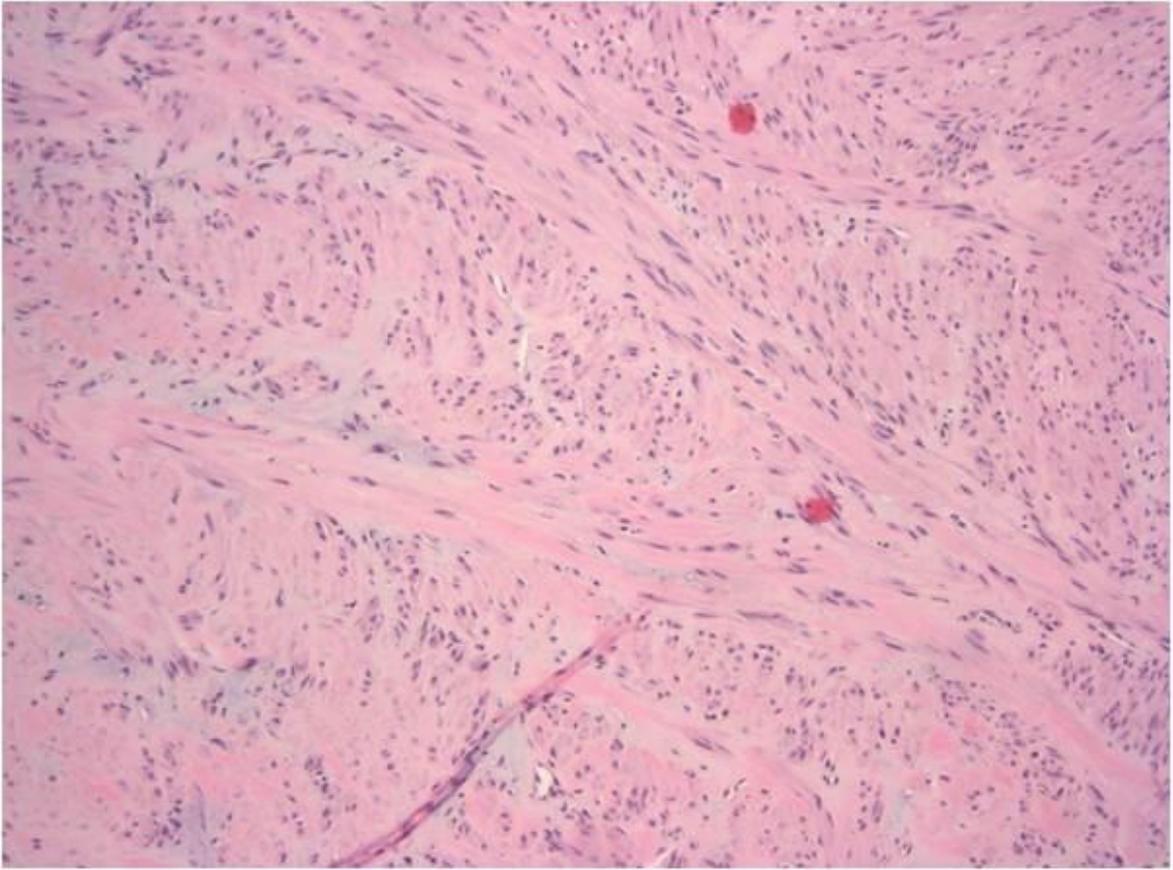


Fig 2. Microscopic appearance of the tumor.

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Combined Ultrasound and Nerve Stimulator Technique for Injecting the GFN in a Patient with CPIP

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Inguinal hernia repair is one of the commonly performed surgical procedures. But chronic postoperative inguinal pain (CPIP) is one of the major complications in patients with inguinal hernia repair. The quality of life in the patients with CPIP is very low due to inguinal pain. We report the treatment of CPIP after inguinal hernia repair using combined ultrasound and nerve stimulator technique for injection of genitofemoral nerve (GFN). A 59-year-old man was diagnosed with left inguinal hernia and performed Laparoscopic hernia repair - Totally extraperitoneal on February 20, 2017. The patient developed pain from the left inguinal area to the scrotum from the beginning of March, and then underwent conservative treatments, including ultrasound (US)-guided nerve block of ilioinguinal nerve (3 cycles) and GFN (1 cycle) block and medication, were performed in pain clinic but the pain persisted. But he suffered a sustained inguinal pain. Therefore, we used nerve stimulator to increase the accuracy of the neural approach. Scrotal contraction and paresthesia on the GFN distribution were confirmed by nerve stimulator after the approach of GFN with ultrasound. This procedure yielded symptom relief. In a follow-up of five-month, he was very satisfied with the treatment because he didn't have any pain and medication. Ultrasound nerve blocks are commonly performed, but the Results may not be satisfactory. Nerve stimulator allows for selective nerve block and greatly enhances the technical ability to perform precise localization and injection. The use of combined ultrasound and nerve stimulator injection technique are an effective and non-invasive approach to treat CPIP.

Pain relief of chest wall pain by electrical twitch obtaining intramuscular stimulation

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INTRODUCTION

Muscle related chest wall pain (CWP) is generally develop under the condition of excessive or sudden activity of untrained muscles. Although pain originating from muscle strain subsides in most cases with conservative management, sometimes pain lasts longer than several days and became intractable. Anatomic characteristic of intercostal muscles which are limited of motion by the skeleton of the thorax, it is difficult to apply physical therapy. In the following three cases, we report the effective pain relief by electrical twitch obtaining intramuscular stimulation (ETOIMS) in patients who experienced no improvement after conventional management of CWP.

CASE REPORT

We report three patients who had chronic chest wall pain originating from intercostal muscle strain despite receiving diverse treatments from other medical departments, and finally visited our pain clinic in a tertiary hospital. ETOIMS was applied to all three patients by monopolar needle into several tender points of each intercostal muscle. Case 1. A 60-year-old man suffered from the 3-months of traumatic chest wall pain which acutely developed during volleyball play. The ETOIMS was performed to right posterior intercostal muscle which showed tenderness between 9th and 10th ribs. The initial NRS or resting chest wall pain was 5, and immediately after ETOIMS, NRS was substantially reduced to 2. Case 2. A 58-year-old woman complaining the 21-months of right anterior chest wall pain after sudden back extension has visited the department of pulmonology and thoracic surgery. ETOIMS was applied to right anterior intercostal muscle presenting tenderness between 6th and 7th ribs. At initial visit, her NRS was recorded as 6 which improved to 3 immediately after ETOIMS. On follow-up after 1 week, NRS was 5. Case 3. A 30-year-old woman who did not have a trauma history noticed shooting chest wall pain. ETOIMS was performed to the right anterior intercostal muscle which showed tenderness between 2nd and 3rd ribs. Her pain score at initial visit was 8 and then subsided to 2 immediately after ETOIMS. On follow-up after 1 week NRS was 1.

DISCUSSION

Even though the mechanisms of ETOIMS have not been completely revealed yet, experimental evidence implies that electrical twitch induces deep muscle contraction.

After muscle contraction, immediate relaxation of tight and shortened muscle may reduce pain by stretching effect. Contraction induced non-painful input makes pain relief by closing a pain gate of nociceptive fiber. Increase in blood perfusion of ischemic muscle following contraction is alsodescribed as a mechanism that causes a pain reduction. In these cases, ETOIMS showed substantial reduction of NRS in the patients with chronic muscular CWP. Our reports indicate that ETOIMS can be a therapeutic option for patients who failed prior conservative management for muscular CWP.

Treatment-Induced Neuropathy of Diabetes : A CASE REPORT

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Introduction

Treatment-induced neuropathy in diabetes (TIND) is considered a rare iatrogenic small fiber neuropathy caused by an abrupt improvement in glycemic control in the setting of chronic hyperglycemia. TIND was defined as the acute onset of neuropathic pain and/or autonomic dysfunction within 8 weeks of a large improvement in glycemic control—specified as a decrease in glycosylated hemoglobin A1C (HbA1c) of 2% points over 3 months. The pain is usually burning or shooting in a length-dependent, distal or diffuse, proximal pattern and is frequently accompanied by allodynia and hyperalgesia. Autonomic testing shows sympathetic and parasympathetic dysfunction. Some patients present with prominent manifestations of autonomic dysfunction including orthostatic hypotension and syncope. The prognosis depends on the type of DM. In type 1 DM, symptoms last from 6 months to 18 months, and in type 2 DM, they continue for up to 2 years. The treatment is not definite, but conservative care is given to each symptom. Symptomatic relief often requires sedatives and opiates analgesics either alone or in combination with various antiepileptic drugs. Fall prevention training and treatment due to orthostatic hypotension is needed. Case A 24-year-old woman was diagnosed with Type 1 DM 10 years ago and admitted to obstetric clinic with cystitis. HbA1c 16.7% was checked on the test. Her insulin was titrated to achieve normoglycemia. Hb A1c that was examined 3 months later was measured at 7.8%. (Fig. 1). One month after discharge, she was admitted to the hospital with weight loss (10kg), back pain, neuropathic pain on four extremities and hyperhidrosis. There was no abnormality in whole spine MRI after hospitalization. The nerve conduction studies suggested asymmetric upper and lower limbs sensory-motor polyneuropathy (Table 1). To control the neuropathic pain, she was prescribed tapentadol 50mg, lyrica 75mg, impactamin power twice daily, amitriptyline 10mg (for intermittent use). After one week, the patient had a 50% reduction in pain.. Onset 2 months later, the patient was admitted to the rehabilitation department with dizziness and falling down. She was diagnosed with orthostatic hypotension (blood pressure at supine position 125/95, after 3minute of standing position 70/53) and checked low score in balance ability assessment (Berg balance test 23/56, Tetrax : fall risk 100%). She was applied anti-embolic stocking and performed balance training with midrone 2mg. Her symptoms have been improved and she was discharged from hospital after the treatment.

Conclusion

TIND typically occurs after a fast improvement in glycemic control in a patient with poor metabolic control, and shows complete recovery. Physicians should educate fall prevention for patients with TIND to prevent possible fall down occurred by orthostatic hypotension.

Table 1. Results of Electrodiagnostic Study

Nerve		Latency (msec)	Amplitude (mV)	CV (m/sec)			
Motor nerve							
Median	Rt	5.2	4.1	37			
Ulnar	Rt	4.2	1.7	34			
Deep peroneal(EDB)	Rt		NR				
Tibial(AH)	Rt		NR				
Median	Lt	4.2	3.0	33			
Ulnar	Lt	3.2	3.6	32			
Deep peroneal(EDB)	Lt		NR				
Tibial(AH)	Lt		NR				
Sensory nerve							
		Latency (msec)	Amplitude (uV)				
Median	Rt		NR				
Ulnar	Rt		NR				
Sural	Rt	2.5	5				
Superficial peroneal	Rt	2.0	6				
Median	Lt		NR				
Ulnar	Lt	2.0	5				
Sural	Lt	2.1	4				
Superficial peroneal	Lt	2.2	4				
Muscle							
		Spontaneous activity		MUAP		Recruitment pattern	
		Fib	PSW	polyphasic	Amplitude		Duration
Lt. Biceps brachi		none	none	none	normal	normal	full
Lt. First dorsal interosseous		none	none	none	normal	normal	full
Lt. Lumbar 3-5 paraspinal muscle		3+	3+				
Rt. Lumbar 3-5 paraspinal muscle		3+	3+				
Rt. Gluteus maximus		none	2+	many	normal	normal	reduced
Rt. FDL		none	2+	many	normal	normal	reduced
Lt. Gluteus maximus		none	2+	many	normal	normal	reduced
Lt. FDL		none	2+	many	normal	normal	reduced

CV, Conduction velocity; Rt, Right; Lt, Left; EDB, Extensor digitorum brevis; TA, Tibialis anterior; AH, Abductor hallucis; FDL, Flexor digitorum longus; NR, No response; MUAP, Motor unit action potential; Fib, Fibrillation; PSW, Positive sharp wave

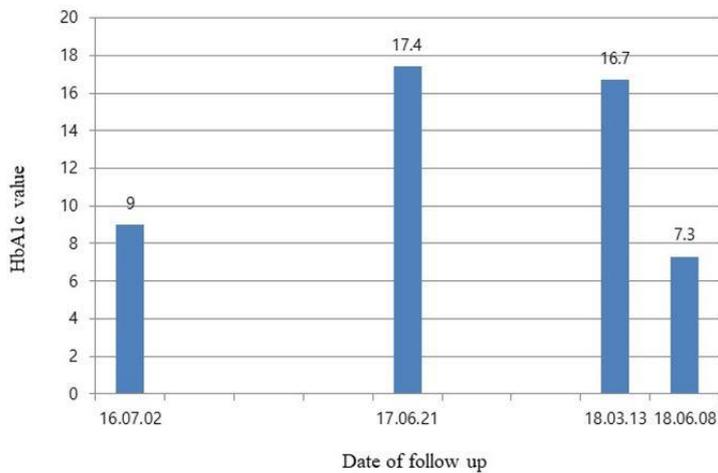


Fig. 1. HbA1c values

Orthostatic Headache due to CSF Leakage Detected by MR Myelography:A CASE REPORT

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BundangJesaeng General Hospital, Department of Rehabilitation Medicine¹

Introduction

Spontaneous intracranial hypotension(SIH) is a well-known clinical entity and the most common cause of SIH is a spinal CSF leak. Diagnostic criteria of SIH include orthostatic headache, brain MR imaging with pachymeningeal enhancement and/or brain sagging. The mainstay of treatment for SIH is autologous epidural blood patch. Cerebrovascular venous thrombosis is an uncommon entity that may occur in the sinuses of dura and cortical veins. Common etiologies include states of hypercoagulability and other causes include inherent thrombophilic states. The impact of intracranial hypotension due to cerebrospinal fluid(CSF) leak on venous flow and thrombosis is not clear. But recent study, Chalouhi et al. suggested that CSF leak and Resulting intracranial hypotension may be a risk factor for cerebral venous sinus thrombosis. Because of targeted therapy may improve clinical outcomes, localization of CSF leakage can be important for treatment. MR myelography(MRM) is a noninvasive Method that can be used for demonstrating and localization of CSF leakage at spine. It has no radiation hazard and can be performed without intrathecal administration of contrast media or radioisotopes, unlike CT myelography(CTM). We present the case and treatment course of the patient who initially presented orthostatic headache due to a CSF leak which was revealed by MRM. Case: A 42-year-old female suffered sudden onset of occipitoparietal headache while changing her posture during sleep in the early morning of April 18th, 2018. She suffered from a holocranial, oppressive, and throbbing headache with nausea and dizziness persisting for several hours. She admitted our hospital on May 11th, 2018(21days after the onset). And she took a Brain MRI with contrast which showed minute SDH(Fig 1) in the convexities and tentorium that means suspicious of the SIH. After she admitted our hospital, she was conservatively managed with bed rest and intravenous hydration. Under suspicion of spontaneous spinal CSF leak, She took MRM which revealed CSF leakage at T 7-8 level(Fig 2). She did not have any episode of trauma or procedure in thoracic level. She complained perioral sensory numbness on May 17th, 2018 and took diffusion MRI which revealed new high signal intensity change in the right parietal lobe sulci, which means of minute SAH. We injected autologous blood (10cc) into the epidural space at T 7-8 level(Fig 3) on May 18th, 2018. After she received epidural blood injection, her orthostatic headache have been improved and she was discharged from hospital 3 days later.

Conclusion

When the patient presented orthostatic headache and diagnosed SIH, we first consider CSF leakage which can detected by MRM. MRM is a useful tool diagnosing SIH due to CSF

leakage without using contrast agents. And MRM is helpful in determining the site where to inject autologous blood into epidural space.

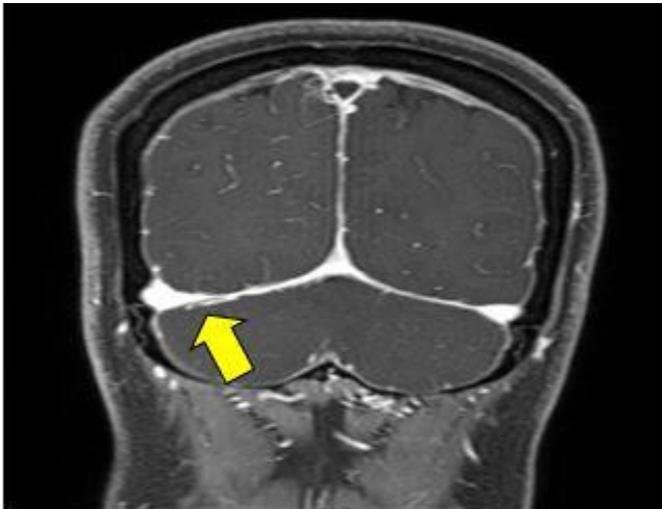


Fig.1.T1-weighted magnetic resonance image shows minute SDH in tentorium 3 weeks after the initial manifestations.

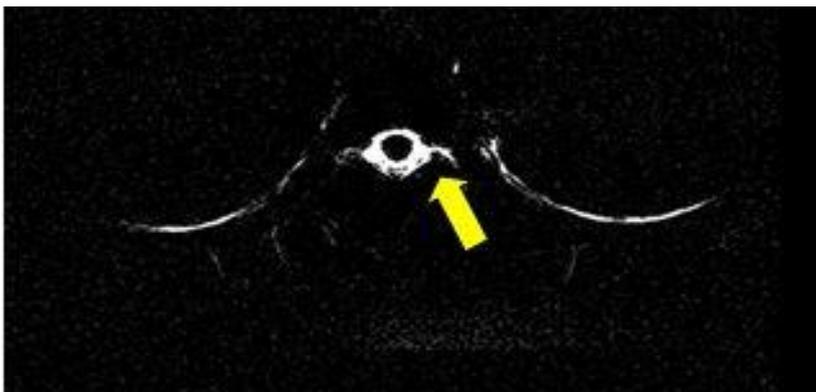


Fig.2.Magnetic resonance myelogram shows CSF leakage at thoracic spine 7-8 level in dural sleeve.

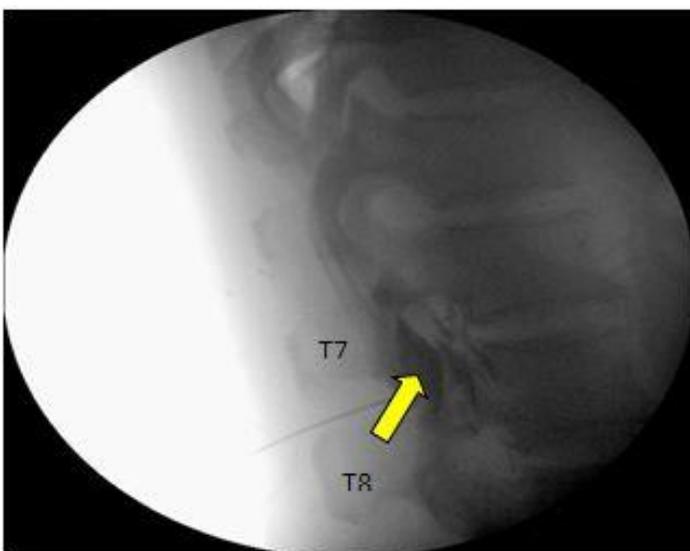


Fig.3.C-arm guided autologous blood injection into the epidural space where CSF leakage at thoracic spine 7-8 level.

The botulinum toxin injection as a treatment for pain in cancer patients with muscle metastasis

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Introduction

In cancer patient with muscle metastasis (MM), painful limitation of motion (LOM) is common problem. MM usually treated by radiotherapy (RTx) and other treatments include chemotherapy (CTx), and operation. But complications associated with RTx include fibrosis, skin burn, and muscle contraction. And sometimes maximum dose can't relief pain. MM can produce pain with several mechanisms including muscle stiffness or spasm. Botulinum toxin injection (BTI) is commonly used for muscle stiffness. Recent research had shown that BTI can relief pain by not only reducing muscle spasm but also inhibiting relief of neurotransmitters that regulate pain. To the best of our knowledge there is no study about using BTI for pain in MM. So we report two cases about use of BTI as adjuvant option for pain relief therapy for patients with MM.

CASE REPORT

Case 1 39 years old woman with recurrent cervical cancer stage IIb was consulted to us for Lt. pelvic and thigh pain (VAS 9) and painful LOM for 3month. They used medication, L2 root block, but pain continued. MRI and PET have done and shows invasion of abdominal lymph node metastasis to psoas muscle fascia. (figure 1) We did psoas compartment block (PCB) and pain decreased to VAS 3~4. But after 1 week, symptom recurred. So we did BTI to iliacus and psoas (100IU each). After 2weeks, pain decrease to VAS 3 and she could do full extension of Rt. Hip, independent walking. The period of pain free was continued during 9 weeks. **Case 2** 68 years old man with Hepatic cell carcinoma with Rt. Psoas, iliacus and iliac bone metastasis (figure 2) was consulted about intractable Rt. Inguinal area, thigh and buttock pain (VAS 9) and painful LOM. They already did palliative RTx to maximum dose, and also used medication but they didn't work. So we did BTI to iliacus and psoas (100IU each). After 2weeks, he could do full extension of Rt. Hip, independent walking and pain decreases to VAS 3-4. The period of pain free was continued during 3 month.

Discussion

We report BTI could be useful option for MM patients with intractable pain. Pain in MM patient is commonly treated with medication, RTx, surgery and CTx. However these therapies have complications including fibrosis, skin burn, adhesion, muscle contraction and permanent LOM. And sometimes with maximum dose can't relief MM related pain BTI is commonly used for muscle spasm and stiffness by blocking the release of acetylcholine at pre-synaptic nerve terminal. Recent studies noted that, BTI also have a pain relief effect by sensitization of C-fiber nociceptor and decreasing release of neurotransmitters including substance P and calcitonin gene-related peptide. In

Conclusion

these cases suggest that BTI can be alternative way for MM patients with pain that can't control by commonly used treatment. And further researches are required.



Figure 1. Representing abdominal lymph node metastasis and its invasion to psoas muscle 1A. MRI T2 image, 1B. MRI T1 image, 1C. PET scan image

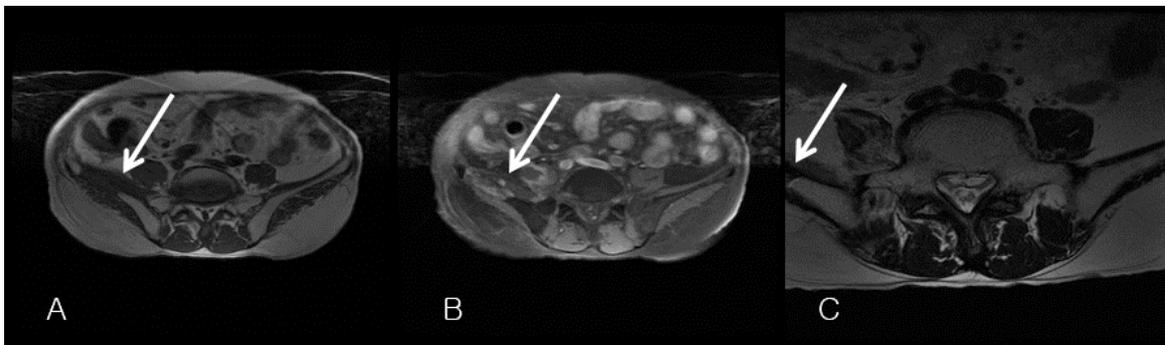


Figure 2. Representing Rt. Psoas, iliacus muscle and iliac bone metastasis 1A. MRI T1 FSE image, 1B. MRI T1 Fat sat FSE image, 1C MRI T2 image

Case review : Flexor carpi radialis rupture due to repetitive golf swing

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Introduction

Flexor carpi radialis (FCR) muscle is located in the forearm anteriorly. The FCR muscle originates on the medial epicondyle of the humerus. It runs through a synovial fibro-osseous tunnel in the forearm and inserts on the base of the second and third metacarpal. The function of FCR muscle is to promote flexion of wrist and abduction of the wrists and the hands. The musculotendinous junction is thought to be the most common site of injury and Flexor tendon ruptures due to trauma without open wounds are quite rare. Therefore, we report a case of FCR rupture secondary to repetitive overuse injury.

CASE REPORT

A 55-year-old man, right-hand dominant, presented with right forearm pain and notable swelling that began 3 days ago while playing amateur golf. On the last day after playing golf for three days, he felt gradual pain and found edema on the volar-ulnar side of right forearm. On the 11-point verbal numeric scale, the severity of pain was 5. The pain was relieved by resting position. But, the pain was aggravated by pressing the site and wrist flexion. He was taking aspirin-containing blood pressure medication for hypertension. Clinical examination revealed focal tenderness and bruising over volar-ulnar region of the right forearm. Plain radiographs showed soft tissue edema from the medial side of right elbow to proximal forearm and no detectable fracture. Ultrasonographic exam showed multiple hypoechoic echo-texture lesion suspected of hematoma in the flexor muscle group of forearm. Definite diagnosis was done via magnetic resonance imaging. He was diagnosed with rupture of FCR tendon at proximal origin and strain of flexor digitorum superficialis & palmaris longus muscle. He received conservative treatment including compressive dressing and restriction of wrist range of motion for 3 weeks. We also recommended him to stop taking aspirin for 3 weeks. Two months later, the edema and bruises that were seen in his forearm were all gone and no tenderness was seen on physical examination. Ultrasound follow-up revealed slightly hypoechoic appearance that there was only trace of lesions suspected as previous injury. He no longer had any trouble with his daily life.

Conclusion

We demonstrate that the FCR rupture secondary to repetitive golf swing for 3 days is possible and should be considered in the differential diagnosis of pain and swelling on the flexor surface of the wrist and forearm.

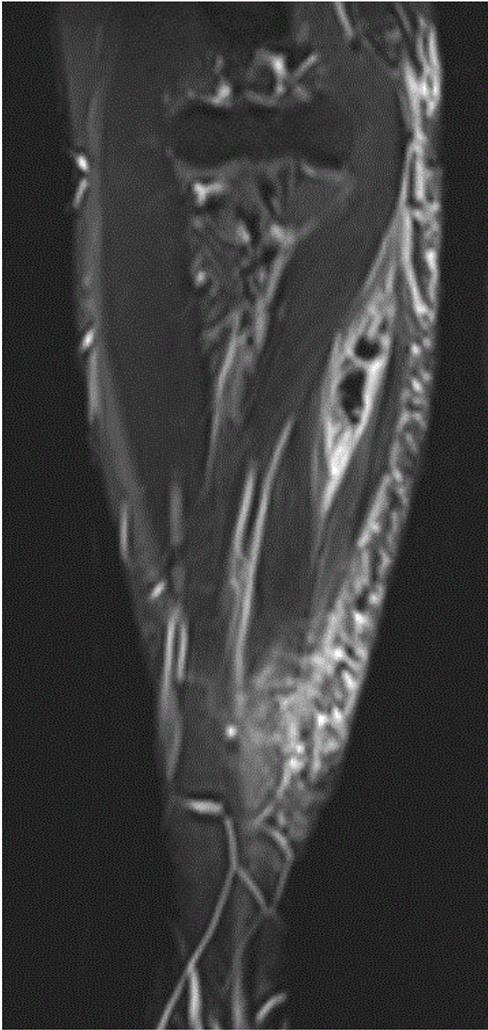


Fig 1. Coronal section of T2 MRI right forearm : Suspected rupture of flexor carpi radialis(FCR) tendon in seen with edematous change in subcutaneous tissue at posteromedial side of right elbow

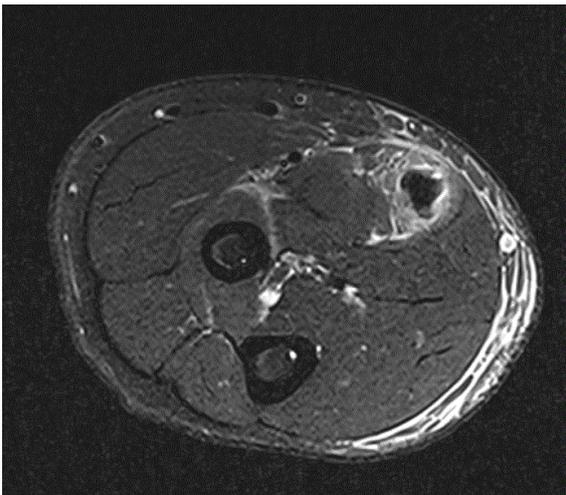


Fig 2. Axial section of T2 MRI right forearm : Like the Fig.1, FCR tendon rupture was seen at proximal origin

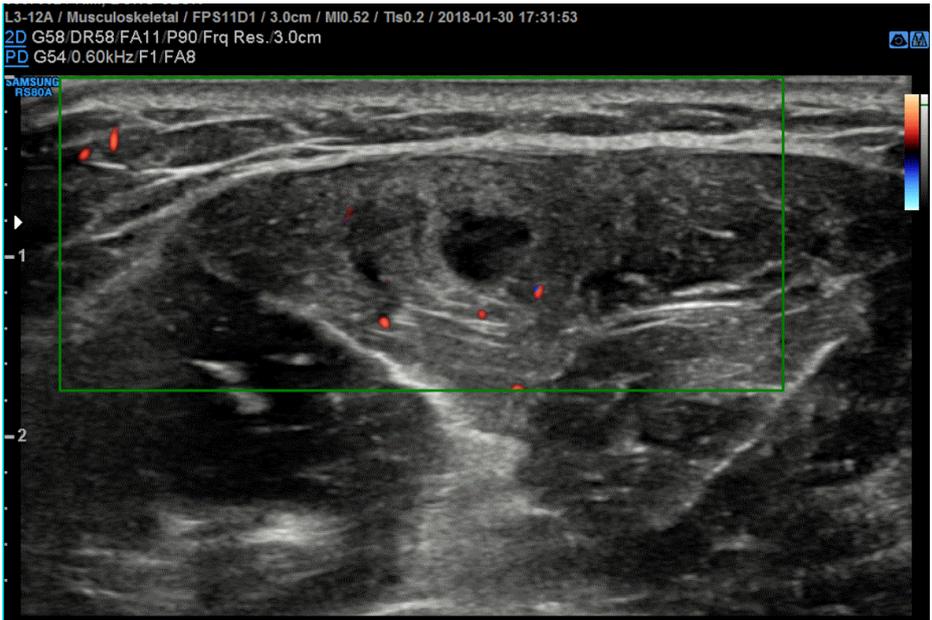


Fig 3. Trasverse view of right forearm of ultrasonograhic exam : This show multiple hypoechoic echo-texture lesion suspected of hematoma in the flexor muscle group of forearm

Septic arthritis of the acromioclavicular joint with chronic hepatitis B. -A CASE REPORT -

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Introduction

Septic arthritis of acromioclavicular (AC) joint is a rare entity. We report a case of septic AC joint in the absence of trauma which was found to be chronic hepatitis B.

CASE REPORT

A 46-year-old female visited our outpatient clinic with a chief complaint of left shoulder pain beginning approximately 24 hours before presentation. The pain was not associated with neck motion and exacerbated by shoulder movement. The patient did not report any radiating pain, paresthesia, numbness, weakness on shoulder and arm. She denied any recent trauma to the shoulder, intravenous drug use. Her past medical history was unremarkable. Vital signs were as follows: blood pressure 121/71mmHg, heart rate 100 beats/min, respiratory rate 20 breaths/min, body temperature 38.4 °C. On physical examination, the left shoulder had no effusion, erythema, or skin rash. Palpation on left AC joint produced sharp pain. The patient was unable to actively range the shoulder more than 30 degrees in flexion, abduction, external rotation due to pain. Internal rotation was relatively spared (70 degrees). Initial laboratory values were as follows: WBC count 9600/uL, neutrophil 82.9%, C-reactive protein 16.85mg/L, AST 33IU/L, ALT 24 IU/L, Anti HCV(-), HBsAb (-), and HBsAg (+). X-ray of left shoulder revealed unremarkable finding except small nodular calcification in left supraspinatus tendon. (Figure 1). Mild AC joint arthritic finding was noted without joint space narrowing or widening on ultrasound examination (Figure 2). Arthrocentesis of the AC joint was attempted, however, we were not able to obtain synovial fluid. So, we injected 0.5cc of aseptic normal saline to the AC joint and aspirated the fluid to wash-out AC joint space. Gram staining and synovial fluid culture was performed with washed out joint fluid. Gram stain demonstrated no bacteria. However, synovial fluid culture demonstrated *Streptococcus agalactiae*. We prescribed amoxicillin 500mg/clavulanate potassium 125mg three times a day for 3 weeks. After 1 week taking antibiotics, she reported her shoulder pain was relieved. After 3 weeks, laboratory findings were completely normalized (Table 1). The patient was referred to department of hepatology. She was diagnosed with chronic hepatitis B and is currently being followed up.

Discussion

Patients with severe shoulder pain should be checked for fever and a blood test should be performed to rule out joint infection. Also, it is important to suspect AC joint lesion as well as glenohumeral joint. AC septic arthritis can easily treated with oral antibiotic therapy. In addition, it is necessary to figure out an underlying disease such as chronic hepatitis in the case of AC septic arthritis.



fig 1. Unremarkable finding except small nodular calcification in left supraspinatus tendon

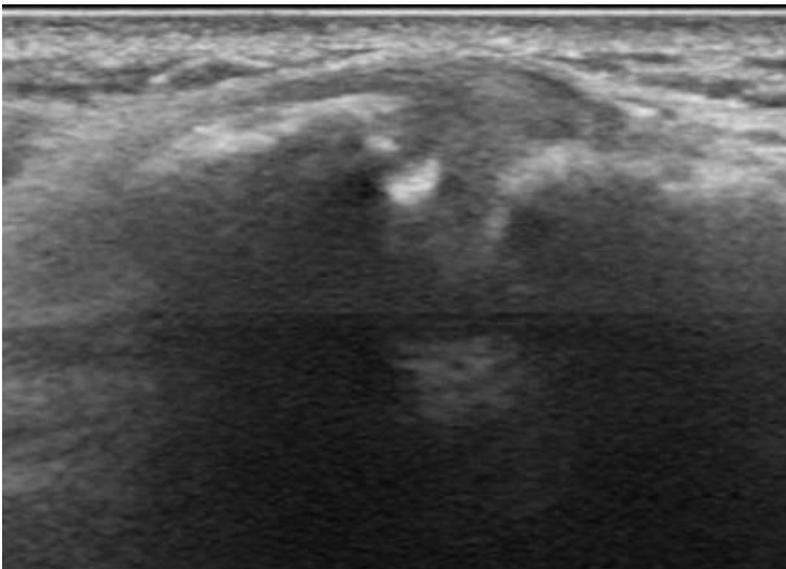


fig 2. Mild AC joint arthritic finding was noted without joint space narrowing or widening on ultrasound examination.

Analysis of 3-Dimensional Structure of upper limb Muscles in Transradial Amputee : A MRI Case study

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Objective

The purpose of this study is to quantify the muscle volume and Surface area of the Unamputated limb and amputated limb of upper extremity.

Subject & Methods

In this study, subject is 55-years-old male who weared myoelectric hand prosthesis with below elbow amputation due to a industrial accident in March 2015. The subject visited the hospital once to take an Magnetic Resonance Imaging(MRI) and the data was reconstructed in three dimensions using 3D Modeling Software(Mimics[®], Belgium). Unamputated limb was analyzed according to the length of amputated limb. And we measured volume and surface area of muscles of the unamputated and the amputated were compared.

Results

We measured the volume and Surface area reduction ratio of the amputated side compared to the unamputated side for each muscle group (Figure 1). Among all the muscles, the highest volume reduction ratio was finger extensor digitorum 76.7% and the lowest reduction ratio was anconeus -0.7% (Table 1). The highest surface area reduction ratio was extensor digitorum 59.4% and the lowest reduction ratio was supinator -1.43% (Table 2).

Conclusion

The purpose of this study is to identify the anatomical structure of the upper limb amputee and the attachment point of the dynamic electromyographic(EMG) sensor. This study can be used as a database for the study on amputees and the development of artificial arm.

Table 1. Volum reduction ratio of each muscle group on the amputated side compared to the unamputated side

Muscle group	Muscle	Unamputation (mm ³)	Amputation (mm ³)	Reduction ratio (%)	
Elbow	Flexor	Biceps	88095.49	49627.78	43.67
		Brachialis	111197.73	101338.52	8.87
		Brachioradialis	60624.68	36908.06	39.12
		AVERAGE			30.55
Extensor	Triceps	149628.79	102815.6	31.29	
	Anconeus	8304.06	8360.8	-0.68	
	AVERAGE			15.30	
Forearm	Supinator	Supinator	21681.97	20664.8	4.69
		AVERAGE			4.69
	Pronator	Pronator teres	32583.97	29548.13	9.32
		AVERAGE			9.32
Wrist	Flexor	Flexor carpi radialis	18550.76	10573.99	43.00
		Flexor carpi ulnaris	14499.22	5574.59	61.55
		AVERAGE			52.28
	Extensor	Extensor carpi Radialis longus	55783.07	25394.26	54.48
Extensor carpi Ulnaris		11107.75	5574.59	49.81	
AVERAGE				52.15	
Phalanx	Flexor	Flexor digitorum Superficialis	34475.74	18651.65	45.90
		Flexor digitorum Profundus	43348.06	25016.61	42.29
		AVERAGE			44.09
	Extensor	Extensor digitorum	29397.84	6853.89	76.69
	AVERAGE			76.69	

Table 2. Surface reduction ratio of each muscle group on the amputated side compared to the unamputated side.

Muscle group	Muscle	Unamputation (mm ²)	Amputation (mm ²)	Reduction ratio (%)		
Elbow	Flexor	Biceps	14033.51	10166.52	27.56	
		Brachialis	21433.48	18739.5	12.57	
		Brachioradialis	17476.72	12531.58	28.30	
	AVERAGE				22.81	
	Extensor	Triceps	22912.75	18898.91	17.52	
		Anconeus	3300.03	3229.42	2.14	
AVERAGE				9.83		
Forearm	Supinator	Supinator	7372.46	7477.73	-1.43	
		AVERAGE				-1.43
	Pronator	Pronator teres	8024.20	8123.86	-1.24	
		AVERAGE				-1.24
	Wrist	Flexor	Flexor carpi radialis	5319.92	4367.86	17.90
			Flexor carpi ulnaris	5054.82	2957.53	41.49
AVERAGE				29.69		
Extensor		Extensor carpi Radialis longus	12956.46	8775.74	32.27	
		Extensor carpi Ulnaris	3800.67	2957.53	22.18	
		AVERAGE				27.23
Phalanx	Flexor	Flexor digitorum Superficialis	8172.68	5318.59	34.92	
		Flexor digitorum Profundus	9088.28	7578.27	16.61	
		AVERAGE				25.77
	Extensor	Extensor digitorum	7445.93	3021.72	59.42	
		AVERAGE				59.42

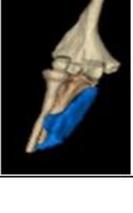
Muscle	Reduction Ratio	Unamputation (Lt.)	Amputation (Rt.)
Extensor digitorum	Volume. 76.7% Surface. 59.4%		
Flexor carpi ulnaris	Volume. 61.6% Surface. 41.5%		
Extensor carpi radialis longus	Volume. 54.5% Surface. 32.3%		
Flexor digitorum superficialis	Volume. 46.0% Surface. 32.3%		
Flexor digitorum profundus	Volume. 35.0% Surface. 16.7%		

Figure 3. Muscle of upper limb – 3D reconstruction

Calcific tendinitis with osseous involvement: CASE REPORT

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INTRODUCTION

Calcific tendinitis is a common cause of shoulder pain, characterized by precipitates of hydroxyapatite crystals. Rarely, these calcifications migrate to other locations, including the bone, and may result in significant bone marrow involvement. Magnetic resonance imaging (MRI) is highly sensitive in detecting bone marrow involvement, but in the presence of focal lesion, cortical erosion and bone inflammatory response, it may not be diagnostic since presence of similar findings are also in osteomyelitic or some bone tumors like periosteal chondroid lesions. We report a case of woman with calcific tendinitis with osseous involvement.

CASE REPORT

A 39-year-old woman presented with a 1-year history of right shoulder pain. A plain radiograph of the right shoulder showed well-defined calcifications overlying head of humerus. Ultrasound guided calcification barbotage was done. The next day, she revisited hospital due to worsening of shoulder pain with elevated body temperature of 37.9°C. Blood tests revealed leukocytosis of 10700 / μ l and increased inflammatory markers, with a C-reactive protein (CRP) level of 7.3 mg/l. MRI showed calcification between infraspinatus and teres minor and edematous changes in the surrounding tissue and bone marrow. Considering MRI images, elevation of CRP and history of prior invasive procedure, we did not completely exclude the possibility of septic arthritis and decided to undergo diagnostic arthroscopy. Arthroscopic exam showed no definite glenohumeral joint infection sign. Calcium deposits were found between teres minor tendon insertion and infraspinatus tendon insertion. Calcium deposits were removed by arthrocare. Five days after arthroscopic exam, there was no subsequent fever and CRP level dropped from 7.3 to 1.1, so did the WBC level from 10700 to 4170. She discharged with only mild discomfort of right shoulder.

CONCLUSION

In many cases the calcification may be asymptomatic, although calcific tendinitis can be an important cause of severe pain. Fever, local edema and raised inflammatory markers may be present. Occasionally, calcific tendinitis can present with aggressive osseous and soft-tissue changes, which mimic infection or neoplasm, especially on MRI. Thus, it is important to acknowledge bone changes reactive to calcification and make the correct diagnosis in patient with calcific tendinitis.

Unusual Peroneal Nerve Palsy caused by Intraneural Ganglion Cyst

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Peroneal nerve palsy is a common clinical problem and has been attributed to numerous causes. Among them, intraneural ganglion cyst is very rare but it sometimes reported as a plausible cause of the peroneal nerve palsy. Intraneural ganglion cyst is mucinous lesions found within the epineurium of nerves, which Results in neurological deficit due to the displacement of nerve fascicles by the cyst contents. We have experienced a case of the intraneural ganglion cyst in the common peroneal nerve, which was located at the level of the fibular head. A 40-year-old male presented to our outpatient clinic with a five-month history of pain over the fibular head area and gait difficulty. Careful physical examination revealed a round and painful lump on the lateral aspect of fibular neck. Weakness was observed in eversion and foot dorsiflexion. Sensory disturbance was matched to the peroneal distribution of the dorsal and lateral side of the foot. Magnetic resonance imaging revealed a cystic articular branch with balloon-like expansion at the level of the common peroneal nerve and multi-lobulated cystic mass extending around the fibular neck (Fig. 1). Surgical exploration revealed a mass invading the sheath of common peroneal nerve and surgical removal of the mass was performed (Fig. 2). The resected mass was histologically compatible with a ganglion cyst. However, the patient's neurologic deficit did not change significantly. In case of intraneural ganglion cyst, accurate diagnosis and prompt treatment are needed. We here report a case of intraneural ganglion cyst, a rare cause of peroneal nerve palsy.

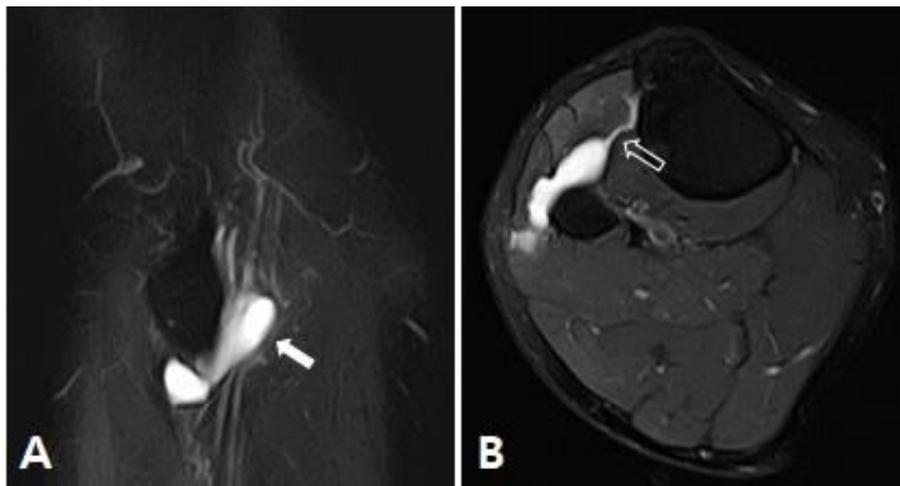


Fig. 1. Magnetic resonance image (MRI) of right knee shows findings of intraneural ganglion cyst. (A) Sagittal and (B) axial scans of MRI demonstrated cystic articular branch with balloon-like expansion at the level of the common peroneal nerve and multi-lobulated cystic lesion with high signal intensity around the fibular neck.



Fig. 2. A mass invading the sheath of common peroneal nerve was shown. The mass was dissected from the sheath of the common peroneal nerve.

Intraspinal synovial cyst resolved by fluoroscopic guided epidural aspiration : a CASE REPORT

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Introduction

Although degenerative zygapophyseal joint synovial cysts are well documented as a potential cause of lumbosacral radiculopathy, only few of intraspinal cysts from spondylolysis are previously reported. To our knowledge, this is the rare reported case of a cyst associated with spondylolysis and radiculopathy, also is the first to describe clinical and radiologic, electrodiagnostic resolution of the cyst with fluoroscopic guided epidural aspiration.

CASE REPORT

He is a 58-year-old male truck driver with a history of bilateral pubic and left acetabulum, ilium fracture due to trauma. He was almost recovered by surgery and rehabilitation. One day, he began to complain about radiating pain on left lower extremity. At that time, LS-spine MRI study showed a cystic lesion in the ventral aspect of left L5 compressing the nerve root with spondylolysis<Figure1>. Acute left L5 radiculopathy was observed on the electrodiagnostic study. We asked to orthopedic surgeons for the need for surgery, but they replied not need to surgery. We attempted fluoroscopic guided epidural aspiration twice<Figure2>, and aspirated about 2 cc of bloody and serous liquid at each time. The patient reported that radiating pain improved after the procedure. Follow-up LS-spine MRI showed a decrease in cyst size<Figure3>. Without further intervention, the patient's symptoms gradually improved over time. Finally, radiating pain of left lower extremity completely disappeared, and only intermittent cramp remained. Follow up electrodiagnostic study showed that all abnormal spontaneous activity was completely disappeared<Table1>. In Conclusion, after fluoroscopic guided epidural aspiration, the patient's symptoms, radiologic findings and electrodiagnostic findings were all improved.

Discussion

Some treatment options for cysts related to spondylolysis may be inferred from the limited information available for zygapophyseal cysts. Retrospective studies indicate high success rates (up to 91%) for improvement of pain after surgical excision of zygapophyseal cysts. The evidence on percutaneous treatment is limited to small retrospective series. Results of these studies indicate that various combinations of fluoroscopically guided transforaminal epidural steroid injection, zygapophyseal joint injection, and attempted cyst aspiration or rupture may be associated with pain relief in up to 70% of patients observed for up to 2 years after treatment. However, it still unclear what treatment is best.

Conclusion

A synovial cyst related to spondylolysis is a rare cause of lumbar radiculopathy. There is limited information available on the pathogenesis, natural history, and most appropriate treatment for these cysts. To our knowledge, this case demonstrates as a first that clinical and radiologic resolution of such a cyst is possible with non-surgical intervention in the patient with radiculopathy.

Table 1. Electromyography at 2017.10.17 and Electromyography at 2018.5.31

Side	Muscle	Ins	Fibs	PSW	Amp	Dur	Poly	Recr
Left	Vastus Medialis	N	N	N	N	N	0	Complete
Left	Tibialis Anterior	N	2+	2+	N	N	0	Reduced
Left	Gastrocnemius (medial head)	N	N	N	N	N	0	Complete
Left	Tensor Fascia Lata	N	3+	3+	N	N	0	Single
Left	Lumbar paraspinal muscle	N	2+	2+			0	

Ins, insertional activity; Fibs, fibrillation potential; PSW, positive sharp waves; Amp, amplitude; Dur, duration; Poly, polyphasic activity; Recr, recruitment; N, normal

Side	Muscle	Ins	Fibs	PSW	Amp	Dur	Poly	Recr
Left	Tibialis Anterior	N	N	N	N	N	0	Complete
Left	Tensor Fascia Lata	N	N	N	N	N	0	Complete

Ins, insertional activity; Fibs, fibrillation potential; PSW, positive sharp waves; Amp, amplitude; Dur, duration; Poly, polyphasic activity; Recr, recruitment; N, normal



fig 1. Cystic lesion at ventral aspect of left spondylolysis, R/O synovial cyst, with severe central canal stenosis and suspicious left L5 nerve root compression on LS-spine MRI at 2017.10.23

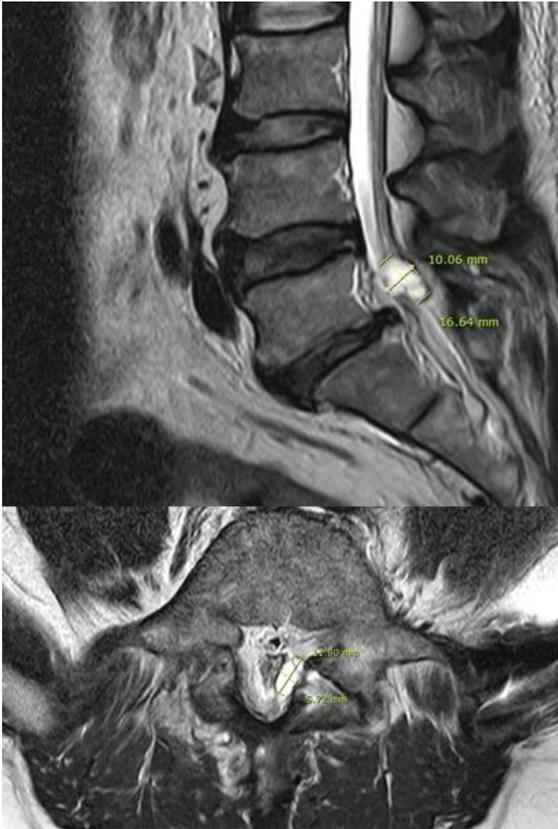


fig 3. Slightly decrease extent of presumed synovial cyst at ventral aspect of left spondylolysis, with slightly improving state of severe central canal stenosis and suspicious left L5 nerve root compression on LS-spine MRI at 2017.11.28

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A Unusual Complication of Sacral nerve root Injury Following Harvesting Bonemarrow : A CASE REPORT

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Rationale

Hematopoietic stem cell transplantation(HSCT) represents an important therapeutic option for many hematologic disease. Many studies showed the complication of recipient after Hematopoietic stem cell transplantation(HSCT). However, complications of harvesting bonemarrow are rare and rarely can cause sacral root injury.

Patient concerns

An 26-year-old man was admitted to our medical center because he complained of acute onset painful burning and tingling sensation at the left posterior thigh and calf. The pain score on the Visual Analogue Scale(VAS) varied from 7/10 to 8/10. He underwent a bonemarrow harvesting procedure two days before the hospitalization as a bonemarrow donor, using both posterior superior iliac spine(PSIS) as a puncture site at the supine position.

Diagnoses

Pelvic MRI showed enhancement around the left S2 nerve root in T1-weighted images. He was examined nerve conduction study and electromyography after 3 weeks later from the admission. Nerve conduction studies revealed normal conduction velocity and amplitude on both lower extremity. Electromyography presents abnormal spontaneous potential and neurogenic motor unit potentials on the S2-innervated intrinsic foot muscle at the left. Interventions He was treated with analgesics for pain control. Lyrica(Pregabalin)

Outcomes

The patient was followed up after 3 and 6 months. Neuropathic pain improved to Visual Analogue Scale(VAS) 3/10, and recovery state was confirmed by reinnervation patterns of motor unit potentials in electromyography.

Lessons

Accurate anatomical knowledge and carefulness are required to avoid the sacral nerve root injury when performing the bonemarrow harvesting procedure.

Table 1. Electromyography findings of patients

Muscle	Electromyography								
	1 month			3 months			6 months		
	PSW	PPP	Recr	PSW	PPP	Recr	PSW	PPP	Recr
TA	N	N	N	N	N	N	N	N	N
PL	N	N	N	N	N	N	N	N	N
AH	1+	N	SD	2+	N	MD	N	P	SD
ADM	1+	P	SD	1+	P	D	N	P	SD
GCN	1+	N	SD	1+	P	SD	N	P	SD
Soleus	N	P	N	1+	N	SD	N	P	SD
SM	N	P	N	N	P	SD	N	P	SD
GM	N	N	N	N	N	N	N	N	N
VM	N	N	N	N	N	N	N	N	N
L-PSP	1+			1+					

TA : Tibialis anterior, PL : Peroneus longus, AH : Adductor hallucis, ADM : Abductor digiti minimi, GCN : Gastrocnemius, SM : Semimembranosus, GM : Gluteus maximus, VM : Vastus medius
L-PSP : Lumbar paraspinalis



Fig 1. Puncture site of bonemarrow harvesiting. The patient underwent bonemarrow harvesting through posterior superior iliac spine(PSIS).

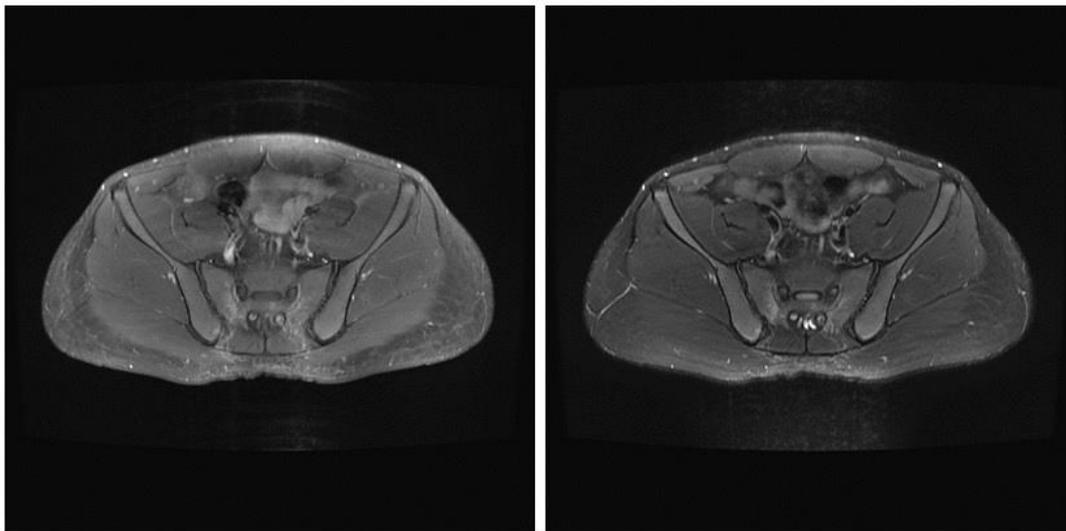


Fig 2. MRI of pelvis-The axial(T1 weighted-left, T2-weighted-right) views show the signal change with enhancement at left S2 nerve root.

Osteoporosis in neurogenic heterotopic ossification patients

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Introduction

Heterotopic ossification (HO) is true bone in extraskelatal ectopic sites. For unknown reasons, pluripotent mesenchymal cells in soft tissues differentiate into osteoblasts and other cell lines involved with bone formation. HO usually presents a swollen, warm painful joint and make it difficult to maintain joint range of motion and its function. Furthermore, HO can also contribute to the development of pressure ulcers or causes compression of nerves and blood vessels and eventually patients need to have an operation. Osteoporosis is another musculoskeletal problem for the patients with prolonged therapeutic bed rest, immobilization due to motor paralysis from injury of the central nervous system or peripheral nerves. Reduction of mechanical stress on bone inhibits osteoblast-mediated bone formation and accelerates osteoclast-mediated bone resorption. We found out recently, a few HO patients had severe osteoporosis and gave pharmacological intervention such as zoledronic acid or ibandronic acid.

Cases

Following patients were tetraplegia and totally dependent on caregiver for transport. Both of them were taking dinol for their hip joint heterotopic ossification. Case 1. A 24-year-old male patient who is tetraplegia d/t cervical level spinal cord injury, ASIA B(2016. 2. 24) and 18 months after the attack, his dual-energy X-ray absorptiometry(DEXA) Results reveal that Z-score -3.4 in the Rt. femur trochanter. Case 2. A 39-year-old female patient who is tetraplegia due to SAH at anterior communicating artery aneurysm rupture(2016. 6. 22) and 13 months after the attack, her DEXA Results reveal that Z-score -5.7 in the left femur trochanter.

Conclusion

Age is a high risk factor for osteoporosis. In the newly updated osteoporosis guideline NOGG 2017, fracture probability should be assessed in postmenopausal women, and men age 50 years or more, who have risk factors for fracture, using FRAX. In individuals at intermediate risk, bone mineral density (BMD) measurement should be performed using dual-energy X-ray absorptiometry and fracture probability re-estimated using FRAX. Those patients were far from younger than 50 years old, but have shown absolutely low bone mineral density. Loss of bone and muscle develop in a vicious circle of immobilization caused by underlying diseases. Recommendation of osteoporosis screening test such as DEXA for the young HO patients can be beneficial to predict the osteoporotic fracture risk and not to go through catastrophic experience as severe pain and disability to individual sufferers.

CASE REPORT : Acute Nuchal pain patient due to acute otitis media

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Introduction

In general, acute otitis media means all acute inflammation in tympanum. In the early stage, symptoms such as rubefaction and expansion of eardrum, feeling of being filled, ear pain, and fever can occur, and in the case of eardrum perforation, otorrhea can occur. In most cases, acute otitis media are known to be cured naturally or through medicine well. This CASE REPORT examined the patient who suffered constantly due to headache because of the failure to find the cause from headache and nuchal pain for a month despite various evaluation, but had the pain removed after the treatment of acute otitis media which was coincidentally found.

Case presentation

A female patient aged 84 was being observed for cervical radiculopathy from February 5th, 2007 until now as an outpatient of the rehabilitation department of this hospital. As the patient suffered HTN, DM, hyperlipidemia, and osteoarthritis in the past, she in being treated. Around May 16th, 2018, In car TA occurred and received treatment at another hospital. At that time, based on brain CT, there were no particular opinion, the patient went home. The patient reported that besides a little numbness in the upper body, the patient had no difficulty in living a daily life. In one week, headache and nuchal pain occurred, due to that the patient visited ER of other hospitals and this hospital, and radiologic evaluations such as brain CT, brain MRI, cervical MRI were conducted. But as there were no particular opinion, the patient was recommended to observe the condition over time. Afterwards, because the pain continued, r/o MPS was conducted for posterior neck and UTZ parts of TPI, but the condition did not improve. After that, for a month the patient suffered headache and nuchal pain, and the feeling of being filled in the ear occurred. After the ENT treatment, acute otitis media was confirmed, after medicine treatment for that was conducted, the pain was completely eased.

Conclusion

This patient was continuously observed for cervical radiculopathy since 2007, during that period nuchal pain occurred twice and the patient received medicine treatment and TPI in the past. The pain occurred this time occurred after a car accident. Brain and cervical evaluation was conducted, but as there were no particular opinion, due to the possibility of r/o MPS of the past history, TPI, which was conducted usually, was implemented. However, the cause of pain was found to be acute otitis media. The general symptom of acute otitis media is pain in the ear rather than nuchal pain. The sense of being filled in the ear, difficulty in hearing, and fever are accompanied. Therefore, in the case of non-particular patient who has just nuchal pain with no additional symptoms, early diagnosis

is not easy. Accordingly, in the case of patient with headache with unclear cause, and sustained nuchal pain, ENT evaluation such as acute otitis media would be helpful.

Bioelectrical impedance phase angle as an assistive device for assessment and monitoring CRPS type I

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Introduction

Complex regional pain syndrome (CRPS) is characterized by continuous and gradual worsening of intense pain. Along with pain, it is a disorder accompanied with paresthesia, reduced motor function and trophic disturbance. Aggravation of posttraumatic inflammation is considered as one of the most important factor of pathophysiology in CRPS. Budapest diagnostic criteria has been widely used for diagnosis of CRPS. However, there are no prognostic indicators in CRPS. Bioelectrical impedance analysis (BIA) is noninvasive, easy to use, and cost-effective device used for analysis of body composition. BIA Phase angle(PA) value reflects cellularity, integrity of cell membranes and function of the cells, clinically, and it also has been found to be a prognostic indicator in several conditions, such as HIV, liver cirrhosis, chronic obstructive pulmonary disease. Acute local inflammation occurring in early phase of CRPS leads to tissue damage and cell death of the affected tissue and this may be reflected as low PA values. This case represents the BIA PA as a prognostic indicator of CRPS type I patients.

CASE REPORT

A 48-year-old female patient who had undergone open reduction and internal fixation with left ankle fracture 3 months ago was referred to our clinic for recurrence of ankle pain. At the time of admission, allodynia, ankle joint ROM limitation, pain, discoloration was seen. Under suspicion of CRPS, the Budapest diagnostic criteria were applied: allodynia and hyperalgesia were found in Sensory category; skin color difference between two sides was found in Vasomotor category; edema and asymmetric sweating were found in Sudomotor/edema category; and reduced ankle ROM was found in Motor/trophic category. Electrophysiologic evaluation showed no evidence of neuropathy. Three phase bone scan test was performed. In osseous phase, asymmetric diffuse increased uptake at left lower leg, especially ankle and foot was found. CRPS type I was diagnosed. At the time of diagnosis, the patient was evaluated by BIA. The segmental PA in 50 kHz was 4.5 in the affected limb and 5.6 in the unaffected limb. PA ratio of affected to unaffected side was 0.80. Follow-up examination was performed after 2 weeks of steroid pulse treatment period. Pain, allodynia, skin color change, edema, and ankle ROM limitation was improved after treatment. Three phase bone scan test demonstrated. In the Osseous phase, diffusely increased uptake at left lower leg, especially ankle and foot, but decreased overall activity compared to previous tests. The follow up BIA showed the PA of the affected limb was 5.1, the PA of the unaffected limb was 5.3, and PA ratio improved to 0.96.

Conclusion

Because there is no Objective prognostic indicator of CRPS type I, only the clinical symptoms are used for current treatment efficacy assessment and follow-up. The PA ratio before and after treatment improved from 0.80 to 0.96. BIA PA can be helpful in assessing and monitoring progress of CRPS.

Automatic stabilized wheelchair seat with angle adjustment

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Objectives

Elderly or disabled people using wheelchairs use lifts and ramps for vertical movement in spaces that differ in height, such as building entrances in their daily lives. The usability assessment studies related to the ramp design were evaluated for the mild wheelchair users who can propel the wheelchair by themselves, and these inclines are not consider the 'wheelchair occupants' who have more severe disabilities and need help when they move or the 'wheelchair assistants' who move the wheelchair on their behalf. Recent studies have suggested that the anterior head posture is known to exert biomechanical stress on the neck and may be associated with the changes in postural control. In this study, a manual wheelchair was equipped with a tilted angle correction sheet (Fig. 1) and we compared the changes when the subjects were seated on a ramp with manual wheelchair occupancy.

Methods

The tilted angle correction sheet was made with a frame consisted of a backboard cushion, seat cushion, micro controller, tilt sensor, linear motor, and a DC battery. The tilted angle correction sheet is operated by the microcontroller to process the information received from the tilt sensor upon entering the ramp, and to command the linear motor so that the seat remains perpendicular to gravity. The ramp used for the experiment was a 10-meter long slope course with an inclination of 5 degrees, 10 degrees, 15 degrees, and the same target were riding on each wheelchair. Also, the left pressure distribution was measured in real time. It also measured the neck movements when driving by attaching position sensors to the head and back. (Fig. 2)

Results

The change of the pressure distribution of the passenger on the wheelchair during the ramp driving increased with the angle of the ramp, but the change of the pressure distribution of the passenger on the wheelchair equipped with the inclination angle correction sheet (Fig. 3) was not different by the change of the angle of the ramp. In addition, the change in the head position of the person on a manual wheelchair was increased with the increase in the tilted angle of the head position, while that of the person on a wheelchair with the tilt angle correction sheet did not change the head position much.

Conclusions

The tilted angle correction seat is effective in minimizing changes in posture when a passenger rides on a ramp, thereby preventing falls in the wheelchair and improving stability. However, the driving assistant is needed because the position of the wheel blades in a wheelchair equipped with these seats varies from time to time for the target to proceed on his own. In the future, it is expected that the target person will be able to push the wheelchair by himself if there is a change in the driving part in accordance with the change in the seat.

Keywords

Postural stability, Angle Modification Wheel Chair, Slope propulsion

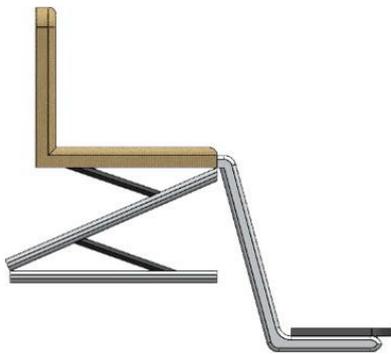


Fig.1 Tilted angle correction sheet

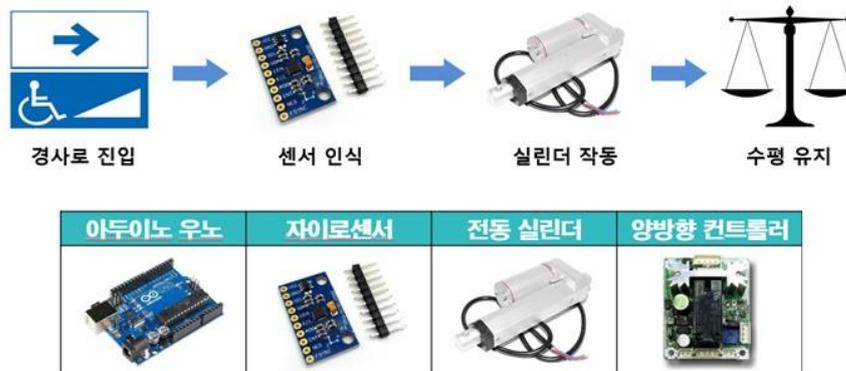


Fig.2 Theory of operation of the tilted angle correction sheet

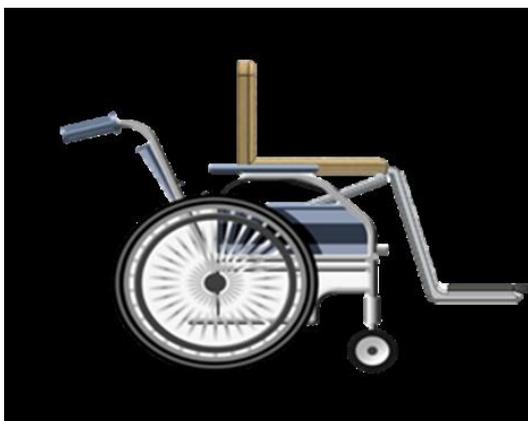


Fig.3 The Attempt to fit the tilted angle calibration sheet to a manual wheelchair

POSTER SESSION 2

게시 및 질의응답 일시 : 2018 년 10 월 26 일(금) 13:15-18:00/15:45-16:30

장소 : 3F 그랜드볼룸

P 2-1

Location of white matter lesions in the swallowing function of older patients with mild stroke

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Purpose

Older patients with stroke have poor functional prognosis compared to younger patients. Patients with stroke who have severe white matter (WM) lesions have been reported to have swallowing problems. Recently, there is growing evidence suggesting that clinical significance can be indicated by the anatomic location of white matter lesions and whether the functional integrity of specific fiber bundles is affected. The aim of this study was to determine whether the location of WM lesions affects swallowing function in older patients with mild stroke.

Materials and Methods

We conducted a retrospective analysis of 88 patients aged >65 years who had a National Institutes of Health Stroke Scale (NIHSS) score ≤ 5 and who underwent videofluoroscopic swallowing examination after their first stroke. The involvement of CBT was determined by two trained researchers depending on the change of signal intensity at the location of CBT, almost halfway between the most anterior and the most posterior points of the lateral ventricle, almost one-third between the midline and the most lateral point of the brain, and anterior and medial compared with the corticospinal tract. Participants were divided into three groups according to the WM lesion's involvement of corticobulbar tract (CBT) as follows: group I, no involvement of CBT; group II, involvement of CBT in one hemisphere; and group III, involvement of CBT in both hemispheres.

Results

Significant differences were observed in the Fazekas grade (PVH), Fazekas grade (DWH), sum score of Fazekas grade, and the laryngeal elevation abnormality among three groups according to the CBT involvement. (Table 1) Statistically significant correlations were observed between the involvement of CBT and delayed pharyngeal transit time and inadequate laryngeal elevation. (Table 2) Linear regression analysis showed that pharyngeal transit time tended to increase according to the involvement of CBT in WM lesion ($p=0.043$). In addition, inadequate laryngeal elevation was related to the involvement of CBT ($p=0.016$). Early spillage, inadequate laryngeal elevation and penetration could also be predicted by Fazekas grade. (Table 3)

Conclusions

In summary, our Results suggest that WM lesion location involving the CBT might affect the integrity of the tract that Results in dysphasia in older patients with mild stroke, regardless of the initial stroke severity. Accordingly, the location of WM lesions can be regarded as a potential predictive factor for dysphagia. Moreover, in patients with WM lesions involving CBT, detailed evaluation of dysphagia is required.

Table 1. Characteristic of three groups according to involvement of corticobulbar tract in white matter lesion[†]

	Group I (n=45) [‡]	Group II (n=25) [‡]	Group III (n=18) [‡]	p value [‡]
Age, years [‡]	69.2 ± 3.1 [‡]	75.64 ± 7.2 [‡]	80.33 ± 5.26 [‡]	0.068 [‡]
Sex (male/female) [‡]	21/24 [‡]	10/15 [‡]	10/8 [‡]	0.605 [‡]
Lesion side (right/left/bilateral) [‡]	21/21/3 [‡]	11/11/3 [‡]	11/7 [‡]	0.796 [‡]
Lesion location (supratentorium/infratentorium) [‡]	30/15 [‡]	21/4 [‡]	12/6 [‡]	0.293 [‡]
NIHSS [‡]	2.75 ± 1.48 [‡]	2.68 ± 1.38 [‡]	2.61 ± 1.72 [‡]	0.921 [‡]
Interval between onset of stroke and VFSS, days [‡]	10.13 ± 8.99 [‡]	8.24 ± 6.48 [‡]	10.89 ± 6.75 [‡]	0.371 [‡]
Fazekas grade (PVH) [‡]	1.47 ± 0.99 [‡]	1.72 ± 0.94 [‡]	2.33 ± 0.69 [‡]	0.006* [‡]
Fazekas grade (DWH) [‡]	0.49 ± 0.63 [‡]	0.96 ± 0.68 [‡]	1.56 ± 0.92 [‡]	0.000* [‡]
Sum score of Fazekas grade [‡]	1.96 ± 1.35 [‡]	2.68 ± 1.38 [‡]	3.89 ± 1.53 [‡]	0.000* [‡]
Lip sealing [‡]	43/2 (4.4%) [‡]	21/3 (12.0%) [‡]	13/5 (27.8%) [‡]	0.052 [‡]
Mastication [‡]	21/24 (53.3%) [‡]	16/9 (36%) [‡]	10/8 (44%) [‡]	0.315 [‡]
Bolus formation [‡]	20/25 (55.6%) [‡]	15/10 (40%) [‡]	9/9 (50%) [‡]	0.464 [‡]
Oral transit time [‡]	0.52 ± 0.59 [‡]	0.41 ± 0.22 [‡]	0.69 ± 1.10 [‡]	0.620 [‡]
Early spillage [‡]	28/17 (37.8%) [‡]	14/10 (40%) [‡]	13/5 (27.8%) [‡]	0.494 [‡]
Oral remnant [‡]	24/21 (46%) [‡]	18/7 (28%) [‡]	11/7 (38.9%) [‡]	0.314 [‡]
Swallowing response time [‡]	0.34 ± 1.18 [‡]	0.37 ± 0.27 [‡]	0.34 ± 0.14 [‡]	0.299 [‡]
Pharyngeal transit time [‡]	0.53 ± 0.51 [‡]	0.53 ± 0.29 [‡]	0.56 ± 0.22 [‡]	0.139 [‡]
Laryngeal elevation [‡]	36/9 (20%) [‡]	19/6 (24%) [‡]	9/9 (50%) [‡]	0.032* [‡]
Penetration [‡]	20/25 (44.4%) [‡]	11/14 (44%) [‡]	5/13 (27.8%) [‡]	0.450 [‡]
Aspiration [‡]	14/31 (31%) [‡]	5/20 (20%) [‡]	4/14 (22%) [‡]	0.551 [‡]

Values are presented as mean ± SD or number of subjects (proportion of abnormal finding).[‡]

Table 2. Partial correlation coefficients between CBT involvement and VFSS findings[†]

VFSS findings [‡]	Correlation coefficient [‡]
Lip sealing [‡]	0.200, p=0.065 [‡]
Mastication [‡]	0.121, p=0.265 [‡]
Bolus formation [‡]	0.173, p=0.111 [‡]
Oral transit time [‡]	0.022, p=0.838 [‡]
Early spillage [‡]	0.021, p=0.851 [‡]
Oral remnant [‡]	0.013, p=0.909 [‡]
Swallowing response time [‡]	0.164, p=0.223 [‡]
Pharyngeal transit time [‡]	0.206, p=0.047* [‡]
Laryngeal elevation [‡]	0.282, p=0.008* [‡]
Penetration [‡]	0.040, p=0.716 [‡]
Aspiration [‡]	0.084, p=0.443 [‡]

Values are adjusted for the age, NIHSS, Fazeka sum score. [†]

*p<0.05[‡]

Table 3 | Factors Affecting VFSS findings: Multivariate Prediction Models Using Logistic Regression Analysis[†]

VFSS parameters [‡]	OR [‡]	95% CI [‡]	p-value [‡]
Early spillage [‡]	[‡]	[‡]	[‡]
Fazeka sum score [‡]	4.112 [‡]	1.012-2.054 [‡]	0.043 [‡]
Laryngeal elevation [‡]	[‡]	[‡]	[‡]
Fazeka sum score [‡]	4.237 [‡]	0.351-0.975 [‡]	0.040 [‡]
CBT involvement [‡]	3.951 [‡]	1.294-12.064 [‡]	0.016 [‡]
Pharyngeal transit time [‡]	[‡]	[‡]	[‡]
CBT involvement [‡]	1.962 [‡]	0.037-0.176 [‡]	0.043 [‡]
Penetration [‡]	[‡]	[‡]	[‡]
Fazeka sum score [‡]	1.533 [‡]	1.068-2.201 [‡]	0.020 [‡]

OR, Odds ratio; CI, Confidence interval; CBT, corticobulbar tract[‡]

Influence of Nasogastric Tube on Swallowing Saliva in Stroke Patients measured with Ultrasonography

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Sahmyook medical center, Department of Physical Medicine and Rehabilitation¹

Objective

To investigate the influence of nasogastric tubes (NGT) on swallowing saliva in stroke patients

Methods

Three groups of participants were enrolled into the study : group A (20 stroke patients with NGT), control group B (25 stroke patients without NGT), or group C (25 healthy adults). Patients in group A were tested twice; with NGT (group A-1) and after NGT were removed (group A-2). The distance of the hyoid bone movement was measured by subtracting the shortest distance between the mandible and hyoid bone (S) from the distance at resting state (R) with ultrasonography. The degree of the movement was calculated by (R-S)/R. The trajectory area of the hyoid bone movement (Area) and the interval between the initiation of hyoid bone movement and the moment of the shortest hyoid-mandible approximation (Interval) were calculated by computer program.

Results

Within group A, R-S and (R-S)/R of group A-2 (1.14 ± 0.36 cm and 0.30 ± 0.09) were significantly greater than those of group A-1 (0.81 ± 0.36 cm and 0.22 ± 0.08), ($p = 0.009$ and 0.005). After removing NGT as seen in group A-2, R-S and (R-S)/R were improved to the level of those of group B (1.2 ± 0.32 cm and 0.30 ± 0.09), ($p = 0.909$ and 0.997). Area of group A2 was larger and Interval of group A2 was shorter than those of group A1 without statistical significance.

Conclusion

NGT interferes with the movement of the hyoid bone during swallowing 1 mL of water in stroke patients and it is restored after removing NGT.

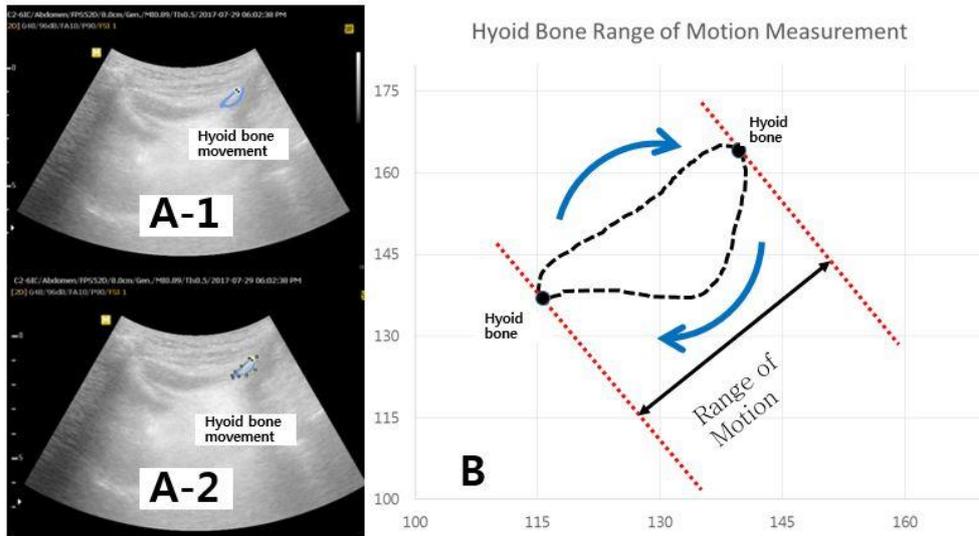
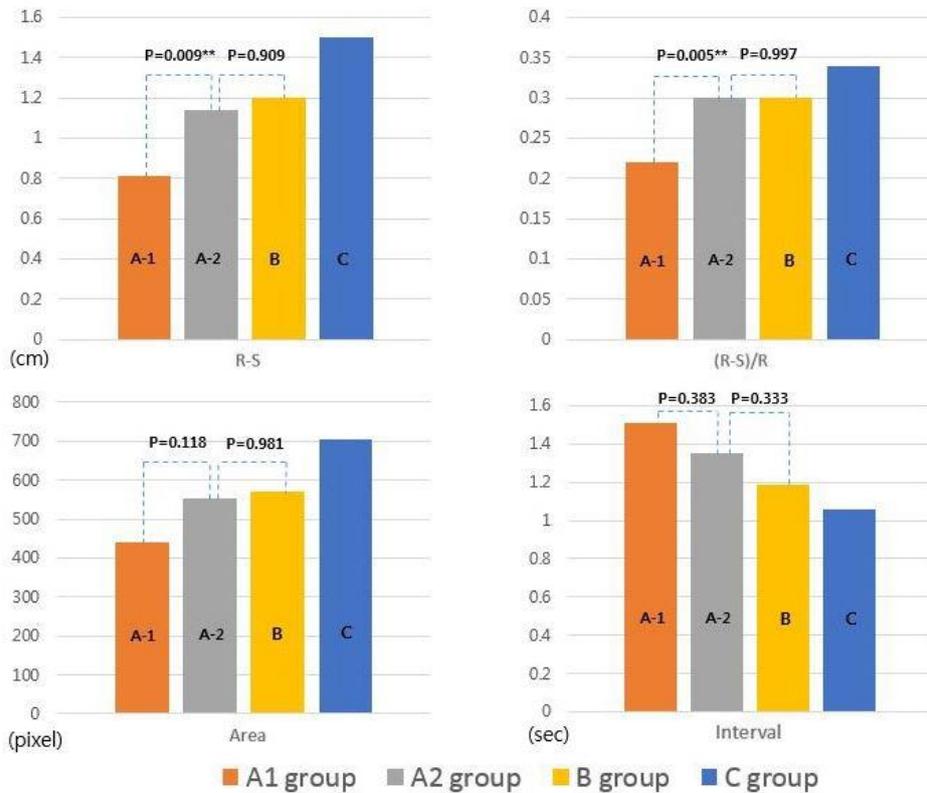


Fig. 1 The range of the hyoid bone movement depicted by a tracer marker at the ultrasonography video taken using a KINVOVEA program 0.8.15 (microanalysis for video) (A-1). The marked range of motion was then measured in pixel units using image J, an image processing and analysis program (A-2). Illustration of the range-of-motion measurement for a hyoid bone trajectory. (B) The illustration shows a hyoid bone trajectory (in black) over a single swallow. The initial resting position of the hyoid is marked with the black circle. The blue arrow shows the direction of motion for the trajectory. The range-of-motion measurement is made by finding the largest displacement between any two points on the hyoid bone trajectory during the swallow. (red dots)



Comparison of ultrasonographic findings in Group A-1, A-2, B and C

Changes in Brain Network after Excitatory rTMS in Chronic Stroke Patients with Aphasia (Pilot Study)

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Seoul National University Bundang Hospital, Department of Rehabilitation Medicine¹

Introduction

In post-stroke aphasia rehabilitation, repetitive transcranial stimulation (rTMS) aimed to reinforce the activity of the brain regions in the left hemisphere. In the present study, we performed functional near-infrared spectroscopy (fNIRS) with excitatory rTMS treatment for selection of the most appropriate application of stimulation and detection of the changes in cortical brain network. The purpose of this study is to assess the changes in brain network after excitatory rTMS in post-stroke non-fluent aphasia patients.

Methods

Five right-handed patients with post-stroke non-fluent aphasia were included in this study. Excitatory rTMS (10Hz, 800 stimuli, 100% of resting motor threshold, tangential to the scalp) at the most activated area in Broca or Wernicke area with navigation system was done in combination with 30 minutes' speech therapy for 10 days. Western aphasia battery (WAB) and fNIRS evaluation before (T0), right after 10 sessions of treatment (T1) and 2 months after the last treatment session (T2) were done. 34 channels were set by arranging 12 sensors and detectors at intervals of 3cm covering Broca and Wernicke area according to the international 10-20 electroencephalography system (Figure 1). Wilcoxon signed-ranks tests were used to evaluate potential improvement in WAB. The most activated area of the left hemisphere in fNIRS analysis was selected for stimulation. The changes in brain network were analyzed by the graph theoretical approach.

Results

The scores from subtests in WAB have increased after excitatory rTMS combined with speech therapy in all subjects (Figure 2). The thresholded correlation in the area of stimulation became higher in all patients. The changes of network parameters such as global efficiency and small-worldness in Broca and Wernicke area was significant after rTMS in all patients (Figure 3).

Conclusion

Aphasia quotient and scores from all subtests in WAB have increased significantly after targeted excitatory rTMS combined with speech therapy in all subjects. The efficiency of brain language network has been changed after excitatory rTMS.

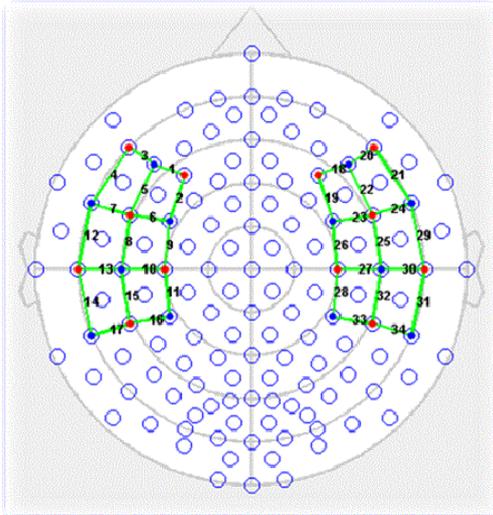


fig1. 34 channels were set by arranging 12 sensors and 12 detectors at intervals of 3cm covering Broca and Wernicke area according to the international 10-20 electroencephalography system.

Subject 1		49/M, Left Middle Cerebral Artery Infarction (2015-2), Global Aphasia, Right handed						
Activated channel: 4 (Broca Area)	Speech	Repeat	Reading	Comprehension	Naming	Writing	AQ / LQ	
	T0	13	16	59	142	43	45	52.0 / 53.9
	T1	14	12	66	140	62	49	56.8 / 58.4
	T2	14	22	65	152	40	47	55.6 / 57.8
Subject 2		67/F, Left Middle Cerebral Artery Infarction (2010-5), Global Aphasia, Right handed						
Activated channel: 8 (Broca Area)	Speech	Repeat	Reading	Comprehension	Naming	Writing	AQ / LQ	
	T0	7	16	45	89	7	18	27.6 / 25.0
	T1	9	20	41	91	16	16	34.4 / 33.1
	T2	9.5	24	39	116	15	13	38.4 / 35.4
Subject 3		45/M, Left Basal Ganglia Infarction (2014-07), Anomic Aphasia, Right handed						
Activated channel: 15 (Wernicke Area)	Speech	Repeat	Reading	Comprehension	Naming	Writing	AQ / LQ	
	T0	19.5	100	100	197	94	99	97.6 / 98.4
	T1	19.5	100	100	200	100	100	99.0 / 99.5
	T2	20	100	100	200	95	100	99.0 / 99.5
Subject 4		60/M, Left Middle Cerebral Artery Infarction (2014-11), Global Aphasia, Right handed						
Activated channel: 13 (Wernicke Area)	Speech	Repeat	Reading	Comprehension	Naming	Writing	AQ / LQ	
	T0	8	60	29	96	51	28	47.8 / 40.1
	T1	9	80	54	130	47	31	56.4 / 51.7
	T2	8	86	50	126	49	30	55.6 / 50.1
Subject 5		60/F, Left Basal Ganglia Hemorrhage (2010-10), Global Aphasia, Right handed						
Activated channel: 13 (Wernicke Area)	Speech	Repeat	Reading	Comprehension	Naming	Writing	AQ / LQ	
	T0	14.5	22	54	146	78	36	63.6 / 57.1
	T1	14.5	28	60	159	82	41	67.0 / 61.6
	T2	12.5	34	65	148	62	32	59.0 / 54.3

fig2. The scores from subtests in WAB have increased after excitatory rTMS combined with speech therapy in all subjects. The activated channel of the left hemisphere in each patient was selected as the stimulation site for excitatory rTMS.

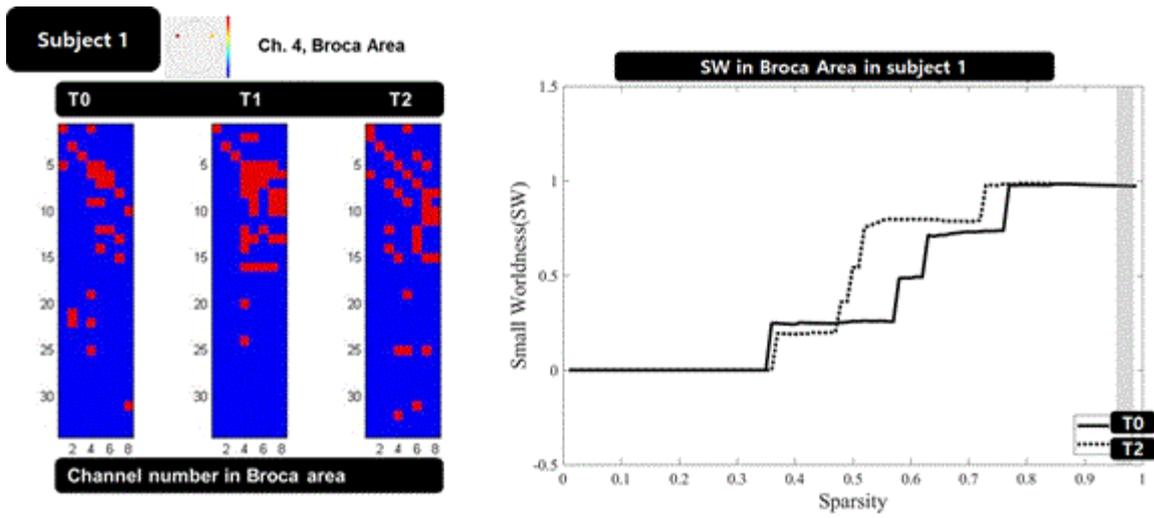


fig3. The number of thresholded correlation in Broca area including channel number 4 which was the excitatory rTMS target site increased along with the value of small worldness at certain sparsity.

Network localization of hallucination in acquired brain injury

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Introduction

Perception is the Result of a complex cerebral process where the information concerning the external world and the internal world is integrated. Hallucination is a profound distortion in a person's perception in the absence of external stimulus. Although hallucinations have been extensively studied in various neuropsychiatric diseases, only little is known about the underlying pathophysiological mechanisms. Here we analyze brain lesions causing hallucination to identify regions causally involved in symptom generation.

Method

We identified 77 cases of lesion-induced hallucination from the literature and mapped each lesion volume onto a reference brain. Using a recently validated technique termed lesion network mapping, we tested whether these lesions belonged to the same functional network. To accomplish this, the network of brain regions functionally connected to each lesion was identified using a connectome dataset from healthy participants. Network maps were overlapped to identify any region functionally connected to our set of lesions (Figure 1). Specificity was evaluated using a case-control design; control cohorts included a group of similar lesions randomized to different brain locations and a second group of lesions causing other neuropsychological disorders. We also investigated differences in lesion network map according to the modality such as auditory and visual hallucination.

Result

Lesions showed heterogeneity in anatomical location (Figure 2). However, at least 80% of these lesions showed network overlap in the cerebellar vermis (Figure 3A) and this connectivity pattern was highly specific for hallucination compared to four other lesion-induced neurological syndromes ($P < 0.0001$). In addition, there was no significant lesion location in subgroup analysis of visual ($N=31$) and auditory hallucination ($N=17$) but striking contrast in connectivity with thalamus was shown according to modality of hallucination (Figure 3B).

Conclusion

Strokes causing hallucination, while anatomically heterogeneous, localize to a common functional network. In addition, it could lead a different manifestations based on that lesion's unique pattern of functional connectivity. These Results advances our understanding of the brain regions involved in neuropsychological disorders.

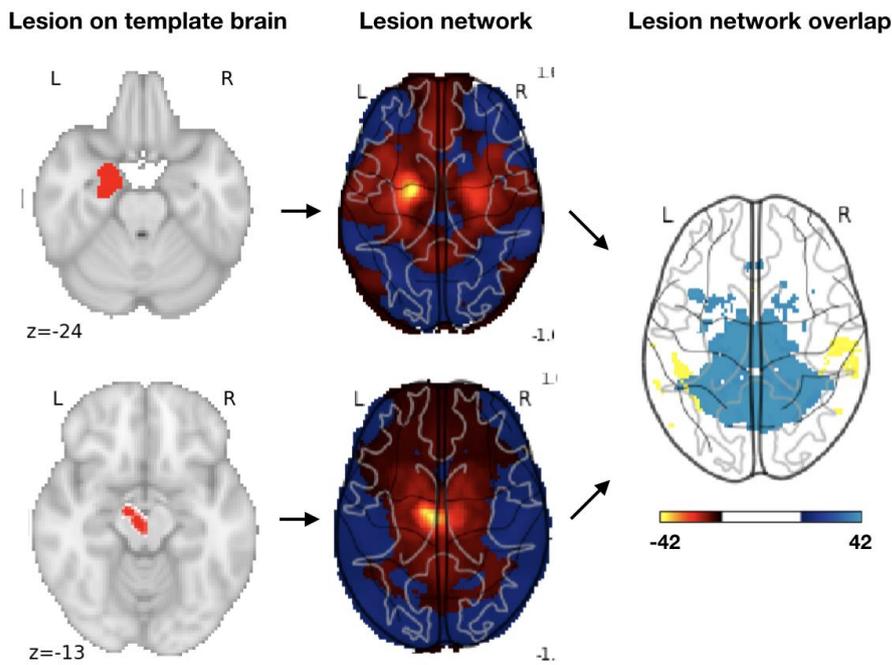


Figure 1. Lesion network mapping Methods

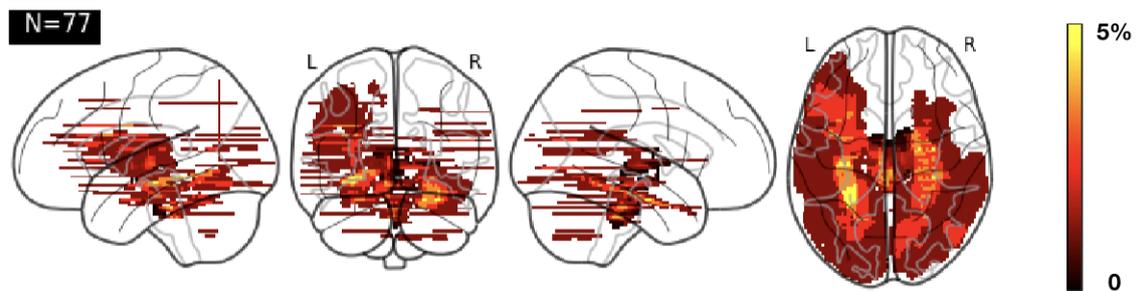


Figure 2. Result of Lesion overlap. Peak overlap was only 4/77 (5.2%)

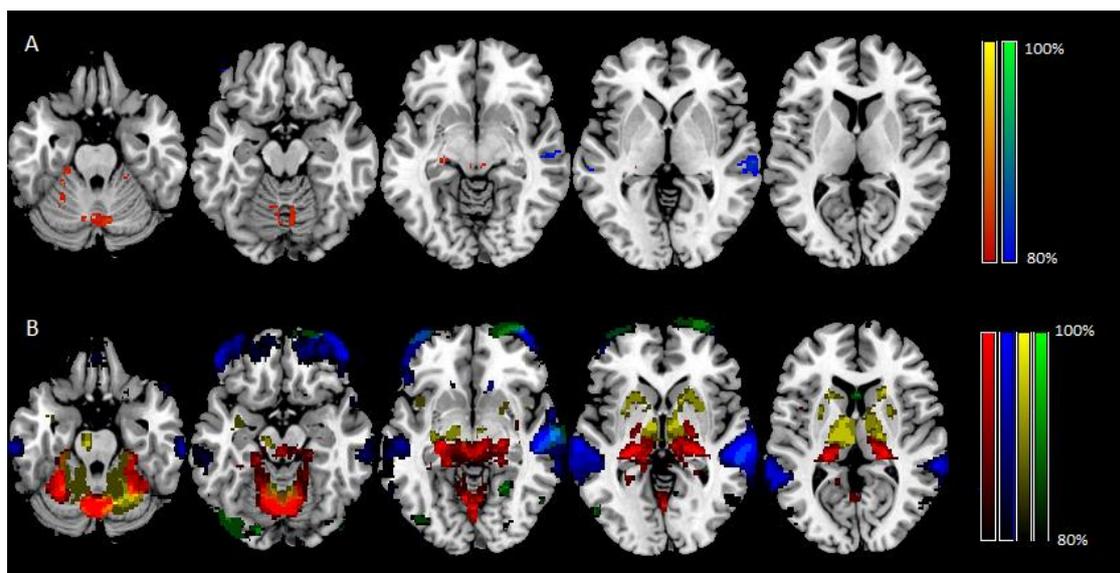


figure 3. A) The connectivity profile of lesions causing hallucination and B) Distinct patterns of lesion network overlap according to modality of hallucination. Functional connectivity of lesions causing visual hallucination was shown as Red-blue color and auditory hallucination as yellow-green color.

The current status of test diet protocols for VFSS in Korean Hospitals

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Objective

This study has been conducted to identify the current status of test diet protocols for Videofluoroscopic Swallowing Study(VFSS) in Korean Hospitals.

Methods

We developed a questionnaire consisting of 25 questions related to current usage status of test diet for VFSS that includes types, texture recipes and supplied amount of test samples etc.. The questionnaire was asked to the expert physicians who directly implementing VFSS in 28 training hospitals, which were sent out and collected by e-mail from December 7, 2017 to February 19, 2018. Among them, 13 out of 28 hospitals selected randomly and we conducted field surveys including observing the process of the VFSS and test diet. The answers of existing e-mail surveys were complemented by in-depth interviews with experts of each hospital on the process of producing test samples and conducting VFSS. We classified the provided food by the level according to the type, and the test diet protocols were classified as stages according to the level and amount of food.

Results

As a Result, the most common protocol was to provide a test sample with 7 stages, which was 28.6% of the total and it was followed by 5 and 6 stages as each 21.4%. The maximum test stages were 8 stages, and all institutions have more than three stages. In the order of provided test samples, 'the small amount of liquid(less than 5ml)' was the most provided in the 1st stage(53.6%). Also, 'the liquid(5~10ml)' and 'semi-solid(honey thick)' sample were the most used in the 2nd and 3rd stage respectively. Porridge and rice were the most commonly used in stages 4 and 5. The samples used at the final stage, 53.6% of institution supplied with 'the drinking with cup' followed by rice with 21.4%. Among the used samples of thin liquid level, 'water mixed with barium' accounted for the highest percentage in 'the small amount of liquid(less than 5ml)', 'the liquid(5~10ml) and 'the drinking with cup'. However, the mixing ratio of the liquid samples and barium was not uniform among each institution. And there was difference in thickened liquid and semi-solid level. 'Yogurt' was used more than 35% and 45% respectively as the 'nectar thick' and 'honey thick'. Various samples were used on 'pudding thick'. But, only 42.9% measured the physical properties of test diets by using the viscometer and texturometer, and there was no case that presented specific values of physical properties such as viscosity, hardness, cohesiveness, and adhesiveness, etc..

Conclusion

In the 28 Korean hospitals, each hospital uses samples depending on experience or according to its own standards rather than unified standard among the institutions. Thus, the protocol and evaluation criteria for each hospital are not standardized, which limits are difficult to the accurate sharing of information about the test Results. Therefore, it will be necessary to make a consensus for the protocol and evaluation standard of VFSS through future research.

Behavioral changes of mild traumatic brain injury in mice: comparison of weight drop and controlled

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Seoul National University Hospital, Department of Rehabilitation Medicine¹, Incheon Workers Compensation Hospital, Department of Rehabilitation Medicine²

Background & Purpose

Mild Traumatic Brain Injury (mTBI) is called concussion, the sudden accident can happen in our daily lives. Furthermore, TBI induces post-concussion syndrome (PCS) and is later known to be a risk factor for degenerative neurological diseases. Various animal models have been developed to mimic mTBI, such as weight-drop (WD) and Closed Head Impact Model of Engineered Rotational Acceleration(CHIMERA). However, the clinical feature of mTBI is too vague and it is difficult to establish an animal model using rodents. WD model is conventional and the most commonly used Method, but there is no consensus on the experimental conditions or the establishment of mTBI. The purpose of our study is to establish an animal model of mTBI using WD through various behavioral tests and comparison of controlled cortical impact (CCI) model.

Method

In order to characterize the outcome of TBI, we studied adult C57BL/6 mice in a WD and CCI model. We developed and characterized a mouse model of mTBI, induced onto the closed head over the frontal hemisphere with an impact device for WD. At a height of 2m, 50g of the weight is dropped into the pipe and then, the mice had accelerated impact that rotated 180° and then landed. In case of CCI, we used device that electromagnetic impact device with stereotaxic, Impact One™ (Leica biosystems). TBI modeling used CCI, open the skull and directly impacts the brain under the conditions of velocity (5m/s), depth (1.5mm), tip size (3mm), dwell time (500ms). To evaluate the perception and behavior of the TBI model, behavior test were performed such as loss of right reflex (LRR), Neurological severity score (NSS), Rotarod treadmill (rotarod) and Tail suspension test (TST).

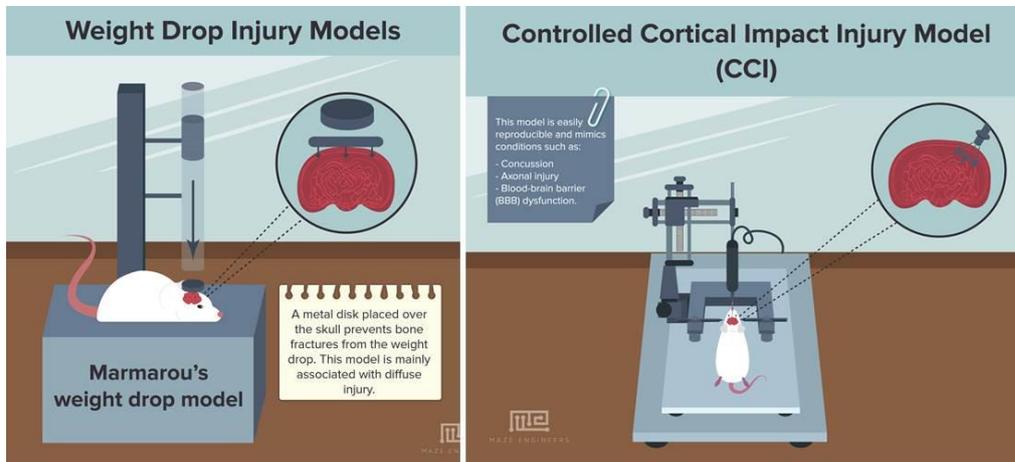
Results

Immediately after the injury, LRR was significantly higher in WD than in CCI (WD:13m29s, CCI:3m90s, Ctrl:1m48s), and the NSS scores were elevated in WD and CCI compared to the control group (WD:4.43, CCI:4.63, Ctrl:1.20, after 1 hour of impact). As time passed, the NSS score decreased, but CCI tended to maintain higher score than WD. However, in the Rotarod test, CCI showed a steady higher score than WD after injury. In both models, TST did not show any particular difference.

Conclusion

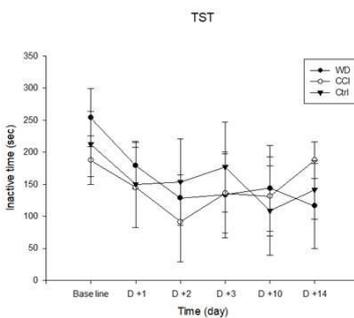
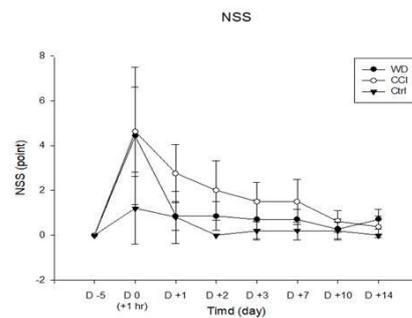
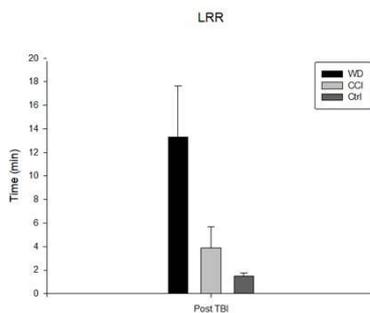
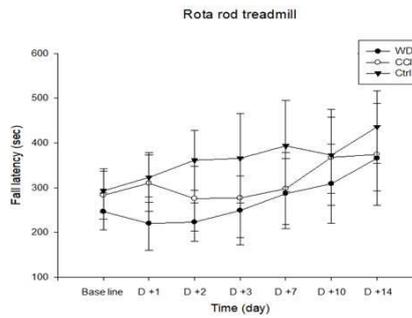
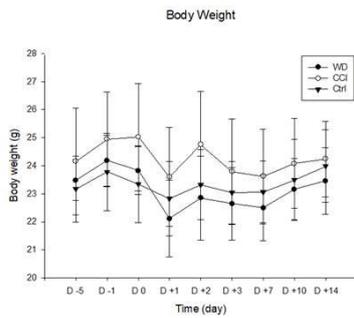
LRR test after the injury was the most prominent behavioral test showing the establishment of mTBI in WD. CCI with partial injury of brain tissue showed better motor

function than WD, but overall neurological evaluation was rather poor. Further investigation is needed to include a detailed behavioral assessment to identify long-term effects of brain damage, such as memory tests.



Weight drop impact
Mild Traumatic Brain Injury

Controlled cortical impact
Severe Traumatic Brain Injury



Upper Extremity Rehabilitation Using Virtual Reality System with tDCS with Stroke Patients

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National Rehabilitation Center, Department of Rehabilitation Medicine¹, Soon Chun Hyang University, Department of Occupational Therapy², National Rehabilitation Center, Department of Rehabilitation Medicine³

Background

Recently, novel tools based on emerging technologies such as non-invasive brain stimulation (NIBS), robotics and virtual reality (VR) have been developed to improve motor function after stroke. There are growing evidences that a combination of NIBS and motor skill training is a new treatment option in the field of neurorehabilitation. However, it lacks of studies about VR-based rehabilitation system combined with NIBS. Therefore, the aim of this study was to investigate the effect of combination of transcranial direct current stimulation (tDCS) and VR-based therapy on distal upper extremity in patients with stroke.

Methods

The present study was a randomized, double-blinded controlled trial (NCT03465631). The study included 20 stroke patients who were randomized to an experimental (VR-based training with tDCS; VR-tDCS) group or a control (VR-based training with sham-tDCS; VR-Sham) group. All participants received a 20 sessions of 20 minutes-intervention (VR program with tDCS or sham-tDCS) over 20days. The primary outcome was the change in the Box and Block Test (BBT) scores, and the secondary outcomes were the changes in the Jebsen–Taylor hand function test (JHFT), Fugl-Meyer assessment of the upper extremity (FMA), Grip strength, and Stroke Impact Scale (SIS) version 3.0 scores. The outcomes were assessed before the intervention, immediately after the intervention, and 1 month after the intervention. The change of those variables were compared between the two groups using the RMANOVA.

Results

Both groups demonstrated gains in all evaluated areas. There was no interaction of time and group, indicating no difference between two groups, although VR-tDCS produced greater improvements in all other outcome measures, except for the SIS-activities of daily living/instrumental activities of daily living (ADL/IADL) domain. There was no adverse events during the study.

Conclusions

These findings suggest that tDCS combined with VR-based rehabilitation could be with safety. However, robust evidence needs to be investigated and clarified with further studies.

Table 1. Baseline Characteristics of Subjects

	VR-dual (n = 10)	VR-sham (n = 10)	P -value
Age (year)	54.2 ± 12.2	53.8 ± 8.7	.631 ^a
Gender, male	8 (80)	5 (50)	.160 ^b
Dominant hand, right	10 (100)	10 (100)	NA
Time from stroke, months	22.2 ± 40.9	20.8 ± 37.1	.529 ^a
Affected arm, right	5 (50)	5 (50)	1.000 ^b
Stroke type, infarction	5 (50)	6 (60)	.653 ^b
MAS wrist flexor	0.4 ± 0.5	0.3 ± 0.5	.739 ^a
MAS wrist extensor	0.5 ± 0.5	0.4 ± 0.5	.739 ^a
MRC wrist flexor	2.7 ± 0.5	2.5 ± 0.7	.631 ^a
MRC wrist extensor	2.9 ± 0.6	2.7 ± 0.5	.529 ^a
MRC finger flexor	3.0 ± 0.8	3.2 ± 0.6	.631 ^a
MRC finger extensor	2.8 ± 0.4	2.8 ± 0.4	1.000 ^a
BBT score	16.2 ± 14.5	23.5 ± 13.6	.247 ^a
FMA-proximal score	26.6 ± 7.2	28.3 ± 7.1	.529 ^a
FMA-distal score	14.4 ± 3.7	15.1 ± 4.6	.796 ^a
JTHF score (sec)	503.1 ± 301.4	343.5 ± 313.8	.280 ^a
Grip power (kg)	5.3 ± 7.5	3.2 ± 4.8	.971 ^a

Abbreviations: VR, virtual reality;

MAS, modified [ashworth](#) scale; MRC, medical research council scale;

BBT, box and block test; FMA, [fugl-meyer](#) assessment; JTHF, [jebsen-taylor](#) hand function test;

NA, not applicable.

Values are mean ± standard deviation or number (%)

^aMann-Whitney U test, ^b χ^2 test

(*MAS: 0:0, 1:1, 2:1+, 3:2, 4:3, 5:4)

Table 2. VR–dual and VR–sham group comparison on the amount of performance change

	T2-T1				T3-T1			
	VR–dual (n = 10)	VR–sham (n = 10)	RM –ANOVA		VR–dual (n = 10)	VR–sham (n = 10)	RM –ANOVA	
			F	P-value			F	P-value
FMA–proximal score	3.9 ± 4.8	4.3 ± 2.6	0.053	.820	4.0 ± 4.5	4.1 ± 3.1	0.003	.955
FMA–distal score	4.7 ± 2.9	5.7 ± 2.4	0.691	.417	5.0 ± 2.2	6.0 ± 2.3	1.023	.325
FMA–total score	5.8 ± 6.4	7.2 ± 3.3	0.378	.547	6.2 ± 4.7	7.3 ± 4.1	0.304	.588
Grip power (kg)	1.9 ± 3.3	1.8 ± 1.6	0.007	.933	1.4 ± 4.5	1.1 ± 1.4	0.040	.844
BBT score	5.6 ± 4.4	5.4 ± 3.8	0.012	.915	4.5 ± 3.8	7.0 ± 3.2	2.506	.131
JTHF–gross (time)	-52.1 ± 82.7	-18.7 ± 36.3	1.367	.258	-51.6 ± 78.2	-9.6 ± 25.9	2.598	.124
JTHF–fine (time)	-25.4 ± 46.5	-20.3 ± 55.3	0.050	.826	-58.3 ± 69.4	-41.2 ± 72.7	0.289	.597
JTHF–total (time)	-77.8 ± 88.3	-39.2 ± 80.5	1.043	.321	-110.1 ± 107.8	-50.7 ± 98.0	1.662	.214
SIS–strength score	6.3 ± 15.8	5.8 ± 13.8	0.003	.954	ND	ND	ND	ND
SIS–hand score	4.0 ± 7.4	17.5 ± 21.4	3.564	.075	ND	ND	ND	ND
SIS–ADL/IADL score	-1.6 ± 6.5	3.5 ± 16.9	0.810	.380	ND	ND	ND	ND
SIS–recovery score	12.0 ± 16.9	11.0 ± 8.7	0.028	.870	ND	ND	ND	ND

Abbreviations: VR, virtual reality; FMA, Fugl-Meyer assessment; BBT, Box and block test; JTHF, Jebsen Taylor hand function test; SIS, Stroke impact scale; ND, no data. Values are mean ± standard deviation. P-value < .05

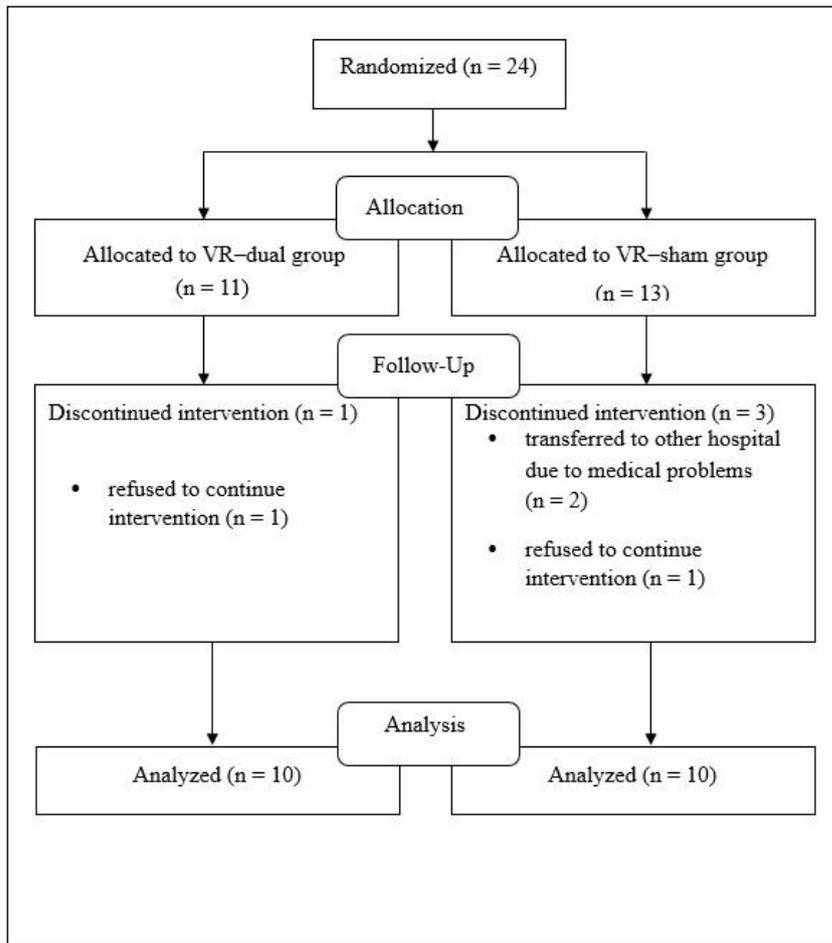


Fig 1. Study flow-chart

Predictive value of pharyngeal width at rest (JOSCYL Width) for aspiration after stroke

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Introduction

Assessment of aspiration in stroke patients is important. The weakness of pharyngeal muscle contraction increases the risk of aspiration. The pharyngeal width at rest decided by the tone and strength of pharyngeal muscle might be an indicator of aspiration in stroke patients. The aim of this study was to develop a new assist tool for predicting aspiration based on the pharyngeal width at rest in stroke patients with aspiration symptom.

Methods

Lateral neck roentgenograms were obtained from 270 patients complaining of dysphagia after stroke (age: 67.9 ± 12.1 years, stroke stage (acute/chronic): 92/178, and 35 healthy and age-matched controls (age: 65.5 ± 3.1 years). Stroke stage was defined as acute stroke within thirty days, and those who were over thirty days as chronic stroke group. The pharyngeal widths were measured at the middle level of the second and third cervical vertebral bodies using lateral neck roentgenogram. We named the average of two pharyngeal widths as JOSCYL width that is a combination of the first letters of the authors' surnames. A video fluoroscopic swallowing study (VFSS) was performed and the Penetration-Aspiration Scale (PAS) and the Dysphagia Outcome and Severity Scale (DOSS) were determined by two physiatrists. Pharyngeal widths were compared between patients and controls and correlations between the pharyngeal widths and the scores of PAS and DOSS were examined in patients (1st, in whole stroke group; 2nd, in stroke stage). To determine the optimal cutoff points for predicting aspiration, a receiver operating characteristic (ROC) curve analysis was performed on pharyngeal width. All statistical significances were defined as CI > 95% and p value < 0.05.

Results

The JOSCYL Widths of the whole stroke group (17.8 ± 6.2 mm; $p < 0.001$), acute stroke group (17.6 ± 5.9 mm; $p = 0.033$), and chronic stroke group (17.8 ± 6.4 mm; $p = 0.011$) were larger than those of the control group (14.6 ± 4.3 mm). Correlations were confirmed between the JOSCYL Widths and the dysphagia scales in whole stroke group (with PAS: $p = 0.006$; with DOSS: $p = 0.007$), in acute stroke group (with PAS: $p = 0.168$; with DOSS: $p = 0.575$), and in chronic stroke group (with PAS: $p = 0.019$; with DOSS: $p = 0.006$). The correlation between the JOSCYL Width and the severity of dysphagia (PAS and DOSS) was statistical significant for the whole stroke group and the chronic stroke group ($p < 0.05$).

The optimal cutoffs for predicting aspiration were 17.8 mm, 17.5 mm, and 17.8 mm in the whole stroke group, acute stroke group, and chronic stroke group, respectively.

Conclusion

The JOSCYL Width is a new assist indicator for predicting aspiration in stroke patients that is precise and easy to use. Approximately, 18 mm was thought of as a cutoff point of pharyngeal width for post-stroke aspiration. The JOSCYL Width could be an easy and useful indicator for predicting aspiration.

Robot-Assisted Upper Arm Training(RAT) in Subacute Hemiplegic Stroke Patients

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Introduction

This study was aimed to investigate the robot-assisted upper arm training was more effective on the motor recovery, upper limb function, the reach & grasp tasks than conventional occupational therapy in subacute hemiplegic stroke patients.

Method

60 subacute hemiplegic stroke patients were enrolled in this study. The subjects were randomly assigned into two groups. The RAT group were received the 30min robot-assisted upper arm training(RAT) with Armeopower (Hocoma AG, Switzerland) and 30min conventional occupational therapy per day, 5 times per week for 4weeks. The COT group did 60min conventional occupational therapy per day, 5 times per week for 4weeks. The clinical outcomes including Fugl-Meyer Assessment(FMA), Motricity Index(MI), Functional Independence Measure(FIM), Modified Ashworth Scale(MAS), Visual Analogue Scale(VAS) for pain, Trunk Control Test(TCT), Range of Motion(ROM), Maximal Voluntary Torques(MVT), Motor Function Test(MFT) and Wolf Motor Function Test(WMFT) were assessed in all patients before(T1), during treatment (T2), after treatment(T3) and 4 weeks after the treatment(T4). Also, the spatiotemporal and kinematic data were obtained during reach & grasp tasks through 3D motion analysis (MX-T10, Vicon Motion Systems Ltd UK). The reach & grasp tasks were composed of four sub-tasks: grasp the cup(P1), arrive at the mouth(P2), put the cup on the table(P3), and return to initial position(P4). Those were compared between two groups by repeated measures ANOVA(Analysis of variance).

Result

The all parameters measured at T1 did not differ between both group. All groups were improved the clinical outcomes after treatment ($P < 0.05$). However, the significant difference of all clinical outcomes (FMA, MI, FIM, MAS, VAS, TCT, ROM, MVT, MFT, WMFT) between RAT and COT group were not found. Also, the all temporospatial and kinematic parameters were not significantly different between both groups during reach & grasp tasks, except the shoulder rotation angle during P2 sub-task and the peak velocity during P1 sub-task ($p = 0.036$, $p = 0.042$).

Conclusion

This study did not agree that robot-assisted upper arm training combined with conventional occupational therapy in subacute post-stroke hemiplegic patients may be superior to the same intensity conventional occupational therapy.

Medical risk factors associated with Parkinson's disease: a 10-year population-based study in Korea

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Introduction

Past research has investigated possible risk factors associated with the onset of Parkinson's disease (PD). However, such studies have rarely included Asian patients. We herein investigate which factors affect the onset of (PD) in the South Korean population.

Methods

This nation-wide study was performed by applying data from the National Health Insurance Database and Health Insurance Review and Assessment Service on reimbursement claims and health check-ups in 2002 and 2003 to a 10-year follow-up cohort model. Of the 5,147,950 people who underwent regular health check-ups during this period, 10%(514,795) were randomly selected. During follow-up, we identified 7,746 patients with PD. We examined age, hypertension, diabetes, use of statin, body mass index, smoking, alcohol consumption, socioeconomic status, depression and anxiety as possible risk factors for PD.

Results

The adjusted HRs of the subjects aged 50-59, 60-69, 70-79, and 80 years or older were 3.101, 8.958, 14.709, and 16.797, respectively; all HRs were statistically significant ($p < 0.0001$). When comparing the prevalence among men and women, the adjusted HR of women was 0.971, which was statistically insignificant ($p = 0.3273$). In cases of hypertension, diabetes, depression, and anxiety, the adjusted HRs were 1.259, 1.255, 1.554, and 1.808, respectively, ($p < 0.0001$ for all). The adjusted HR of the group taking statins was 1.157, which was higher than that of the group not taking statin at the time of diagnosis. Relative to the normal weight group, the risk of PD was only higher in the highest BMI group ($BMI > 30.0$, $p < 0.0001$). The adjusted HRs of ex-smokers and current smokers were not significantly different (0.920), but that of current smokers was statistically significant ($p < 0.0287$). Except for the almost-daily-drinking group ($p = 0.6530$), the adjusted HRs of all alcohol-drinking groups were < 1 and were statistically significant ($p < 0.0001$). As Medicaid was set as the standard, the adjusted HR was < 1 in all groups ($p < 0.05$), indicating that SES and PD were closely related.

Conclusion

We found no difference in the prevalence of PD between men and women. Age; vascular risk factors, including the history of hypertension, diabetes, and use of statin; severe obesity; non-smoking; and non-alcohol drinking may increase the risk of PD. We further

found an association between lower socioeconomic status and the risk of PD. Depression and anxiety are related to PD, but further study is needed to identify whether they are risk factors or an initial symptom of PD. Though the findings of the present study benefited from an immense dataset, future studies should validate our findings.

P 2-11

Correlation of foot radiographs with kinematics during gait of children with motor disabilities

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Objectives

Clinical decisions about foot deformities in children with motor disabilities are mainly made through the radiographs of the foot and ankle. However, because the radiographs are static position data, it is not known exactly how foot kinematics are related to these static images during gait. The Oxford foot model (OFM) is a multi-segment model to estimate the hindfoot and forefoot motion on sagittal, coronal and transverse planes. Kinematics of foot and ankle during gait can be analyzed based on this model using motion capture system. The purpose of this study was to investigate whether foot radiographs were correlated with foot kinematics during gait using the OFM.

Subjects

This study reviewed foot radiographs and computerized gait analysis data from 30 ambulatory children with motor disabilities, such as cerebral palsy, spina bifida, brain tumor, etc.

Methods

We analyzed the foot radiographs on standing posture from all subjects. Talo-calcaneal angle and talo-1st metatarsal angle were measured in both lateral and anterior-posterior (AP) views. Calcaneal pitch angle was measured in lateral view as well. Walking was tested barefoot at a self-selected speed along a 8-m path, and the marker trajectories were recorded with an 6-camera optometric system for kinematic analysis (Vicon, Oxford, UK) computerized with a sampling rate of 100 Hz to measure the kinematic data (angle of each joint) during the gait cycle. A modified Helen Hayes marker set for lower limbs and OFM for foot and ankle were used. Spearman rank correlation coefficients were computed to evaluate the relationship between the foot radiographs and foot kinematics based on OFM during gait.

Results

Talo-1st metatarsal angles in lateral view were correlated with maximum forefoot dorsiflexion on sagittal plane (FFSP max) and talo-1st metatarsal angles in AP view were correlated with maximum forefoot abduction on transverse plane (FFTP max) during gait. ($p < 0.05$) Talo-calcaneal angles in AP view were correlated with maximum hindfoot valgus on frontal plane (HFFP max) during gait. ($p < 0.05$)

Discussion

According to this study, we could find that which parameters of static foot radiographs during standing were more correlated with abnormal foot kinematics during gait in children with motor disabilities. The larger the Talo-1st metatarsal angles in lateral and AP view, the greater the value of FFSP max and FFTP max. Additionally, the larger the Talo-calcaneal angles in AP view, the greater the value of HFFP max.

References

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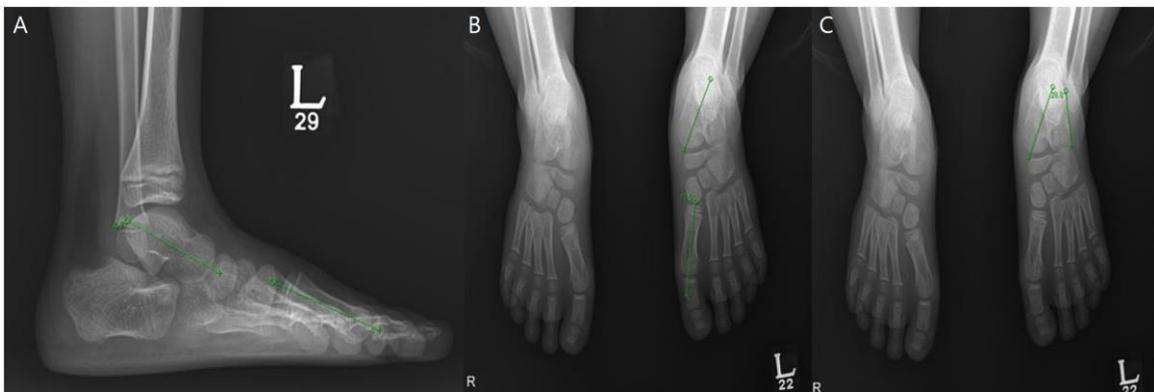


Figure 1. A : Talo-1st metatarsal angles in lateral view in a subject, B : Talo-1st metatarsal angles in AP view in a subject, C : Talo-calcaneal angles in AP view in a subject

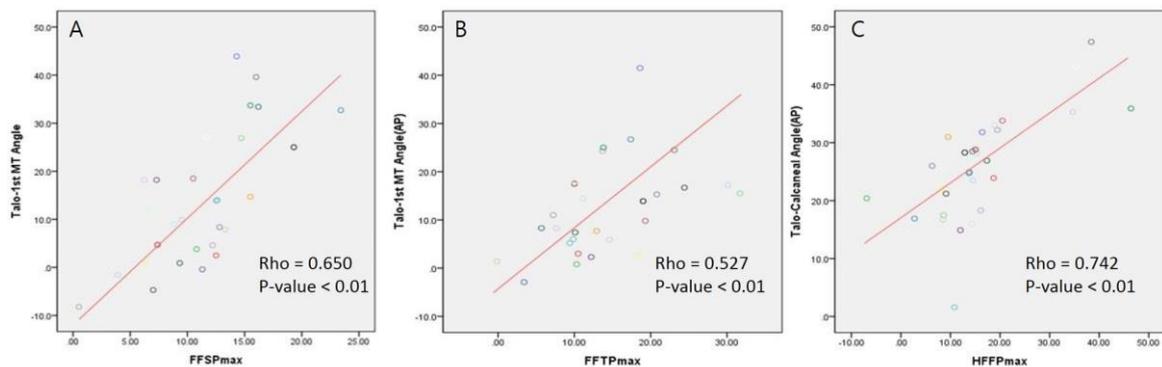


Figure 2. A : Scatter plot of Talo-1st MT Angle and value of FFSP max, B : Scatter plot of Talo-1st MT Angle(AP) and value of FFTP max, C : Scatter plot of Talo-Calcaneal Angle(AP) and value of HFFP max

Botulinum Toxin Type A Injection for Cervical Dystonia in Adults with Dyskinetic Cerebral Palsy

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Objective:

We aimed to evaluate the efficacy and safety of injecting botulinum toxin A (BoNT-A) into the neck muscles to treat cervical dystonia (CD) in patients with dyskinetic cerebral palsy (CP).

Method

This was a randomized, double-blinded, placebo-controlled trial with cross-over design. We prospectively enrolled adults with dyskinetic CP who were over 20 years old and had been clinically diagnosed with CD for more than one year. The primary outcome measure was the change in Toronto Western Spasmodic Torticollis Rating Scale (TWSTRS) at four weeks from the baseline TWSTRS.

Results

Seventeen patients were initially enrolled, but one patient was excluded after the final evaluation because of a violation of the study protocol. Demographic and clinical data for the sixteen participants included in the study are presented in Table 1. - Changes on the TWSTRS after the Injection TWSTRS total scores at baseline, four weeks, and 12 weeks are presented in Figure 1. At four weeks, the BoNT-A injections showed significant improvement in the TWSTRS total score (Figure 1A) compared to the saline injections ($p = 0.0286$ for ANCOVA). At 12 weeks, the BoNT-A injections had a tendency to show greater improvement than the saline injections, but this difference was not statistically significant ($p = 0.0783$). There was no significant difference between the two injections on the TWSTRS severity score (Figure 1B). At four weeks there was a significant improvement in the TWSTRS disability score (Figure 1C) for the BoNT-A injections compared to the saline injections ($p = 0.0152$), but there was no significant difference after 12 weeks ($p = 0.6444$). On the TWSTRS pain score (Figure 1D), the BoNT-A injections showed statistically significant improvement compared to the saline injections at both four and 12 weeks ($p = 0.0013$ and 0.0200 , respectively). - Changes in Numerical Rating Scale (NRS) after the Injection Figure 2 presents the NRS for both pain and disability at baseline, four weeks, and 12 weeks and the NRS for satisfaction at four weeks and 12 weeks. On the pain NRS (Figure 2A), the BoNT-A injections had a tendency toward lower pain at four and 12 weeks, but there was no statistically significant difference between the two treatments ($p = 0.0603$ and 0.1796 , respectively). On the disability NRS (Figure 2B), the BoNT-A injections had a tendency toward lower disability at four weeks, but there was no statistically significant difference between the two treatments ($p = 0.1466$). On the satisfaction NRS (Figure 2C), which was not obtained at the baseline, the BoNT-A injections scored higher at four weeks and 12 weeks. This difference reached statistical significance only at four weeks ($p = 0.0176$).

Conclusion

BoNT-A injection for CD in adults with dyskinetic CP is relative safe and improves pain and disability.

Table 1. Baseline characteristics and clinical status of the study participants.

		Number = 16
	Items	
	Male/Female, number	8/8
	Age (years), mean (SD)	46.00 (6.44)
	Retrocollis/Anterocollis, number	7/9
Demographics	GMFCS level, number (%)	
	I	4 (25.00)
	II	7 (43.75)
	III	0 (0)
	IV	4 (25.00)
	V	1 (6.25)
	Maximal Kellgren score for cervical spondylosis, number (%)	
	0	0 (0)
	1	2 (12.50)
	2	3 (18.75)
3	8 (50.0)	
4	3 (18.75)	
Clinical data	TWSTRS total score at baseline, mean (SD)	41.69 (13.36)
	TWSTRS Severity score, mean (SD)	20.63 (11.13)
	TWSTRS Disability score, mean (SD)	11.13 (5.66)
	TWSTRS Pain score, mean (SD)	9.94 (4.47)
	JOA score at baseline, mean (SD)	11.34 (2.84)
	NRS pain score at baseline, mean (SD)	4.25 (2.08)
	NRS disability score at baseline, mean (SD)	5.19 (2.46)

TWSTRS, Toronto Western Spasmodic Torticollis Rating Scale; JOA, Japanese Orthopedic Association Score; NRS, Numerical Rating Scale; GMFCS, Gross Motor Function Classification System.

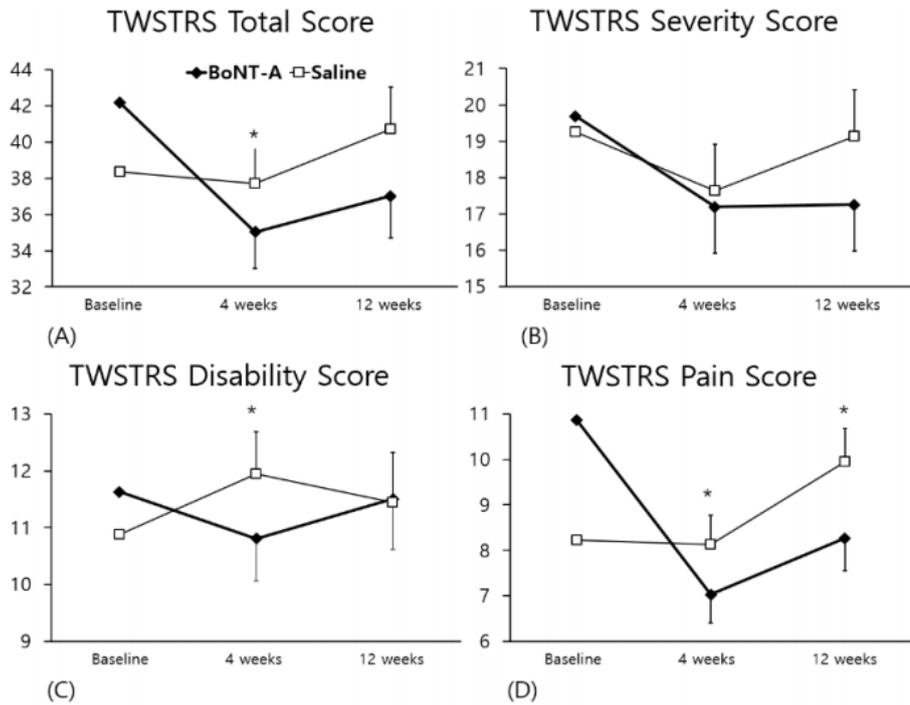
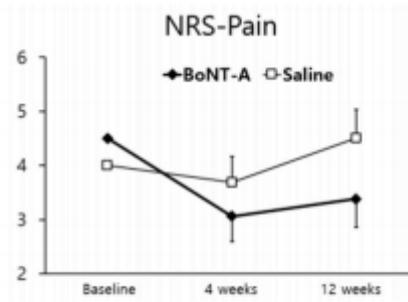
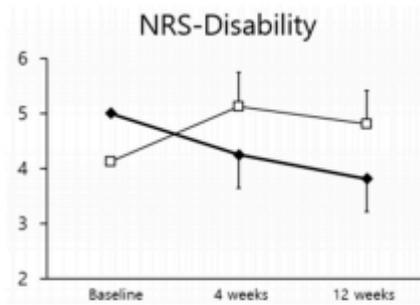


Figure 1. Comparison of the TWSTRS change between the BoNT-A and the Saline injection. * $p < 0.05$ for ANCOVA. The error bar indicates the SE for LS mean change from baseline. BoNT-A Botulinum toxin A, ANCOVA, Analysis of covariance, SE standard error, LS least-squares. (A), TWSTRS total score change, scale ranges from 0 to 85, (B), TWSTRS severity subscale change, scale range from 0 to 35, (C), TWSTRS disability subscale change, scale range from 0 to 30, (D), TWSTRS pain subscale change, scale range from 0 to 20, TWSTRS; Toronto Western Spasmodic Torticollis Rating Scale.



(A)



(B)



(C)

Figure 2. Comparison of NRS scores between the BoNT-A and the saline injection. Comparison of the NRS score at four weeks and 12 weeks between the BoNT-A and the saline injection, * $p < 0.05$ for ANCOVA (A,B) and Wilcoxon signed-rank test (C), In Figure 2A,B, the error bar indicates the SE for LS mean change from baseline. In Figure 2C, the error bar indicates the standard deviation. NRS Numeric rating scale, BoNT-A Botulinum toxin A, ANCOVA, Analysis of covariance, SE standard error, LS least-squares.

Ipsilateral Hypertrophy of the Mastoid Process in Surgical Cases of Congenital

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Objectives

Secondary musculoskeletal asymmetry is one of the main complications of congenital muscular torticollis (CMT). Common examples include: cervical and thoracolumbar scoliosis, craniovertebral abnormalities and other various forms of craniofacial asymmetry, which include depression of the frontal bone and zygomatic arch on the CMT side, posteriorly positioned ear on the CMT side, deformational plagiocephaly on the non-CMT side, and deviation of the chin towards the non-CMT side. From our clinical experience, we hypothesized that ipsilateral hypertrophy of the mastoid process on the side of CMT is common in patients with severe CMT. To the best of our knowledge, there have been no reports on the volumetric asymmetry of the mastoid process in CMT patients. Therefore, the Objectives of this study were to verify ipsilateral hypertrophy of the mastoid process in surgical patients with CMT and to analyze this change in reference to age.

Methods

This is a case-control study in a tertiary hospital. Surgical cases of CMT were enrolled, along with the age- and gender-matched controls. The volume of mastoid process was calculated and compared for both groups on the computed tomography axial images. A linear regression analysis was performed between the age at the time of computed tomography and the intra-subject volume difference of the mastoid process in the CMT group.

Results

A total of 212 CMT patients (age, 50.9 ± 44.3 months) and 212 controls (age, 50.4 ± 44.2 months) was included. The volume of the mastoid process in the CMT side (32.2 ± 30.3 cm³) was significantly larger than that of the non-CMT side (21.9 ± 22.8 cm³) in the CMT group, as well as that of the right (21.6 ± 24.6 cm³) or left (21.2 ± 23.8 cm³) side in the controls ($p > 0.05$). The volumetric asymmetry of the mastoid process was 9.3 times greater in the CMT group compared to that of the controls. The ipsilateral hypertrophy of the mastoid process in CMT group significantly increased with age.

Conclusions

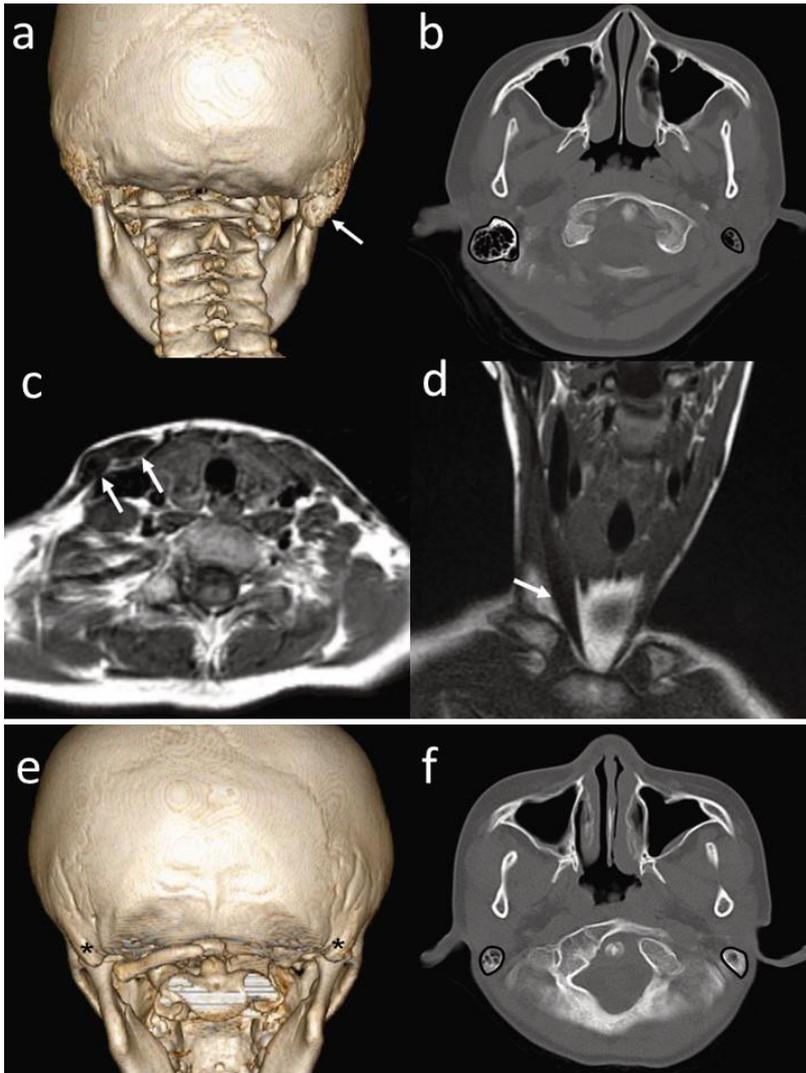
This is the first study showing volumetric change of the ipsilateral mastoid process by CMT. Chronic mechanical strain by the contracted ipsilateral SCM muscle of CMT could be responsible for ipsilateral hypertrophy of the mastoid process. Ipsilateral hypertrophy of the mastoid process could reflect severe CMT that requires surgical treatment. We think

that the ipsilateral hypertrophy of the mastoid process in CMT seems to be one of in vivo examples of functional adaptation of bones to mechanical strain. It is evident that CMT causes asymmetry of the mastoid process and it should be included in the list of craniofacial asymmetries caused by severe CMT. There may be a progression of skeletal deformities if the contracted SCM muscle is not released. Timely surgical release should be emphasized to minimize asymmetric development of the craniofacial skeleton, including ipsilateral hypertrophy of the mastoid process.

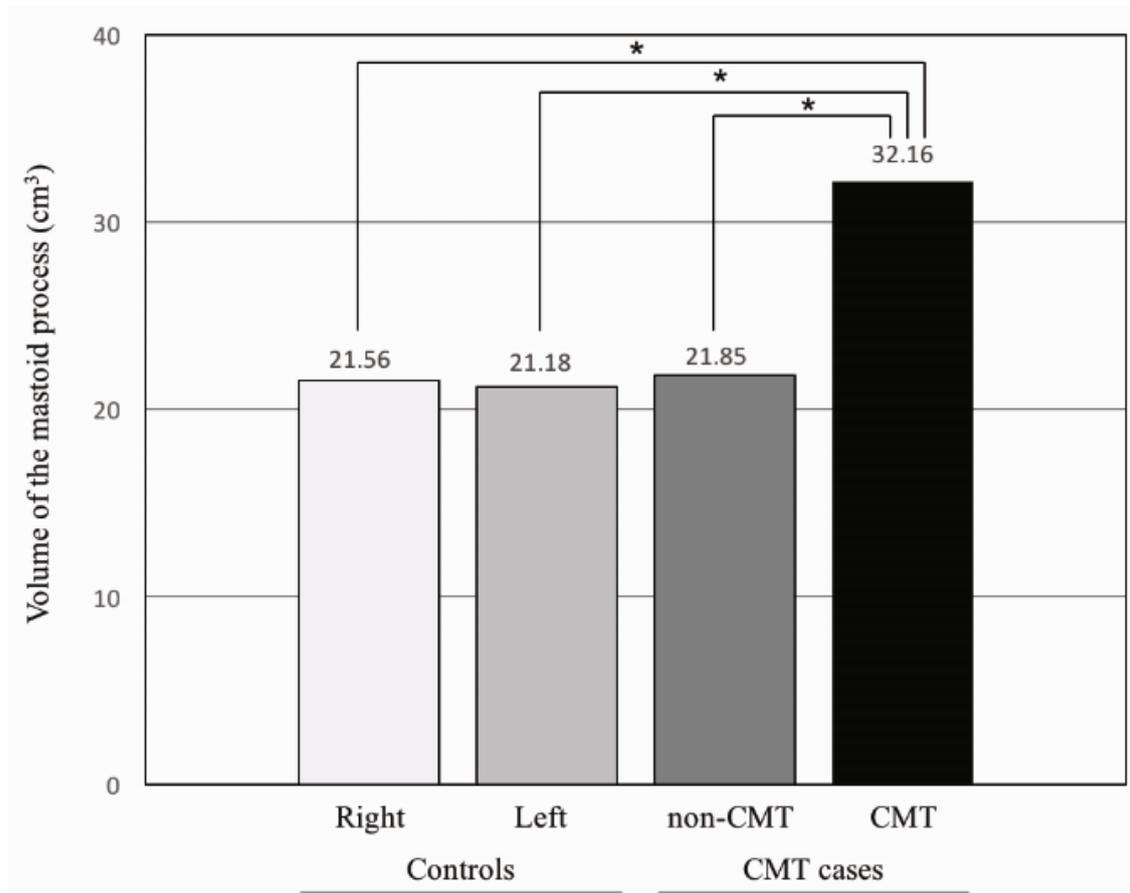
TABLE 1. Characteristics of the Subjects

Characteristics	CMT group	Control group	<i>p</i> value
Number of subjects	212	212	
Number of subjects by gender (men:women)	125: 87	125:87	1.000
Age at the time of CT (months; mean \pm SD)	50.91 \pm 44.30	50.35 \pm 44.24	0.897
Number of subjects by CMT side			
Right CMT	125 (59%)	NA	
Left CMT	87 (41%)	NA	

SD, standard deviation; CMT, congenital muscular torticollis; NA, not applicable.



Ipsilateral hypertrophy of right mastoid process of a nine-year-old patient with right congenital muscular torticollis (CMT). The three dimensional computed tomography (CT) image shows hypertrophy of right mastoid process of the CMT side (arrow) compared to the mastoid process of the non-CMT side (a). The axial computed tomography image also shows hypertrophy of right mastoid process of the CMT side, where solid lines show bilateral mastoid process (b). The magnetic resonance images of the neck in the above patient with right CMT reveals low signal intensity (arrows) within right sternocleidomastoid muscle due to fibrotic change on axial (c) and coronal T1 weighted images (d). A nine-year-old control girl does not show any significant difference between right and left mastoid process on the three dimensional (e) and axial CT images (f), where asterisks and solid lines indicate bilateral mastoid process.



Comparison of the volume of the mastoid process. The congenital muscular torticollis (CMT) side in the CMT group showed significantly larger volume of the mastoid process compared to that of non-CMT side or that of either side of the controls. An asterisk (*) indicates $p < 0.05$. There was no significant difference among the volume of the mastoid process in the non-CMT side of the CMT group

The Branching Pattern of the Axillary Nerve and the Nerve to the Long Head of the Triceps Brachii

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Introduction

The axillary nerve originates from the posterior cord of the brachial plexus at the level of the axilla and contains nerve fibers from C5 to C6. Lately, some cadaveric studies have reported that the long head of the triceps brachii muscle (LHT) is innervated by the axillary nerve. Considering this anatomical variation, it would be necessary to examine the LHT in needle electromyography for diagnosis of axillary neuropathy. The aim of the study is (1) to investigate the branching pattern of the axillary nerve in the quadrangular space and (2) to investigate the anatomical variation of the motor branch of nerve to the LHT.

Methods

Cadaveric dissection of bilateral shoulders of six fresh cadavers was performed (Table 1). The axillary nerve was identified from the quadrangular space and its branches to nearby muscular structures were dissected. The motor branch of nerve to the LHT was carefully traced from the penetrating point into the muscles to its origin. Dissections were performed with both anterior and posterior approach.

Results

1) The branching pattern of the axillary nerve : Eleven shoulders were examined. 3 types of variations in the course and branching pattern of the axillary nerve were noticed (Table 1). In five out of eight specimens, the axillary nerve bifurcated into anterior and posterior branches after it exits the quadrangular space. (Fig. 1; Type 1) In one specimen, the axillary nerve bifurcated into anterior and posterior branches before the quadrangular space. (Fig. 1; Type 2) The posterior branch gave off a muscular branch innervating the teres minor muscle, a branch innervating posterior part of the deltoid muscle, and then superior lateral brachial cutaneous branch. The anterior branch innervated to acromial and clavicular parts of the deltoid muscle. In two specimens, a branch innervating posterior part of the deltoid muscle was originated from the anterior branch of the axillary nerve. (Fig. 1; Type 3) 2) The motor branch of nerve to the LHT : All 12 LHTs were innervated by the radial nerve. (Table 1, Fig. 2)

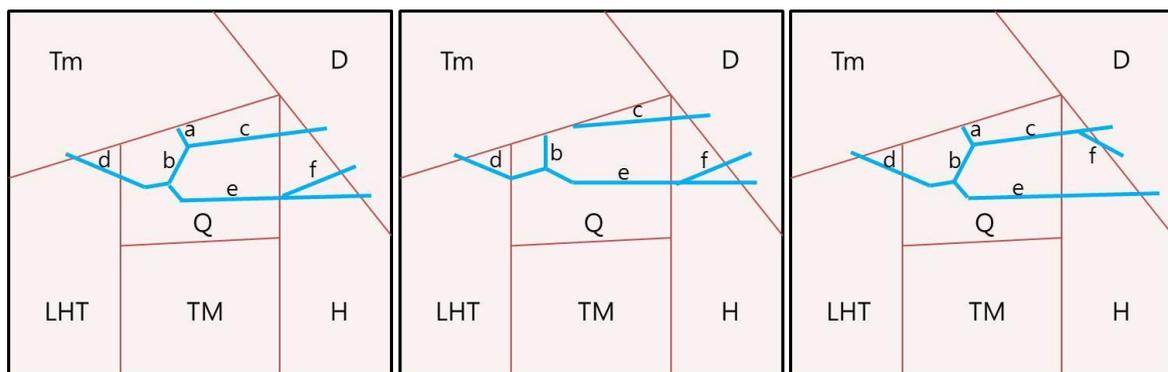
Discussion

We noted many types of branching pattern in the axillary nerve around the quadrangular space. For example, in two specimens we found a variation that posterior branch to deltoid was originated from the anterior branch of the axillary nerve. Some articles

reported that LHT is innervated by the radial nerve or/and axillary nerve. Understanding this variation may help planning the surgical treatment of the axillary nerve injury, as a nerve transfer to the deltoid muscle using the nerve to the LHT can be chosen for restoration of deltoid muscle function in axillary nerve injuries or upper brachial plexus injuries. However, there was no anatomical variation of axillary innervation to LHT identified in the present study. We only dissected 6 cadavers, so interpretation should be cautioned and further study including many cadavers will be needed.

table1. The branching types of axillary nerve and innervation to the long head of the triceps brachii muscle in cadavers dissected. *; because of the damage during the dissection

No.	Sex	Age	Arm	Innervation to LHT	Axillary nerve branching type
1	M	92	Rt.	Radial	Uncheckable*
			Lt.	Radial	Uncheckable*
2	F	79	Rt.	Radial	Uncheckable*
			Lt.	Radial	Type 2
3	F	85	Rt.	Radial	Type 1
			Lt.	Radial	Type 3
4	F	95	Rt.	Radial	Type 3
			Lt.	Radial	Uncheckable*
5	F	88	Rt.	Radial	Type 1
			Lt.	Radial	Type 1
6	F	94	Rt.	Radial	Type 1
			Lt.	Radial	Type 1



Type 1

Type 2

Type 3

fig 1. Schematic images of three types of branching pattern of the axillary nerve. a, main trunk of axillary nerve; b, posterior branch of axillary nerve; c, anterior branch of axillary nerve; d, branch to teres minor; e, superior lateral brachial cutaneous branch; f, posterior branch to deltoid Tm, teres minor; TM, ters major; D, deltoid; H, humerus; LHT, long head of the triceps brachii; Q, quadrangular space

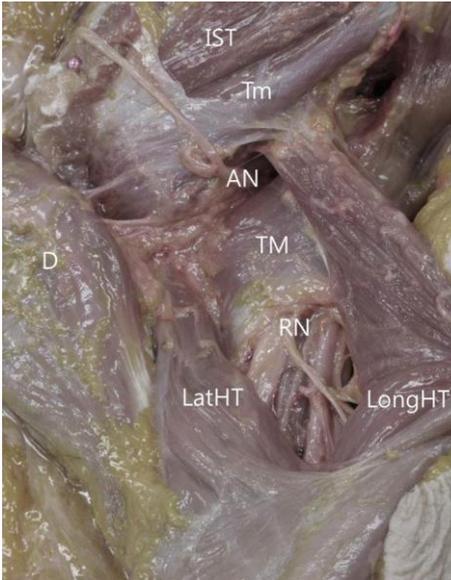


fig 2.The radial innervation of the long head of the triceps brachii and adjacent muscular structures. AN, axillary nerve; RN, radial nerve; IST, infraspinatus; Tm, teres minor; TM, teres major; D, deltoid; LatHT, lateral head of triceps brachii; LongHT, long head of triceps brachii

Effect of Bisphosphonate for Bone Marrow Density in Adult Duchenne Muscular Dystrophy

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Abstract Objective

DMD(duchenne muscular dystrophy) is the most frequent type of genetic muscular dystrophy with severe activity of daily living deterioration progressed during childhood. The reasons for rising risks in osteoporosis in DMD are a sedentary life style, a rare sun exposure with vitamin D deficiency and a decrease in muscle power. The process of osteoporosis in those children is assessed by central bone marrow density. The efforts to find the treatment about osteoporosis in younger DMD patient have been made in several studies, but not in adult groups due to the short life expectancy. Bisphosphonate is a commonly used medication of osteoporosis in general population, which inhibits osteoclast activity and reduces bone resorption. There is little evidence of effectiveness of bisphosphonate in DMD. The aim of this study is that to verify the effect of the most frequently used osteoporosis medication in adult DMD patients by dual-energy X-ray absorptiometry(DXA) of spine.

Materials & Methods

We retrospectively collected data of DMD patients who was diagnosed by gene study or muscle biopsy at a single tertiary university hospital from June 2007 to June 2017. We included the patient who had been examined BMD-DXA at the age over 18, while taking bisphosphonate at least for a year. The data was analyzed throughout the patient without scoliosis surgery. The patients who had been applied steroid therapy were excluded.

Result

Total 147 subjects were collected and statistics analysis was conducted on 70 patients who were taken BMD-DXA of spine at least twice. The average age at the initial examined period was 25.1 and the mean of Z-score was -4.196. BMD-DXA measured at approximately 1 year intervals were listed for each patient to identify the trend using the Spaghetti plot (figure 1). We used linear-mixed models to establish that the examined data changed significantly over time. Z-score increased 0.084 per year significantly (p-value = 0.0063) (Table 1). There was a significant increase observed in values in 3rd years and 5th years compared to the initial examined period (Table 2).

Conclusion

Continuous use of bisphosphonate in DMD adult patients shows significant increase in BMD-DXA Z-score of spine over periods. We can carefully conclude that it takes about a minimum of three years to bring a significant change to bone marrow density.

Table 1. The actual change of BMD-DXA Z-score of spine (per year).

	Z-score(SE)	p-value
Total (N=70)	0.084(0.024)	0.0063

Table 2. Significance of the change of BMD-DXA Z-score values at the initial examined period and at each 1-year period. The data regularly measured at approximately a year interval from the initial period shows significant increases in 3rd years and 5th years compared to the initial.

Time (year)	Estimated mean(SE)	Post-hoc p-value					
		0	1	2	3	4	5
0	-4.196(0.225)	Ref	0.0904	0.9828	0.0031	0.2438	0.0234
1	-3.994(0.237)		Ref	0.1696	0.2351	0.9808	0.1414
2	-4.194(0.236)			Ref	0.0104	0.2837	0.0292
3	-3.818(0.240)				Ref	0.3315	0.4015
4	-3.998(0.266)					Ref	0.1696
5	-3.587(0.336)						Ref

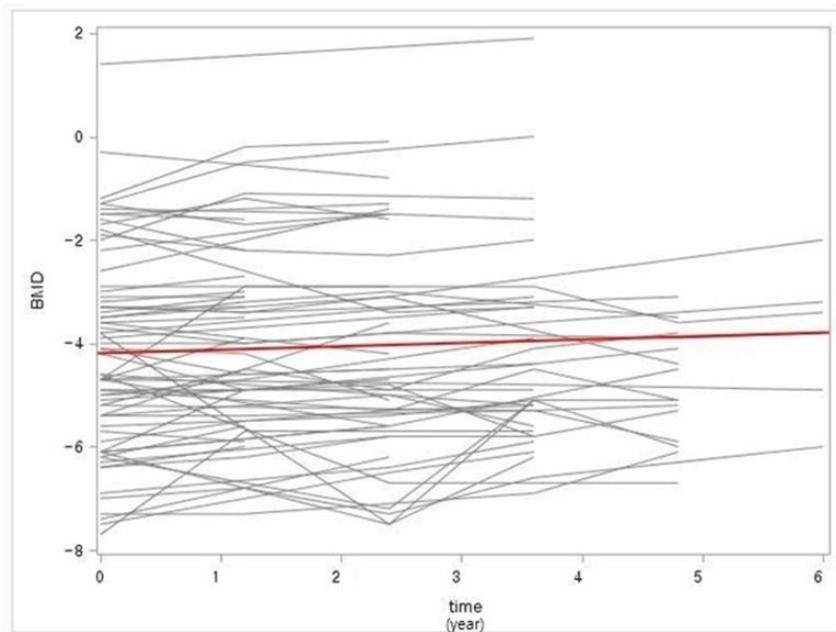


Figure 1. Changes of BMD-DXA Z-score of spine at each year on spaghetti plot.

Comparison of diaphragm excursion between ultrasonography and fluoroscopy in brain injury patients

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Objective

Acquired brain injury not only causes weakness in the limb muscles, but it can also affect the respiratory system. Patients after acquired brain injury presented decreased pulmonary function and diaphragm excursion (DE) that can affect locomotion or activities of daily living. The radiological assessment of diaphragm excursion has traditionally relied upon fluoroscopic evaluation, but, several recent studies have used M-mode ultrasonography of for diaphragm excursion measurement. The Objective of this study was to determine whether assessment with ultrasonography or fluoroscopy differed, and which technique was more correlated with pulmonary function in patients with acquired brain injury.

Materials & Methods

From September 2017 to April 2018, we prospectively enrolled patients with acquired brain injury who were admitted to our general hospital. Patients underwent pulmonary function test (PFT), and DE was measured using M-mode ultrasonography and fluoroscopy on admission. A single experienced physiatrist who was blinded to PFT Results performed the DE evaluations. The transducer was positioned on the abdominal wall just below the ribs between the midaxillary line and the mammillary line, forming a 45° angle between the transducer and the surface of the abdominal wall in the cephalic direction using M-mode ultrasonography. For videofluoroscopy evaluation, we set a metallic round Object of diameter 2.6 cm in the field of X-ray, with the aim of allowing its visualization in the video recording. (Figure 1) The mean value after 3 attempts was used for analysis. The forced vital capacity (FVC), forced expiratory volume at 1 second (FEV1), FEV1/FVC, maximal inspiratory pressure (MIP), maximal expiratory pressure (MEP) were measured by another physiatrist who was blinded to DE, based on guidelines by the American Thoracic Society/European Respiratory society.

Results

The mean measured DE using ultrasonography was 1.33±0.54 cm for right side and 1.38±0.52 cm for left side. The mean measured diaphragm excursion using fluoroscopy was 1.80±0.66 cm for right side and 1.80±0.63 cm for left side. After adjusting age, sex, height, and weight, correlation coefficient between ultrasonography and fluoroscopy was 0.744 for right side and 0.631 for left side ($P < 0.05$). MIP and MEP were significantly associated with DE measured by fluoroscopy and ultrasonography for both right and left side ($P < 0.05$) (Figure 2). Whereas, PCF showed significant correlation with DE of left side ($P < 0.05$).

Conclusions

There is a significant correlation between measurement Method of DE between ultrasonography and fluoroscopy, especially for right side hemi-diaphragm. And respiratory muscle strength showed significant relationship with DE measured by both 2 Methods. M-mode ultrasonography could be an alternative Method for DE measurement in patients with acquired brain injury.

Table 1. Correlation analysis of pulmonary function test and diaphragm excursion

	Fluoroscopy		M-mode Ultrasonography	
	Right	Left	Right	Left
MIP (cmH ₂ O)	0.406*	0.441*	0.407*	0.417*
MEP (cmH ₂ O)	0.341*	0.377*	0.315*	0.690*
FVC (L)	0.075	0.251	0.017	0.058
FEV ₁ (L/min)	0.120	0.121	-0.028	-0.054
FEV ₁ /FVC (%)	0.017	-0.068	0.044	-0.102
PCF (L/min)	0.158	0.387*	0.260	0.468*

MIP, Maximal inspiratory pressure; MEP, Maximal expiratory pressure; FVC, Functional Vital Capacity; FEV₁, forced expiratory volume at 1 second; PCF, Peak Cough Flow

* *P*-value <0.05

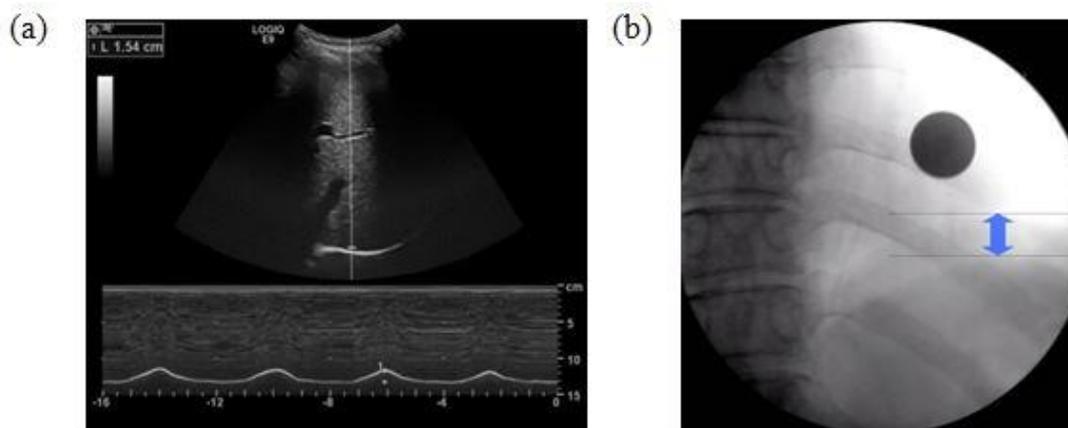


Figure 1. Measurement of diaphragm excursion using (a) ultrasonography and (b) fluoroscopy

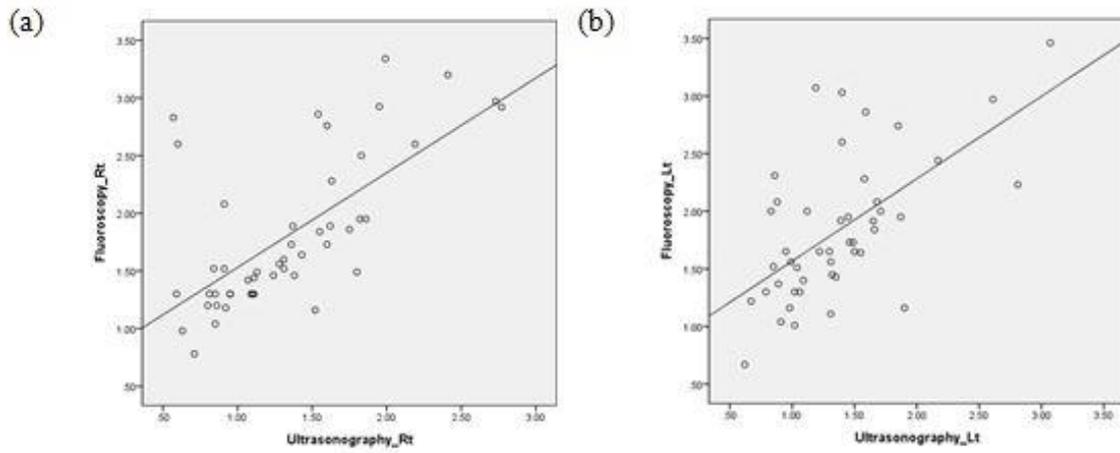


Figure 2. Correlation analysis of diaphragm excursion measurement using ultrasonography and fluoroscopy. Scatterplot of the correlation for (a) right and (b) left side.

P 2-17

Mobility alone is a poor predictor of health-related quality of life in advanced cancer patients

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Objective

To investigate predictors of general QoL and health status of advanced cancer patients in the outpatient setting considering disease severity and disability related variables including mobility and to find the association between subjective symptoms and mobility.

Method

A cross-sectional study involved 494 patients with advanced cancer with five types of cancers (colon, breast, uterus, liver and lung) using stratified sampling. Data collection was carried out through one-on-one interviews by trained nurses. Global Disability (GD) including mobility was evaluated using the 36-item version of WHODAS 2.0 questionnaire while symptom and performance were assessed using Memorial Symptom Assessment Scale-Short Form and Karnofsky performance Status Scale. Hierarchical block regression analyses were conducted to identify predictors of general quality of life, measured with vas score.

Results

About 30% of advanced cancer patients had moderate/severe GD and general health status decreased with increase especially in the domains of mobility (β coefficient = 0.78, $p < 0.001$). Advanced cancer patients with three factors of anxiety, pain and fatigue explained 23% of the variance of mobility. In the subgroup divided according to the cancer type, fatigue significantly predicted disability in all cancer types, however, pain significantly related only in colon, uterus and breast cancer patients after adjustment of other symptoms. With a unit increase in the domains of mobility, there was 66% increase in GD after adjustment of three symptom factors.

Conclusion

The general health status of the advanced cancer patients are influenced by the disability level especially of mobility and participation limitation. Some symptoms such as anxiety, pain and fatigue may affect the functional level in different patterns according the cancer types. Intervention for improving the mobility level could be effective management for patients with advanced cancer.

Pilot study on the effect of botulinum toxin type A in rats with neuropathic pain after spinal cord

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Background

The application of botulinum toxin type A (BTX-A) has been recently explored in a number of painful neuropathic conditions. We aim to determine the changes in pain behavior after spinal cord injury, and the effects of botulinum toxin type A (BTX-A) on neuropathic pain after spinal cord injury through behavioral sensory test and electrophysiological assessments.

Methods

Twelve male Sprague-Dawley rats(300-350g) were induced to thoracic spinal cord injury by contusion Method. One week after injury, BTX-A (20U/kg) or saline was administered to the plantar surface by subcutaneous injection. Behavioral tests were conducted preoperatively and weekly for 5 weeks postoperatively. Mechanical allodynia was measured using von Frey filament, and thermal hyperalgesia was measured on a hot plate analgesia meter. Sensory evoked potential was detected in the cortex by stimulating the posterior tibial nerve. Two-way analysis of variance (ANOVA) with repeated measures was used to detect statistical significance.

Results

The paw withdrawal threshold (PWT) to mechanical stimulation decreased immediately and significantly after spinal cord injury. The paw withdrawal latency (PWL) to thermal stimulation gradually decreased to the lowest level at 3 weeks after injury. Amplitude of sensory evoked potential gradually decreased after spinal cord injury (Figure 1) After subcutaneous injection of BTX-A, the PWT to mechanical stimulation was increased and higher than that of the control group. Similarly, the PWL to thermal stimulation was measured to be higher in the BTX-A injection group. Subcutaneous injection of BTX-A reversed the amplitude reduction of sensory evoked potentials, and the amplitude measured after 5 weeks of injury was higher than that of the control group. However, there was no statistically significant differences in all variables (Figure 2, Table 1).

Conclusions

Subcutaneous injection of BTX-A tended to be effective in neuropathic pain. It is necessary to evaluate the effect of BTX-A on neuropathic pain through a large sample study in the future.

Table 1. Effects of botulinum toxin type A on pain threshold and sensory evoked potential in spinal cord injury rat model.

Group	Before injury	Spinal cord injury 1wk	Injection 1wk	Injection 2wk	Injection 3wk	Injection 4wk
Paw withdrawal threshold (g)						
Saline(n=6)	54.3 ±13.9	35.5± 19.5	35.5± 19.5	33.7 ±20.9	46.8 ±20.7	48.7± 17.6
BTX-A(n=6)	52.5± 18.4	37.3± 17.6	38.5 ±24.1	38.2± 24.6	51.7± 20.4	52.5 ±18.4
Paw withdrawal latency (s)						
Saline(n=6)	44.6 ±5.86	33.8± 10.2	25.3± 15.4	17.8± 13.2	21.5± 9.6	17.8± 8.8
BTX-A(n=6)	44.7± 8.2	31.4± 4.9	31.6± 15.2	18.8± 11.5	27.0± 16.3	25.6 ±10.1
Amplitude of sensory evoked potential (μV)						
Saline(n=6)	1.8 ±0.5	1.6± 0.9	-	-	-	1.2± 0.7
BTX-A(n=6)	1.9 ±1.1	1.6± 1.2	-	-	-	2.1± 0.9

Data are means ± standard deviation.

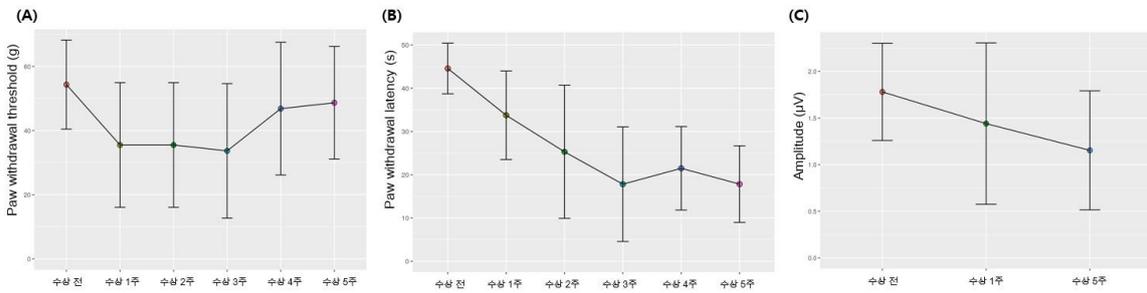


Figure 1. Change in withdrawal threshold to mechanical and thermal stimulation, amplitude of sensory evoked potential after spinal cord injury.

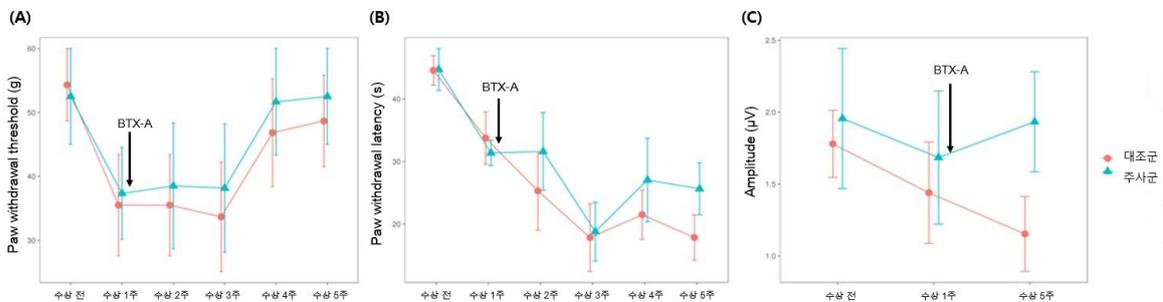


Figure 2. Comparison of withdrawal threshold to mechanical and thermal stimulation, amplitude of sensory evoked potential after subcutaneous injection of botulinum toxin type A.

Histopathological change following exercise time course in spinal cord injured rats with G-CSF

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Objective

Many experimental studies have been performed for motor functional recovery in rats with spinal cord injury (SCI). In previous study, we observed the combined effect of G-CSF treatment and aerobic exercise for motor function recovery in rats with spinal cord injury. The purpose of this study was histopathological change following exercise time course in SCI rats with G-CSF.

Methods

SCI rats treated with G-CSF were divided into 2 groups: a group treated with treadmill exercise plus G-CSF (intervention group, n=12) and a group without exercise (control group, n=6). Laminectomy at the T8–10 spinal levels with compression injury of the spinal cord was performed in all rats. G-CSF (20 μ g/ml) was administered via intraperitoneally for 5 consecutive days after SCI in intervention groups. From one week after surgery, intervention group received 30 minutes of exercise 5 days per week for 4 weeks. Functional recoveries were assessed using the Basso, Beattie, and Bresnahan (BBB) scale. 5 days (n=4), 3 weeks (n=4), and 5 weeks (n=4) after SCI in intervention group, hematoxylin and eosin staining for cavity size and immunohistochemistry for glial scar formation and neuro-regeneration factor expression were assessed. Statistical analysis was performed with SPSS version 22.0 (SPSS, Chicago, IL). The nonparametric Kruskal-Wallis test was used to identify statistically significance to evaluation values between each group. Post hoc analysis used Mann-Whitney U test. P-values of < 0.05 were considered statistically significant.

Results

BBB scores showed better locomotory ability in intervention group the longer the exercise preod (Fig.1). H&E Results showed the destructive nature of the injuries, and the longer the exercise period, cavity size was reduced continuously in intervention group (Fig 2). Immunohistochemical analysis was also performed at 5 days, 3 weeks, and 5 weeks post-SCI. No expression of VEGF and BDNF at 5 days post-SCI was shown. The expression of GFAP patterns showed that glia cell formation was suppressed continuously with longer exercise period. The expression of BDNF on neurogenesis and VEGF on angiogenesis initiated after 5 days post SCI. While the expression of VEGF was the highest at 3 weeks of SCI and declined thereafter, BDNF were more expressed continuously with longer exercise period (p<0.05).

Conclusion

In this study, we found the mechanism of motor function recovery that angiogenesis first occurred and neurogenesis was observed later using immunohistology in SCI rats with exercise and G-CSF. Thus, exercise time course was important for restoring motor function.

Key Words

G-CSF, spinal cord injury, exercise, BDNF, VEGF, GFAP Abbreviation: BDNF: brain derived neurotropic factor, VEGF: vessel endothelial growth factor, GFAP: glia fibrillary acidic protein

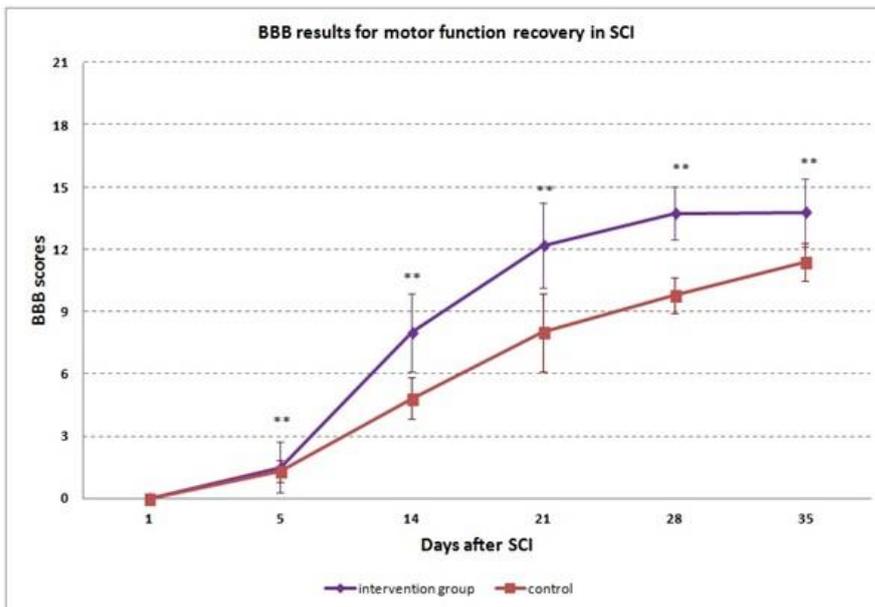


Figure 1 The therapeutic activities of intervention group and control group were examined with the BBB scale analysis. Rats showed more effective motor function recovery in intervention group than that in control group (double asterisks indicate $P < 0.01$).

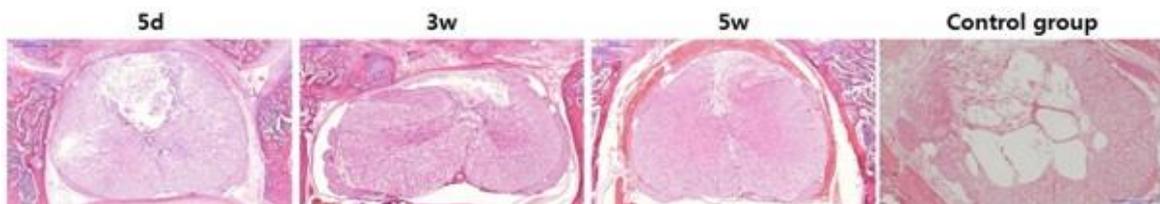


Figure 2 H & E stained spinal cord cross sections ($\times 20$) 5 days, 3 weeks, and 5 weeks after injury in intervention group showed that the cavity size continues to decrease over time. Image of control group was after 5 weeks in rats only treated with G-GCF. Scale bar represents $500\mu\text{m}$ (d: days, w: weeks).

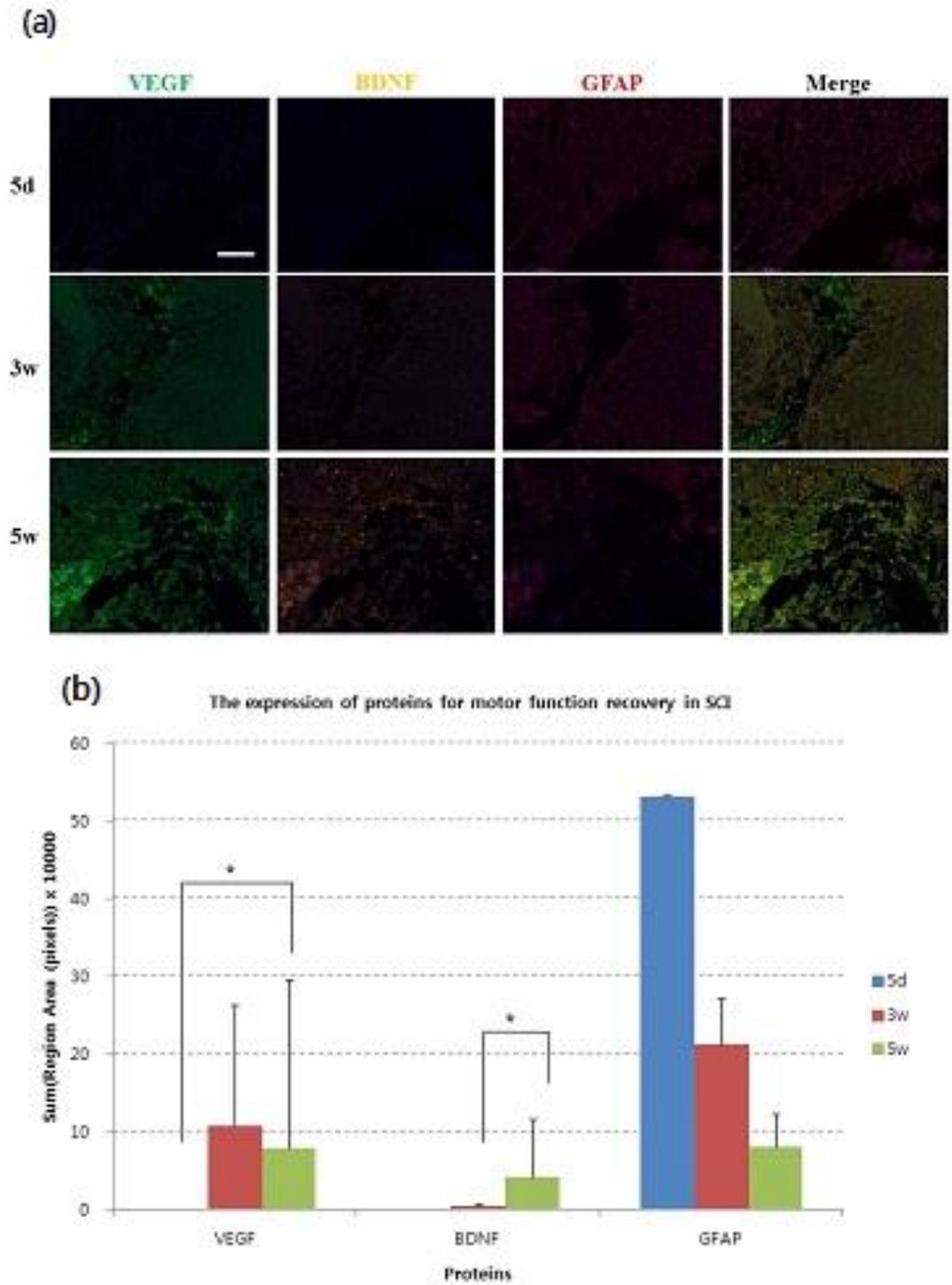


Figure 3 Spinal cord tissues were immunostained for BDNF, VEGF, and GFAP 5days, 3 weeks, and 5 weeks after the injury. (a) BDNF, GFAP, and VEGF immunoreactivities in spinal cord tissues at 5 weeks after injury. Sections were imaged at $\times 200$ using a PerkinElmer Vectra. (b) Areas (pixels) of BDNF, GFAP, and VEGF immunostaining in each group was represented with inForm analysis software (both from PerkinElmer). Scale bar represents $118.7 \mu\text{m}$ (asterisks indicate $P < 0.05$, d: days, w: weeks).

Changes in Diffusion Metrics of Red Nucleus after Cervical Myelopathy

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Objective

Cervical myelopathy (CM) is a common age-related disorder, which doesn't have proper known treatment for the symptoms such as motor paralysis and sensory disturbances. Nevertheless, some evidences showing significant motor recovery of rubrospinal neurons after few weeks in cervical axotomized rats have been reported and are attracting our attention, which haven't been explored in human despite of its clinical significance. The diffusion tensor imaging (DTI) is most sensitive Method for measuring damage in neural tract. Thus, in this study, we aimed to find out whether there were some differences in red nucleus (RN) diffusion metrics in CM patients compared to controls as well as whether differences existed between pre- and post-operative condition in CM patients.

Methods

Eighteen healthy controls (mean age 50.0±21.7 years) and age-matched CM patients (mean age 56.8±14.2 years) were recruited. Controls acquired DTI once and the CM patients acquired DTI twice (before and 2 weeks after laminoplasty) and obtained modified Japanese Orthopedic Association (mJOA) scale twice. Four areas were selected as region-of-interest (ROI): RN, primary motor cortex (M1), ventral pons (VP: ventral descending motor fibers selected in color coded DTI) and dorsal pons (DP: dorsal descending motor fibers selected in color coded DTI). Fractional anisotropy (FA), mean, axial, and radial diffusivity (MD, AD, RD) were obtained at each ROIs. We performed independent t-test to analyze difference in each value between patient and control, paired t-test to see change before and after surgery. Pearson correlation was conducted between mJOA scale and diffusion metrics. A p-value < 0.00625 were considered to be statistical significant after correction of multiple comparisons problem.

Results

1. In group comparison, there was significant changes in patients' RN network compared to controls (decreased right RN RD, p=0.002; decreased left VP FA, p=0.003). 2. There was no significant change in diffusion metrics between pre- and post-operative condition although there was significant improvement in mJOA score in postoperative condition (p=0.003). 3. In correlation analysis, only in control group, the FA of both RN was significantly increased as the age increased (p=0.012, p=0.004, respectively). Contrast to control group, there was no correlation between age and RN diffusion metrics. .

Conclusion

Our Results imply the importance of rubrospinal tract in recovery of spinal cord injury and illuminate age related change at red nucleus in healthy people. Further investigation should be conducted with a larger number of patients and broad spectrum of severity.

A Case of Catastrophic Antiphospholipid syndrome triggered by traumatic spinal cord injury

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Introduction

Antiphospholipid syndrome (APS) is a multisystem autoimmune condition characterized by vascular thromboses associated with persistently positive antiphospholipid antibodies (aPL). Catastrophic APS (CAPS) is the most severe form of APS with multiple organ involvement developing over a short period of time, usually associated with microthrombosis. We report a case of patient with traumatic spinal cord injury, who developed rapid course of complication due to underlying CAPS.

Case

A 41 years old tetraplegia man with diagnosed traumatic incomplete SCI (American Spinal Injury Association impairment scale C, neurologic level of injury at C3 cervical vertebra) was transferred to our department after receiving laminoplasty at C4-5-6 level with partial laminectomy (on 19th post operation day(POD) and 20th hospital day(HD)). He had been receiving early rehabilitative intervention from POD 5, including ROM exercise of both upper and lower extremities twice a day, 5 days a week. At the time of transfer, there were 5 noticeable complications. 1) Fever of Unknown Origin with no definite routine laboratory evidence of inflammation, 2) Rapid development of large sized deep vein thrombosis (DVT) (Fig. 1.) with pulmonary thromboembolism (PTE) (Fig. 2.) that developed within 10 days and refractory to prophylactic administration of dabigatran, 3) Multiple atypical ulcerations in ascending colon and rectum (Fig. 3.), 4) Grade 3 pressure sore in coccyx, and 5) uncontrollable orthostatic hypotension that did not response to midodrine. At first, these problems were regarded as independently related post spinal cord injury complications that occurred at similar time coincidentally. However, time course of the complications was abrupt and when considering patient's neurologic functional ability, the degree of these complications was vicious.

Results

To exclude possibility of combined systemic disorders, additional laboratory examination was performed and elevated anti B2-GPI IgG (34.5 U/mL) was detected. Based on diagnostic criteria, he was diagnosis as APS, warfarin was started at a dose of 2 mg per day, targeting international normalized ratio of 2-3. Moreover, fludrocortisone was administered for orthostatic hypotension. Then, the patient's fever was subsided and after 10 days warfarin therapy started, follow up CT showed resolving state of PTE and a recurrence of thrombotic events was not observed later. Symptom of autonomic dysfunction was improving that he was able to endure tilt table training up to 70 degrees.

Conclusion

The clinical manifestations of CAPS may develop rapidly leading to fatal systemic complications and may be challenging to make diagnosis without high index of clinical suspicion when accompanied with post spinal cord injury complications. To provide urgent treatment, possibility of underlying systemic diseases should not be missed when unexplainable rapid onset of vascular complications in SCI patients is encountered.



fig1. DVT CT with angiography showed a filling defect in left common iliac vein (arrow)

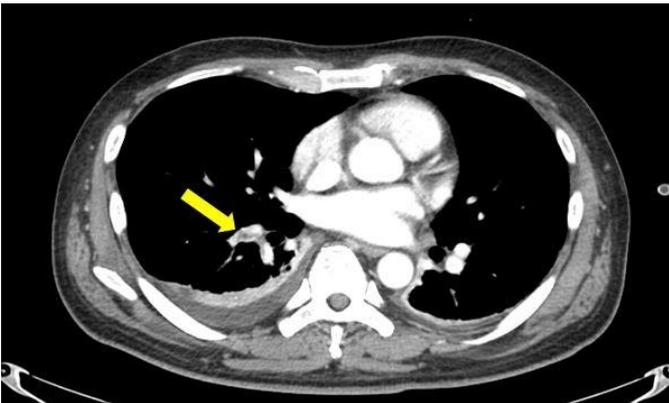


fig2. DVT CT with angiography showed a filling defect in right pulmonary artery (arrow)

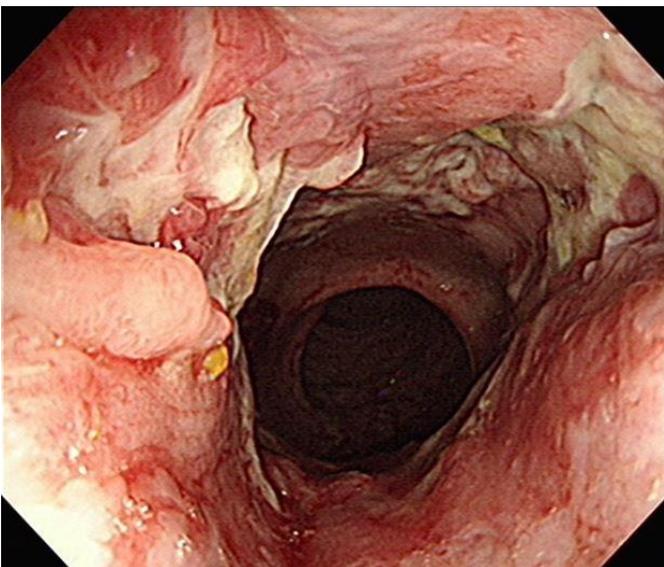


fig3. Colonoscopy showed multiple linear, circular, transverse and geographic patterns of ulceration

Coincidental Spinal Accessory Nerve Injury In Patient With Spinal Cord Injury : A CASE REPORT

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Introduction

The spinal accessory nerve (SAN) is the pure motor innervation to the trapezius and sternocleidomastoid (SCM) muscles. The trapezius muscle is a major stabilizer of the scapula. The SAN injury causes weakness of the trapezius, which leads to scapular winging. Most of the reported cases of SAN injury are associated with iatrogenic injury caused during various surgical procedures in the posterior triangle of the neck, such as tumor resection, cervical lymph node biopsy, and radical neck dissection. It can hardly find a case which has SAN injury in a patient with a spinal cord injury (SCI).

Case Presentation

A 46-year-old man with thoracic spinal cord compression due to subluxation of T3-4 and T11-12 by pedestrian traffic accident admitted for rehabilitation after surgery. His motor power was grade 3/5 in the shoulder, grade 4/5 to 5/5 in the distal upper extremity and grade 0/5 in the lower extremities. Neurological examination revealed atrophy of the left SCM (Sternocleidomastoid muscle) and trapezius, and scapular winging of the same side was also observed (Figure1). There was no definite evidence to suspect left winged scapular on Brain MRI or C-spine MRI. The MRI shows the left SCM atrophy (Figure2). In electrodiagnostic study, the amplitude of CMAPs (compound muscle action potential) in both trapezius was low, and denervation potentials was found in left trapezius, left SCM, left supraspinatus, left pronator teres, left flexor carpi radialis and neuropathic potential in Right trapezius, right SCM and the Result of this test suggested a bilateral spinal accessory nerve injury(Left dominant) and left C6 radiculopathy. In order for the patient to perform the wheelchair-bed, wheelchair-toilet transfer independently, the patient performed shoulder girdle muscle strengthening and transfer training. After 2 months of rehabilitation therapy, the patient's shoulder muscle power was improved from grade 3/5 to 4/5, but the independent wheelchair transfer, which was our rehabilitation goal, was not achieved.

Conclusion

The Accessory nerve has a cranial and spinal portion. The cranial portion arises from the medulla, and passes through the jugular foramen (see Figure 3.). The cranial portion contributes fibers to pharynx and intrinsic laryngeal muscles. The spinal portion from the spinal cord enter the posterior fossa through the foramen magnum, and then leave the skull through the jugular foramen to innervate the sternocleidomastoid and trapezius muscles. We assumed that the injury would be caused by some forces at the cervical level when he got accident because he has no dysfunction relating cranial portion of the

accessory nerve, and no definite Injury around jugular foramen seen in the brain MRI. Although it is rare, the SAN injury in SCI patients is a debilitating condition that limits functional development.

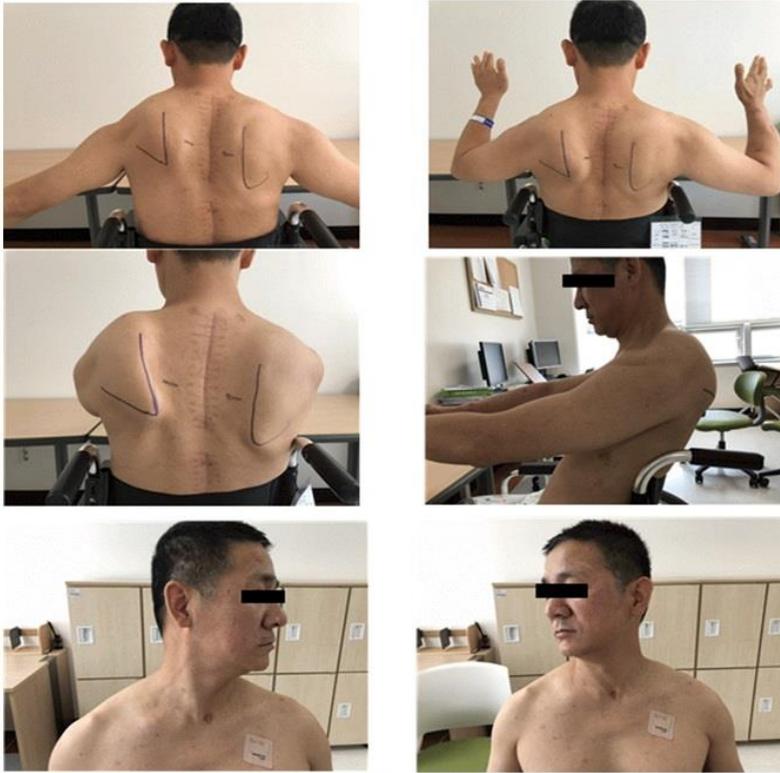


Figure 1. Winged scapular and atrophy of left sternocleidomastoid muscle.

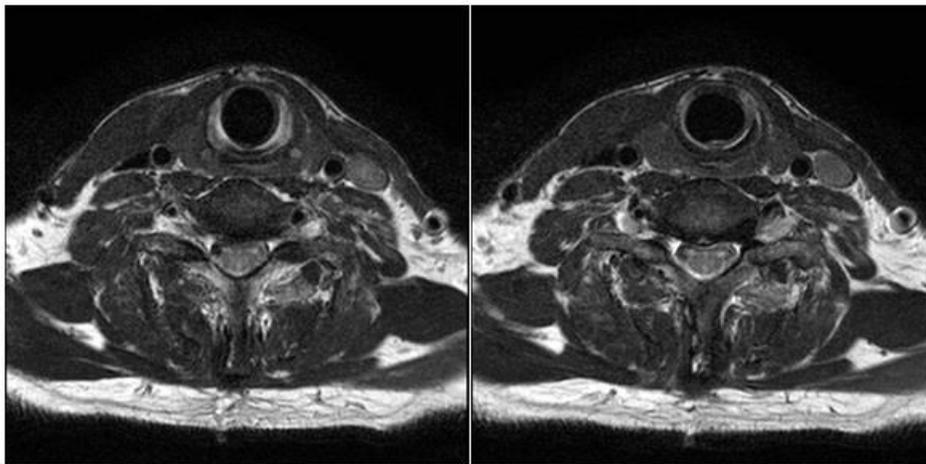


Figure 2. The MRI shows atrophy of left sternocleidomastoid muscle.

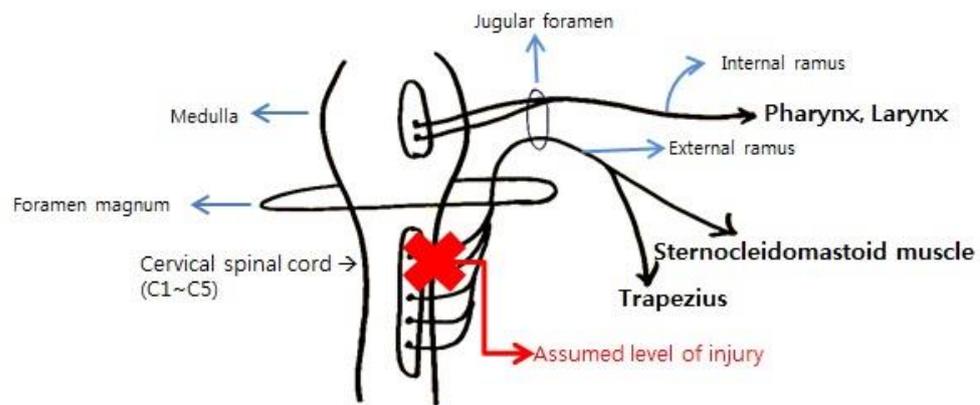


Figure 3. Anatomy of the accessory nerve

Quantitative Weight Bearing Exercise Using Lower Body Positive Pressure Treadmill: Case series Study

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Introduction

Weight bearing after lower extremity fracture is an important issue in post-operative rehabilitation, but it has not been established yet. High-quality clinical studies of weight bearing protocols have been rarely studied, since it is difficult to quantify the actual loads of each limb and provide a constant weight load. By training with a lower body positive pressure treadmill (LBPPT) and using a pressure measurement insole, weight bearing exercise can be performed with actual loads quantified during training. In this study, we reports three cases of lower extremity fracture patients who underwent 4-week quantitative partial weight bearing rehabilitation program using LBPPT.

Cases

Three patients began training within 1 month of injury, and were trained through a 4-week rehabilitation program consisting of 10 sessions per week and 30 minutes each. The foot impulse (FI) was measured weekly prior to training, and body weight percentage was set based on the Results. Functional evaluation was performed before, after, and 6 months after the training. (Fig 1) Patients showed significant improvement in functional assessment such as the 10-meter walking test and the berg balance scale. (Table 1) The FI of the surgically treated limb was gradually increased, while the ratio of FI to the contralateral foot remained constant during rehabilitation program. In the 6-month evaluation, the FI of the affected side was almost the same to the unaffected side. (Fig 2) Complications such as fixation failure did not occur during training.

Conclusion

This study suggests that quantitative partial weight bearing training using LBPPT is feasible and that this rehabilitation program is useful and safe for patients with lower extremity fractures.

Table 1. Functional outcome

		10MWT(s)	TUG(s)	L-test(s)	BBS	NRS-R	NRS-W
Case 1	pre	NT	NT	NT	37	0	NT
	post	15.96	17.15	40.46	41	0	3
	6mo	9.34	11.2	23.33	52	1	2
Case 2	pre	NT	NT	NT	NT	5	NT
	post	19.73	18.67	46.66	36	3	5
	6mo	11.93	12.37	22.38	44	3	3
Case 3	pre	NT	NT	NT	NT	5	NT
	post	26.96	25.57	65.16	NT	2	4
	6mo	8.77	8.54	17.98	48	1	2

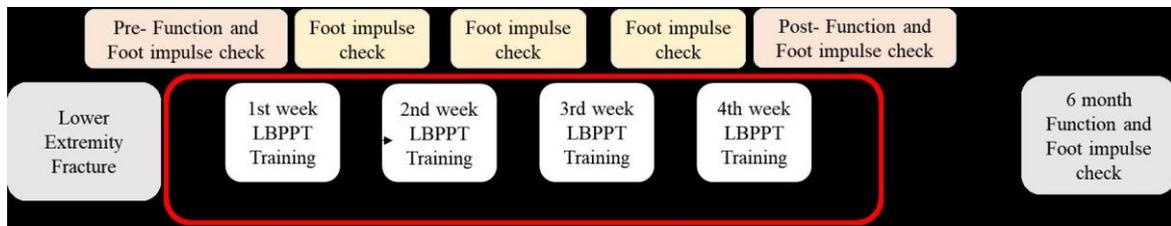


Fig 1. Rehabilitation program

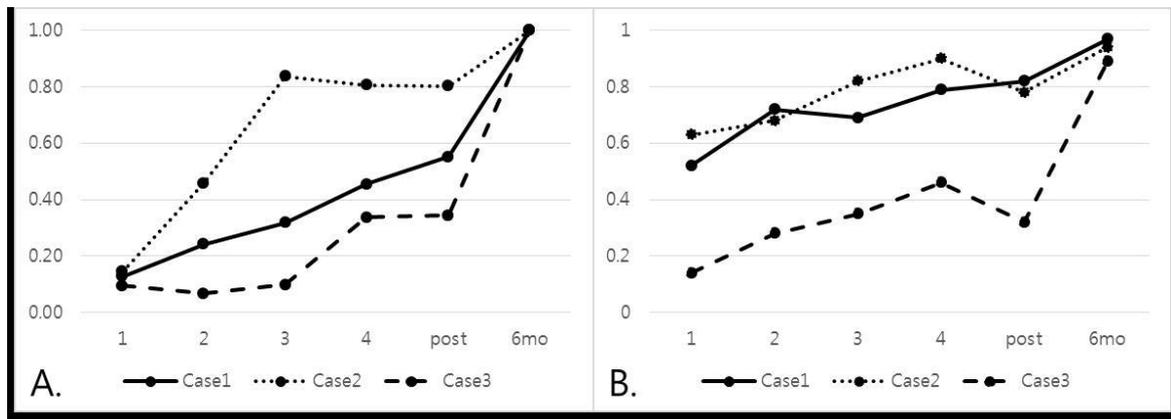


Fig 2. A. The ratio to estimated normal value of FI B. The ratio of affected and unaffected side

The therapeutic effect of hydraulic distension with pumping technique in frozen shoulder

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Introduction

Frozen shoulder, one of the most common shoulder pain diseases, is characterized by shoulder pain and limited range of motion. Conservative treatment is preceded by surgical treatment to reduce pain and recover range of motion. Hydraulic distention was one of the conservative procedures in which a sufficient amount of solution is injected into the shoulder joint to rupture the rigid joint capsule. The optimal Method of hydraulic distension is still a matter of controversy. Recently, it has been proposed that continuously maintaining the expanded capsular state after injection, without the process of rupturing the rigid joint, reduces the side effects. However, to obtain maximal stretching effect, we proposed a new hydraulic distension Method called 'pumping technique' in which we inflate and shrink the rigid joint capsule by repeating the process of infusion and regurgitation of the injection fluid into the capsule. Case A 74-year-old female patient had been suffering from shoulder pain for 3 months. Ultrasonography revealed degenerative rotator cuff disease, but there were no other abnormal pathologic findings. Physical examination of the shoulder revealed limited range of motion and patient complained of severe shoulder pain during examination. Ultrasonographically guided hydrodynamic inflation was performed by injection under aseptic Method (Accuvix V10; Samsung Medison, Seoul, Korea) in a lateral lying posture and 0.5% lidocaine at a minimum of 20 mL to 29 mL with tamceton 40 mg (Total injection volume: 21 mL to 30 mL) was injected into the shoulder. Each procedure was separated by 2 weeks, and follow-up evaluation was performed 4 weeks after the third procedure. In case of left shoulder, conservative hydraulic distension was performed and the right shoulder was subjected to a 'pumping technique'. The injection fluid was infused to the glenohumeral joint and was maintained for 15 seconds followed by regurgitation. The same procedure was repeated 10 times to stretch the rigid capsule. After 4 weeks, during which total of 3 procedures were performed, the increase in the range of motion of the right shoulder was 27% more than that of the left shoulder using conservative hydraulic distention. Pain improved in both shoulders according to Visual Analog Scale (VAS) score. Right shoulder using pumping technique showed interval change from 8 to 2 points, and left shoulder using conventional hydraulic distension showed interval change from 7 to 2 points.

Conclusion

In frozen shoulder, our proposed 'pumping technique' reduced pain and was shown to be more effective in increasing range of motion than the conventional hydraulic distension. This 'pumping technique' can be suggested as an effective therapeutic option for frozen shoulder.

Table 1. Comparison between Pumping Technique and Conventional Hydraulic Distension Technique

Right shoulder		After		After		After	
:Pumping		1st Inj		2nd Inj		3rd Inj	
technique		(2 wks)		(4 wks)		(8 wks)	
		Deg of	Deg of	Deg of	Deg of	Deg of	Deg of
		Imp(%)	Imp(%)	Imp(%)	Imp(%)	Imp(%)	Imp(%)
Forward flexion, ^o	100	130	30	135	35	170	70
Abduction, ^o	70	90	29	90	29	110	57
Internal rotation, ^o	45	60	33	60	33	70	56
VAS	8	4	50	2	75	2	75
Left shoulder		After		After		After	
:Conventional		1st Inj		2nd Inj		3rd Inj	
Technique		(2 wks)		(4 wks)		(8 wks)	
		Deg of	Deg of	Deg of	Deg of	Deg of	Deg of
		Imp(%)	Imp(%)	Imp(%)	Imp(%)	Imp(%)	Imp(%)
Forward flexion, ^o	110	120	9	125	14	140	27
Abduction, ^o	70	70	0	80	14	90	29
Internal rotation, ^o	30	40	33	45	50	55	83
VAS	7	5	29	2	71	2	71

Inj: injection, Deg: Degree, Imp: Improvement, wks: weeks, VAS: Visual Analogue Scale

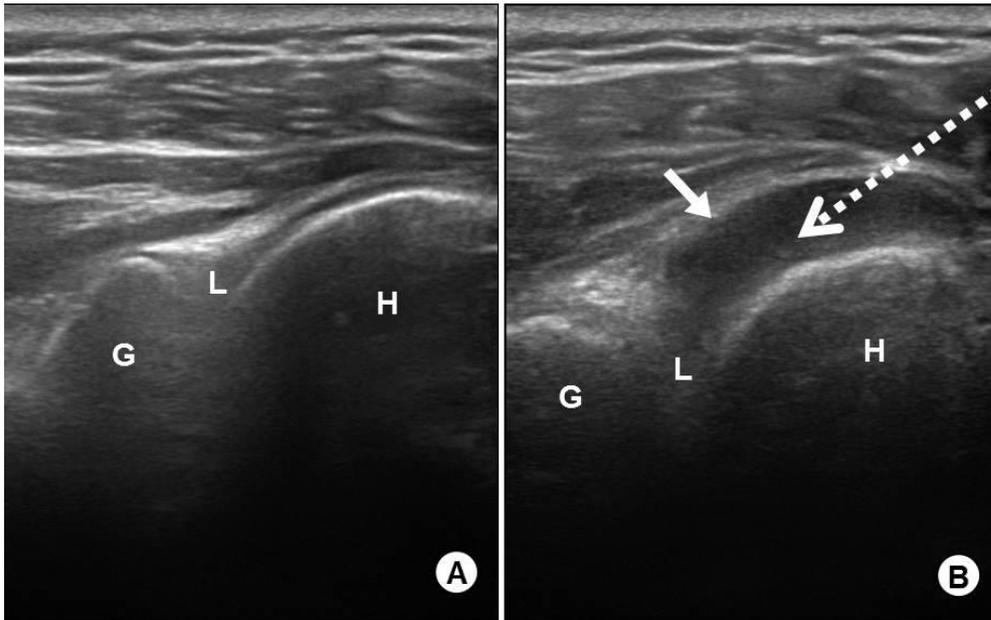


Fig. 1. 'Pumping technique' in a patient with frozen shoulder. While the patient was lying down comfortably, the needle was inserted to the glenohumeral joint (dotted arrow) 1 cm lateral to the ultrasound transducer and was advanced into joint capsule under ultrasound guidance. The injection fluid was infused to the glenohumeral joint and was maintained for 15 seconds followed by regurgitation. The same procedure was repeated 10 times to stretch the rigid capsule. (A) Before sono-guided intraarticular injection at glenohumeral joint. (B) After sono-guided injection with capsular distension (arrow). G (Glenoid), H (Humeral head), L (Labrum).

Arm swelling 30 years after breast cancer operation diagnosed as venous thoracic outlet syndrome

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Introduction

Thoracic outlet syndrome (TOS) is a well-described disorder caused by thoracic outlet compression of the brachial plexus and/or the subclavian vessels. Neurogenic thoracic outlet syndrome is the most common manifestation, presenting with pain, numbness, tingling, weakness, and vasomotor changes of the upper extremity. Vascular complications of thoracic outlet syndrome are uncommon and include thromboembolic phenomena and swelling. After the breast cancer operation, patients with ipsilateral arm swelling visit the outpatient department of rehabilitation medicine suspecting lymphedema. Here we report a case of unilateral arm swelling after ipsilateral breast cancer operation, which was diagnosed as venous thoracic outlet syndrome.

CASE REPORT

The patient was a 64-year-old woman who had a breast cancer operation as right modified radical mastectomy 30 years ago. Swelling in her right arm started in February 2018. She visited local hospital and has taken a medication, but it was ineffective. Her symptom sustained and she took chest computed tomography (CT) in local hospital and visited the outpatient department of rehabilitation medicine on June 2018. On physical examination, her right upper arm, forearm and hand were swollen as a whole, but the strength of the right upper limb was normal. And although there is no inconvenience in everyday life, she had dyspnea on exertion which was developed 30 years ago. On chest CT, atelectasis in the right upper lobe and right diaphragm elevation were found. In addition, calcified ribs and subpleural reticular opacities, which are probably caused by radiation, were found. The patient was referred to department of thoracic surgery to rule out diaphragm eventration and thoracic outlet syndrome. On upper extremity vein CT, focal right subclavian vein stenosis was suspected at right costoclavicular junction level. And diffuse swelling was found throughout the right arm. The patient was diagnosed as venous TOS and recommended venogram for more accurate diagnosis and surgery. Because the patient wanted to receive conservative treatment, further evaluation was deferred.

Conclusion

We report a patient presenting unilateral arm swelling 30 years after ipsilateral breast cancer operation, which was diagnosed as venous thoracic outlet syndrome. Up to 40% of the women treated for breast cancer had lymphedema, and it is easy to diagnose such patient's arm swelling as lymphedema. But in this patient, venous TOS was diagnosed. If

there are any atypical findings, physicians treating breast cancer patients should suspect TOS, and further evaluation is warranted.

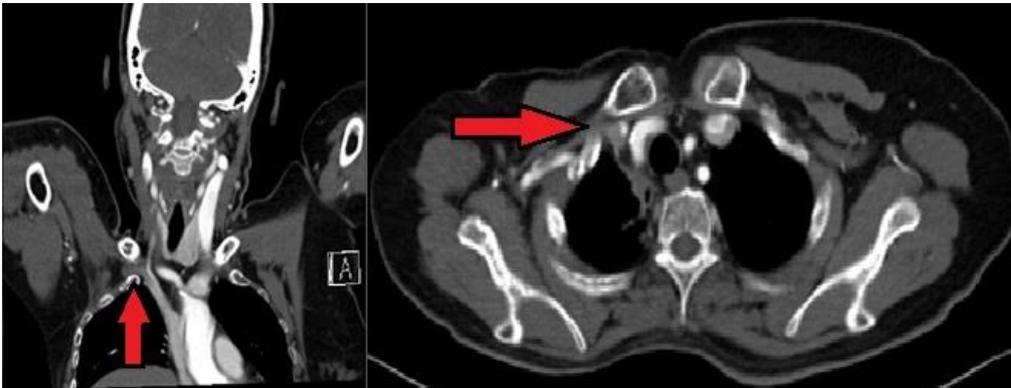


Fig. 1. Computed tomography showed focal right subclavian vein stenosis at costoclavicular junction.

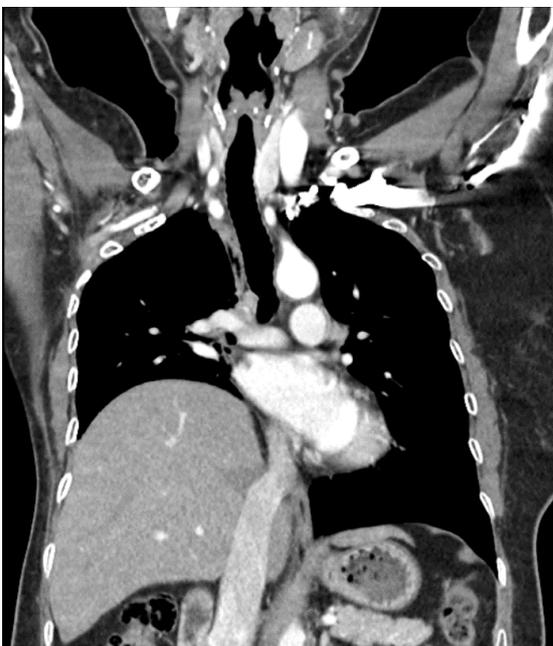


Fig. 2. Computed tomography showed right diaphragm elevation.

Iatrogenic Nerve Injury following Varicose Vein Surgery: Case Series

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Korea University Ansan Hospital, Department of Rehabilitation Medicine¹

INTRODUCTION

Although nerve injuries following varicose vein surgery are rare, it may be permanent or ongoing symptoms. Nerve injuries after varicose vein procedure may be diagnosed using clinical examination, electrophysiologic and ultrasonographic examination. We report three cases with nerve injuries related with varicose vein operation.

CASE REPORT

CASE 1: A 62-year-old man who received left varicose vein operation had sensory loss on the foot dorsum. Electrophysiologic study suggested severe injury of medial dorsal cutaneous branch of left superficial peroneal sensory nerve. Ultrasonography demonstrated two neuromas of medial dorsal cutaneous branch of the left superficial peroneal nerve located 3 cm proximal to intermalleolar line (Figure 1A). The patient received neuroma excision operation (Figure 1B). Also, 4 cm sized inside out vein graft from the ipsilateral great saphenous vein was done for the neuroma excision defect site.

CASE 2: A 55-year-old woman complained hypoesthesia on the left calf and sole which developed 2 weeks after the varicose vein surgery. The motor grade of left ankle plantar flexion was good. Electrophysiologic study suggested severe left tibial neuropathy around the popliteal fossa sparing muscular branch to soleus. Ultrasonographic examination revealed traumatic neuroma of the left tibial nerve around popliteal fossa (Figure 2A). Exploration and neurolysis was performed, and traumatic neuroma-in-contiguity of medial sural cutaneous nerve and adhesion on posterior portion of tibial nerve were identified (Figure 2B).

CASE 3: A 57-year-old man who underwent varicose vein surgery complained the sensory change on the left sole. Sensation on the left lateral sole and calf was decreased. Muscle testing of the left ankle plantar flexion was good grade (grade IV). Electrophysiologic study revealed incomplete left tibial neuropathy around popliteal fossa. Ultrasonography study found traumatic neuroma of the left tibial nerve around popliteal fossa (Figure 3A). Surgical exploration demonstrated traumatic neuroma of the left tibial nerve and the surrounding adhesion around popliteal fossa where varicose vein operation was performed (Figure 3B).

CONCLUSION

In our patients, one superficial peroneal nerve injury and two tibial nerve injuries were diagnosed using electrophysiologic and ultrasonographic studies, which were confirmed with surgical exploration and excision of traumatic neuroma. Ultrasonographic examination based on the electrophysiologic findings would be very useful for evaluating the patients with suspected iatrogenic nerve injury from varicose vein surgery.

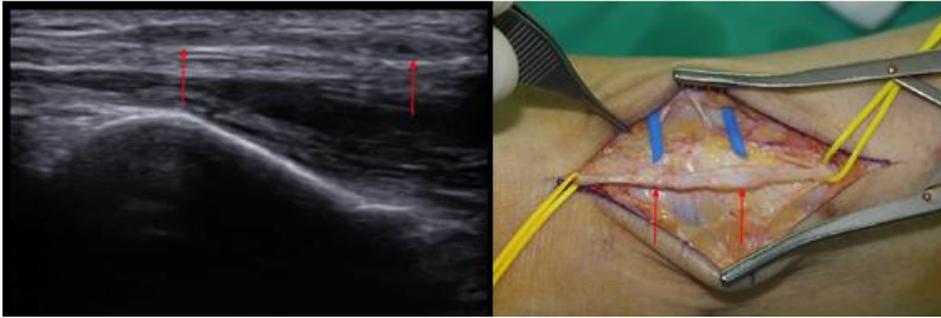


Figure 1. Ultrasonographic findings and intraoperative findings. Two neuromas(arrow) of left superficial peroneal nerve is describe at the ankle level.

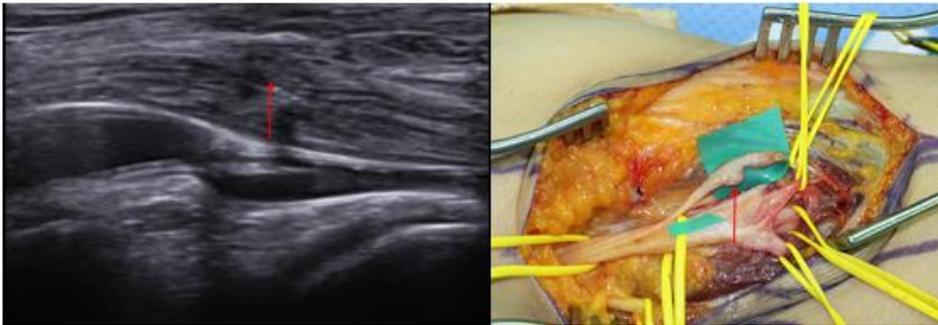


Figure 2. Ultrasonographic findings and intraoperative findings. Neuroma(arrow) of medial sural cutaneous nerve.

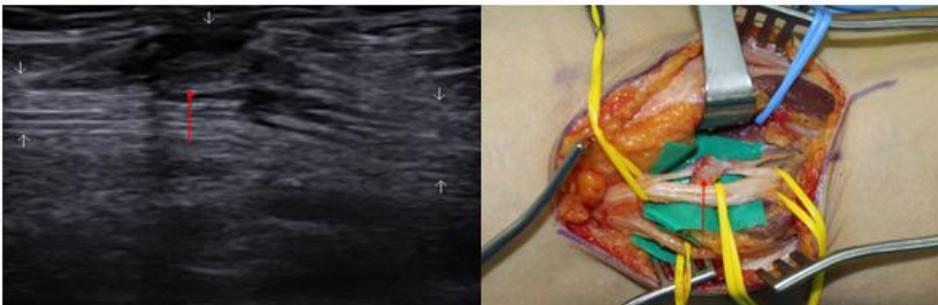


Figure 3. Ultrasonographic findings and intraoperative findings. Traumatic neuroma(arrow) of the left posterior tibial nerve around popliteal fossa

Neuromuscular Junction Disorder with Progressive Cerebellar Dysfunction in A Lung Cancer Patient

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Introduction

Paraneoplastic neurologic syndromes (PNS) can affect the central nervous system (eg, paraneoplastic cerebellar degeneration [PCD]) and the neuromuscular junction (eg, Lambert-Eaton myasthenia syndrome [LEMS] and myasthenia gravis [MG]). A small percentage of patients with small cell lung cancer (SCLC) have a PNS, of which the most frequent is LEMS. The symptoms of PNS could arise before the diagnosis of SCLC. And we need to pay attention to these patients. The screening recommendation for the patient with motor weakness due to neuromuscular junction disorder (LEMS type) would be repeated cancer screening tests including CT or positron emission tomography (PET) scans. Early diagnosis can advance initiation of anti-tumor therapy and thereby improve survival. We experienced a patient, who presented initially LEMS, MG and PCD, was finally diagnosed with PNS by SCLC.

CASE REPORT

A patient, 60-year-old man, admitted because of ataxia, dysarthria, ptosis, dizziness and weakness of proximal limbs with difficulties in walking over 14-days period. On physical examination, he had nystagmus with balance disturbance on standing, and tandem gait was impossible. Brain MRI showed no specific abnormal findings. In serologic study, AChR-Ab, anti-MuSK Ab and paraneoplastic antibodies were negative. Thyroid function test was normal. In motor nerve conduction study (NCS), the findings were delayed latencies, low amplitudes but conduction velocities were preserved. The sensory NCS was unrevealing. On electromyography, proximal and distal muscle of limbs showed motor units changes with short duration and variable amplitudes. Repeated electrical stimulation (RNS) showed decremental response in ADQ by 22% on low-frequency (3Hz) stimulation.(Fig 1a) However, in high rate stimulation (20Hz), there were incremental responses in APB by 40.8%.(Fig 1b). The initial chest CT showed a mass in anterior mediastinum and PET scan showed no remarkable lesion in thorax (Fig. 2a). He got thymectomy but cytology revealed thymic cyst only. He was administered oral prednisolone and pyridostigmine. However, the effect of medical treatment was not clear as well as additional IVIG therapy. Considering of progressive ataxia, dysarthria, and motor weakness, we strongly suspected the possibility of PCD with neuromuscular junction disorders caused by lung cancer. Follow up after 3 months chest CT and PET-CT showed lymphadenopathy in right upper paratracheal area and the biopsy confirmed metastatic SCLC (Fig. 2b). Bone scan shows no evidence of metastasis (Fig. 3).

Conclusion

We have experienced a case with progressive weakness, ataxia and dysarthria as initial symptoms of lung cancer without respiratory symptoms. These changes were diagnosed as a PNS (LEMS, MG and PCD). Early recognition of PNS and repeated screenings would improve the diagnosis and treatment of these cancers.

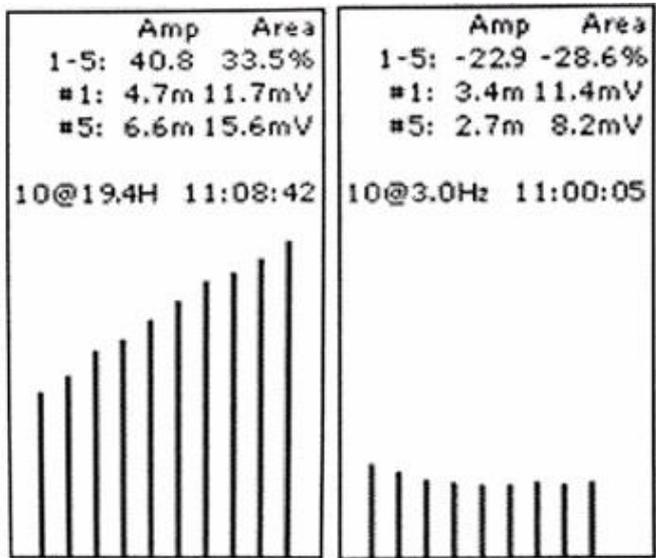


Fig. 1a : MG pattern, marked decrement of CMAP amplitude in ADM on 3Hz stimulation Fig. 1b : LEMS pattern, marked increment of CMAP amplitude after exercise in APB on 20Hz stimulation

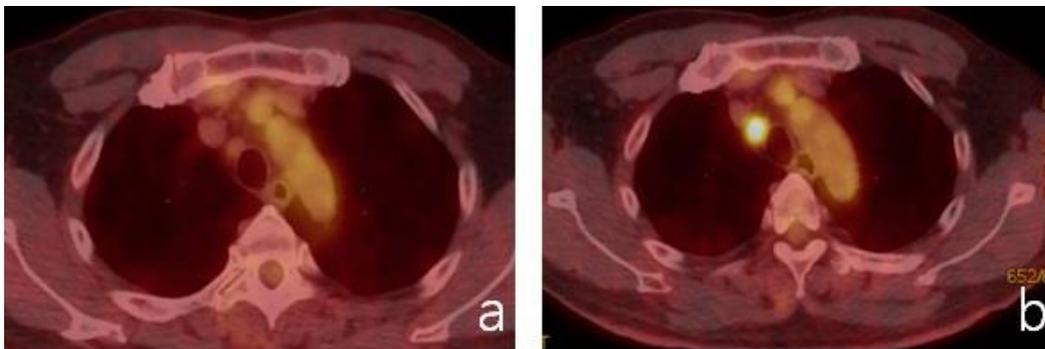


Fig. 2a: Initial PET-CT showed no abnormal lesion Fig. 2b: Follow up after 3 months PET-CT showed lymphadenopathy in right upper paratracheal area.



Fig. 3: Bone scan shows no evidence of metastasis

Posterior interosseous neuropathy Resulted from ganglion cyst mimicking Schwannoma in elbow

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Background

Posterior interosseous neuropathy (PIN) Resulted from mass lesions (e.g., ganglion cysts, tumor) is rare. The clinical presentation of persons with PIN is somewhat variable depending upon the location of neural insult. We report an unusual PIN due to ganglion cyst mimicking Schwannoma.

CASE REPORT

Twenty seven years old man visited with complaints of right elbow pain, which began 3 months ago without history of trauma. He did not complain of weakness and sensory change in hand and forearm. Small palpable fixed mass was detected between brachioradialis muscle and biceps tendon. MRI showed cystic mass of low signal intensity (SI) on T1WI and high SI on T2WI with split fat sign along radial nerve between brachioradialis muscle and brachialis tendon, which findings suggest the possibility of Schwannoma. (Fig. 1.) After 50 days of first visit, he underwent surgery for mass excision. At admission mild weakness of finger extension (thumb extension MRC grade 4, 2nd finger extension grade 4, 3rd-5th finger extension grade 3) without sensory change, which was found just prior to surgery, was detected. After excision the mass was identified as ganglion cyst with stalk connected with radiocapitellar joint capsule, (Fig. 2) After 3 months of surgery, third and fourth finger weakness slightly improved from grade 3 to grade 4 and electrodiagnostic (EDX) study confirmed posterior interosseous neuropathy with mild partial axonotmesis state.

Conclusions

The occurrence of ganglion cyst in the elbow joint causing PIN is unusual and can be misdiagnosed as Schwannoma. Fortunately neurologic deficit was followed after detection of mass. Accurate diagnosis is important to treatment and prognosis.

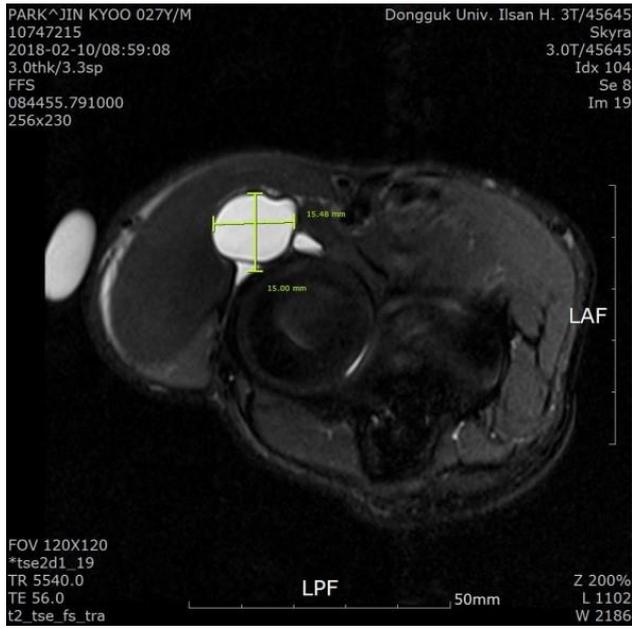


fig1. Preoperative T2-weighted MRI shows lobulated cystic mass along radial nerve



fig2. Ganglion cyst connected radiocapitellar joint along radial nerve (Intraoperative finding)

Feasibility of gastrostomy in amyotrophic lateral sclerosis patients with low forced vital capacity

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Introduction

In patients with amyotrophic lateral sclerosis (ALS), bulbar-innervated muscle impairment occurs therefore all patients requires enteral nutrition, eventually. But there is no definite consensus regarding the optimal timing of gastrostomy tube insertion and it is still controversial. The aim of this study is to investigate the safety of gastrostomy in a large number of advanced ALS patients with forced vital capacity less than 30% of predicted value (FVCpred) and, finally, to suggest a new standard of FVC in gastrostomy procedure.

Method

We evaluated a total 479 of patients who were diagnosed with ALS according to Revised El Escorial Criteria in our hospital between January 1, 2005 and December 31, 2017. 126 patients who underwent gastrostomy for the first time among those patients who had not undergone tracheostomy and under 30% of FVCpred. The medical charts were retrospectively analyzed for ventilation status, complications from gastrostomy tube insertion to the first tube change.

Result

The gastrostomy procedure was safe regardless of FVC status or respiratory support. There were complications related to the gastrostomy procedure in 7 of 126 patients and all were managed through conservative care. Comparing non-invasive intermittent positive pressure ventilation(NIPPV) to invasive positive pressure ventilation(IPPV), complications were seen in 5 of 106 patients (4.7%) and 9 of 104 patients (8.7%). There was no statistically significant difference between two groups($p=0.386$). No respiratory complications were found in any patient.

Conclusion

Percutaneous placement of gastrostomy is safe, effective procedure and can be performed in the ALS patients who have low vital capacity (FVCpred<30%). This study shows that only with non-invasive respiratory support such as NIPPV or ambu-bagging, gastrostomy was performed without severe complications such as respiratory decompression in patients who did not undergo tracheostomy surgery. We suggest that there should be a new standard of FVC to allow performing gastrostomy for ALS patients.

Table 1. Baseline demographics and clinical characteristics

	n=126
Age at PEG/PRG insertion, years	56.5±11.4
Disease duration from diagnosis at PEG/PRG insertion, years	1.9±1.8
Sex, n(%)	
Men	66(52)
Women	60(48)
Site of disease onset, n(%)	
Limb	99(79)
Bulbar	27(21)
Forced Vital Capacity, %	
Sitting	13.3±10.0
Supine	11.9±9.4
Methods of ventilation, n(%)	
Non-invasive ventilation	106(84)
Ventilator free	20(16)

Variables are expressed as mean±SD(Standard deviation).

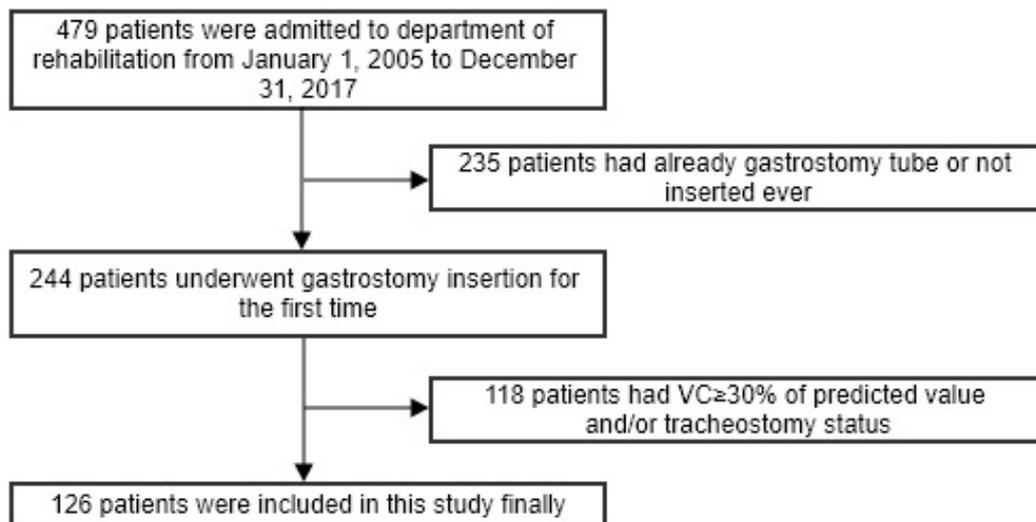


Figure 1. Flow chart of patients inclusion in this retrospective study.

Comprehensive pulmonary rehabilitation in patients with Bronchiolitis obliterans

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Introduction

Graft versus host disease (GVHD) is one of the most common complications after allogeneic hematopoietic stem cell transplantation (HSCT) and affects multiple organs. When GVHD affects the lungs, pulmonary dysfunction can be presented as bronchiolitis obliterans syndrome (BOS). BOS is a chronic irreversible airway obstruction disease and presents respiratory/skeletal muscle weakness. Although BOS patients are typically treated with immunosuppressive agents, there is no strong evidence that any specific therapies are effective in improving long-term outcomes. In these cases, we report the effect of pulmonary rehabilitation (PR) in patients with BOS. Case1) A 42-year-old woman was referred to PR clinic with complaint of dyspnea on exertion. She was diagnosed with BOS after receiving allo-HSCT. When she visited PR clinic, her mMRC scale was 3. She was using a portable oxygen concentrator. Pulmonary function test (PFT) showed obstructive pattern with FVC 44%, FEV1 26% and FEV1/FVC 50.4%. In six minute walk test, she could walk 215m with oxygen supply of 3L. Cardiopulmonary exercise (CPX) test showed peak oxygen uptake (VO₂peak) was 15.7ml/kg/min, while she couldn't attain the target heart rate (HR). Aerobic exercise, breathing technique education, and respiratory muscle strengthening were included in PR programs. She exercised on treadmill for a total of 39 mins, three times a week for 12 wks at the hospital. Her aerobic exercise program consisted of a 5-min warm-up at 20-30% of heart rate reserve (HRR), followed by four times of 5-min intervals of walking on a treadmill at 50% of HRR with three active pauses of 3-min walking at 20-30% of HRR and a 5-min cooldown at 20-30% of HRR. After 12 wks of PR, her mMRC scale was changed from 3 to 2 and she did not use oxygen concentrator at daytime. Follow up PFT was improved in FVC. The distance of six minute walk test increased from 215m to 297m and follow up VO₂peak was 18.4ml/kg/min. Case 2) A 19-year-old man visited PR clinic with complaint of dyspnea and limitation of activity of daily life. He was diagnosed with BOS after receiving allo-HSCT. His mMRC scale was grade 2. PFT showed FVC 55%, FEV1 41% and FEV1/FVC 57.2%. The Results of six minute walk test was 450m, while his resting HR was 110 and maximum HR was 154. He underwent comprehensive PR program that consisted of 45 min of aerobic exercise and 15 min of respiratory muscle training. He received PR 2 times a week for 2 months at hospital. After 2 months of PR, his mMRC scale was 2. The follow up PFT improved in FVC. The distance of six minute walk test was increased from 450m to 534m. Furthermore, his resting HR decreased from 108 to 98.

Conclusion

Comprehensive PR can be effectively applied not only to COPD but also to various chronic lung diseases. In these cases, PR improved exercise capacity and dyspnea in BOS patients. More research is needed to confirm the effectiveness of PR and make the appropriate program for BOS patients.

Table 1. Changes of exercise capacity and pulmonary function before and after PR

Variables	Case 1	Case 2
VO_{2peak} (ml/kg/min)		
Baseline	15.7	26.4
After PR	18.4	Not tested
Change rate (%)	+ 17.20	
6 MWT (m)		
Baseline	215	450
After PR	297	534
Change rate (%)	+ 38.14	+ 18.67
mMRC		
Baseline	3	2
After PR	2	2
FVC (%)		
Baseline	44	55
After PR	71	71
Change rate (%p)	+ 27	+ 16
MIP (cmH₂O)		
Baseline	70	71
After PR	104	91
Change rate (%)	+ 48.57	+ 28.17
MEP (cmH₂O)		
Baseline	83	51
After PR	89	89
Change rate (%)	+ 7.23	+ 74.51
FEV₁ (%)		
Baseline	26	41
After PR	27	42
Change rate (%p)	+ 1	+ 1

6 MWT=six minute walking test, FVC=forced vital capacity, MIP=maximum inspiratory pressure,

MEP=maximum expiratory pressure, FEV₁=forced expiratory volume in 1 second

Predictive value of pharyngeal width at rest (JOSCYL Width) for aspiration in elderly people

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Introduction

Dysphagia in elderly people without brain disorder is mostly due to weakness of pharyngeal muscle contraction. The pharyngeal width determined by the strength of pharyngeal constrictor muscle might be an indicator of aspiration. In this study, we used a simple non-invasive technique to characterize the anatomical changes associated with pharyngeal weakness. Lateral neck roentgenogram, video fluoroscopic swallowing study (VFSS) and dysphagia scales (Penetration Aspiration scale, PAS; Dysphagia Outcome and Severity Scale, DOSS) were used and we determined if the average of pharyngeal width (named as JOSCYL Width) has a value of the index indicating the possibility of aspiration.

Methods

Lateral cervical spine x-rays at rest were obtained from 40 participants aged 65 and over suffering from swallowing difficulty without brain disorder and 33 healthy volunteers aged 65 and over with no swallowing difficulty. Before examination, one physician evaluated age, gender, body mass index (BMI) and neck circumference of the participants. Two physicians measured the pharyngeal width on the lateral cervical spine x-ray. JOSCYL width was defined as the mean value of two pharyngeal widths measured at mid-oropharynx (A) and lower oropharynx (B) (figure 1). A video fluoroscopic swallowing study (VFSS) was performed and the Penetration-Aspiration scale (PAS) and the Dysphagia Outcome and Severity Scale (DOSS) were determined as Objective parameters of dysphagia. Independent t-test and chi-square test were used for analyzing demographic data. The correlation between the JOSCYL width and the scores of PAS and DOSS was analyzed in the participants with swallowing difficulty and control group using Spearman correlation analysis. A receiver operating characteristic (ROC) was performed on JOSCYL width.

Results

The ages of dysphagia group ranged between 65 and 91 years old (with a mean age of 78.15 ± 7.1 years) and control group ranged between 66 and 92 years old (with a mean age of 77.84 ± 9.1 years). Through Independent t-test and chi square test, age, gender and neck circumference between both groups was not statistically significant. The JOSCYL Widths of the dysphagia group (17.8 ± 5.5 mm) was larger than those of the control group (14.7 ± 3.7 mm; $p < 0.05$). The correlation between the JOSCYL Width and the severity of dysphagia was significant for dysphagia group ($p < 0.05$). The optimal cutoffs for predicting aspiration were 19.04 mm in the dysphagia group.

Conclusion

The JOSCYL Width was wider in elderly people with swallowing difficulty than healthy elderly people and well correlated with the severity of dysphagia. Compared to the current dysphagia assessment tools, the JOSCYL width is easy and precise tools to predict dysphagia. So, it can be a new indicator for predicting aspiration in elderly with swallowing difficulty



Fig 1. Pharyngeal widths measured at mid-oropharynx (A) and lower oropharynx (B)

Wearable Hip-Assist Robot Reduces Muscle Fatigue and Metabolic Energy Cost in Elderly Persons

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Objective

The purpose of the present study was to investigate the effect of newly developed wearable hip-assist robot on muscle fatigue and cardiopulmonary metabolic energy cost during walking in elderly persons.

Methods

Twenty elderly persons (age means: 71.5 ± 3.71 , 11 males) participated in this study. The Gait Enhancing Mechatronic System version 3.0 (GEMS V3, Samsung Electronics Co., Ltd., Korea), which functions as a wearable hip-assist robot was used in this experiment. All participations performed randomly assigned three conditions (free gait without robot assistance [FG], robot-assist gait with zero torque [RAG-Z] and robot-assist gait [RAG]) of treadmill walking during 6 min at self-selected speed. In all conditions, muscle fatigue were acquired and analyzed using the 12-channel wireless surface electromyography system (Desktop DTS system, Noraxon, USA) and cardiopulmonary metabolic energy cost ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) were obtained from portable cardiopulmonary metabolic system (COSMED K4B2, Rome, IT).

Results

The RAG condition demonstrated lesser lower extremity muscle fatigue during 6 minutes treadmill walking than the FG and RAG-Z. Furthermore, net cardiopulmonary metabolic energy cost during 6 minutes treadmill walking was significantly lower in the RAG (decreased of 33.14% than FA) than the FA and RAG-Z ($P < 0.05$) (Figure 1).

Conclusion

These Results demonstrate that a newly developed wearable hip assist robot, the GEMS V3, is a potentially useful device for improving gait function by reducing the muscle fatigue and also by decreasing cardiopulmonary metabolic cost during walking in elderly persons. We will perform a study to confirm the effect of gait training effect of GEMS V3 with neural disorder patients in the near future.

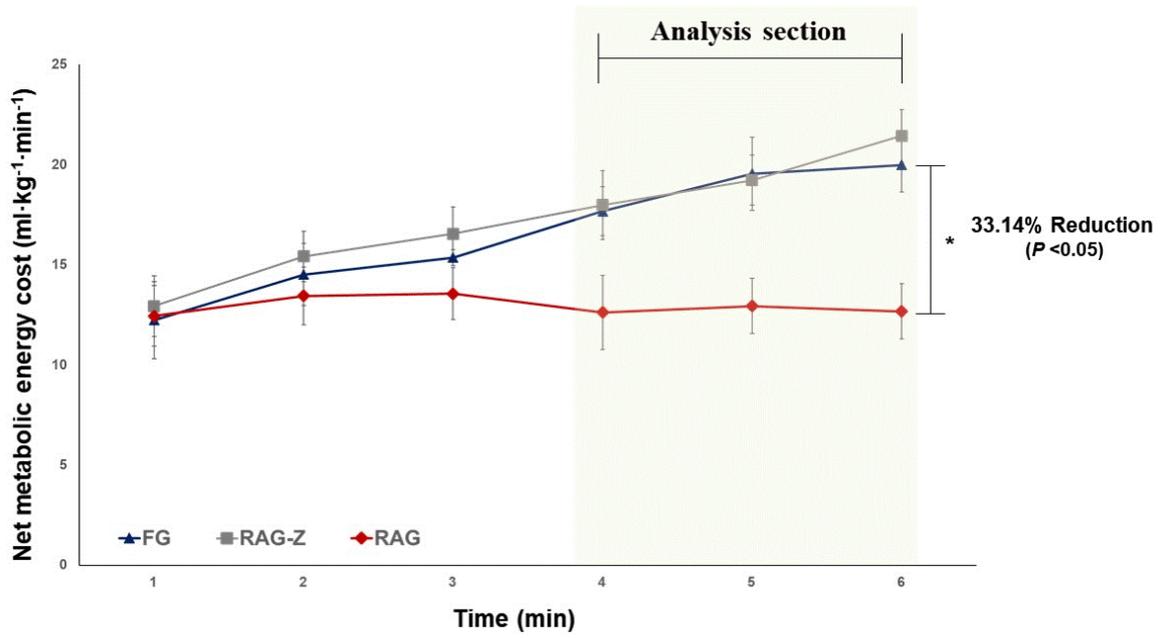


Fig 1. Trajectory of change in Net metabolic energy consumption with 3 conditions (FG vs. RAG-Z vs. RAG). FG: free gait without robot assistance, RAG-Z: robot-assist gait with zero torque, RAG: robot-assist gait

Difficult Task During Activity of Daily Living in the Frail Elderly

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Introduction

The aim of this study was to investigate the level of difficulty in performing activity of daily living (ADL) in elderly, and compared it between the non-frail and frail elderly groups.

Method

The questionnaire was obtained from 104 elderly people aged over 65 years old from local community from July to August, 2017. It composed of basic information (sex, birth, height, weight, Body Mass Index and past medical history), Korean version of FRAIL scale (K-FRAIL scale) and checklist of the difficulty of 29 items related to ADL. 29 ADL items were developed based on Frenchay Activities Index, Katz index and Lawton-Brody instrumental ADL scale. The level of difficulty is measured on a Likert scale rating from 1, 5 (1 - most difficult, 5 - the easiest). Participants were categorized into 2 groups of frail elderly (K-FRAIL score ≥ 3) and non-frail elderly (K-FRAIL score ≤ 2). The difficulty level of ADL in all participants was analyzed by independent t-test.

Result

The mean age of the 104 participants (90 women and 14 men) were 78.3 ± 5.1 . The mean score of K-FRAIL scale for all participants is 2.4 ± 1.3 . Among the 104 participants, 56 (53.9%) of frail elderly group was founded. The top five most difficult items in all participants were in order: riding bicycle (1.5 ± 1.5), moving heavy Objects (1.8 ± 0.9), lifting heavy Objects over 5kg (1.9 ± 1.0), cleaning floors (2.4 ± 1.1) and cleaning windows (2.5 ± 1.3). The top five most difficult activities in the frail elderly groups riding bicycle (1.7 ± 1.7), moving heavy Objects (2.0 ± 1.0), lifting heavy Objects over 5kg (2.1 ± 0.9), cleaning floors (2.7 ± 1.2) and cleaning Windows (2.9 ± 1.4), and those in the non-frail elderly groups were in order: riding bicycle (1.4 ± 1.2), moving heavy Objects (1.5 ± 0.9), lifting heavy Objects over 5kg (1.8 ± 1.0), down the stairs (2.1 ± 0.9) and climbing stairs (2.1 ± 0.7). 27 items were significantly more difficult ($p < 0.05$) in frail elderly group compare to non-frail elderly group, except riding bicycle ($p = 0.296$) and lifting heavy Objects over 5kg ($p = 0.168$).

Conclusion

This study suggests that elderly people felt more difficult in the activities that require the loading and overcoming the gravity, and compared to the non-frail elderly, frail elderly felt most activities more difficult. The Results of this study may be helpful to develop the proper exercise and assistive device to improve the daily activity in the frail elderly.

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Correlation between Korean Fall Efficacy index and other parameters through exercises in elderly

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Objective

To identify the correlation between Korean Fall Efficacy index (KFES-I) and other gait ability parameters through the strengthening exercise program in elderly people

Methods

Between July 2015 and April 2018, patients who participated in the exercise program for preventing falls, and completed the evaluation before and after the program were enrolled retrospectively. We included patients aged over 60, those experienced a fear of falling, and those can gait independently even with gait orthoses, but complaining of disturbance during gait. The exercises was comprised of lower extremities and core muscle strengthening exercises following stretching exercises twice a week for 8 weeks. All participants were rated for fear of falling using KFES-I, the timed up and go (TUG) test, gait analysis, balance test using posturography, strength test using manual muscle test and isokinetic dynamometer, Berg Balance Scale (BBS), and functional status using modified Barthel Index (MBI). We compared these parameters before and after the program, especially KFES-I. In addition, we also compared these Results in two groups by ages.

Results

Of the 50 participants were enrolled. After the program, significant improvements were noted in the stride length on right side ($p=0.013$) in gait analysis, MBI ($p=0.012$), BBS ($p<0.000$), TUG test ($p<0.000$), and KFES-I ($p<0.000$). KFES-I was significantly correlation with MBI ($r=-0.35$, $p=0.013$). In addition, there was no significant difference between the group under 75 old ages and the others over 75 years.

Conclusion

In this study, participants showed an increase of their functional and balancing ability using the exercises for preventing the falls. Above all, an improvement in KFES-I suggest the decrease of fall-fear, which is significantly correlated with MBI scores. In addition, this effect was presented regardless of ages. Therefore, consistent exercise of stretching, strengthening, and balancing exercises may contribute to positive effect for preventing falling in older people.

Parameters	Pre (N=50)		Post (N=50)		p value	
	Rt.	Lt.	Rt.	Lt.	Rt	Lt.
MBI	90.70±9.78		92.76±8.53		0.012**	
BBS	41.68±10.27		44.72±9.88		<0.000**	
TUG	21.25±16.14		16.82±11.50		<0.000**	
KFES-I	36.34±12.46		30.64±11.89		<0.000*	
Cadence (steps/min)	83.82±22.25	84.22±22.36	95.93±21.17	96.51±21.34	0.898	0.787
Walking velocity (cm /s)	69.56±27.87	70.01±28.51	72.21±30.9	73.92±32.04	0.115	0.058
Stride Length (cm)	83.82±22.24	84.22±22.37	87.17±26.07	84.87±29.35	0.013*	0.588
Gait analysis						
Stance phase (%)	66.81±5.01	64.33±7.06	65.06±5.22	35.22±5.25	0.094	0.574
Single support (%)	34.93±5.81	33.20±5.00	35.22±5.25	34.13±5.23	0.677	0.088
IDS	16.08±5.07	15.63±5.28	15.39±4.3	15.42±5.18	0.029	0.624
TDS	15.80±5.08	16.25±5.02	17.25±14.74	15.25±4.05	0.565	0.119
Isokinetic dynamometer						
120°/s	26.60±19.08	29.98±21.09	38.12±24.82	42.67±26.99	0.001*	<0.000*
210°/s	19.84±13.59	22.92±14.53	29.96±19.52	32.22±20.09	<0.000*	<0.000*
Balance test						
WD I	10.35±6.06		11.48±8.24		0.236	
Stability index	33.35±23.93		31.71±18.99		0.630	

Changes of parameters before and after the exercise program. *p value<0.05 (Paired T-test) **p value<0.05 (Wilcoxon-signed rank test) BBS: Berg balance scale, IDS: Initial double stance, KFES-I: Korean version of Fall efficacy international scale, MBI: modified Barthel index, TDS: terminal double stance, TUG: Timed up and go test, WDI: weight distribution index

New Long-term Evaluation of Parkinson's Disease Gait

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Objective

This study aimed to quantitatively measure the pathological gait of Parkinson's patients using a foot pressure sensor for a long-term, to confirm the possibility of the use in clinical care and to use it as a basic data for developing a footwear-based activity tracker.

Subjects and Methods

Two patients with Parkinson's disease participated in the study (Table 1). The gait ability of the patients were measured with walking course that included straight lines and turns on a self-paced for 300 seconds in the medication "On" state. Excepting when the FOG is triggered, it was evaluated that stride time, step time, stance time, force, pressure and area in gait measures. The number of FOG and time of FOG in FOG measures were detected from the collected data based on force-time integral data for 300 seconds. The assessment was measured by Pedar[®]-X (Novel GmbH, Munich, Germany). Calories per minute were also measured during walking by using portable cardiopulmonary metabolic system (Cosmed K4B2, Rome, Italy).

Result

Long-term quantitative measurements of two Parkinson's patients showed a decrease in distance and velocity, increase of stance time (8%, 7%) and decrease of swing time (13%, 10%). Additionally, gait initiation duration was shown as 0.78s, 0.1s and number of FOG was 8 times, 4 times and time of FOG was 138.6s, 25.8s in each of Parkinson's disease patients during a 300 second recording. Other variables showed different Results depending on patients. (Table 2).

Conclusion

In this study, the gait ability, number of FOG, and time of FOG with Parkinson's disease patients were measured by using a foot pressure sensor for a long-term. These data could be used to analyze the pathological gait more quantitatively than short-term visual analysis for outpatient at clinical care. In further studies, it is necessary to evaluate data from a large number of patients with Parkinson's disease and stroke. We propose the necessity of a footwear-based activity tracker to quantitatively measure long-term pathological gait in daily life.

Table 1. Characteristics of Patients

	Parkinson's Disease	
	Case 1	Case 2
Age (year)	74	64
Sex	male	male
Height (cm)	173.5	144.9
Weight (kg)	71.6	53.6
Body mass index (kg/m ²)	23.8	22.5
Shoe Size (mm)	260	240
Hoehn & Yahr score		
"On" medication	3	2

Table 2. Gait measures and FOG measures

	Parkinson's Disease	
	Case 1	Case 2
Number of Steps (n)	453	300
Time (s)	300	300
Distance (m)	139.2	208.8
Energy Expenditure (kcal/min)	2.8	5.7
Velocity (m/s)	0.46	0.70
Stride Time (s)	1.31	1.07
Stance Time (%)	65	64
Swing Time (%)	35	36
Mean Maximum Force (kgf) / Bodyweight (kgf)	8.1	9.0
Maximum Pressure (kPa)	120	138
Mean Pressure (kPa)	64	73
Area (cm ²)	133	99
Gait Initiation Duration (s)	0.78	0.10
Number of FOG (n)	8	4
Time of FOG (s)	138.6	25.8

FOG, Freezing Of Gait.

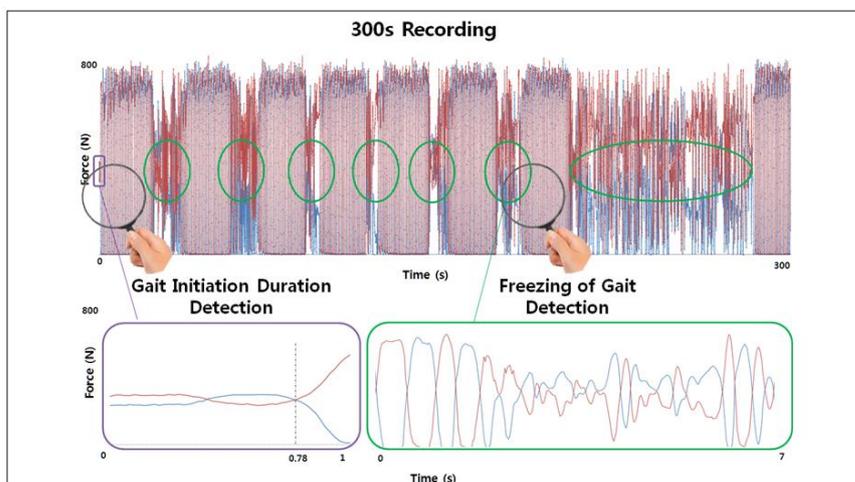


Figure 1. Detection of Freezing Of Gait Based on Force Time Integral for 300s

Effects of whole body vibration training in hospitalized older adults with sarcopenia

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Background and aims

Sarcopenia is defined as the loss of skeletal muscle mass and strength with increased age. Increased activity following whole body vibration (WBV) has been reported in patients with chronic illness, but few studies reported the effect of WBV on the physical function of patients with acute illness. This study aimed to investigate the effects of WBV training using vibration platform with tilt table on muscle mass and physical performance in hospitalized older adults with sarcopenia.

Methods

Inclusion criteria were as follow : 1) age more than 70 years old 2) unable to independently ambulate due to long term hospitalized care 3) patient who was diagnosed as sarcopenia. Patient who underwent surgical implantation because of trauma during recent 2 months, or patient who had medically unstable course was excluded. Participant were randomly allocated into WBV group using side-alternating vibration platform with tilt table vs. conventional physical therapy composed of passive range of motion exercise, balance and ambulation training. It took 40 minutes a day, 5 sessions per week for both groups to receive the intervention. In WBV group, subjects lied down on tilt table at 60 degree with bare foot. Then, subjects stood on the platform board which could vibrate. All subjects were in a squat position, with flexed knee at 30 degree. During whole body vibration, frequency was 12 Hz and amplitude was 4 mm. Initial evaluation included muscle power, muscle mass, hand grip force, balance test using Leonardo mechanography, Berg balance scale (BBS), timed get up & go (TUG) test, gait speed and activities of daily living (ADL). Muscle power was evaluated using manual muscle test (MMT). In balance test using mechanography, as a center of path parameters, standard ellipse area (SEA), path length (PL) were evaluated. After 2 weeks, when both groups finished 10 sessions, 2nd evaluation was conducted.

Results

A total of 17 patients admitted at one university hospital were identified. During the screening, one patient was excluded because of exacerbation of medical disease. Among the rest of 16 patients, one patient was dropped out because of isolation caused by infection. There were no significant differences between two groups in demographic characteristics (Table 1). Subjects were hospitalized due to infection, aggravation of known disease, frailty, or injury. At initial assessment, there were no significant differences in both groups except for SEA (Table 2, Table 3). After intervention, WBV

group showed improvements in muscle mass, SEA, BBS, TUG, gait speed, ADL. However, there were no statistically significant differences in all outcomes at 2nd evaluation.

Conclusion

WBV training may improve muscle mass, ability of ambulation and ADL in hospitalized older adults with sarcopenia. Further study with large sample size is needed.

Table 1. Demographic characteristics of both groups. Values are presented as mean±standard deviation; WBV, Whole body vibration

Variables	Control	WBV
Sex		
Male : Female (n)	4 : 3	3 : 5
Age (years)	83.5±6.9	79.7±3.9
Height (cm)	160.7±9.4	157.5±8.1
Weight (kg)	59.9±9.9	52.7±9.1
Cause of hospitalization (n)		
Infection	3	4
Aggravation of known disease	1	2
Frailty	2	1
Other cause	1	1

Table 2. Muscle power and muscle mass of both groups. Values are presented as mean±standard deviation; WBV, Whole body vibration

Variables	Control	WBV
Hip flexion		
Pre (Right : Left)	3.42 : 3.42	3.62 : 3.50
Post (Right : Left)	3.57 : 3.57	3.62 : 3.62
Hip extension		
Pre (Right : Left)	3.14 : 3.28	3.62 : 3.50
Post (Right : Left)	3.71 : 3.71	3.62 : 3.62
Knee flexion		
Pre (Right : Left)	4.00 : 3.85	3.50 : 3.50
Post (Right : Left)	4.00 : 3.85	3.62 : 3.62
Knee extension		
Pre (Right : Left)	3.85 : 3.71	3.57 : 3.50
Post (Right : Left)	4.0 : 4.0	3.62 : 3.62
Lean muscle mass		
Pre	37.11±7.22	35.75±7.78
Post	35.78±8.74	38.93±7.84
Grip strength		
Right		
Pre	14.08±5.08	8.02±5.14
Post	14.27±6.23	10.51±5.08
Left		
Pre	13.87±6.51	9.01±5.15
Post	14.41±7.06	10.33±5.51

Table 3. Physical performance in both groups. Values are presented as mean±standard deviation; WBV, Whole body vibration; SEA, Standard ellipse area; PL, Path length; BBS, Berg balance scale; TUG, Time to up and go; ADL, Activities of daily living

Variables		Control	WBV
Balance test			
SEA			
	Pre	5.62±5.59	2.23±2.22
	Post	6.57±7.03	1.61±1.79
PL			
	Pre	0.66±0.43	0.35±0.31
	Post	0.33±0.10	0.37±0.38
BBS			
	Pre	15.71±14.48	21.37±18.02
	Post	23.71±19.13	29.62±15.65
TUG			
	Pre	31.82±11.87	38.45±11.29
	Post	27.28±15.45	29.97±14.49
Gait speed (m/s)			
	Pre	0.31±0.04	0.32±0.07
	Post	0.33±0.19	0.36±0.15
ADL			
	Pre	45.85±23.08	41.0±19.60
	Post	61.0±23.51	56.62±52.31

Relationships between low hand grip strength and social, physical and medical status in the elderly

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Hand grip strength (HGS) is a measure of the maximum static force that a hand can squeeze using a dynamometer. HGS is a way to indirectly assess health status and physical abilities. And low HGS is also used as an index to evaluate sarcopenia in the elderly population. Currently HGS is widely used because it is easy and inexpensive to evaluate. Annually the Korea National Health and Nutrition Examination Survey (KNHANES) conducted by the Korea Centers for Disease Control and Prevention, and surveyed social status, nutrition, physical status and other medical history including HGS. Based on 7th KNHANES, In this study, we investigated the relationships between social, physical and other medical status and low HGS in the male and female elderly Korean population. According to the guideline of European Working Group on Sarcopenia, elderly low HGS was defined as a population at 65 years of age or older who showed weak HGS below -2 standard deviation based on the peak value of the young age group. A total of 903 subjects (male=411, female=492) were included in the analysis. And univariate and multivariate logistic regression analyses were used to analyze the factors associated with low HGS in men and women. Univariate logistic regression analysis showed that age, body mass index, degree of aerobic exercise, total energy intake, house income and education level were associated with low HGS in men. And, in women, age, weight gain, fat intake, education level were significantly related. However, in the multivariate logistic regression analysis for the related factors with adjusted age and body mass index, low intake of fat and protein, and low education level was associated with low HGS in men, however weight gain was associated with low HGS in women. In Conclusion, we analyzed the various factors associated with low HGS, and there were differences between men and women in the related factors. Based on this Results, it was thought that active approach and intervention are needed for the prevention of sacropenia through the correction of those related factors. Furthermore, different approaches are needed depending on gender.

Fall risk assessment in the elderly people in the rural area in korea

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Background

Falls are a major cause of mortality, disability and physical limitation in the older people. Korea is rapidly aging and the health problems of the elderly are emerging as major social problems including the aging of the elderly.

Objective

The purpose of this study is to analyze the causes of falls and risk factors for elderly population aged 65 years or older in rural areas, and to identify the differences between falls people and non-falls people based on basic health status, self-assess assessment, and physical evaluation.

Methods

As part of the farmers' health promotion project, retrospective study was performed from March 2016 to December 2016. A total of 350 elderly people were recruited. The subjects were divided into two groups: 254 faller and 96 non fallers. Participants were asked to visit the hospital once during this period in order to have a questionnaire and a physical evaluation.

Results

The statistically significant factor in the univariate analysis in Falling are female ($p=0.001$), age (70-79 years) ($p=0.003$), lives alone ($p<0.001$), less than middle school graduate ($p=0.001$), skeletal muscle mass ($p=0.004$), mini mental state examination ($p=0.005$), knee osteoarthritis ($p=0.003$), hip torque mean ($p=0.005$), hip power mean ($p=0.005$), knee torque mean ($p<0.001$) and knee power mean ($p<0.001$). The multivariate logistic regression model (backward Method), female (OR 3.83, 95% CI 1.51–9.72; $p=0.0048$) and age (70-79 years) (OR 5.25, 95% CI 1.67–16.50; $p=0.0046$) were independent risk factors for the presence of fall. In the receiver operating characteristic curves (ROC) analysis, 0.6515 (95% CI 0.58-0.71) for hip torque mean, 0.6516 (95% CI 0.58-0.71) for hip power mean, 0.6596 (95% CI 0.60-0.71) for knee torque and 0.6562 (95% CI 0.60-0.71) for knee power mean. The four AUC values ($0.65 < \text{AUC} < 0.7$) we measured were not significantly relevant because of their less accuracy.

Conclusions

We concluded that especially women and elderly people (70-79 years) can be considered as an important risk factor for falls, so special attention should be paid to this in rural area. In addition, weakened lower extremity strength can be considered as a factor to increase the risk of falling, so efforts should be made to lower the risk of falling by improving lower extremity function.

P 2-39

Grip strength and normalized grip strength in their relationship with metabolic syndrome in elderly.

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Purpose

Strength measures should be normalized by body mass but the definition of sarcopenia contains only simple grip strength. This study was conducted to compare the relationship of grip strength and grip strength divided by body weight with several major consequences of sarcopenia, namely, metabolic syndrome and poor quality of life.

Methods

This is a cross-sectional observational study using the data from the Sixth Korea National Health and Nutrition Examination of total of 1,273 men and 1,436 women. Metabolic syndrome was defined according to the ATP III guidelines with some modifications appropriate for Koreans. Quality of life was assessed by the EuroQoL (EQ)-5D. Multiple logistic regression models were used to evaluate the association between grip strength/grip strength divided by body weight and metabolic syndrome/quality of life.

Results

Grip strength was not related to metabolic syndrome whereas grip strength/body weight revealed a dense dose-response relationship. Both measures showed a similar correlation with quality of life.

Conclusions

Grip strength divided by body weight can be superior to simple grip strength measure in representing the metabolic aspects of sarcopenia.

Risk factors for fall-related major fractures in older patients: a retrospective review

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Objective

This study was to investigate risk factors for major fractures (compression fracture, femur neck fracture, and distal radius fracture) in elderly patients after fall-down.

Methods

This retrospective study was performed between January 2010 and December 2013. Data were collected from Injury Monitoring System in Emergency Department. The variables were the year of visit, age, sex, past medical history (including history of orthopedic surgery, osteoporosis and neurodegenerative disease), and diagnosis at the Emergency room (including major fractures) for the 4662 final patients sample who visited Emergency Department after a fall. Logistic regression model were used to evaluate the associated factors, and we further explored by repeating the analyses separately for those with and without osteoporosis.

Result

Age (OR=1.04), female gender (OR=2.50), history of orthopedic surgery (OR=2.03), and osteoporosis (OR=2.06) were associated with major fractures after fall-down. Female patients were at higher risk of major fracture than male patients. There was no significant difference in risk of major fracture between patients who had neurodegenerative disease and those who did not. The same statistical analysis was performed with patients who did not have osteoporosis, and female patients showed higher risk of major fracture than male patients (OR=2.49), with statistical significance ($p < 0.05$).

Conclusion

Previous Orthopedic surgery is a risk factor for fall related fractures, but neurodegenerative diseases were. Regardless of osteoporosis prevalent, women are most likely to suffer falls-related fractures. To prevent major fracture, customized care should be taken to those in older people in accordance of their medical history and gender. Medical therapy is needed to prevent or control osteoporosis, and appropriate orthotic support is recommended to provide safe environment for the patients who had recent orthopedic surgery.

Measuring gait speed with usual walking pace between stopwatch and automatic timer in older adults

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Background

Measuring of 4-meter gait speed with the manual using a stopwatch is the gold standard Method for evaluating the health and functional status of older adults. Recently, measuring gait speed using devices have been reported to improve accuracy. In addition, the NIH suggests a standing start, but several studies have evaluated gait speed using the moving-start. The purpose of this study was to compare manual stopwatch and automatic measuring instrument of gait speed obtained from the individual's usual walking pace using a 4-meter walking test with different starting protocol (standing vs. moving) in healthy older adults.

Methods

One hundred fifty-three healthy older adults aged 65 years and older (n=153, 57 men, 96 women, age=75.21±5.14 years, SPPB=11.17±0.98) participated. The gait speed was measured from a 4-meter walking test using the manual stopwatch and automatic timing system with or without the 2-meter acceleration and deceleration phases. Each participant completed two consecutive trials for different starting protocol with a rest period of two minutes. Data were analyzed with independent t-test, and significance was set at p<0.05.

Results

On average, the timed gait speed by the automatic timer was 0.2 m/s faster in standing start (1.41±0.26 vs. 1.21±0.21 m/s, p<0.001) and 0.17 m/s faster in moving start (1.44±0.25 vs. 1.27±0.20 m/s, p<0.001) during 4-meters walking compared with the manual stopwatch, respectively. The moving start protocol the usual gait speed measured by the stopwatch was significantly faster than the standing start (1.27±0.20 vs. 1.21±0.21 m/s, p=0.019), while there was no difference between the start protocols when measuring with the automatic timer (1.44±0.25 vs. 1.41±0.26 m/s, p=0.327). In both men and women, the gait speed obtained from the start protocols was also different between the manual stopwatch and the automatic timer (p<0.001), but the gait speed according to the timing protocols did not show any significant difference between the standing start and the moving start.

Conclusion

Timed usual gait speed on a 4-meter course is affected by the measuring Method (manual stopwatch vs. automatic instrument), and in particular, the starting protocol (standing vs. moving start) should be considered when using the manual stopwatch in older adults. Therefore, we suggest that careful attention should be taken to be

misvaluated when measuring gait speed for functional assessment of older adults using the automatic instrument or using the moving start Method.

Head rotation is effective for dysphagia related to anterior cervical osteophyte: CASE REPORT

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Background

Anterior cervical osteophytes are generally asymptomatic but can be problematic, often lead to progressive swallowing difficulty in some cases. Dysphagia with anterior cervical osteophyte can be managed through conservative treatments or surgery. Conservative treatments include inflammatory medication, steroids, muscle relaxants, and anti-reflux medication. But there are only few studies that have determined the effects of compensatory technique to improve dysphagia with anterior cervical osteophyte. In this CASE REPORT, we present a case of an elderly man with dysphagia due to huge anterior cervical osteophyte who showed improvement of dysphagia with compensation maneuvers. Case description: A 72-year-old man complaining of swallowing difficulties was referred for a videofluoroscopic swallowing study (VFSS) for the evaluation of dysphagia. He had experienced swallowing discomfort for several years. Specifically, he complained of intermittent aspiration symptom when drinking water, and he felt globus sensation when swallowing solid food. Gag reflex, mastication, and tongue movement evaluations showed normal finding. He did not complain of pain or sensory abnormalities during swallowing. However, a VFSS revealed impaired epiglottic tilting and severe residue around vallecular fossa and pyriform sinuses, leading to after swallow penetration and aspiration (Figure 1A). Incidentally, enlarged cervical vertebrae forming a wedge-shaped prominence narrowing the pharyngeal space was noted. Lateral cervical spine X-ray (Figure 1B) and computed tomography (CT) scan (Figure 1 C, D) revealed large anterior osteophytes at C3-C4 and C5-C6 levels. The C3-C4 osteophyte extended approximately 1.2cm anteriorly Resulting in marked narrowing of the hypopharynx at the level of epiglottis. Flexible endoscopic evaluation of swallowing (FEES) was performed, which also showed severe protrusion of the cervical osteophyte with restricted epiglottic motion and narrowing of pharyngeal space (Figure 2A). As a compensation maneuver, we tried head rotation and chin down. Though chin down position (Figure 2B) or right head rotated position (Figure 2C) showed severe narrowing of pharyngeal space, left side head rotation (Figure 2D) revealed opening of the pharyngeal spaces with the epiglottis no longer obstructed by the osteophyte. Bolus swallowing in left head rotation position allowed for direction of subsequent boluses through the widened pharyngeal spaces without significant residue. However, chin down positioning put the epiglottis in proximity to the pharyngeal wall, thus aggravating pharyngeal residue.

Conclusion

This CASE REPORT with the FEES images highlights that head rotation compensation can be a simple, yet highly successful in alleviating post swallow bolus residues related to anterior cervical osteophyte by widening the pharyngeal space.

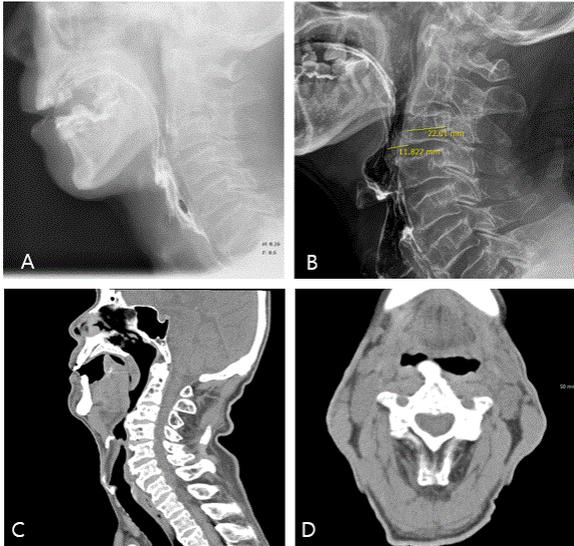


Figure 1. Pooling of barium contrast material in vallecular due to profound mass effect originating from anterior C3-C4 cervical osteophyte in VFSS (A). Large anterior cervical osteophyte in lateral cervical x-ray (B), sagittal view (C) and axial view (D) of CT scan

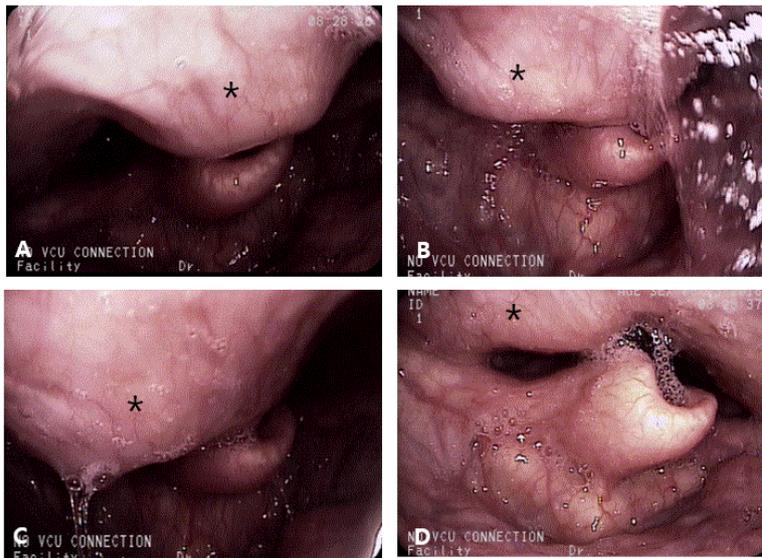


Figure 2. FEES shows the anterior projection (*) due to huge anterior cervical osteophyte at C3-C4 vertebra level (A). Chin down position (B) and right side head rotation (C) aggravate narrowing of pharyngeal space. Left side head rotation (D) provides widened space for epiglottic tilting.

Dysphagia accompanying aspiration after peritonsillar abscess followed by deep neck space infection

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INTRODUCTION

Dysphagia is one of the complications that can be seen after deep neck space infection, and most of the symptoms are temporary, complaints of throat irritation or effortful swallowing but swallowing difficulty with failure of esophageal bolus transit or accompanied aspiration has never been reported. We report a case of a patient with structural change due to deep neck space infection in which swallowing difficulty due to esophageal bolus transit failure caused by lack of upper esophagus sphincter(UES) opening and pharyngeal muscle movement was improved by swallowing rehabilitation.

CASE REPORT

A 72-year-old man visited the emergency room with the left tonsillar edema and pain for 5 days. Hypertrophy and redness of the left tonsil and posterior pharyngeal wall were observed. Peritonsillar abscess and deep neck space infection were diagnosed by neck computed tomography(CT)(Fig. 1). Intravenous antibiotics were administered. Incision with drainage and quincy tonsillectomy were performed on the second day of admission. On the 6th day of admission, mediastinitis was found in chest CT and incision and drainage were done. The patient underwent fasting and total parenteral nutrition until 12 days after admission. The nasogastric tube was used to start feeding on the 13th day of admission. In the video fluoroscopic swallowing study(VFSS) performed on the 23rd day of admission, mild decrease of tongue movement, mastication with moderately decrease of laryngeal movement was observed. Liquid and pudding diets did not advance to the esophagus with lack of the UES opening. After VFSS, he began the swallowing rehabilitation designed to facilitate the movement of the pharyngeal muscles and the opening of the UES. The rehabilitation was performed twice a day for 30 minutes with functional electrical stimulation therapy. And the patient was instructed by Masako, Mandelsohn maneuver and Shaker exercise three times a day for 50 times respectively. Although UES opening was improved in VFSS performed 2 weeks after rehabilitation, aspiration is still showed in 2cc liquid. Most of the pudding remained in the vallecula and stagnated without compensation for repetitive swallowing attempt. Three weeks after the rehabilitation, the patient discharged for outpatient rehabilitation. On VFSS after 4 weeks of outpatient rehabilitation, direct aspiration was observed in liquid, but no aspiration and penetration were observed in pudding, banana, semi-solid and solid diet feeding and UES opening was improved(Fig. 2). By Result of this study, we started for him to ingest liquid with viscosity enhancer and to intake advanced dysphagia diet.

CONCLUSION

We report a case, which had a therapeutic effect of swallowing rehabilitation in severe dysphagia with dysfunction of UES and decreased movement of pharyngeal muscle due to sequelae of deep neck space infection treatment, whose dysphagia mechanism was clearly identified and active swallowing rehabilitation was applied.

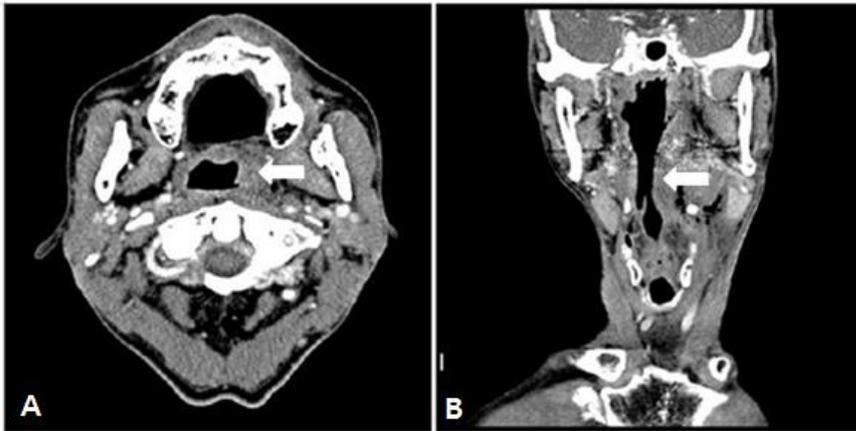


Fig. 1 CT of the neck, transverse view (A), sagittal view (B) Neck CT showed irregular peripherally enhancing low density collection in lt. palatine tonsil and parapharyngeal space(arrow).

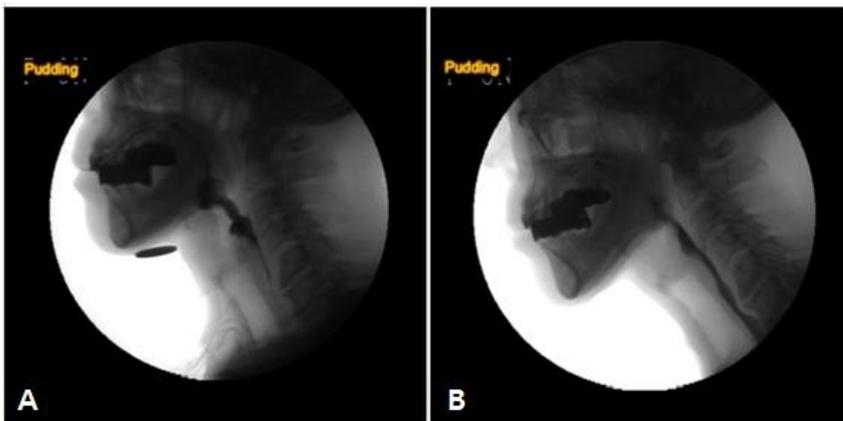


Fig. 2 VFSS before (A) and after (B) swallowing rehabilitation VFSS showed improvement of the bolus transit through the esophagus.

Optimal Placement of Needle EMG Electrode for Biceps Femoris Short Head: a Cadaveric Study

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Optimal Placement of Needle EMG Electrode for Biceps Femoris Short Head: a Cadaveric Study Dong Hwee Kim, Jong heon Park, Ha kyoung Lim, Jae hyun Cha, Ki jun Shin, Dasom Kim,* Im Joo Rhyu,* Department of Physical Medicine & Rehabilitation, Korea University College of Medicine * Department of Anatomy, College of Medicine, Korea University

Objectives

Needle electromyographic examination of biceps femoris short head muscle should be considered in differentiating common peroneal neuropathy around knee from proximal lesion such as sciatic neuropathy. Several techniques for needle EMG of the BFS muscle have been proposed. Most of Methods suggest medial or lateral approach to the tendon of biceps femoris long head around popliteal fossa. However, considering close approximation between common peroneal nerve and the tendon of biceps femoris long head, medial approach would be dangerous as the needle penetrate the nerve. The purposes of this study is to assess the optimal placement site for electromyographic examination of biceps femoris short head muscle through cadaver dissection. .

SUBJECTS AND METHODS

Twenty-one lower legs from 12 fresh cadavers were dissected. We performed dissection from ischial tuberosity to knee. The distance from the lateral margin of common peroneal nerve to the biceps femoris long head tendon (BFL_CPN distance) at 5 cm proximal to the tip of fibular head (P1), 4 finger breadths proximal to the tip of fibular head (P2, 7 cm), upper apex of popliteal fossa (P3), midpoint of biceps femoris short head (P4) (minus values, if, measuring point lied lateral to BFL tendon). Relative location of biceps femoris short head or long head to the biceps tendon was checked. .

RESULTS

The median values (minimum-maximum) of BFL_CPN distance were +2.0mm (-5.0 ~ 10.0) at P1, 3.0mm (-6.0+13.0) at P2, +0.0mm (-12.5 ~ 42.0) at P3, 0.0mm (-15.0 ~ 16.5) at P4 level. Overall, the CPN courses in proximity to the medial margin of the BFL tendon. Biceps femoris short head muscle was located lateral to the tendon of biceps femoris long head, biceps femoris long head muscle, medial side to the tendon of biceps femoris long head (unipennate type).

CONCLUSION

The medial approach of needle electrode for electromyographic examination of biceps femoris short head would have high risk of injury to the common peroneal nerve. Considering lateral location of biceps femoris short head muscle, lateral approach would be strongly recommended for electromyographic examination of this muscle.

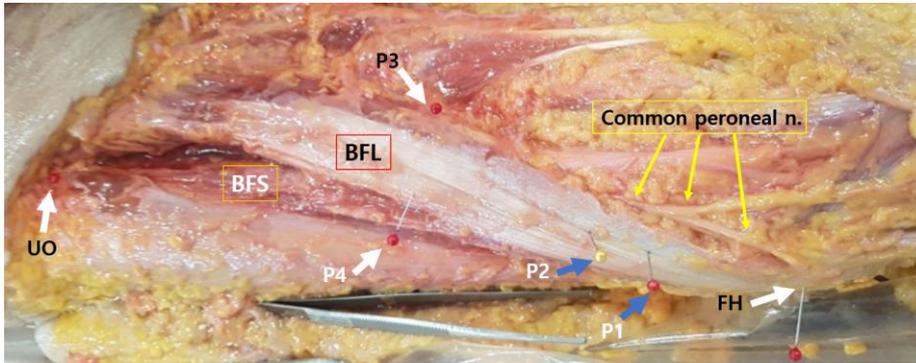


Fig 1. Anatomic relationship of common peroneal nerve, biceps short head and long head muscles to the tendon of biceps femoris long head.

Uncertainty Analysis in Median Sensory Nerve Conduction Study

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Objectives

Nerve conduction study (NCS) is an essential tool to evaluate functions and pathologic conditions of peripheral nerves, and could offer the critical clues for diagnosing neuromuscular disease. However, because of the uncertainty of measurement affected by subject, physician, instruments, and other laboratory environment, there is no standardized reference data according to demographics not only for South Korean but also for the world. It brings out a variety of reference values at each lab, makes diagnosis confusing, and Results unnecessary retest. To establish reference standards of NCS measurement index, in this precedent research, we calibrated the instruments and calculated the expanded uncertainty (U_{exp}) during the median sensory NCS.

Methods

We operated the antidromic way for median sensory NCS, recording at 2nd finger, and stimulated at 14cm distal from active electrode with 20% supramaximal intensity. The skin temperature of hand was between 32° and 36°. We calculated calibration uncertainty (UC), Type A intra-rater uncertainty (UA), Type B inter-rater uncertainty (UBI), and Type B uncertainty according to device resolution (UBR). To calculate UC, we made the EPCs generating 5ms of onset latency (Lo) and 63.456uV of peak to peak amplitude (A_{ptp}), and measured it through electro-diagnostic machines (Nicolet EDX, Natus, USA) 10 times (Fig. 1). The EPCs was secured traceability by accredited calibration company. For UA, a skilled physician measured 10 times of a median sensory nerve in a normal subject who has no neuromuscular disease. And for UBI, 10 different skilled physicians measured the subject (Table 1). UBR was calculated from the resolution of 0.01ms by 0.01uV fields.

Results

The measured EPCs values through the machine were 5.12ms for Lo, and 59.39uV for A_{ptp}. The correction values were -0.12ms and 2.033uV for Lo and peak amplitude (A_p), respectively. The Results of Lo and A_p of UC were 0.030ms and 0.635uV, UA were 0.0158ms and 0.5724uV, UBI were 0.0133ms and 0.07767uV, and UBR were 0.0029ms and 0.0029uV, respectively. According to the formula calculating total combined standard uncertainty (U_{com}), the U_{com} of Lo and A_p were 0.037ms and 1.155uV. At last, the final report of the median sensory NCS for the subject examined by one physician can be

described in corrected mean measurand with the U_{exp} values. These are 2.60 ± 0.073 ms of Lo and 45.30 ± 2.309 μ V of Ap (CI 95%, $k = 2$) (Table 2).

Conclusions

In this study, we measured Lo and Ap of median sensory nerve with U_{exp} for the first time. The other reference standards, such as the duration, area and the nerve conduction velocity can be obtained at future, and further study according to age and sex also would be necessary. The further research and web based sharing of NCS reference standards of South Korean can improve inter-laboratory reliability, encourage accurate diagnosis of disease, and establish credible research about neuromuscular disease.

Table 1. The measured values for inter and intra-rater uncertainty.

Nerve / Sites	Onset latency (ms)	Amplitude (μ V)	Nerve / Sites	Onset latency (ms)	Amplitude (μ V)
R MEDIAN – Conductor 1			R MEDIAN - Conductor from 1 to10		
Wrist	2.71	68.5	Conductor 1	2.72	71.13
2	2.60	72.0	Conductor 2	2.79	72.98
3	2.76	71.8	Conductor 3	2.73	72.15
4	2.76	70.7	Conductor 4	2.81	77.78
5	2.66	72.4	Conductor 5	2.85	67.81
6	2.71	70.8	Conductor 6	2.81	65.11
7	2.76	69.0	Conductor 7	2.81	66.33
8	2.76	70.3	Conductor 8	2.80	71.33
9	2.71	74.0	Conductor 9	2.79	71.24
10	2.76	71.8	Conductor 10	2.83	71.01

Table 2. Combined standard uncertainties and expanded uncertainties in median sensory NCS.

Uncertainty factors	Type	Distribution	Onset latency			Peak Amplitude		
			Values	Divisor	Standard uncertainty (ms)	Values	Divisor	Standard uncertainty (μ V)
EPCs calibration (U_C)	B	normal	0.030 (SD)	2	0.015	0.635 (SD)	2	0.317
Intra-rater uncertainty (U_A)	A	normal	0.050 (SD)	$\sqrt{10}$	0.016	1.810 (SD)	$\sqrt{10}$	0.572
Inter-rater uncertainty (U_{BR})	B	normal	0.040 (SD)	3	0.013	2.330 (SD)	3	0.777
Resolution (U_{BR})	B	Rectangular	0.010	$2\sqrt{3}$	0.003	0.010	$2\sqrt{3}$	0.003
Combined standard uncertainty(U_{COM})		Presumed normal	0.037			1.155		
Expanded uncertainty (U_{EXP})		Presumed normal	0.073			2.309		

The U_{EXP} is reported based on a U_{COM} , multiplied by a coverage factor of $k=2.00$, providing a confidence level of approximately 95%; the U_{COM} is calculated by $\sqrt{U_C^2 + U_A^2 + U_{BI}^2 + U_{BR}^2}$ formula; SD, standard deviation.

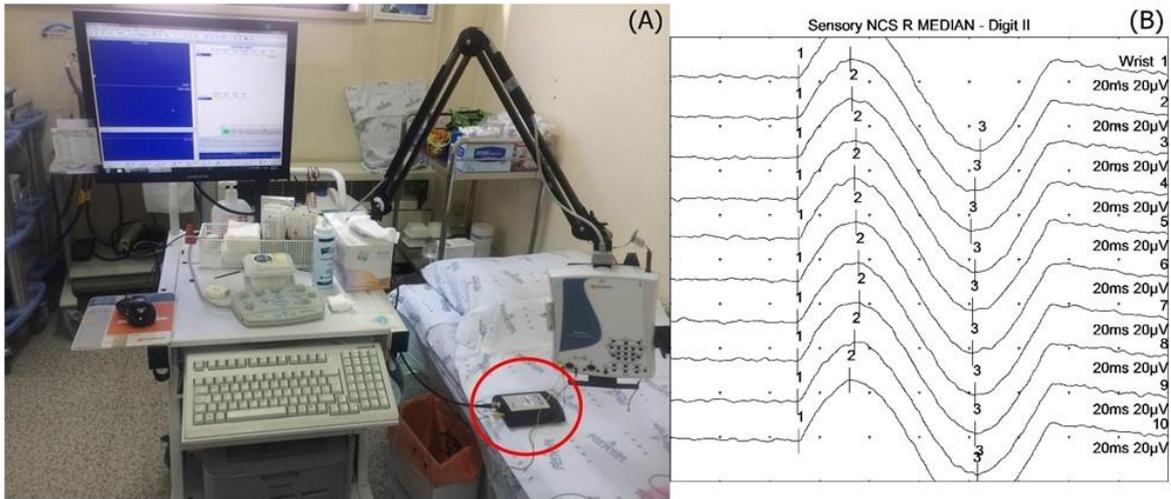


Fig. 1. The electro-diagnostic machine measure the standard signal generator (EPCs, in red circle) (A) 10 times (B). The EPCs was secured traceability from calibration company (KTICC, South Korea) accredited by Korean Laboratory Accreditation Scheme (KOLAS). The difference between the measured values through the machine and the generated values by EPCs was 5.12ms versus 5.00ms for onset latency, and 59.39µV versus 63.456µV for peak to peak amplitude. The correction values were -0.12ms and 2.033µV for onset latency and peak amplitude, respectively.

Difference of Electrophysiologic Values between Pre and Intraoperative Neurophysiologic Monitoring

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Introduction

Intraoperative neurophysiologic monitoring (IONM) techniques, especially motor evoked potential (MEP), somatosensory evoked potential (SEP), auditory evoked potential (AEP), and electroneurography (ENoG) are considered useful and practical. References of MEP and SEP were established in many studies, however those had differences between preoperative and intraoperative monitoring. This study is aimed to compare preoperative and during operative electrophysiologic values.

Methods

85 patients who underwent aneurysmal clipping, tumor mass removal, carotid endarterectomy, bypass surgery, artery ligation in brain and spinal surgery, and 38 who underwent microvascular decompression (MVD) were divided into two groups (Table 1). First group underwent MEP and SEP, and second group did ENoG and AEP before and during surgery. The monitoring parameters were latency (msec) and amplitude (mV) of 1st dorsal interosseous (FDI), abductor pollicis brevis (APB), and tibialis anterior (TA) in MEP, and median, posterior tibial and peroneal nerve in SEP. Also, four muscles, such as frontalis, orbicularis oculi, orbicularis oris, and mentalis, and AEP were monitored.

Results

In MEP, latency of FDI/APB and TA were significantly delayed during surgery compared to preoperative values in bilateral extremities and amplitudes decreased during surgery (Table 2). Also, latency of median and posterior tibial were similar Results in SEP, but peroneal SEP showed no significant differences between before and after operation (Table 2). In ENoG, latency and amplitude of all facial muscles and AEP showed no significant differences between pre and during operation (Table 3).

Conclusions

Result suggests neurophysiologic monitoring parameter were changed during surgery. The reason of this Result is assumed that anesthetics used during surgery would have influenced the latencies and amplitudes of MEP, SEP, and ENoG during operation. Therefore, it would be better to understand this concept of changes during the surgery.

Table 1. Demographic Characteristics

	MEP, SEP study		Facial nerve motor conduction, AEP study	
	Brain operation	Spine operation	Hemifacial spasm	Trigeminal neuralgia, Cerebellopontal angle tumor
Numbers	51	34	29	9
Sex(M/F)	25/26	20/14	9/20	3/6
age	59.96 ± 1.82	55.94 ± 3.29	55.10 ± 2.15	58.10 ± 4.23
Affected side or level	Right 31 Left 20	Cervical 5 Thoracic 14 Lumbar 15	Right 13 Left 16	Right 8 Left 1
Operation name	Aneurysm neck clipping (30) Tumor mass removal (14) Carotid endarterectomy (4) Bypass surgery (2) Artery ligation (1)	Laminectomy (28) Anterior fixation (1) Posterior fixation (4) Others (1)	MVD (29)	Tumor mass removal (3) MVD (6)
TOF	64.89 ± 6.38	62.20 ± 7.74	78 ± 70	77 ± 15

MEP, motor evoked potential; SEP, somatosensory evoked potential; AEP, auditory evoked potential; M, male; F, female; MVD, microvascular decompression; TOF, train of four

Table 2. Comparison of Motor Evoked Potential and Somatosensory Evoked Potential Studies in Pre- and During Operation

	Right					Left				
	N	Preoperation	N During operation	ΔDuring-Preoperation	P-value	N	Preoperation	N During operation	ΔDuring-Preoperation	P-value
Brain operation										
MEP	51		51			51		51		
FDI/APB latency (msec)	51	21.83 ± 0.19	45	25.58 ± 0.52	3.65 ± 0.50 <0.001*	51	22.09 ± 0.24	45	34.94 ± 0.99	2.95 ± 0.51 <0.001*
FDI/APB amplitude (mV)		2.99 ± 0.39		1.67 ± 0.21	-1.48 ± 0.42 0.005*		2.51 ± 0.29		0.48 ± 0.13	-0.90 ± 0.31 0.020*
TA latency (msec)	50	30.44 ± 6.10	21	34.95 ± 0.99	4.38 ± 0.73 <0.001*	50	30.71 ± 0.39	21	35.13 ± 0.96	4.95 ± 0.75 <0.001*
TA amplitude (mV)		1.16 ± 0.14	22	0.49 ± 0.13	-0.45 ± 0.16 0.005*		1.13 ± 0.14	22	0.64 ± 0.21	-0.48 ± 0.32 0.040*
SEP	51		51			51		51		
Median N19 (msec)	51	19.10 ± 0.21	50	21.04 ± 0.61	1.90 ± 0.57 0.003*	50	19.06 ± 0.19	49	21.22 ± 0.57	2.12 ± 0.53 <0.001*
Median P23 (msec)		24.7 ± 0.28		28.46 ± 0.84	3.74 ± 0.85 <0.001*		24.93 ± 0.32		28.69 ± 0.69	3.81 ± 0.69 <0.001*
Tibial P1 (msec)	51	41.20 ± 0.61	39	43.09 ± 1.25	1.97 ± 1.07 0.005*	50	40.68 ± 0.59	42	41.13 ± 1.17	1.89 ± 1.14 0.050*
Tibial N1 (msec)		49.53 ± 0.72		51.71 ± 1.96	2.98 ± 1.22 0.010*		49.04 ± 0.74		53.21 ± 1.21	3.63 ± 1.46 0.002*
Spine operation										
MEP	34		34			34		34		
FDI/APB latency(msec)	34	22.95 ± 0.54	3	24.07 ± 2.00	2.33 ± 2.55 0.557	34	22.54 ± 0.47	3	23.13 ± 1.62	2.03 ± 1.80 0.717
FDI/APB amplitude(mV)		2.35 ± 0.37		1.93 ± 1.18	0.01 ± 1.02 0.743		2.40 ± 0.44		2.01 ± 1.25	0.17 ± 1.01 0.800
TA latency(msec)	31	32.84 ± 1.03	11	34.39 ± 1.92	3.23 ± 1.63 0.448	31	32.08 ± 0.93	13	36.55 ± 1.75	5.06 ± 1.23 0.017*
TA amplitude(mV)		1.12 ± 0.19		0.69 ± 0.16	-0.39 ± 0.27 0.210		1.04 ± 0.16		0.39 ± 0.16	-0.67 ± 0.29 0.021*
SEP	34		34			34		34		
Median N19 (msec)	34	19.83 ± 0.44	8	25.36 ± 3.01	5.05 ± 2.65 0.001*	34	19.34 ± 0.34	8	23.93 ± 2.46	3.85 ± 2.25 <0.001*
Median P23 (msec)		25.74 ± 0.45		33.15 ± 3.79	7.26 ± 3.58 <0.001*		24.95 ± 0.44		31.96 ± 3.32	6.62 ± 2.92 <0.001*
Tibial P1 (msec)	29	41.97 ± 0.85	25	43.27 ± 1.18	1.44 ± 1.05 0.362	29	42.22 ± 0.87	24	43.45 ± 1.66	1.56 ± 1.49 0.490
Tibial N1 (msec)		49.73 ± 0.89		53.98 ± 1.02	3.92 ± 1.19 0.002*		49.27 ± 1.16		53.81 ± 1.76	5.14 ± 1.87 0.028*
Peroneal P1 (msec)	4	44.25 ± 3.61	4	41.53 ± 5.24	-1.70 ± 2.45 0.639	4	43.37 ± 52.35	4	41.78 ± 4.36	-1.20 ± 1.62 0.720
Peroneal N1 (msec)		53.07 ± 3.23		49.43 ± 5.29	-3.4 ± 3.14 0.527		52.35 ± 3.43		52.63 ± 6.10	1.66 ± 4.77 0.965
Total operation										
MEP	85		85			85		85		
FDI/APB latency(msec)	85	22.28 ± 0.25	48	25.49 ± 0.49	3.56 ± 0.48 <0.001*	85	22.27 ± 0.23	48	24.99 ± 0.49	2.89 ± 0.48 <0.001*
FDI/APB amplitude(mV)		2.73 ± 0.27		1.69 ± 0.21	-1.38 ± 0.39 <0.001*		2.46 ± 0.24		1.70 ± 0.21	-0.83 ± 0.30 0.038*
TA latency(msec)	81	31.36 ± 0.46	32	34.75 ± 0.89	3.99 ± 0.71 <0.001*	81	31.23 ± 0.43	34	35.65 ± 0.86	4.99 ± 0.63 <0.001*
TA amplitude(mV)		1.15 ± 0.11	33	0.55 ± 0.10	-0.43 ± 0.14 0.002*		1.10 ± 0.10	35	0.54 ± 0.14	-0.55 ± 0.22 0.003*
SEP	85		85			85		85		
Median N19 (msec)	85	19.39 ± 0.21	58	21.63 ± 0.67	2.33 ± 0.61 <0.001*	84	19.17 ± 0.18	57	21.60 ± 0.59	2.36 ± 0.54 <0.001*
Median P23 (msec)		25.14 ± 0.25		29.10 ± 0.89	4.20 ± 0.86 <0.001*		24.96 ± 0.25		29.14 ± 0.74	4.15 ± 0.70 <0.001*
Tibial P1 (msec)	80	41.48 ± 0.49	64	43.16 ± 0.88	1.78 ± 0.76 0.081	79	41.25 ± 0.49	66	43.24 ± 0.94	1.77 ± 0.89 0.051
Tibial N1 (msec)		49.61 ± 0.55		52.65 ± 1.22	3.56 ± 0.88 <0.001*		49.12 ± 0.62		53.42 ± 0.98	4.19 ± 1.13 <0.001*

MEP, motor evoked potential; SEP, somatosensory evoked potential; FDI 1st digit interosseous; APB, abductor pollicis brevis; TA, tibialis anterior; Op, operation
*P-value < 0.05

Table 3. Comparison of Electroneurography and Auditory Evoked Potential Studies in Pre- and During Operation

	N	Preoperation		N	During operation		Δ	P value	
Hemifacial spasm									
Facial motor conduction	29			29					
Frontalis latency (msec)	29	2.98 ± 0.10		28	3.87 ± 0.39		0.87 ± 0.39	0.029*	
Frontalis amplitude (mV)	28	0.82 ± 0.12			1.06 ± 0.19		0.25 ± 0.19	0.311	
Oculi latency (msec)	29	3.08 ± 0.16		25	3.70 ± 0.48		0.60 ± 0.41	0.223	
Oculi amplitude (mV)	28	0.28 ± 0.03			0.54 ± 0.10		0.26 ± 0.12	0.017*	
Oris latency (msec)	29	10.7 ± 0.64		21	8.36 ± 0.65		-2.38 ± 0.80	0.013*	
Oris amplitude (mV)	27	0.17 ± 0.04			0.21 ± 0.05		0.01 ± 0.03	0.606	
Mentalis latency (msec)	29	11.73 ± 0.79		25	10.89 ± 0.51		-0.61 ± 0.68	0.383	
Mentalis amplitude (mV)	27	0.28 ± 0.05			0.15 ± 0.02		0.15 ± 0.06	0.035*	
AEP (msec)		Right	Left		Right	Left	Right	Left	
I	29/29	1.77 ± 0.04	1.78 ± 0.04	27/29	1.58 ± 0.07	1.67 ± 0.07	-0.20 ± 0.06	-0.10 ± 0.05	0.028*/0.221
III		4.06 ± 0.04	4.02 ± 0.03		3.99 ± 0.08	4.10 ± 0.08	-0.08 ± 0.08	0.07 ± 0.06	0.428/0.396
V		5.92 ± 0.05	5.9 ± 0.06		6.01 ± 0.09	6.08 ± 0.08	0.09 ± 0.07	0.18 ± 0.06	0.377/0.071
Trigeminal neuralgia and cerebellopontine angle tumor									
Facial motor conduction	9			9					
Frontalis latency (msec)	8	3.61 ± 0.31		6	2.81 ± 0.27		-0.44 ± 0.44	0.070	
Frontalis amplitude (mV)		1.24 ± 0.41			0.74 ± 0.33		-0.10 ± 0.42	0.352	
Oculi latency (msec)	8	3.35 ± 0.31		6	2.3 ± 0.38		-1.19 ± 0.27	0.043*	
Oculi amplitude (mV)		1.72 ± 0.60			0.54 ± 0.21		-0.18 ± 0.45	0.140	
Oris latency (msec)	5	3.88 ± 0.37		5	-		-	-	
Oris amplitude (mV)		2.54 ± 0.93			-		-	-	
AEP (msec)	9	Right	Left	9	Right	Left	Right	Left	
I	8/9	1.95 ± 0.07	1.92 ± 0.06	6/8	2.18 ± 0.21	2.05 ± 0.18	0.18 ± 0.20	0.09 ± 0.15	0.251/0.479
III		4.19 ± 0.07	4.19 ± 0.13		4.23 ± 0.18	4.16 ± 0.10	-0.03 ± 0.16	-0.06 ± 0.23	0.819/0.855
V		6.05 ± 0.12	6.08 ± 0.16		6.38 ± 0.28	6.13 ± 0.13	0.20 ± 0.16	0.002 ± 0.23	0.233/0.754
Total operation									
Facial motor conduction	38			38					
Frontalis latency (msec)	37	3.11 ± 0.10		34	3.68 ± 0.33		0.60 ± 0.33	0.697	
Frontalis amplitude (mV)	36	0.92 ± 0.13			1.00 ± 0.16		0.17 ± 0.17	0.697	
Oculi latency (msec)	37	3.14 ± 0.14		31	3.43 ± 0.40		0.24 ± 0.35	0.468	
Oculi amplitude (mV)	36	0.61 ± 0.16			0.54 ± 0.09		0.17 ± 0.13	0.748	
AEP (msec)		Right	Left		Right	Left	Right	Left	
I	37/38	1.81 ± 0.04	1.81 ± 0.04	33/37	1.69 ± 0.07	1.75 ± 0.07	-0.13 ± 0.07	-0.06 ± 0.05	0.171/0.463
III		4.09 ± 0.03	4.06 ± 0.04		4.03 ± 0.07	4.11 ± 0.07	-0.07 ± 0.07	0.04 ± 0.07	0.486/0.523
V		5.95 ± 0.05	5.94 ± 0.05		6.08 ± 0.08	6.09 ± 0.06	0.11 ± 0.06	0.14 ± 0.06	0.194/0.085

AEP, auditory evoked potential; Op, operation

*P-value < 0.05

Cadaveric study of Electromyographic Needle Approach to the Rhomboid

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Objective

Safe and accurate electromyographic needle access to the rhomboid major (RM) is challenging due to the overlying trapezius muscle and a risk of pneumothorax. This study was performed to investigate the safe and accurate electromyographic needle insertion site of the RM through cadaver dissection.

Methods

Cadaver dissections of the trapezius and RM muscles in 18 scapulae of 9 fresh cadavers were performed. The point (point A) at which the lateral margin of the lower trapezius crosses the medial border of the scapula and the distal insertion point (point DI) of the RM to the scapula were determined. The midpoint (point M) between point A and the point DI was also determined. The distance from the inferior angle of the scapular to the point A, point DI, and point M were measured, respectively.

Results

The average length of the medial scapula was 12.9 ± 1.2 cm from the root of the scapular spine to the inferior angle of the scapula. Point A and Point DI were located at a mean distance of 8.4 ± 0.7 cm and 1.8 ± 0.4 cm proximal to the inferior angle of the scapula, respectively. Point M was sited at a distance of 5.1 ± 0.5 cm from the inferior angle of the scapula.

Conclusion

Needle electromyographic examination of the RM can be accomplished safely and more precisely through the middle to lower part of the RM (about 40 percent distance of the medial scapula from the inferior angle to the root of scapular spine) not covered by the trapezius.

Table 1. Anatomical parameters of the rhomboid major and trapezius muscles. Parameters are distances from the inferior angle of the scapula. Values are mean \pm SD (median; range). A, the point where the lateral margin of the trapezius crosses the medial border of the scapula; DI, the distal insertion point of the rhomboid major to the medial margin of the scapula; M = the midpoint between the point A and the point DI; Point_A_ratio, ratio of point A to the distance between the inferior angle and the root of the scapular spine (length of medial scapular margin); Point_M_ratio, ratio of point M to the length of the medial scapula.

Parameters ^o	Values ^o
Point_A (cm) ^o	8.4 \pm 0.7 (8.3; 6.9 to 9.4) ^o
Point_A_ratio (%) ^o	65.4 \pm 6.0 (65.9; 53.0 to 75.8) ^o
Point_DI (cm) ^o	1.8 \pm 0.4 (1.8; 1.0 to 2.4) ^o
Point_M ^o	5.1 \pm 0.5 (5.0; 4.3 to 5.8) ^o
Point_M_ratio (%) ^o	39.7 \pm 3.7 (39.6; 32.0 to 47.5) ^o

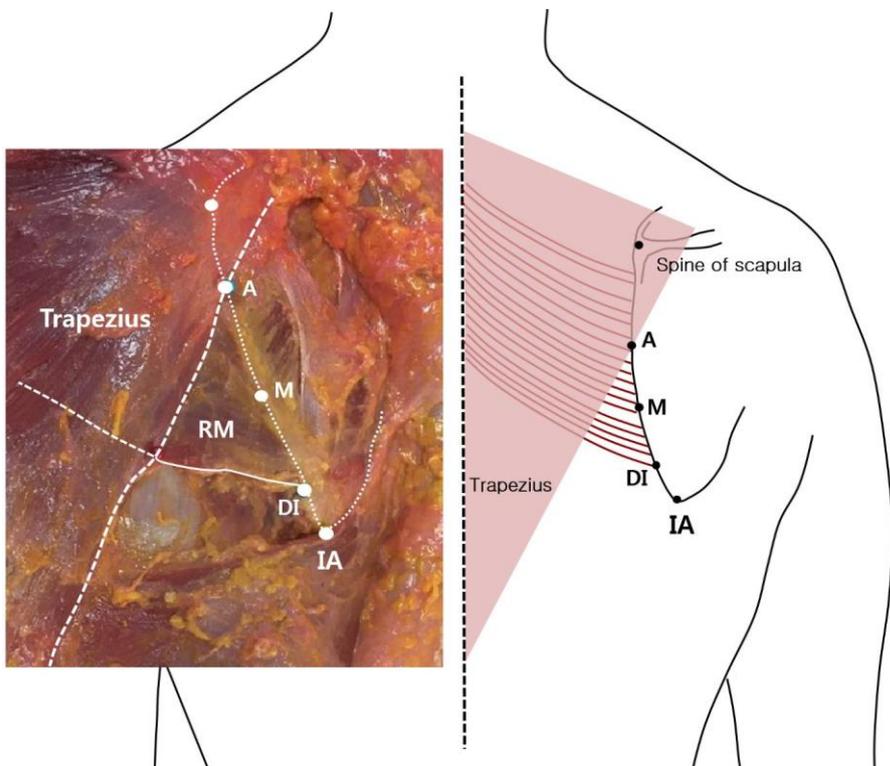


Fig 1. Anatomical relation of the trapezius and the rhomboid major (RM) is investigated after dissection of the subcutaneous tissue of cadaver. A, the point where the lateral margin of the trapezius crosses the medial border of the scapula; DI, the distal insertion point of the rhomboid major to the medial margin of the scapula; M, the midpoint between the point A and the point DI; IA, inferior angle of the scapula.

Optimal needle placement for extensor hallucis longus muscle using ultrasound verification

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Introduction

The extensor hallucis longus muscle (EHL) arises from the middle part of the anterior surface of the fibula and the interosseous membrane and is attached to the dorsal aspect of the base of the distal phalanx of the great toe. The EHL muscle is important for the diagnosis of neurologic lesions and is also a target muscle for injection treatment. Various Methods for needle placement on EHL have been suggested, but none of these can provide the essential information about the appropriate depth or accurate location of the needle insertion for safety purposes. Therefore, we investigated the EHL with ultrasonography in order to identify the motor point of the muscle and to determine safe needle placement.

Methods

A total of 96 legs of 48 healthy volunteers were examined through ultrasonography. The structures that would be penetrated by four referred Methods were assessed (Figure 1), and we identified the midpoint of EHL (MD') using landmarks to find the optimal needle placement.

Results

The mean values of bimalleolar line-MD' and tibial crest-MD' were 10.5 ± 1.2 cm and 3.6 ± 0.4 cm, respectively. The depth of midpoint was 1.6 ± 0.2 cm. According to the four referred Methods, the probability of the needle penetrating EHL was 13% to 79% and that of the needle penetrating the neurovascular bundle was 50% to 89%. The anatomical structures that would be penetrated according to the four different referred Methods are demonstrated in Table 1 and the ultrasound cross-section views of each point are shown in Figure 2. Fifty-four legs of 27 participants who agreed to participate in additional analysis were evaluated by ultrasound to see if the needle was placed in the EHL. Using the mean values, the accuracy of the needle on EHL was 100%.

Conclusion

Various Methods for needle placement on EHL have been suggested, but none of these can provide the essential information about the appropriate depth or accurate location of the needle insertion for safety purposes. In our study, the optimal needle placement for EHL could be performed safely at the point about 10.5 cm proximal from the BML and

about 3.6 cm lateral from TC' with 1.6 cm depth. This needle placement showed 100% accuracy and is expected to be employed with ease in clinical practice.

Table 1. Anatomical structures that would be penetrated according to the four different referred methods in the ultrasound cross-section view (n = 96)

	EHL muscle (middle portion + other)	Middle portion of EHL	NVB	EHL tendon	TA tendon	TA muscle	EDL muscle
A*	68 (70.8) 1.45-2.69 cm [‡]	11 (11.5)	63 (65.6) 2.69 cm [§]	0 (0.0)	0 (0.0)	79 (82.3)	15 (15.6)
B†	28 (29.2) 0.94-1.46 cm [‡]	0 (0.0)	89 (92.7) 1.67 cm [§]	1 (1.0)	0 (0.0)	62 (64.6)	0 (0.0)
C‡	13 (13.5) 0.97-1.37 cm [‡]	0 (0.0)	50 (52.1) 1.42 cm [§]	1 (1.0)	64 (66.7)	92 (95.8)	0 (0.0)
D§	79 (82.3) 1.39-2.69 cm [‡]	22 (22.9)	63 (65.6) 2.66 cm [§]	0 (0.0)	0 (0.0)	66 (68.8)	35 (36.5)

Data expressed as number of penetrated (% of the number of penetrated over total n). EHL, extensor hallucis longus muscle; NVB, neurovascular bundle; TA, tibialis anterior; EDL, extensor digitorum longus.

*A: Lee and DeLisa, †B: Preston and Shapiro, ‡C: Perotto and Delagi, §D: Chu-Andrews and Johnson; ‡ In case of the needle penetrating EHL, the value means the range of the mean superficial and deep depth of EHL, § In case of the needle penetrating NVB, the value means the mean depth of NVB.

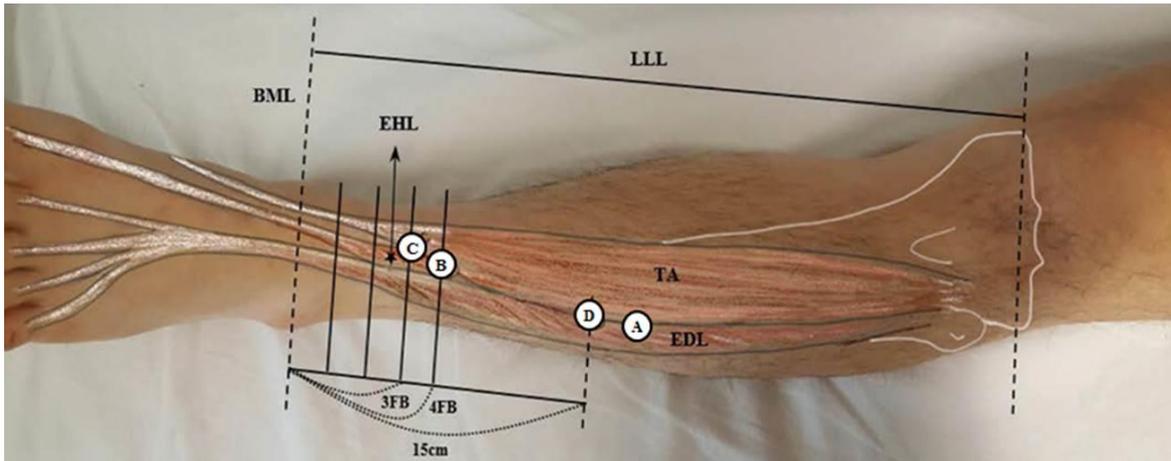


FIGURE 1. The various Methods for extensor hallucis longus muscle needle placement (A, Lee and DeLisa, inserting the needle at the junction between the middle and lower third of the tibia and at the space between the tendons of tibialis anterior and extensor digitorum longus; B, Preston and Shapiro, inserting the needle at four fingerbreadths above the ankle lateral to the tibialis anterior muscle; C, Perotto and Delagi, inserting the needle at three fingerbreadths above the bimalleolar line (BML) of the ankle just lateral to the crest; D, Chu-Andrews and Johnson, inserting the needle 15 cm proximal to the BML between the tendons of tibialis anterior and extensor digitorum longus). BML, bimalleolar line; LLL, lower leg length; EHL, extensor hallucis longus muscle; TA, tibialis anterior; EDL, extensor digitorum longus; FB, fingerbreadths.

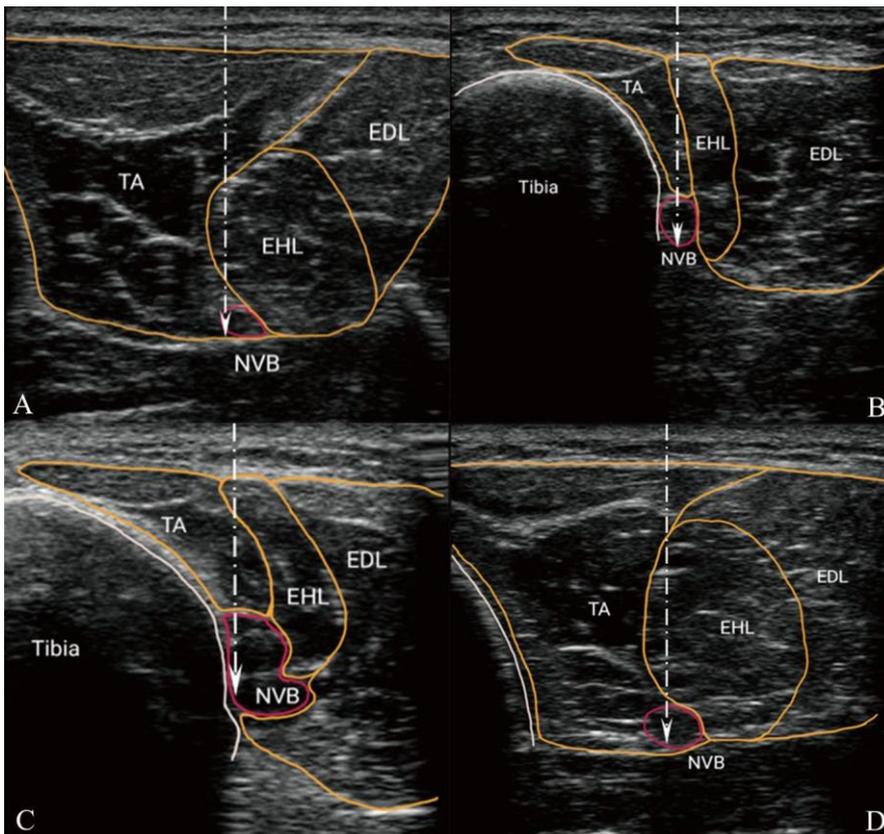


FIGURE 2. Cross-section views of referred Methods and anatomical structures that would be penetrated (A, Lee and DeLisa; B, Preston and Shapiro; C, Perotto and Delagi; D, Chu-Andrews and Johnson). White arrow demonstrates the needle pathway. TA, tibialis anterior; EDL, extensor digitorum longus; EHL, extensor hallucis longus muscle; NVB, neurovascular bundle.

The usefulness of High-Resolution Ultrasonography for Diagnosing Unilateral Cervical Radiculopathy

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Introduction

Cervical radiculopathy (CR) is a pathologic process caused by compression or inflammation of the cervical nerve root and is usually diagnosed by a combination of clinical examination and additional studies including magnetic resonance imaging (MRI) or electrodiagnostic test (EDX). Ultrasonography (US) is more suitable for screening than other studies by providing a high-resolution image that can be obtained quickly and easily in any environment. These characteristics of US can be applied to the diagnosis of CR. The aim of this study was to investigate the usefulness of high-resolution US to make a diagnosis of unilateral CR by comparing the cross-sectional area (CSA) of affected and unaffected sides of cervical NR.

Methods

Total 17 CR patients and 13 healthy volunteers were enrolled in this study. The CR patients must meet all the following conditions: (1) symptoms of unilateral CR (2) diagnosis of unilateral CR (C6 or C7) by EDX, (3) cervical disc herniation or cervical degenerative spondylosis confirmed by MRI. The exclusion criteria were as follows: (1) myelopathy, (2) neck pain only, (3) diabetes or other metabolic dysfunction inducing polyneuropathy (4) multilevel CR, (5) history of surgical intervention. Controls were healthy volunteers without symptoms of CR, history of cervical trauma, diabetes, and other metabolic dysfunction. The cervical nerve roots were imaged at the most proximal location possible by US, where they exited over the transverse process. The CSAs of cervical nerve roots were measured using continuous trace tool of US device, tracing just inside the hyperechoic border of each nerve roots (Fig. 1). In the CR patients, the CSAs of affected and unaffected sides were measured at the level of CR. In the control group, the CSAs of bilateral C6 and C7 nerve roots were measured. We conducted a Wilcoxon signed-rank test for comparing the CSAs between affected and unaffected side of C6 and C7 nerve roots in the CR patients. Side to side differences of CSA in cervical nerve roots (Δ CSA) were calculated in the CR patients and control group, and then a Mann-Whitney U test was used for comparing Δ CSA between the CR patient and control group.

Results

The baseline characteristics of the study participants are shown in Table 1. In the C7 CR patient, the CSAs of affected nerve roots were significantly larger than those of unaffected nerve roots (C6: $p=0.144$, C7: $P=0.013$, Table 2). In the C6 and C7 CR patients, Δ CSAs were significantly larger than those of the control group (C6: $P=0.048$, C7: $P=0.008$, Table 2).

Conclusion

This study revealed that the CSA of the affected nerve root was enlarged than the unaffected nerve root in CR patient, and Δ CSA in the CR patient was greater than in the control group. We recommend measurement of the CSAs of affected and unaffected nerve root at the same cervical level for increasing the diagnostic accuracy of CR and making the diagnosis of CR easily and rapidly.

Table 1. Baseline characteristics of the CR group and the control group

	CR patient		Control
	C6	C7	
Total (n)	5	12	13
Side [Rt(%) / Lt(%)]	1 (20%) / 4 (80%)	6 (50%) / 6 (50%)	-
Gender [n(%)]			
Male	3 (60%)	9 (82%)	8 (67%)
Female	2 (40%)	3 (18%)	4 (33%)
Age	57.4 \pm 5.2	60.5 \pm 10.5	44.6 \pm 10.3
Body mass index	26 \pm 5	27 \pm 4	26 \pm 3

CR Cervical radiculopathy, Rt right, Lt left
Values are mean \pm SD.

Table 2. CSA and of cervical NRs in the CR group and the control group

	CSA (mm ²)	
	C6 NR	C7 NR
Control	10.64 \pm 1.36	10.79 \pm 1.35
Unaffected side	11.80 \pm 1.64	11.58 \pm 2.44
Affected side	14.54 \pm 1.67	14.31 \pm 1.80
P-value (Affected vs. Unaffected)	0.144	0.013*

	Δ CSA (mm ²)	
	C6 NR	C7 NR
Control	1.31 \pm 0.95	1.13 \pm 0.83
CR patient	3.58 \pm 1.53	3.75 \pm 1.35
P-value (CR patient vs. Control)	0.013*	< 0.001*

CSA cross-sectional area, Δ CSA side to side difference of bilateral CSA, NR nerve root
Values are mean \pm SD. * Statistically significant.

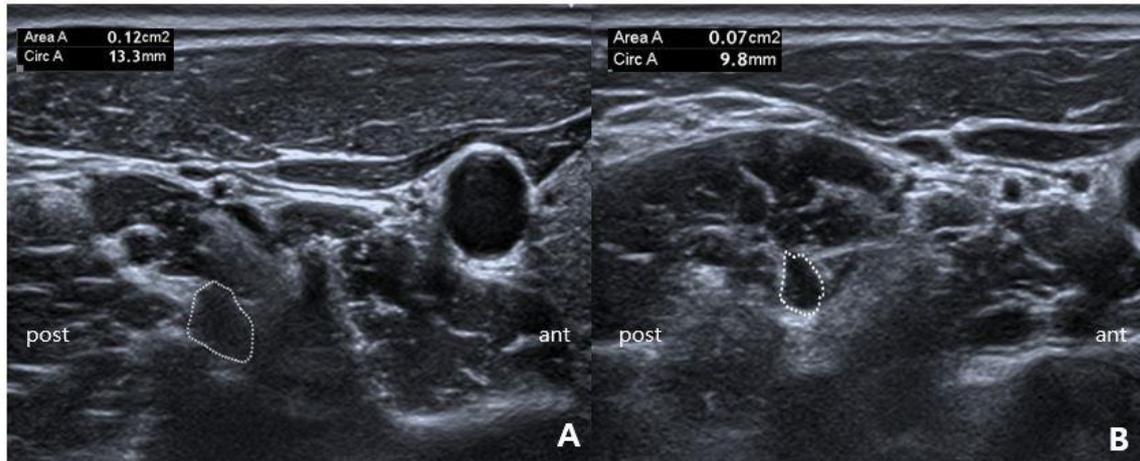


Fig. 1. Transverse scan of C6 nerve root (dotted line) in a patient diagnosed as left C6 CR. The CSAs of the affected (A) and unaffected (B) sides were measured with trace tool at most proximal location, which can be detectable in ultrasonography. NR nerve root, CR cervical radiculopathy, CSA cross-sectional area, ant anterior, post posterior

Factors associated with limited hand motion after hand trauma

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BACKGROUND

The purpose of this study was to identify factors that are independently associated with hand total active motion (TAM).

METHODS

A total of 50 patients with unilateral hand injury were included in this retrospective study. The associations between various demographic, injury-related and clinical assessment factors and TAM were determined by univariate and multivariate linear regression analyses. Nerve injuries recognized during surgery and diagnosed with electrodiagnostic (EDX) studies were compared using Pearson's chi square test.

RESULTS

Among multiple injury-related and initial clinical assessment factors, nerve injury diagnosed with EDX studies, hospital stay length, elevated CRP and skeletal injury were independently associated with TAM in the affected hand after adjusting for covariates. Nerve injuries diagnosed with EDX studies were not consistent with those recognized during surgery.

CONCLUSIONS

Our Results suggest that high-energy trauma leading to skeletal and nerve injury with inflammation is associated with limited hand motion after surgery and post-operative immobilization. A comprehensive EDX study may enable identifying occult or recovered nerve injuries, which would be helpful in understanding limitations in finger movements.

Application of Automatic Kinematic analysis program for the Evaluation of Dysphagia in ALS patients

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Introduction

Dysphagia in motor neuron disease may increase the risk of malnutrition, dehydration, and aspiration pneumonia. Though VFSS is considered as the primary evaluation tool, it is a qualitative evaluation. A kinematic analysis of VFSS can provide detailed movement of the anatomical structures and bolus, revealing subtle abnormalities of swallowing. The subsequent contractions of suprahyoid and infrahyoid muscles accomplish the circular motion of hyoid bone and the infrahyoid muscles assist in prolonged laryngeal elevation and UES opening. The hyoid muscles coordinate the movement of hyoid bone and directly affect swallowing function. However, manual extraction processes of kinematic analysis require expert skills as well as a lot of time and labor. Moreover, the accuracy of diagnosis can vary in accordance with the degree of skillfulness of the examiner. To overcome these limitations, we developed an automated kinematic analysis program (AKAP) that analyzes the trajectory of the hyoid bone via a visual tracking Method. The aim of this study is to investigate the hyoid movement of motor neuron disease patients using AKAP and compare with nondysphagic subjects.

Method

30 motor neuron disease patients (12 males; mean age 67.6) from 40 to 88 years of age who conducted VFSS. Ten non-dysphagic subjects were enrolled (5 males, mean age 52.8) from 40 to 71 years of age as a control group. VFSS were conducted with thin fluid and yogurt. Hyoid bone movement were analyzed by dividing into vertical, horizontal distance with four peak point (A, B, C, D) and time of each points were also calculated. (Figure 1)

Results

Time ABC, Time ABCD, and Duration C were significantly increased in MMD patients (Time ABC $p=0.026$, Time ABCD $p=0.01$, Duration C $p<0.001$) when swallowing fluid. In swallowing FT2, only Time ABC and Duration C were increased. (Time ABC $p=0.012$, Duration C $p=0.009$) However both vertical and horizontal distances were not significantly different in fluid and FT2.

Conclusion

In Conclusion, the dysphagia of MMD is caused by delayed hyoid bone movement by weakness of hyoid muscles although the distance does not change. The parameters of

kinematic analysis could be used to quantitatively evaluate the dysphagia in motor neuron disease.

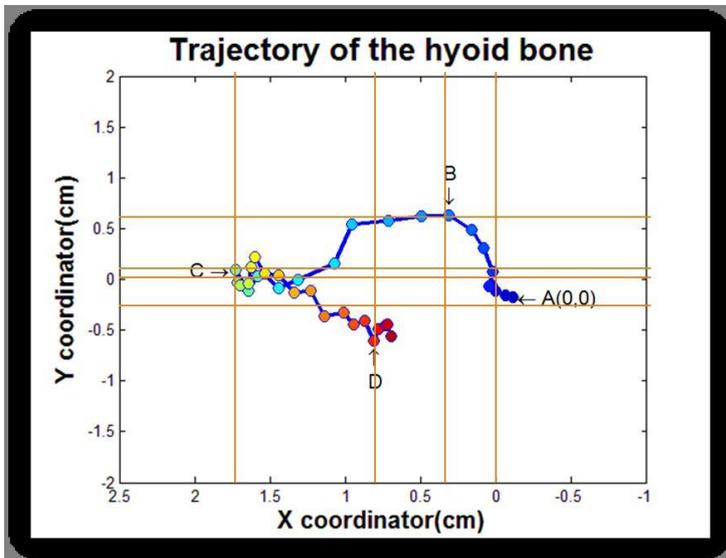


Figure 1 AKAP Result example

Ultrasonographic Risk Assessment of Injury to Palmar Cutaneous Branch of Median Nerve: Pilot Study

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Introduction

The palmar cutaneous branch of the median nerve (PCBMN) is the last collateral branch of median nerve (MN) given off in the distal forearm. Several cadaveric studies have shown that invasive procedures in wrists including volar locking plates, carpal tunnel injection or endoscopic carpal tunnel release have a risk of damage to PCBMN. The aim of this study was to evaluate the relationship between the PCBMN and surrounding anatomical structures by using high-resolution ultrasonography (HRUS) to assess the risk of injury and suggest safe approaches minimizing the risk in various interventions performed on the wrist.

Method

The volar wrists of 8 healthy volunteers without symptoms suggesting neuropathy of PCBMN or MN were examined with HRUS. The scanning technique relied on images obtained in transverse plane between MN and the flexor carpi radialis tendon (FCR). To better recognize PCBMN, the examiner performed dynamic scanning by sweeping the probe slowly up and down over its course (Figure 1). After identifying course of PCBMN, we measure the distance between PCBMN and other anatomical structure including palmaris longus tendon (PL) and flexor carpi radialis tendon (FCR) at the bistyloid line (BSL), and then the distance between origin of the PCBMN from MN and BSL was measured (Figure 2). The depth of PCBMN from skin at BSL and origin of PCBMN were also measured. All measured distances were calculated by caliper mode of HRUS device. At the BSL, the cross-sectional area (CSA) of PCBMN was measured by continuous trace mode.

Results

HRUS was able to depict the PCBMN in 14 (88%) of the 16 wrists. All morphometric measurement data by scanning HRUS were shown in Table 1. The CSA of PCBMN was $0.63 \pm 0.15 \text{ mm}^2$ at BSL. The PCBMN appeared from the radial aspect of the median nerve in all cases. The PCBMN branched off from the radial aspect of the MN at $4.69 \pm 0.89 \text{ cm}$ proximal to the BSL and tracked radially toward the FCR. The PCBMN ran within the ulnar edge of the sheath of the FCR but did not cross the tendon in this study. The PCBMN became more superficial and perforated the antebrachial fascia between the FCR laterally and PL medially. The PCBMN was located at $3.85 \pm 0.56 \text{ mm}$ on the ulnar aspect of the FCR, and at $7.54 \pm 0.36 \text{ mm}$ (center to center) or $2.10 \pm 0.40 \text{ mm}$ (end to end) on the radial aspect of the PL at the BSL. The depth of PCBMN from skin at BSL was $1.92 \pm 0.41 \text{ mm}$. The depth of PCBMN from skin at the origin was $5.55 \pm 0.99 \text{ mm}$.

Conclusion

This is the first ultrasonographic study to investigate the relationship between PCBMN and surrounding anatomical structures related to invasive procedures in wrist. HRUS can identify the PCBMN and provide its relationship with other anatomical structures. This study provides the data that can predict the location of PCBMN, which will help avoid injury of PCBMN during invasive procedures performed on the wrist.

Table 1. Morphometric data of PCBMN

Morphometric measurement	Mean \pm SD
CSA of PCBMN (mm ²)	0.63 \pm 0.15
Depth at BSL (mm)	1.92 \pm 0.41
FCR to PCBMN (mm)	3.85 \pm 0.56
PL to PCBMN (center to center, mm)	7.54 \pm 0.36
PL to PCBMN (end to end, mm)	2.10 \pm 0.40
Origin to BSL (cm)	4.69 \pm 0.89
Depth at origin (mm)	5.55 \pm 0.99

CSA cross-sectional area, PCBMN palmar cutaneous branch of the median nerve, BSL bistyloid line, FCR flexor carpi radialis, PL palmaris longus

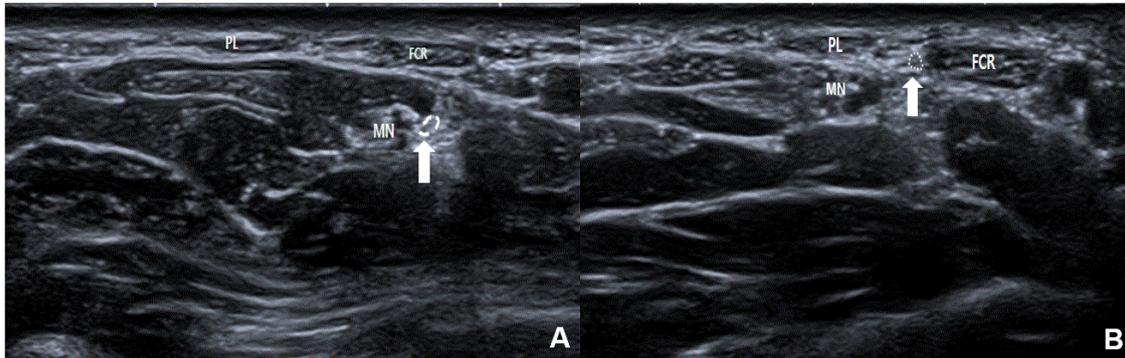


Fig. 1. Transverse scan obtained at from proximal to distal over PCBMN (arrow head) A, transverse scan at origin level. B, transvers scan at BSL level. PCBMN palmar cutaneous branch of the median nerve, BSL bistyloid line

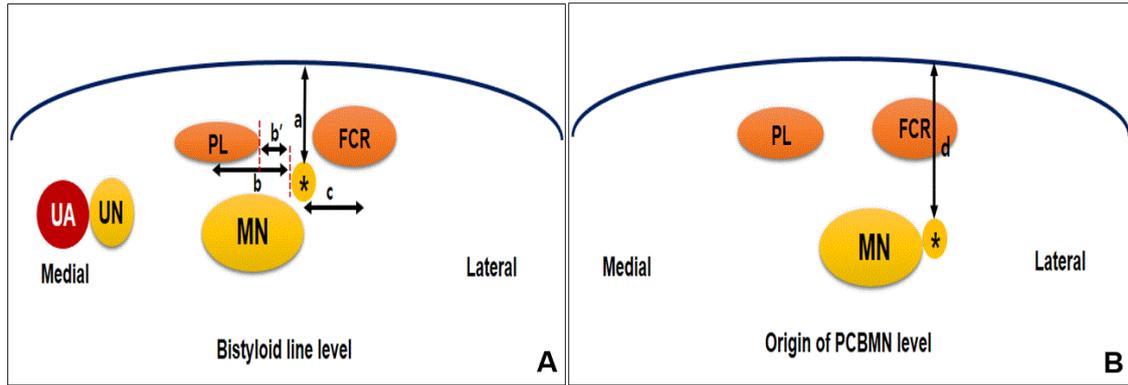


Fig. 2. Schematic diagram of PCBMN and other anatomical structures in transverse scan A, Diagram at BSL level. a: depth of PCBMN from skin, b: horizontal distance of PL to PCBMN (center to center), b': horizontal distance of PL to PCBMN (end to end), c: horizontal distance of FCR to PCBMN (center to center) B, Diagram at origin level. d: depth of PCBMN at origin level from MN PCBMN palmar cutaneous branch of the median nerve, BSL bistyloid line, PL palmaris longus tendon, FCR flexor carpi radialis tendon, MN median nerve, UN ulnar nerve, UA ulnar artery

Electrodiagnosis using SNAP for the C7,8 nerve root entrapment due to foraminal stenosis

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Background

The diagnosis of nerve root injury and its corresponding roots are visibly difficult. Sensory nerve action potential (SNAP) decreases in amplitude when the lesion is present at or distal to the dorsal root ganglion. Previous study showed that the amplitude of SNAP on the impinged side were comparatively lower than the unaffected side in foraminal L5 nerve root entrapment. The aim of study is to investigate the latency and amplitude of SNAP in patients with cervical foraminal stenosis relative to unimpeded patients.

Methods

As a retrospective study, we enrolled a total of 751 patients who visited the electromyography (EMG) clinic from January to December 2017. The exclusion criteria include patients with median neuropathy, ulnar neuropathy, peripheral neuropathy and brachial plexopathy diagnosed by EMG. Patients examined by the unilateral nerve conduction study or patients with no MRI findings were excluded. Bilateral SNAPs were recorded for the median nerve at third digit and the ulnar nerve at fifth digit. This study employed Methods to assess the onset to peak amplitude and the peak latency. The patients were divided into two groups based upon the Results of MRI. Group A (29 patients) included patients whose lesion was located at C6-7, C7-T1 foraminal stenosis. In group B (55 patients), there are no lesions at C6-7, C7-T1 foraminal stenosis. The amplitude and latency of SNAPs on the affected side to that on the unaffected side were compared between group A and B. The abnormal SNAP responses were compared between two groups. This study set up the cut-off value as 20 μ V in amplitude of median nerve, as 10 μ V in amplitude of ulnar nerve, as 3.6ms in latency of median and ulnar nerve.

Results

The amplitudes of median nerve and ulnar nerve for group A were lower than group B ($p = 0.001, 0.002$, respectively, by t-test). On the other hand, the latency period of median nerve for group A was longer than group B ($p = 0.010$, by t-test). The latency of ulnar nerve for group A was longer than group B, but between the two groups, there were no statistical differences ($p = 0.237$). The abnormalities of SNAP amplitude and latency were more frequent in patients with foraminal stenosis.

Conclusions

Patients with foraminal stenosis had a significantly longer latency period of median nerve and a lower amplitude of median and ulnar nerve than those without foraminal stenosis. SNAP could be an useful additional parameter to diagnose the cervical foraminal stenosis.

Table 1 The comparison of the SNAP parameters between patients with foraminal stenosis and without foraminal stenosis

	Foraminal stenosis (+) ^b	Foraminal stenosis (-) ^c	<i>p</i> -value ^a
Amplitude of Median nerve	26.1±12.6	37.5±14.6	0.001*
Amplitude of Ulnar nerve	20.2±10.2	30.4±14.3	0.002*
Latency of Median nerve	3.4±0.5	3.2±0.4	0.010*
Latency of Ulnar nerve	3.1±0.4	3.2±0.3	0.237

^aAnalysis was done by t-test

^bThe value of affected side was used

^cThe value of symptomatic side was used

Table 2 Baseline characteristics

	Foraminal stenosis (+)	Foraminal stenosis (-)	<i>p</i> -value
Gender (Female : Male)	14 : 15	25 : 30	0.808
Age (years)	60.3±10.7	51.3±13.2	0.002
Weight (kg)	70.1±14.4	66.0±13.1	0.232
Height (cm)	163.5±9.7	163.3±9.7	0.938
BMI (kg/m ²)	26.0±3.3	27.5±11.7	0.528
side of foraminal stenosis or symptoms (Rt side : Lt side)	16 : 13	25 : 30	0.492

Table 3 The comparison of the number of abnormal SNAP between patients with foraminal stenosis and without foraminal stenosis

	Foraminal stenosis (+)	Foraminal stenosis (-)
Abnormal value in Amplitude of Median nerve, (%)	3 (10.3)	2 (3.6)
Abnormal value in Amplitude of Ulnar nerve, (%)	1 (3.7)	0 (0)
Abnormal value in Latency of Median nerve, (%)	2 (6.9)	2 (3.6)
Abnormal value in Latency of Ulnar nerve, (%)	2 (7.4)	2 (3.8)

Correlation between Oro-buccal Symptoms and Respiratory Function in Patients with ALS

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Introduction

Amyotrophic lateral sclerosis (ALS) is progressive neurodegenerative disorder. Subtypes of ALS with initial exclusive bulbar or spinal involvement are associated with prognosis. Predicting when respiratory failure will occur in the patient with ALS is important to plan appropriate clinical interventions. In patients with predominant bulbar weakness, it is limited to measure pulmonary function accurately. The aim of this study is to investigate correlation between oro-buccal symptoms (dysphagia, dysarthria, and sialorrhea) and respiratory function in patients with ALS according to bulbar weakness.

Methods

Medical records of 91 patients with ALS were reviewed and this is a cross-sectional study. Of these, 37 had bulbar-onset ALS (bALS) and 54 spinal-onset ALS (sALS). Functional status of subjects was scored using Korean version of Amyotrophic Lateral Sclerosis Functional Rating Scale-Revised (K-ALSFERS-R) and especially oro-buccal symptoms were assessed using bulbar domain of K-ALSFERS-R (b-K-ALSFERS-R), which consists of speech, salivation and swallowing. Respiratory dysfunction was assessed by pulmonary function test (PFT) and diaphragm fluoroscopy. Parameters were measured as forced vital capacity (FVC), peak cough flow (PCF), maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) in supine and sitting position. To assess pulmonary function in a non-oral way, movements of diaphragm while forced respiration were measured in centimeters by fluoroscopy. Pearson correlation analysis was used.

Results

The mean age of total 91 ALS subjects was 59 ± 10.51 , 37 bALS subjects was 63 ± 8.1 years and 54 sALS patients was 57 ± 11.2 years. The mean K-ALSFERS-R and b-K-ALSFERS-R of total ALS patients was 17 ± 11.4 and 4 ± 2.47 , those of bALS patients was 16 ± 11.9 and 3 ± 2.2 , and those of sALS patients' was 19 ± 11.3 and 5 ± 2.3 in order. In 91 ALS patients, b-K-ALSFERS-R is statistically associated with all parameters of PFT ($p < 0.05$). There was the positive linear correlation between b-K-ALSFERS-R and the left forced diaphragm movement ($p < 0.05$). In sALS group, the b-ALS-FRS-R was statistically associated with supine FVC, supine MEP, sitting PCF, and sitting MEP ($p < 0.05$). Among subjects with bALS, there was no statistically correlation between the b-ALS-FRS-R and any parameter of PFT and diaphragm movements.

Conclusion

This study suggest that oro-buccal symptoms could be predictors for respiratory insufficiency in ALS. In sALS patients revealed correlation with maximal expiratory

pressure, trunk muscle strength, in supine and sitting position in sALS patients. In generally sALS patients undergo oro-buccal and respiratory dysfunction in more progressed state than bALS patients. Prediction and correlation between oro-buccal symptoms and respiratory insufficiency is limited in bALS patients, therefore assessing symptoms of respiratory insufficiency such as dyspnea and orthopnea are important.

Table 1. Demographic and clinical characteristics of subjects

Variables	Total (n=91)	Bulbar-onset (n=37)	Spinal-onset (n=54)	<i>p</i> -value
Age (years)	59 ± 10.51	63 ± 8.1	57 ± 11.2	<0.01
Gender				
Male	60 (65.9%)	23 (62.2%)	37 (68.5%)	2.08
Female	31 (34.1%)	14 (37.8%)	17 (31.5%)	
Duration of disease (years)	2 ± 1.78	3 ± 1.8	1.5 ± 1.2	0.06
K-ALSFRS-R	17 ± 11.4	16 ± 11.9	19 ± 11.3	0.23
b-K-ALSFRS-R	4 ± 2.47	3 ± 2.2	5 ± 2.3	1.18

K-ALSFRS-R; Korean version amyotrophic lateral sclerosis functional rating scale revised, b-K-ALSFRS-R; bulbar domain of K-ALSFRS-R

Table 2. Pearson correlation coefficients (*r*) between bulbar domain of K-ALSFRS-R with each variable

Variables	Total (n=91)		Bulbar onset (n=37)		Limb onset (n=54)	
	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value	<i>r</i>	<i>p</i> -value
Supine						
FVC	.290*	.005	.169	.319	.270*	.048
PCF	.265*	.011	.012	.945	.251	.067
MIP	.245*	.019	.176	.296	.190	.168
MEP	.320*	.002	.187	.269	.330*	.015
FMRD	.114	.280	-.226	.179	.113	.414
FMLD	.176	.096	-.197	.250	.139	.316
FMBD	.160	.131	-.223	.184	.141	.309
Sitting						
FVC	.247*	.018	.166	.327	.203	.141
PCF	.295*	.005	.073	.667	.291*	.032
MIP	.253*	.015	.179	.290	.207	.133
MEP	.310*	.003	.217	.197	.374*	.005
FMRD	.129	.222	-.093	.184	.162	.240
FMLD	.255*	.015	.030	.859	.244	.075
FMBD	.217*	.039	-.034	.841	.230	.095

**p*<0.05, K-ALSFRS-R; Korean version amyotrophic lateral sclerosis functional rating scale revised, FVC; forced vital capacity, PCF; peak cough flow, MIP; maximal inspiratory pressure, MEP; maximal expiratory pressure, FMRD; the forced movement of the right diaphragm, FMLD; the forced movement of the left diaphragm, FMBD; mean value between the forced movement of both diaphragms

Spontaneous Electrical Activities in Myofascial Trigger Points

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Introduction

Myofascial pain syndrome is diagnosed clinically. Associated muscle pain and tenderness are known to be caused by trigger points. The electrophysiological findings of myofascial trigger points have been studied and they revealed spontaneous electrical activities (SEA) are more likely to be recorded at myofascial trigger points compared to normal muscle tissues. This study is designed to compare the electrophysiological characteristics of active myofascial trigger points and latent one using 2-channel EMG recording.

Materials & Methods

Among the patients who had visited the clinic of Physical Medicine and Rehabilitation Medicine for pain in neck and shoulder area, 104 upper trapezius muscles were enrolled. The subjects had clinical characteristics of myofascial trigger point which were hyperirritable spots in a palpable taut band, referred pain, and local twitch response (LTR) in upper trapezius. The presence of spontaneous pain was the differential point between active trigger point and latent one. Intramuscular electrical activities were explored using 2-channel EMG recording and 37mm disposable monopolar needle electrode was used. The test needle was located at the trigger point within a taut band and the control needle was placed 1 ~ 2cm away from the test site but not in a tender area of that muscle. After the confirmation that insertion of the control needle did not make corresponding pain and insertion of the test needle evoked LTR, examination using the test needle proceeded. The test needle was advanced very slowly about 1mm of eight times to search for SEA. Following eight advancements in one track, another two tracks rotating the needle at the angle of 15 degrees were examined and making a total of 24 advances at each muscle. SEA was identified, as known, as EPN (End-Plate Noise) and EPS (End-Plate Spikes).

Results

Active myofascial trigger points presenting the spontaneous pain were detected clinically in 41 muscles and latent myofascial trigger points were observed in 63 muscles. The number of points that exhibited EPN was 731 (74.3%) of 984 sites of active trigger points and 575 (38.0%) of 1512 sites of latent trigger points. This difference was statistically significant ($p < 0.05$). The number of points exhibited EPN with EPS in active trigger points was 702 (71.3%), compared to 192 (12.7%) in latent trigger point, was also significantly different ($p < 0.05$).

Conclusion

End-Plate noise could be recorded in both active and latent myofascial trigger points but more prevalent in active trigger points. End-Plate spike seems to be characteristics of the active myofascial trigger points.

The Changes of Swallowing Function before and after Expansion Sphincter Pharyngoplasty

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Objective

Some obstructive sleep apnea (OSA) patients may present swallowing dysfunction, such as premature loss of food to hypopharynx, food stasis in the hypopharynx and laryngeal penetration without subjective symptoms. Expansion sphincter pharyngoplasty (ESP) is the surgery for OSA patients to divide the muscle on the sides of the throat behind the tonsil (palatopharyngeus) and pulling it forward and laterally to sew it in place. This study was aimed to find out the changes of swallowing function using videofluoroscopic swallow study (VFSS) before and after ESP in OSA patients.

Methods

From December 2016 to March 2018, eight OSA patients (7 men and 1 woman, age: 55.37 ± 5.55 years, mean Apnea-Hypopnea Index (AHI): $33.9 \pm 21.1\%$, Body Mass Index: 26.7 ± 3.86 kg/m²), who underwent ESP were recruited. VFSS was conducted and recorded before and 1 month after ESP. We measured a few quantitative parameters of swallowing function including oral transit time (OTT), pharyngeal transit time (PTT), pharyngeal delay time (PDT) and laryngeal elevation (LE) with liquid diet (water), yogurt, soft diet (porridge) and solid diet (cooked rice). AHI is estimated from the average number of episodes of apnea (cessation of airflow with duration of at least 10 seconds) plus episodes of hypopnea (reduced airflow) per hour during sleep. Statistical analyses were performed with SPSS software program for Windows (version 23.0, Chicago, USA). Mann-Whitney U test was used to verify the differences in the quantitative parameters of swallowing function before and after ESP. Spearman's correlation analysis was done to find out the correlation between the quantitative parameters of swallowing function and AHI. A p-value < 0.05 was considered significant.

Results

1) All the parameters measured during VFSS were within normal ranges. OTT, PTT, PDT and LE in all test diets showed no differences before and after ESP, but PTT with liquid diet significantly shortened after ESP ($p = 0.050$) (Table 1). 2) There was no significant correlation between AHI and the quantitative parameters of swallowing function.

Conclusion

After ESP, pharyngeal function showed the improvement with liquid diet. ESP might help pharyngeal passage of liquid diet in OSA patients by expanding the oropharynx. However, swallowing function was not correlated with the severity of the OSA.

Key words

Obstructive sleep apnea, Swallowing, Videofluoroscopic swallow study, Expansion sphincter pharyngoplasty

TABLE1. The changes of quantitative parameters of swallowing function before and after expansion sphincter pharyngoplasty

	Before	After	P-value
Liquid diet			
OTT (sec)	1.05±0.70	0.58±0.38	0.105
PTT (sec)	0.46±0.18	0.31±0.13	0.050*
PDT (sec)	0.16±0.09	0.28±0.26	0.382
LE (cm)	2.40±0.45	2.45±0.38	1.000
Yogurt			
OTT (sec)	1.00±0.63	0.57±0.30	0.130
PTT (sec)	0.41±0.63	0.32±0.09	0.195
PDT (sec)	0.14±0.10	0.12±0.08	0.798
LE (cm)	2.44±0.40	2.51±0.25	0.574
Soft diet			
OTT (sec)	0.50±0.23	0.52±0.28	1.000
PTT (sec)	0.33±0.16	0.36±0.20	0.798
PDT (sec)	0.18±0.11	0.11±0.11	0.130
LE (cm)	2.52±0.35	2.55±0.40	0.798
Solid diet			
OTT (sec)	0.80±0.47	0.80±0.41	0.574
PTT (sec)	0.66±0.70	0.46±0.63	0.279
PDT (sec)	0.36±0.63	0.25±0.51	0.959
LE (cm)	2.66±0.41	2.67±0.39	0.195

Values are mean ± standard deviation; OTT, oral transit time; PTT, pharyngeal transit time; PDT, pharyngeal delay time; LE, laryngeal elevation; *statistically significant ($p<0.05$) before and after ESP.

P 2-57

Predictive value of H-reflex in S1 radiculopathy using selective nerve root block

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Predictive Value of H-reflex in S1 radiculopathy using selective nerve root block

Introduction

H-reflex is useful to electrophysiologically diagnose S1 radiculopathy. However, there are some cases in which the clinical symptoms and/or the findings of imaging studies suggestive of S1 radiculopathy do not correlated with H-reflex parameters. The predictive value of H-reflex is analyzed in patients with L5 and/or S1 radiculopathies using selective nerve root block (SNRB).

Objective

Patients complained of more than 3 months of low back pain (LBP) and/or radicular pain to ipsilateral lower extremity enrolled. Each subject underwent electrodiagnostic study including H-reflex, MRI study of lumbosacral spine and SNRB.

Method

A retrospective chart review was done on 85 patients who received spine interventions from September of 2015 to April of 2018. Of them, subjects who were post spine surgery syndrome, those who were given SNRB of L5 and S1 levels at the same time, were excluded. Of the remaining 29 patients, no responses of H-reflex were 12 and delayed latency 7, so they were given S1 SNRB. Ten patients with normal H-reflex were injected L5 SNRB (Table 1). Post-injection pain (NRS) was compared with pre-injection one, and according to the Results, the patients were grouped as effective (more than 33% decrease of pain score) or not-effective group (less than 33%) to define the predictive value of H-reflex (Table 2).

Result

Positive predictive value of H-reflex in S1 radiculopathy confirmed by SNRB was 73.7% and negative predictive one was 60.0%.

Conclusion

The clinical utility of H-reflex in diagnosis of S1 radiculopathy is validated by SNRB.

Table 1. Demographic Characteristics of the Participants

Demographic variable	H-reflex	
	Abnormal ^{a)} (n=19)	Normal (n=10)
Age	66.4 ± 10	52.8 ± 11
Sex		
Male	7	5
Female	12	10

Total n=29

Data presented as mean ± SD or n

a) Abnormal included patients with delayed latency and no responses of H-reflex

Table 2. Intervention^{a)} Outcomes

	Abnormal (n=19)	Normal (n=10)
Pain		
Pre	5.6 ± 1.8	6.1 ± 1.0
Post	3.7 ± 1.3	4.7 ± 1.6
<i>P</i> value	0.000	0.000
Effects		
Effective	14	6
No-effective	5	4
Predictive value (%)	73.7 ^{b)}	60.0 ^{c)}

Data presented as mean ± SD or n or %

a) Abnormal group received intervention in S1, normal group received intervention in L5

b) Positive predictive value

c) Negative predictive value

Nerve conduction study and shoulder motor power in children with brachial plexus injury

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Introduction

The brachial plexus is a network of nerve fibers that run from the spine and supplies the musculature of the arms. One of the most common causes of brachial plexus injury (BPI) of infants include force during delivery and excessive stretching. When an infant has a brachial plexus injury, it can happen to any part of the nerve fibers, therefore, the clinical features differ from patient to patient. Like adults, pediatric patients are diagnosed with BPI by clinical symptoms also with nerve conduction studies (NCS) and electromyography (EMG) or imaging study such as magnetic resonance imaging.

Objective

Electrodiagnosis performed in children is often ends with minimal and an incomplete study due to poor cooperation. Therefore, it is difficult to judge how relevant electrodiagnostic Results are to clinical features beside diagnostic role. To investigate their prognostic role of electrodiagnosis, especially on functional shoulder movement of children, we assessed the relationship between the electrodiagnostic Results and muscle power of shoulder flexion.

Method

A retrospective chart review was done in children who visited rehabilitation department outpatient clinic from January 2009 to October 2017 with diagnosis of BPI. Among 29 children, 19 patients had record of electrodiagnostic studies. A child with brain lesion was excluded and 18 patients were divided into two groups based on the muscle power of shoulder flexion. Those two groups are as follows: a group with shoulder flexion power above fair grade in the manual muscle test, and the other group with less than fair grade. The manual muscle test (MMT) was based on the time of the EMG, and one of them was excluded from the group because there was no Result of MMT on the chart. Amplitude ratio in percentage was used which is calculated as amplitude of affected side divided by the amplitude of the unaffected side on each nerve. In case of not evoked, the amplitude ratio was regarded as zero. A Mann-whitney test was done to determine statistical differences of the ratio of amplitudes of NCS between two groups.

Result

At the time of the electrodiagnosis test, the mean age of 18 patients was 425.68 ± 447.25 days. And the mean of birth weight is 3831.66 ± 803.09 gram. Clinical characteristics are as in Table 1. There was no statistically significant difference between the two groups on amplitude of NCS in all sampled nerves (Table 2).

Conclusion

It is important to determine when to perform the NCS and EMG for accurate diagnosis. It seems that the electrodiagnostic Results of children does not correlate with severity of shoulder flexion. However, in this study, there is a limit to reflect only the power of shoulder flexion among clinical features. And the age of NCS study was quite variable. Further cumulative and prospective data are needed to figure out the correlation between electrodiagnostic Results and functional movement.

Table 1. Clinical characteristics of subjects

Clinical characteristics	N=18
Age of initial visit (days)	437.05 ± 461.98
Age of initial NCS(days)	448.31 ± 448.58
Gestational age(weeks)	38.17 ± 1.77
Gender (male : female)	9 : 9
Side involved (Right : Left)	12:6
Birth weight (g)	3831.66 ± 803.09

Values are presented as mean ± standard deviation

Table 2. Amplitudes ratio according to motor power of shoulder flexion

	Shoulder flexion		Total	P value
	Fair or more	Less than fair		
Nerves	N=10	N=7	N=18	
Median sensory-first digit	39.1±55.1	25.0±35.3	34.4±27.7	0.481
Median sensory	48.0±51.0	66.3±37.4	58.4±27.7	0.215
Ulnar sensory	62.3±45.9	46.2±43.0	62.1±44.0	0.68
Radial sensory	21.1±31.7	3.2±6.4	15.2±24.1	0.467
Lateral antebrachial cutaneous sensory	70.4±5.51	0	46.9±40.8	0.221
Median motor	60.5±42.4	92.5±84.8	78.3±62.1	0.462
Ulnar motor	59.9±40.4	55.8±49.2	65.4±44.3	0.515
Axillary motor	70.6±51.4	68.5±54.3	90.8±95.3	0.699
Musculocutaneous motor	79.0±58.3	60.8±51.5	72.0±54.3	0.588

Values are presented as mean ± standard deviation

Osteochondroma at distal forearm affecting both median and ulnar nerves: Report of a rare case

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Introduction

Osteochondroma are common benign bone tumor, constituting 15% of all bone tumors. It is usually asymptomatic and does not affect neuromuscular function. 50% of osteochondroma are found in the lower limbs. For the upper extremity, it is relatively often found in humerus, but rarely in hand or wrist. We report a rare case of large-sized osteochondroma at distal forearm level which Resulted in both median and ulnar neuropathy altering the course of the nerves.

CASE

The patient was a female office worker of age 43 and had hypoesthesia and numbness on the left index and middle fingers. She also complained abduction weakness on the left thumb. The symptoms started four years ago. The physical exam revealed an obvious atrophy on thenar muscle and the deformity on left wrist, 2nd and 3rd fingers. Motor power of thumb abduction measured by manual muscle test was grade two. The paresthesia was localized in median innervated area of the hand and the ulnar nerve innervated area was relatively spared. After taking X-ray (figure 1), she was consulted to the Department of Rehabilitation Medicine for electrodiagnostic evaluation to have differential diagnosis about neuropathy without CT and MRI image. At first, nerve conduction study (NCS) was done following the routine Methods of evaluating median and ulnar nerve. Abnormal findings were observed from both motor and sensory nerve in median and ulnar nerve. Assuming that the course of the nerves could have been altered due to osteochondroma, ultrasonographic evaluation was done for tracking actual nerve course. (figure 1) The actual course of median nerve shifted to the radial side from distal forearm and the compression of median nerve was observed in the ill-defined Carpal tunnel level. (Figure 2) With this information, we performed NCS again after drawing the direction of median and ulnar nerve on the wrist, and moved the stimulation sites toward proper directions. (Table 1) Median motor and sensory NCS showed no change with sonoguided stimulation. The latency of ulnar motor nerve ranged in normal limit with sonoguided stimulation. Electromyogram studies showed denervation potential at left abductor pollicis brevis and left opponens pollicis. Final electrodiagnosis was concluded as median motor and sensory neuropathy and ulnar sensory neuropathy. After hospitalization, the alternation of the nerve route was confirmed again by MRI. The surgery was operated for two times with weekly interval, extirpating approximately 3*3*2cm of osteochondroma from wrist.

Conclusion

We present a rare case of an osteochondroma arising from distal ulna causing both median and ulnar neuropathy which has not been reported. As seen from the case, when evaluating neuropathy with the lesion which is suspected to alter the course of nerve direction, sono-guided correction to the routine NCS technique can be added for the accurate Results.

Table.1 Findings of electrodiagnostic study

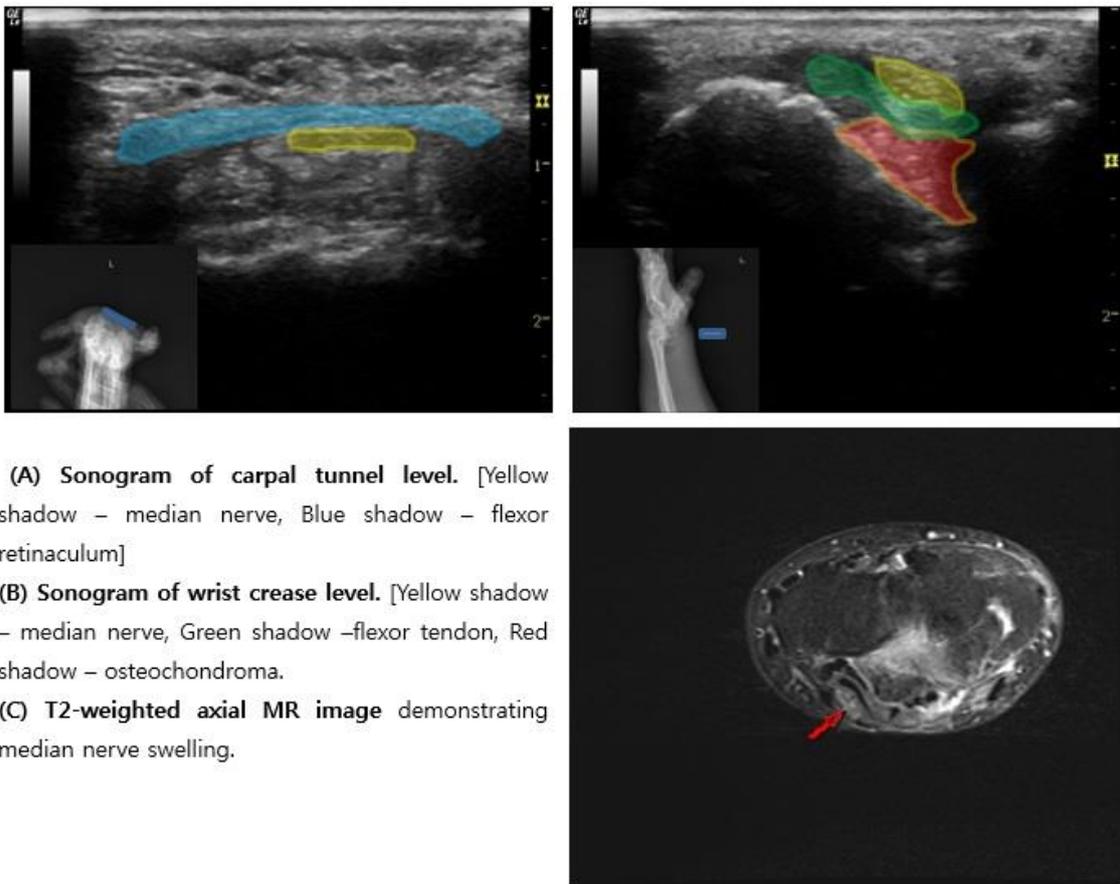
Motor nerve	Stimulation – Recording site	Method	Latency(mSec)	Amplitude(mV)
Lt. Median	Wrist – APB	Routine	Unobtainable	Unobtainable
		Sonoguided	Unobtainable	Unobtainable
Lt. Median	Wrist- 2 nd LM	Routine	Unobtainable	Unobtainable
Lt. Ulnar	Wrist-ADM	Routine	3.7	8.3
		Sonoguided	3.1	10.5
Lt. Ulnar	Wrist-2 nd LM	Routine	2.9	7.9
Sensory nerve	Stimulation – Recording site	Method	Latency(mSec)	Amplitude(uV)
Lt. Median	Wrist-1 st finger	Routine	Unobtainable	Unobtainable
		Sonoguided	Unobtainable	Unobtainable
Lt. Median	Wrist- nd finger	Routine	Unobtainable	Unobtainable
		Sonoguided	Unobtainable	Unobtainable
Lt. Ulnar	Wrist-5 th finger	Routine	3.9	21.4
		Sonoguided	3.5	20.2

APB, abductor pollicis brevis;ADM, abductor digit minimi;LM, lumbrical muscle;



- A. altered course of median nerve estimated by ultrasonography
- B. assumed course of median nerve in general population
- C. altered course of ulnar nerve estimated by ultrasonography

Figure 1. X-ray and Picture showing altered course of nerve in left fingers and wrist.



- (A) Sonogram of carpal tunnel level. [Yellow shadow – median nerve, Blue shadow – flexor retinaculum]
- (B) Sonogram of wrist crease level. [Yellow shadow – median nerve, Green shadow –flexor tendon, Red shadow – osteochondroma.
- (C) T2-weighted axial MR image demonstrating median nerve swelling.

Figure 2. Sonogram and MRI image of median nerve lesion.

Iatrogenic femoral neuropathy: A report of two cases

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Introduction

Iatrogenic femoral neuropathy (FN) is a rare condition that could occur diverse symptoms. Most of them had shown benign courses but some patients experience long-term disability. We report two cases of FN after arterial blood sampling and pelvic surgery.

Case 1

A 43-year-old female with liver cirrhosis visited emergency room presenting onset of hematemesis and confused mental status. The patient admitted to intensive care unit and treated for esophageal varix and hepatic encephalopathy. Femoral artery puncture was done for arterial blood gas analysis during the admission. She complained weakness and sensory change of left lower extremity after recovery of consciousness. Initial manual muscle test (MMT) revealed 3/5 of left hip flexor, 0/5 of left knee extensor, and otherwise normal. Loss of left quadriceps deep tendon reflex (DTR) and hypesthesia on left anteromedial thigh and medial lower leg were found on physical exam. Nerve conduction study (NCS) was performed at 2 weeks of onset that showed absent response of left femoral and saphenous nerves. On needle electromyography (EMG), left vastus medialis (VM) and rectus femoris (RF) showed positive sharp waves and no motor unit action potential (MUAP). With iliopsoas (IP) hematoma confirmed on CT and MRI, we concluded left FN caused by IP hematoma, and prescribed isometric strengthening of left lower extremity and gait training with knee stabilizer. On the onset of 30 weeks, follow-up NCS showed small waveform of femoral nerve with regeneration evidence of MUAP at left VM and RF. Clinically, she could walk without orthosis, and MMT revealed 5/5 of left hip flexor and 4/5 of left knee extensor.

Case 2

A 51-year-old female with endometrial cancer had a radical abdominal hysterectomy under general anesthesia for 4 hours. On the 1st postoperative day, she complained weakness and sensory change of right lower extremity, and visited outpatient clinic after 4 weeks of onset with partial improvement. Initial MMT revealed 5/5 of hip flexor and 2/5 of knee extensor, and loss of right quadriceps DTR and hypesthesia of medial lower leg were observed on physical exam. NCS showed reduced amplitude of right femoral and saphenous nerves. On needle EMG, positive sharp waves and reduced recruitment pattern were noted in right IP, VM and RF. We diagnosed right FN after pelvic surgery and prescribed strengthening exercise of lower extremity and gait training. On the onset of 12 weeks, follow-up electrophysiologic study showed no change, but weakness was improved to 5/5 in both right hip flexor and knee extensor without disability.

Conclusion

We report two cases of iatrogenic FN after femoral artery puncture and prolonged pelvic surgery. In both cases, clinically, they had shown nearly full recovery without disability, although there was only partial improvement in electrophysiologic study. Proper exercise and orthotic management could help to reduce disability and improve mobility.

Bilateral Lumbar Plexopathy and Rhabdomyolysis Complicating Carbon Monoxide Poisoning

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Introduction

Carbon monoxide (CO) is a colorless, odorless gas produced primarily as a result of incomplete combustion of any carbonaceous fossil fuel. The clinical symptoms of CO poisoning are variable including nonspecific viral illnesses, neuropsychiatric symptoms and delayed neurological syndrome. Previous reports of rhabdomyolysis due to CO poisoning are rare. Neuropathy is also rarely documented after CO poisoning. We present a case of CO poisoning with rhabdomyolysis that resulted in bilateral lumbar plexopathy. **Case report** A 32-year-old man visited to the rehabilitation department because of decreased muscle strength in his bilateral lower extremity during 40 days after the suicide event. From patient's history taking and medical record, we found out that he was affected by burning coal. He was a healthy employee prior to the incident and had no history of medical problem. He attempted suicide by burning coal in a closed space. He was admitted to internal medicine for 5 days and discharged at his will without permission. Initial laboratory data were as follows; creatine phosphokinase 24480 IU/L, CK-MB 45.5 IU/L, Troponin T 0.042 ng/ml, lactate dehydrogenase 985 U/L. These findings suggested that rhabdomyolysis had occurred due to CO poisoning. For treating rhabdomyolysis, only conservative treatment without surgery was done. The patient complained of numbness in the left medial knee area and lower extremity weakness after CO poisoning. Physical examination showed symmetrical knee jerk, diminished touch and pinprick sensation in the left medial knee. A manual muscle test identified weakness of bilateral hip flexor (MRC grade 2) and knee extensor (MRC grade 2). However, upper extremities and ankle strength were normal. We conducted nerve conduction study and electromyography 40 days after onset. There was no response in bilateral saphenous nerve stimulation in sensory study. In the motor study, bilateral femoral nerves showed no response. Except saphenous and femoral nerves, the other nerve conduction study in both lower extremities showed normal. In the electromyography, bilateral vastus medialis, iliopsoas showed fibrillation potential (FP) and positive sharp wave (PSW) at rest, and no motor unit action potential (MUAP) during voluntary contraction. Results showed bilateral lumbar plexopathy. (Figure 1.) 5 months after onset, we conducted follow-up nerve conduction study and electromyography. Nerve conduction study was almost the same compared to the previous study. In electromyography, bilateral iliopsoas showed FP and PSW at rest and partial to complete recruitment patterns and bilateral vastus medialis showed FP and PSW at rest and no MUAP during voluntary contraction. These findings suggested that regeneration change started from the proximal part. After taking a 6-month rehabilitation program for lower extremity weakness including therapeutic exercise and electrical stimulation therapy, the patient could walk a distance of 300-meters without gait aids.

motor				EMG		
Nerve	Latency(ms)	Amplitude	Velocity(m/s)	Muscle	Resting	On volition
Rt.Median	3.44/7.45	10.7/10.6	54.9	Paralumbbar	Silent	
Rt.Ulnar	2.86/6.46	12.6/12.5	58.4	Rt. Iliopsoas	P&F(2+)*	No motor unit potential*
Lt.Median	3.44/7.60	11.3/10.2	52.8	Rt. Rectus Femoris	P&F(2+)*	No motor unit potential*
Lt.Ulnar	3.18/6.56	11.0/10.1	62.1	Rt. Vastus medialis	P&F(2+)*	No motor unit potential*
Rt.Tibial	5.99/15.42	25.1/19.6	41.2	Rt. Peroneus longus	Silent	Normal motor unit potential Full recruitment
Rt.Peroneal	3.13/10.89	8.4/7.9	43.8	Rt. Tibialis anterior	Silent	Normal motor unit potential Full recruitment
Rt.Femoral	Not evoked*			Rt. Gastrocnemius	Silent	Normal motor unit potential Full recruitment
Lt.Tibial	5.83/14.38	25.4/18.1	43.3	Lt. Iliopsoas	P&F(2+)*	No motor unit potential*
Lt.Peroneal	3.54/10.83	9.0/8.8	46.6	Lt. Rectus Femoris	P&F(2+)*	No motor unit potential*
Lt.Femoral	Not evoked*			Lt. Vastus medialis	P&F(2+)*	No motor unit potential*
				Lt. Peroneus longus	Silent	Normal motor unit potential Full recruitment
				Lt. Tibialis anterior	Silent	Normal motor unit potential Full recruitment
				Lt. Gastrocnemius	Silent	Normal motor unit potential Full recruitment
sensory				FU EMG		
Nerve	Latency(ms)	Amplitude	Velocity(m/s)	Muscle	Resting	On volition
Rt.Median	2.55	51.1	50.9	Paralumbbar	Silent	
Rt.Ulnar	2.19	32.1	54.9	Rt. Iliopsoas	P&F(2+)*	Polyphasic motor unit potential* Reduced recruitment*
Lt.Median	2.5	56	52	Rt. Rectus Femoris	P&F(2+)*	No motor unit potential*
Lt.Ulnar	2.4	36.6	50.1	Rt. Vastus medialis	P&F(2+)*	No motor unit potential*
Rt.Sural	2.55	25.4	41.1	Lt. Iliopsoas	P&F(2+)*	Polyphasic motor unit potential* Reduced recruitment*
Rt.Peroneal	2.6	30.2	46.1	Lt. Rectus Femoris	P&F(2+)*	No motor unit potential*
Rt.Saphenous	Not evoked*			Lt. Vastus medialis	P&F(2+)*	No motor unit potential*
Lt.Sural	2.5	32.8	42	Lt. Iliopsoas	P&F(2+)*	Polyphasic motor unit potential* Reduced recruitment*
Lt.Peroneal	2.66	32.9	45.2	Lt. Rectus Femoris	P&F(2+)*	No motor unit potential*
Lt.Saphenous	Not evoked*			Lt. Vastus medialis	P&F(2+)*	No motor unit potential*

fig1. Initial and follow up nerve conduction study and electromyography

The usefulness of ultrasonography for burn-related compression neuropathy: A Case report

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Department of Rehabilitation Medicine¹

Introduction

We reported that compression peripheral neuropathy was found in burn patients by using ultrasonography. In burn patients, the nerve can be compressed by fibrosis or tissue swelling. Electromyography (EMG) is used for finding burn-related neuropathy. However, EMG is a painful test and it cannot be done in case of severe skin defect in burn patients. Therefore ultrasonography can be the useful diagnostic Method for burn-related compression neuropathy.

Case reports

A 64-year-old woman was referred to the department of rehabilitation medicine for evaluating tingling sensation in her right hand. She had a 2nd-degree contact burn injury with bullae on her right wrist four weeks ago (Figure 1.). When she came to our department, there were no bullae and we could only find swelling in her wrist. Physical examination revealed Poor grade of right thumb abduction and Good grade of right 5th finger abduction by manual muscle test. She complained diffuse tingling sensation on her whole right palm and fingers and the Tinel's sign was positive. For evaluation of the peripheral nerve, we conducted ultrasonography and EMG. On ultrasonography, there was compressive median nerve with overlying swollen soft tissue around the injury site (Figure 2). In the transverse scan, the thickness of soft tissue on the right side was about two times longer than in the left side (Figure 3). Therefore, it was considered that the soft tissue swelling made the compression median neuropathy. We conducted the EMG test for diagnosis of peripheral neuropathy. On the EMG study, sensory nerve action potential and compound muscle action potential of the right median nerve were not evoked. We could find that the EMG findings were compatible with the ultrasonography findings.

Conclusion

Ultrasonography is the useful diagnostic tool for burn-related compression neuropathy. Burn-related neuropathy is a common disorder. However, sometimes it is diagnosed only with clinical features. In a patient with burn-related neuropathy, ultrasonography is a simple and easily accessible examination of peripheral nerve.



Figure 1. Bullae on the wrist

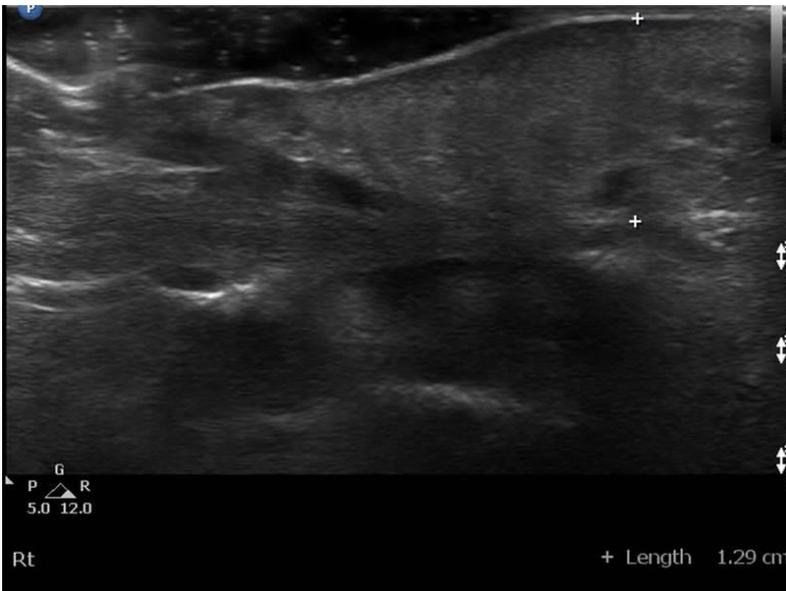


Figure 2 Longitudinal scan of the right wrist. The length of soft tissue swelling was 1.29cm.

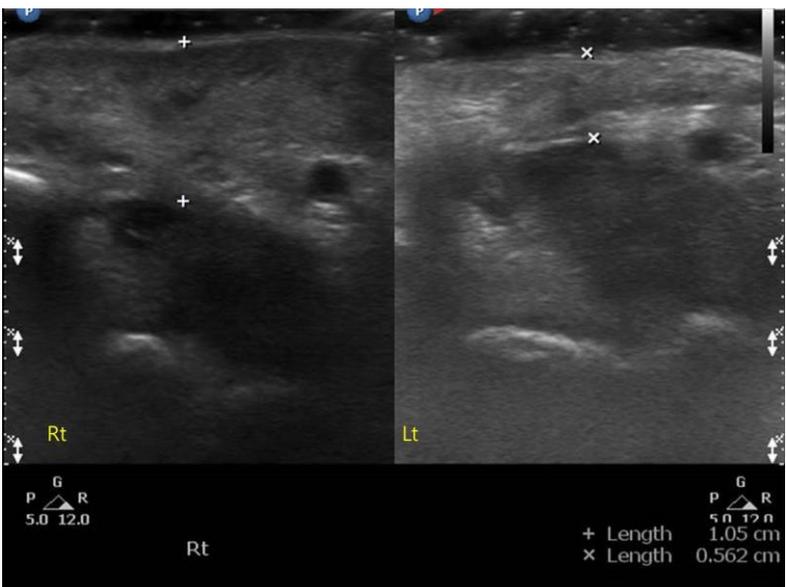


Figure 3 Transverse scan showed soft tissue swelling on the right side (1.05cm) comparing with the left side (0.56cm).

Telbivudine induced mitochondrial myopathy in a patient with chronic hepatitis B: A Case report

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Introduction

Chronic hepatitis B virus (HBV) infection is a major global health problem. It is a leading cause of liver cirrhosis, hepatocellular carcinoma and liver failure. Recently, there have been two approved antiviral therapy for chronic HBV infection. One is interferon therapy and the other strategy is nucleotide analogues. Telbivudine is a synthetic nucleotide analogue. It is a common therapeutic option for chronic HBV infection. However, it has been related with creatine kinase (CK) elevations and on rare occasions, clinical myopathy. The actual prevalence of telbivudine induced myopathy is unknown. Reports of electromyography (EMG) and muscle biopsy studies have been rare. We report here a case of telbivudine induced mitochondrial myopathy confirmed by muscle biopsy in patient after long term administration of telbivudine for chronic HBV infection.

Case report

A 52-year-old man who had received telbivudine plus adefovir therapy for chronic hepatitis B presented with weakness of his extremities, dysphagia and weight loss over the previous 5 months. At the time of admission to the clinic, he was taking 600 mg of telbivudine and 10 mg of adefovir once daily for 40 months. His serum HBV DNA level had decreased to less than 20 IU/ml, and serum alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels were normal. However, the patient suffered from dysphagia and generalized weakness, especially of his legs, and had difficulty in climbing stairs. He had decreased deep tendon reflexes, and atrophy was observed in the proximal muscle of upper extremity. Decreased pharyngeal contraction, large amount of pharyngeal residue and laryngeal penetration were observed on the videofluoroscopic swallowing study (VFSS). The EMG study indicated myopathy with characteristic myopathic discharges on all extremities. The patient was admitted for further evaluation of the weakness and dysphagia. Laboratory test on admission showed AST of 27 U/L (reference range: 0 to 34 U/L), ALT 17 U/L (10 to 49 U/L), and CK 206 U/L (32 to 294 U/L). Tests for serum autoimmune markers were negative. MRI findings on both thighs showed no definite abnormal signal intensity. We planned to perform a muscle biopsy for confirmation. A muscle biopsy performed on the vastus lateralis muscle showed many degenerating atrophic and multiple regenerating myofibers, variation in fiber size. Telbivudine was discontinued and the patient was switched to tenofovir. The extremity weakness and dysphagia were improved two months after discontinuation. He was able to climb stairs more easily than before. Follow up VFSS showed a slight reduction of pharyngeal residue, decreased aspiration tendency, and improved subjective swallowing.

Conclusion

Despite few cases of telbivudine induced mitochondrial myopathy were reported, physicians should take into consideration the possibility of the relationship with telbivudine to detect this reversible adverse event without delay.



Figure 1. The patient shows proximal muscle atrophy, especially of the both infraspinatus and rhomboid muscle.

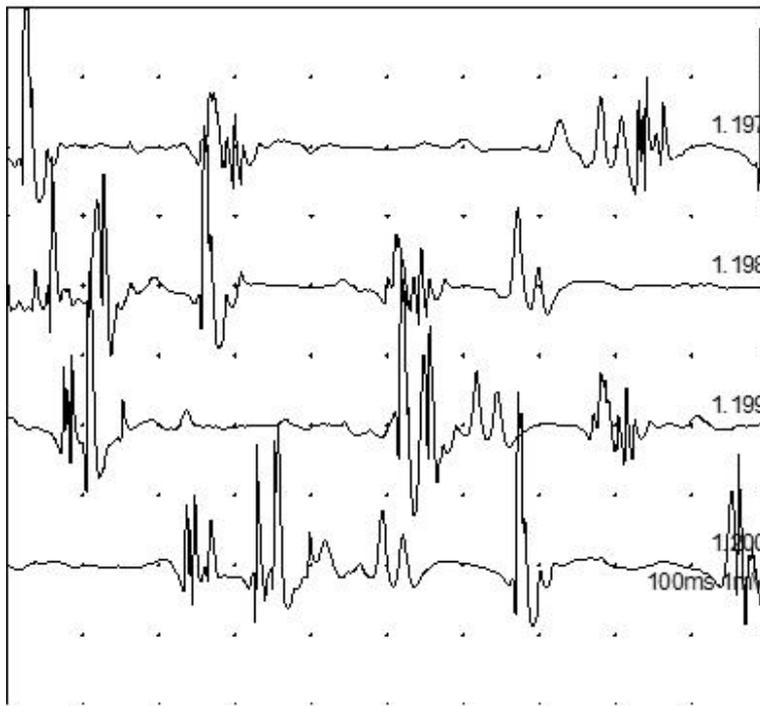


Figure 2. Electromyographic findings of the patient. Short duration and polyphasic motor unit action potentials with early recruitment patterns were recorded in the right vastus medialis muscles.

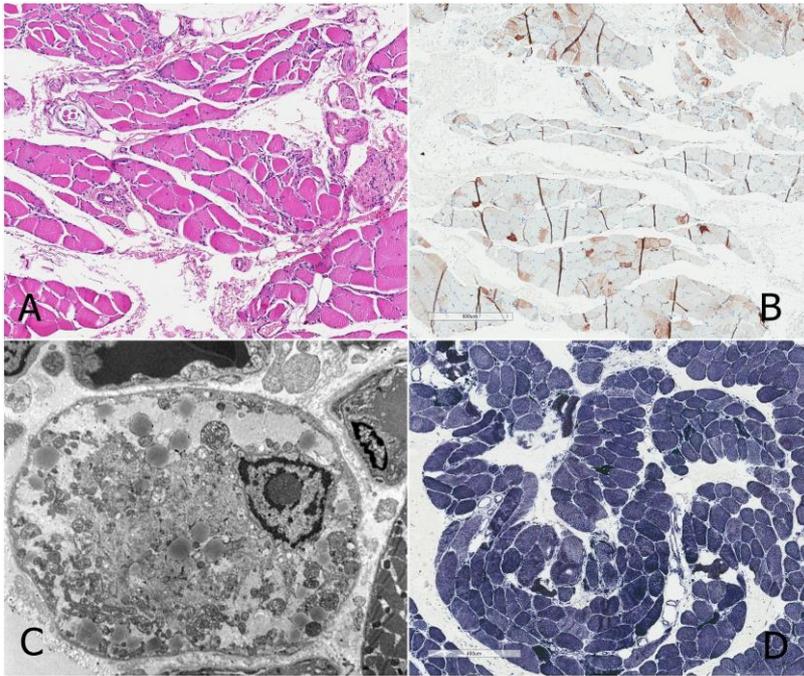


Figure 3. Muscle biopsy specimen (A) Many degenerating and regenerating myofibers and mild endomysial fibrosis and fat ingrowth (Hematoxylin and eosin stain) (B) Many degenerating myofibers (CD56 immunohistochemistry) (C) Many degenerated myofibers with moderate size variation and subsarcolemmal accumulation of swollen mitochondria with abnormal arrangements of cristae or vesicular cristae (Electron microscopy; magnification, 6000x) (D) Type I fiber predominance, no grouping and hyperstained and mottled myofibers (NADHase stain)

Idiopathic Neuralgic Amyotrophy Presenting as Debilitating Unilateral Lumbosacral Radiculoplexopathy

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Introduction

Neuralgic amyotrophy is characterized by neuropathic pain and subsequent motor weakness. Little is known regarding the etiology of this disorder. We describe a case of neuralgic amyotrophy involving unilateral lumbosacral radiculoplexus which progressed from proximal to distal, and finally more severe affected in the distal muscles.

Case presentation

A previously healthy 63-year-old man visited our outpatient clinic with low back pain and left lower extremity pain which was developed after in-car traffic accident about 4 months before. He showed motor weakness of left lower extremity (grade 3 in hip flexion and 4 in ankle plantarflexion on the Medical Resource Council scale, MRC), diffuse muscle atrophy and severe pain (grade 10 on the Visual Analogue Scale, VAS). These symptoms had been gradually progressed. In initial electrodiagnostic study, nerve conduction study showed normal conduction, however, needle electromyography (EMG) showed abnormal spontaneous activities (positive sharp waves or fibrillation potentials) in the left lumbosacral paraspinal, adductor longus, tibialis anterior, peroneus longus, vastus medialis, rectus femoris and gluteus maximus muscles. Also, interference patterns are decreased in almost muscles. However, in lumbar spine MRI, only mild bulging disc in L4/5 level was seen. Positron Emission Tomography-Computed Tomography (PET-CT) and laboratory test with tumor markers were performed to rule out the cancer related disorder. There were no abnormal findings suggesting malignancy. The pain was temporarily reduced to grade 7 on VAS by taking medicines such as opioid analgesics or prednisolone and receiving interventions. Two months later, pain worsened again to grade 10 on VAS. Weakness and atrophy of left lower extremity were also aggravated. Manual muscle test of his ankle dorsiflexion and plantarflexion became zero. In follow up electrodiagnostic study, nerve conduction study showed abnormal values in compound muscle action potential (CMAP) of left femoral, tibial, peroneal, and sciatic nerves. Also, sensory nerve action potential (SNAP) of left lateral femoral cutaneous, superficial peroneal, saphenous and sural nerves showed abnormal values, such as decreased amplitude or absent response. Needle EMG showed abnormal spontaneous activities in all muscles of left lower extremity with more aggravated interference pattern. Pelvic MRI showed diffuse thickening and enhancement of the left S1 plexus and sciatic nerve, and follow-up PET-CT showed focal increased uptake in the left sciatic and femoral nerves. These findings were compatible with left lumbosacral radiculoplexopathy.

Conclusion

We report a rare case of debilitating left lumbosacral radiculoplexopathy that progressed from proximal to distal peripheral nerves. We could diagnose the idiopathic neuralgic amyotrophy of the left lumbosacral radiculoplexus, clinically more severe involving distal than proximal nerves.



Fig 1. Pelvic MRI contrast enhanced T1WI. Diffuse thickening and enhancement of S1 plexus and sciatic nerve

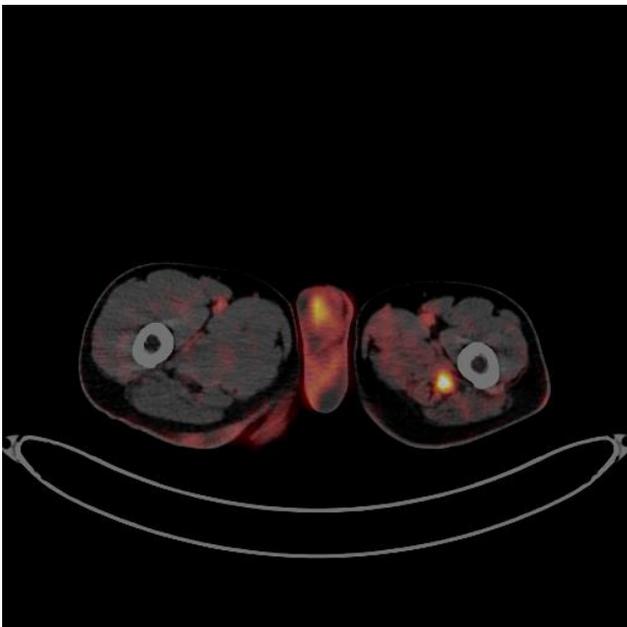


Fig. 2. PET-CT. Diffuse hypermetabolism in the left sciatic nerve (maxSUV 8.32)

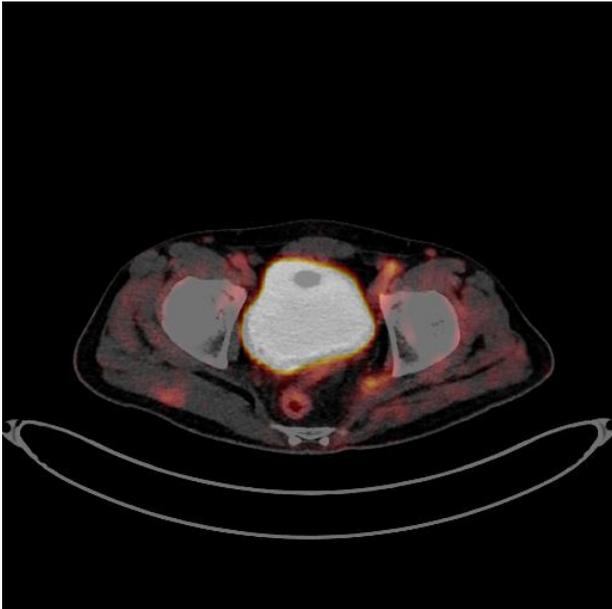


Fig 3. PET-CT. Focal mild hypermetabolism in the left femoral nerve.

Swallowing difficulty due to hypothyroid myopathy - A Case report –

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Introduction

Hypothyroidism often induce muscular symptoms. When only the muscular symptoms are prominent among the various symptoms of hypothyroidism, it could be called hypothyroid myopathy (HM). If HM also occur to swallowing muscles, theoretically it could Result in swallowing difficulty. However, no study has yet dealt with a direct linkage between hypothyroidism and swallowing difficulty in pharyngeal stage of swallowing. Here we report a case of histologically identified swallowing difficulty due to HM with a full recovery after levothyroxine administration.

Case report

A 51-year-old man was referred to our hospital for worsening swallowing difficulty over the previous 2 months. For the evaluation of dysphagia, we conducted videofluoroscopic swallowing study (VFSS) and fiberoptic endoscopic evaluation of swallowing (FEES). At first FEES revealed diminished laryngopharyngeal sensation, inability to clear material from valleculae, pyriformis or endolarynx and mild saliva pooling around posterior pharyngeal walls and laryngeal vestibules. Incomplete airway closure Resulted in liquid aspiration with score 8 of penetration aspiration scale (Fig. 1). In addition, VFSS showed decreased laryngeal elevation and weakness of pharyngeal contraction (Fig. 2). To identify the dysphagia of unknown origin, we checked over the past history. We found out from previous medical record that he was diagnosed with subacute hypothyroidism incidentally with subtle weakness of both upper and lower proximal limbs recently. In the next step, dysphagia with muscle disorder such as endocrine myopathy was suspected because he had weight loss and subtle muscle weakness. Needle electromyography examination showed early recruitment patterns of motor unit action potentials (MUAPs) in proximal limbs in upper and lower extremity and tongue muscles with decreased amplitudes and short durations of MUAPs in the needle exam. Above EDX findings are suggestive of myopathy. Histopathologic assessment showed a mild infiltration of mononuclear cells in the endomysium, consistent with myopathy (Fig. 3). A hormone replacement therapy (levothyroxine 0.15mg/day) was started. The follow-up VFSS was performed 3 weeks after treatment, and improvement of pharyngeal contraction ability and improvement of aspiration were observed. So the patient was then able to take a regular diet again.

Discussion

In terms of its reversibility, it would be helpful to consider HM induced dysphagia for the differential diagnosis in circumstances where it is not possible to make a definite diagnosis of swallowing difficulty. It is assumed that there are a number of cases in which

HM induced dysphagia was not diagnosed at the actual clinical setting. We think this Case report is clinically worthy of Discussion in that swallowing difficulty is recovered reversibly in the patient with dysphagia of unknown origin accompanied by hypothyroidism.

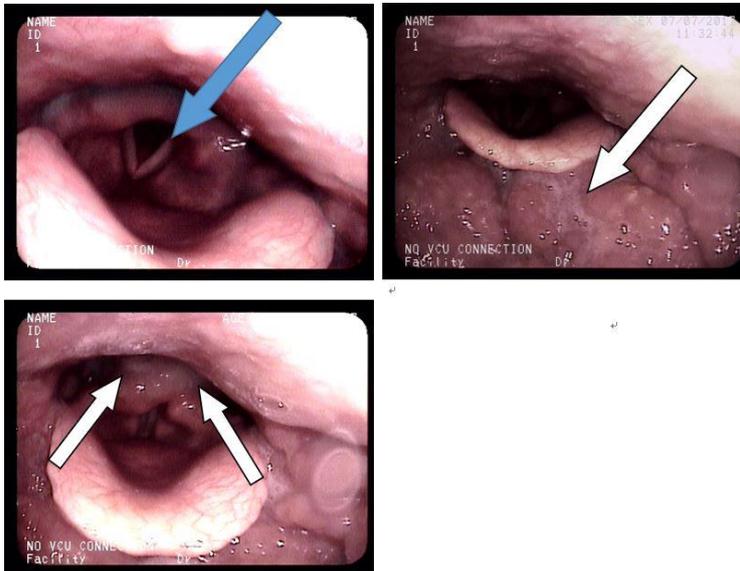


FIG1. FEES performed during the patient evaluation revealed A) aspiration of blue dye liquid past the vocal folds due to delayed airway closure (blue arrow), B) saliva and secretion pooling around the posterior tongue base and C) the piriform sinuses (white arrows).

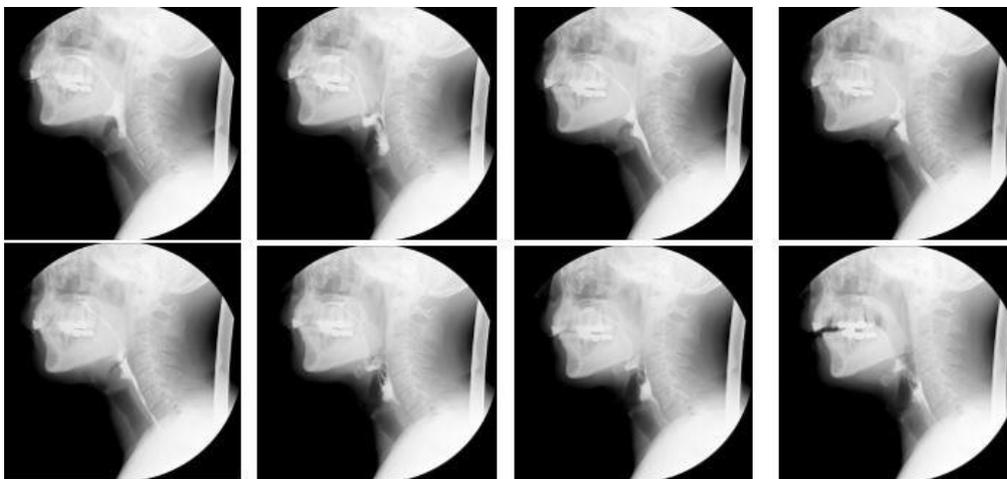


FIG2. VFSS showed decreased laryngeal elevation and weakness of pharyngeal contraction.

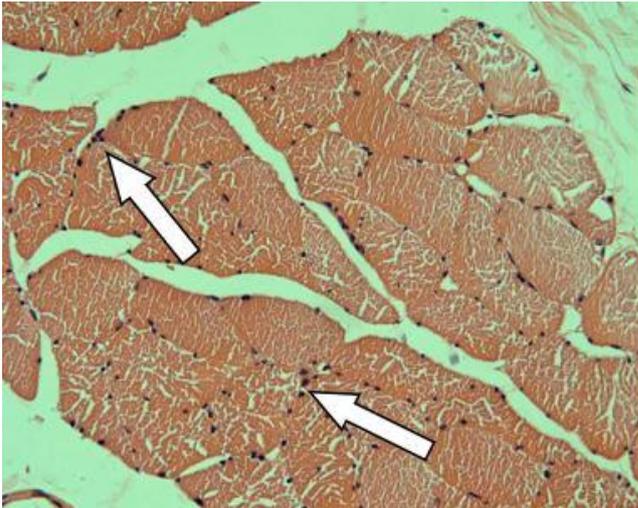


FIG3. On histopathologic evaluation of deltoid muscle, Hematoxylin-eosin stain suggested myopathy with mild mononuclear cell infiltration in the endomysium (white arrows).

Polyneuropathy with subacute combined degeneration of the spinal cord following nitrous oxide abuse

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Introduction.

Nitrous oxide (N₂O) is known to induce vitamin B12 deficiency, leading to myeloneuropathies. This report describes two cases of subacute combined degenerations (SCD) of the spinal cord following N₂O abuse, concomitant with motor dominant polyneuropathies.

Case 1.

A 22-year old female with a history of N₂O abuse for nearly 6 months, complaining weakness of both lower limbs and gait disturbance for 2 weeks, was admitted. Primary physical examinations showed motor grades of 3 (Fair), bilateral hypoesthesia of T4 dermatomes and below, decreased proprioception, and hyperactive knee jerks. Spine magnetic resonance imaging demonstrated high signal intensities on the dorsal columns of the spinal cord at C2-C5 on T2 weighted images (Figure 1. A, B), suggestive of SCD. Initial electrodiagnostic studies (EDX) Resulted in demyelinating and axonal polyneuropathies, mainly involving the motor nerves (Table 1). Chart reviews revealed a history of vitamin B12 deficiency, which was normalized after treatment. Additional vitamin B12 supplements were administered and comprehensive rehabilitation programs were initiated. After 3 weeks, motor grades of the lower extremities and gait performance showed considerable ameliorations. Follow up EDX also exhibited some improvements: normalization of the H-reflex latencies, amplitude increments of compound motor action potentials (CMAPs) of the median nerve (Table 1).

Case 2.

A 33-year old male with a history of N₂O abuse for 7 months complained gait difficulties, numbness of the trunk and below, and weakness of the lower limbs for 3 weeks. He was diagnosed with SCD of C2-C6 levels of the spinal cord (Figure 1. C, D) in a local hospital. The patient was transferred to our hospital for further evaluation since symptoms continued in spite of vitamin B12 supplements. Initial physical examinations showed motor grades of 2 (Poor) for both ankle dorsiflexors and toe extensors, bilateral hypoesthesia of the T3 dermatomes and below, hyperactive knee jerks, and a positive Romberg's sign. The patient was able to walk independently, but the dynamic standing balance was impaired. EDX suggested motor dominant polyneuropathies (Table 2). After rehabilitation, dynamic standing balance and ankle strengths were improved. Parallel to clinical improvements, follow up EDX also displayed some improvements in CMAPs (Table 2).

Conclusion.

In these cases, vitamin B12 deficiency due to N2O inhalation was suspected as the primary cause for SCD. Vitamin B12 deficiency, however, is mainly known to affect sensory nerves, and therefore difficult to account for the motor dominant polyneuropathies in our cases. Based on such fact, it may be suggested that N2O induced polyneuropathy can occur independently from vitamin B12 deficiency. We, therefore, suggest for possible polyneuropathies in SCD patients with a history of N2O abuse, even with normal vitamin B12 levels.

Table 1. Motor and Sensory Nerve Conduction Study Results of Case 1.

		Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	NCV (m/sec)	F wave (msec)
Initial (after symptom onset of 2 weeks)	Motor	M	APB	Wrist	2.7	8.2	24.8
		U	ADM	Wrist	1.9	15.5	25.8
	NCS	T	AH	Ankle	5.8*	2.3*	55.8*
		P	EDB	Ankle	6.4*	1.0*	54.6
		H-reflex		Right	36.09*		
				Left	36.15*		
		Stimulation site	Recording site	Peak latency (msec)	Amplitude (uV)		
Sensory	NCS	M	Digit II	Finger	2.7	28.0	
		U	Digit V	Finger	2.4	36.5	
	S	Leg	Ankle	2.6	9.9		
	S.P	Leg	ankle	2.3	7.4		
		Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	NCV (m/sec)	F wave (msec)
Follow up (after symptom onset of 5 weeks)	Motor	M	Wrist	APB	3.5	13.2	28.0
		U	Wrist	ADM	2.9	12.4	27.0
	NCS	T	Ankle	AH	5.5*	2.6*	54.0*
		H-reflex		Right	29.3		
				Left	30.4		
		Stimulation site	Recording site	Peak latency (msec)	Amplitude (uV)		
Sensory	NCS	M	Wrist	Digit III	3.6	49.0	
		U	Wrist	Digit V	3.9*	44.0	
	S	Leg	Ankle	4.0	14.0		
	S.P	Leg	ankle	4.0	6.0		

NCS: nerve conduction study, M: median nerve, U: ulnar nerve, T: tibial nerve, P: peroneal nerve, S: sural nerve, S.P: superficial peroneal nerve, APB: Abductor pollicis brevis, ADM: abductor digiti minimi, AH: abductor hallucis, EDB: Extensor digitorum brevis, NR: no response

Abnormal values are presented with an asterisk (*).

Table 2. Motor and Sensory Nerve Conduction Study Results of Case 2

			Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	NCV (m/sec)	F wave (msec)	
Initial (after symptom onset of 4 weeks)	Motor		M	APB	Wrist	4.5*	1.9*	29.5	
			U	ADM	Wrist	2.5	5.5	56	28.3
	NCS	Right	T	AH	Ankle		NR*		NR*
			P	EDB	Ankle		NR*		NR*
			H-reflex		Right	32.34*			
					Left	32.92*			
				Stimulation site	Recording site	Peak latency (msec)	Amplitude (uV)		
	Sensory		M	Digit II	Finger	2.9	48.3		
		NCS	Right	U	Digit V	Finger	2.7	20.3	
	S			Leg	Ankle	2.7	8.5		
S.P	Leg			ankle	2.3	5.8			
					Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	NCV (m/sec)
Motor		M	Wrist	APB	3.9	3.7*	50	28.6	
		U	Wrist	ADM	3.5	6.1	55	29.0	
NCS	Right	T	Ankle	AH	4.8*	0.2*	40	NR*	
		P	Ankle	EDB		NR*		NR*	
		H-reflex		Right	32.2*				
				Left	32.0*				
			Stimulation site	Recording site	Peak latency (msec)	Amplitude (uV)			
Sensory		M	Wrist	Digit III	3.3	26.0			
	NCS	Right	U	Wrist	Digit V	3.7	27.0		
S			Leg	Ankle	3.9	5.0			
S.P			Leg	ankle	3.9	5.0			

NCS: nerve conduction study, M: median nerve, U: ulnar nerve, T: tibial nerve, P: peroneal nerve, S: sural nerve, S.P: superficial peroneal nerve, APB: Abductor pollicis brevis, ADM: abductor digiti minimi, AH: abductor hallucis, EDB: Extensor digitorum brevis, NR: no response

Abnormal values are presented with an asterisk (*).

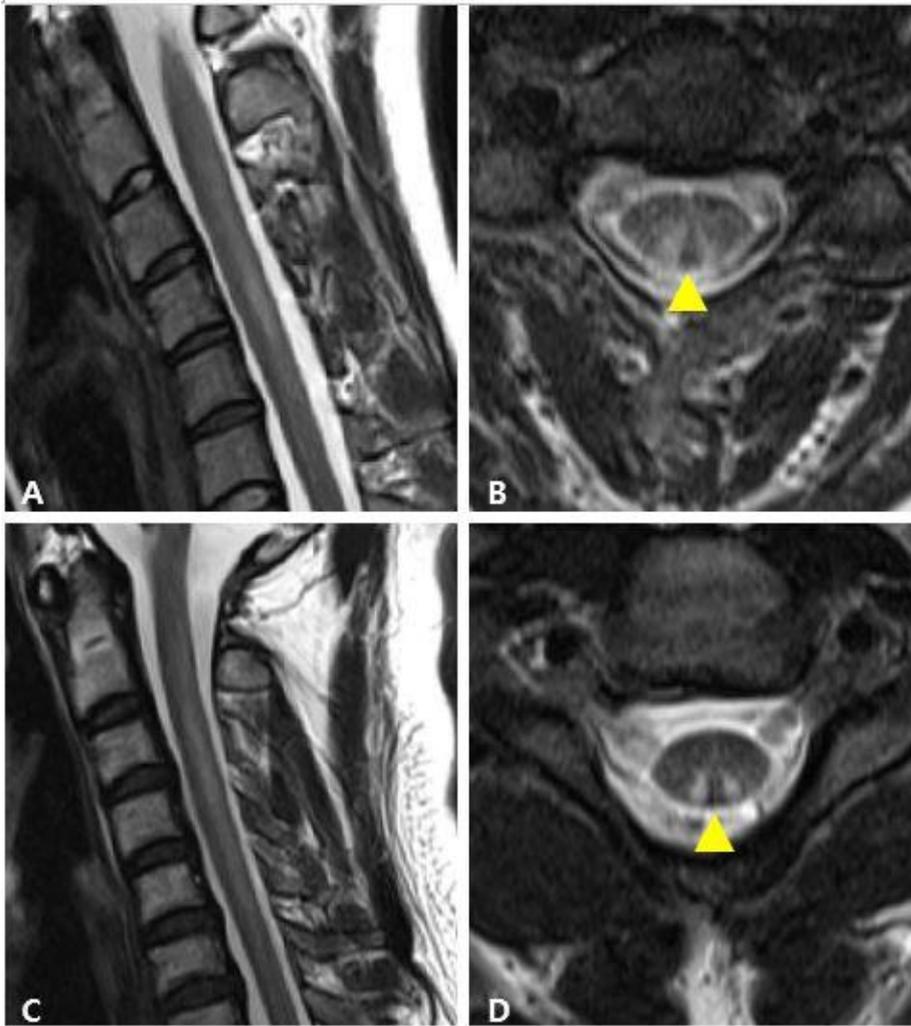


Figure 1. T2 weighted images of cervical MRI.

Sagittal (A), (C) and axial (B), (D) images of case 1 and case 2.

High signal intensity lesions are evident in the posterior column, presented as 'Inverted V sign' (arrow head).

Hourglass Constriction Neuropathy Affecting Suprascapular Nerve: Case report

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Keimyung University Dongsan Medical Center, Department of Rehabilitation Medicine¹

Introduction

Hourglass constriction (HGC) neuropathy is a neurologic condition caused by non-traumatic, non-compressive fascicular constrictions of one or more individual peripheral nerves. Differential diagnostic approaches for non-traumatic acute unilateral shoulder weakness are important for further treatments. We present a case of HGC affecting suprascapular nerve which were visualized by SHINKEI (nerve-SHeath signal increased with INKed rest-tissue RARE Imaging) magnetic resonance neurography (MRN) and describe the Result of nonsurgical treatments in this case.

Case

A 26-year-old female presented with a 5 month history of scapular pain and difficulty in elevating left arm over head. Past medical history revealed complete remission of non-Hodgkin's lymphoma 15 years ago and Kikuchi diseases 5 years ago. 10 days before the development of weakness, she experienced extremely severe pain in the shoulder girdle area with 3 days preceding flu-like symptoms. After the pain decreased over ten days, she noticed her weakness. Manual muscle tests revealed weakness of shoulder abductor and external rotator (Medical Research Council [MRC] Grade, 3/5), although elbow flexor and wrist extensor was normal. There were no abnormalities in sensory tests. On inspection, the suprapinatus and infraspinatus were mildly atrophied. Electromyography showed denervation of the supraspinatus and infraspinatus. Neck, chest, and abdominal computed tomography revealed normal findings. At 3 months after the onset, she visited other hospital. Cervical spine magnetic resonance imaging (MRI) revealed no disc herniation or foraminal stenosis (Fig. 1A), and shoulder MRI (Fig. 1B) demonstrated increased signal intensity of supraspinatus and infraspinatus suggesting denervation related edema. At that time, she was presumptively diagnosed as an idiopathic neuralgic amyotrophy (INA). At 5 months after the onset, she visited our clinic and performed high-resolution MRN using SHINKEI protocol. MRN revealed three focal constrictions of the suprascapular nerve (Fig. 1C and 1D). Laboratory tests including cerebrospinal fluid analysis, anti-nuclear autoantibody, and anti-ganglioside antibodies were normal. Thus, she was diagnosed as a HGC neuropathy of suprascapular nerve rather than an INA. She was treated with oral steroid (prednisolone 10mg for 14 days) and ultrasonography guided perineural injection (triamcinolone acetonide 20mg) once, and then improved to near normal (motor strength of shoulder abduction and external rotation [MRC, 5-/5]) at the 10 months after the onset.

Discussion

Although HGC neuropathy is a rare entity and the exact etiology is still unclear, it should be considered as a potential cause of spontaneous nerve palsy, especially unilateral shoulder weakness. Because HGC neuropathy clinically mimics an INA, high resolution MRN should be performed to differentiate HGC neuropathy from INA.

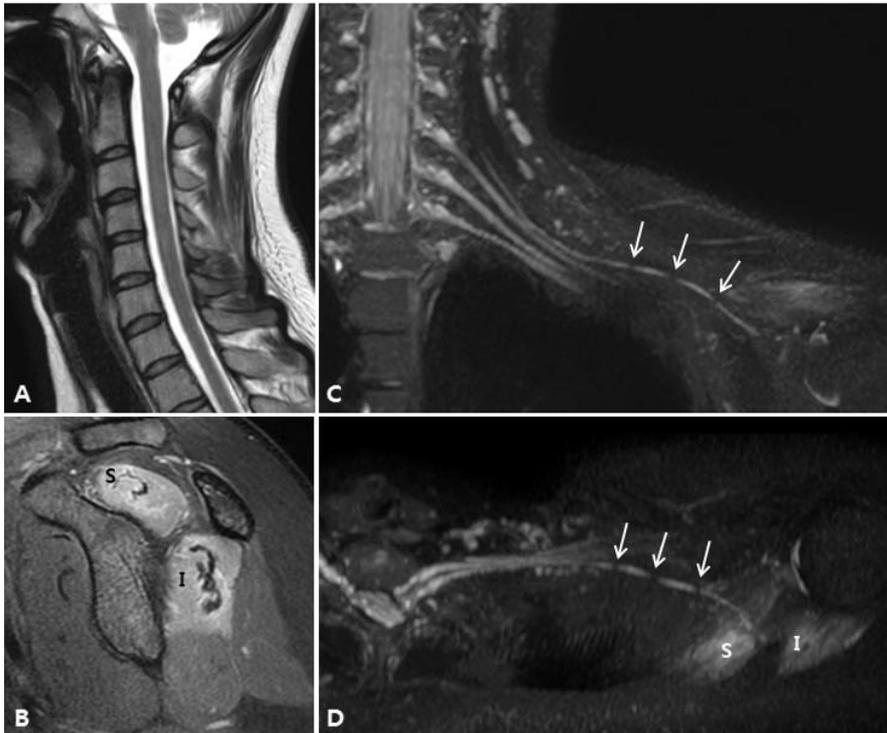


Fig. 1. Images of Case 1. (A) No evidences of cervical disc herniation or foraminal stenosis. (B) Sagittal 2D T-weighted fat suppression image demonstrates denervation-related edematous change of the supraspinatus (S) and infraspinatus (I) muscles. (C) Curved reformatted coronal 3D SHINKEI magnetic resonance neurography (MRN) reveals three focal constrictions (arrows) of the suprascapular nerve. (D) Curved reformatted axial 3D SHINKEI MRN reveals three focal constrictions (arrows) of the suprascapular nerve with denervation-related edematous change of the supraspinatus (S) and infraspinatus (I) muscles.

A Coincidental Existence of Myotonic Dystrophy and Charcot-Marie-Tooth disease: A Case report

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Introduction

Myotonic dystrophy type 1 (DM1) is an autosomal dominant multisystem disorder and one of the most common muscular dystrophies affecting adults. Charcot-Marie-Tooth (CMT) disease, a common hereditary neuropathy, is characterized by atrophy of the distal limbs and peripheral nerve abnormalities. The authors report a rare case involving a 24-year-old female who was diagnosed simultaneously with both DM1 and CMT1A based on the Results of a nerve conduction study (NCS).

Case report

24-year-old female, with complaints of bilateral lower extremity weakness and an inability to run since she was 10 years of age, was admitted for bilateral lower extremity pain in 2010. No other medical history, such as diabetes mellitus, was reported. On physical examination, the patient exhibited signs indicative of percussion myotonia, grip-release myotonia, and cramping. In addition, she also exhibited atrophy in both calf muscles and bilateral high arched foot. A manual muscle test revealed a good grade in all extremities, but only a fair grade in the ankle joint. No spasticity was noticed, and decreased deep tendon reflexes of all extremities were identified. She reported a tingling sensation below the knee and in both upper extremities. An EDX was performed to investigate weakness in all extremities and paresthesia. A motor and sensory NCS of all extremities revealed abnormalities. F-wave for the upper and lower extremities and H-reflex showed no response. Needling EMG revealed increased insertional activity, abnormal spontaneous activity, including positive sharp waves, and myotonic discharges in both the right upper and lower extremities. Based on physical examination and EDX abnormalities, the patient had a high probability of being diagnosed with myotonic dystrophy combined with chronic inflammatory demyelinating polyneuropathy. Genetic evaluation (DMPK gene study) was performed and revealed an abnormal number of CTG repeats that confirmed classic DM type 1. Five years later, the patient was admitted for dizziness with headache and lower extremity pain. Among all evaluations, EDX findings continued to reveal NCS abnormalities, indicating sensorimotor demyelinating polyneuropathy. Therefore, an additional genetic study was performed to identify whether she had other hereditary neuropathies in addition to DM1. Peripheral myelin protein-22, PMP-22 for CMT1A and myelin protein zero, MPZ gene for CMT1B were examined, and a novel diagnosis of CMT1A was made by validating the duplication of the PMP-22 gene.

Discussion

The present case demonstrates that DM1 and CMT, which are different hereditary neuromuscular disorders, can be diagnosed at the same time, and that EDX is an essential element in determining the comorbid condition. Severe serial abnormalities in an NCS in a DM1 patient may suggest the incidental coexistence of hereditary neuropathies, and further evaluations, such as genetic studies, should be performed for proper diagnosis.

Importance of Screening Acute Porphyria in Severe Polyneuropathy reckoned as Guillain Barre Syndrome

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Introduction

Acute intermittent porphyria (AIP) is a rare, genetic disorder which induces severe disabilities. Development of symptoms is associated with various exacerbating factors, from medications to poor oral intake or stress in patients with genetic factors. Clinical manifestations include abdominal pain, neurological symptoms and sensorimotor polyneuropathy. Considerable recovery could be expected with early diagnosis and treatment.

Case presentation

A 23-year-old single woman presented to the hospital because of cramping abdominal pain in February 2018. An abdominal computed tomography (CT) scan showed two intussusception sites. She was discharged 10 days after underwent laparoscopic manual reduction and post operation care, with limited oral intake. Six hours after discharge, she had a sudden deterioration of consciousness level and four serial convulsions taking about 3-5 minutes long. Brain CT and CSF tapping were normal, but the patient's condition continued to aggravate with the need to admit to intensive care unit (ICU) requiring intubation and mechanical ventilation. Magnetic Resonant Imaging (MRI) was taken and posterior reversible encephalopathy syndrome was observed without definite etiology (Figure 1). On the 23th postoperative day (POD), both upper and lower limbs power was of Medical Research Council (MRC) grade 2/5, progressively deteriorated to grade 1/5 the day after, with all deep tendon reflex were absent in all limbs. Nerve conduction study (NCS) revealed severe sensorimotor axonal polyneuropathy with no response in routine NCS of bilateral upper and lower extremities. Patient was considered Guillain-Barre Syndrome (GBS) and treated with intravenous immunoglobulin for 5 days on POD 31, with no definite effect. Abdominal pain, neurological symptoms and unexplained severe polyneuropathy raised the suspicion of AIP. 10 days after suspicion, AIP diagnosis was confirmed by urine porphobilinogen (102.01 mg/day) on POD 40 (Table 1). Intravenous hemin was administered 2 times after diagnosed, for 4 days each. All extremities power showed no change after hemin injection. NCS was taken 2 months later after quadriplegia. There were no responses in all sensory and motor nerves tested. It is considered as a sequel of AIP.

Conclusion

AIP could cause severe peripheral axonal polyneuropathy. Porphyric neuropathy should be considered as one of the differential diagnoses in a patient with an acutely progressing severe polyneuropathy, especially as with GBS.

Table 1. Laboratory data of case patient at POD 31.

Laboratory tests	Values	Normal range
Porphobilinogen, 24hour Urine	102.01mg/day	0 - 2.5mg/day
Delta-Aminolevulinic acid, 24hour Urine	31.0mg/day	1.5– 7.5mg/day
Total porphyrin, blood	Negative	
Total porphyrin, urine	Positive	
Spot urine Coproporphyrin	Positive	
Urine Porphyrin	Positive	
Urine Uroporphyrin	Positive	
Anti GM1 Ab IgM	Negative	
Anti GD1b Ab IgM	Negative	
Anti GQ1b Ab IgM	Negative	
Anti GM1 Ab IgG	Negative	
Anti GD1b Ab IgG	Negative	
Anti GQ1b Ab IgG	Negative	
Anti-Mitochondrial Ab	Negative	
Anti-Smooth muscle Ab	Negative	
LKM1 Ab	Negative	
ANA titer, serum	< 1 : 40	< 1 : 40

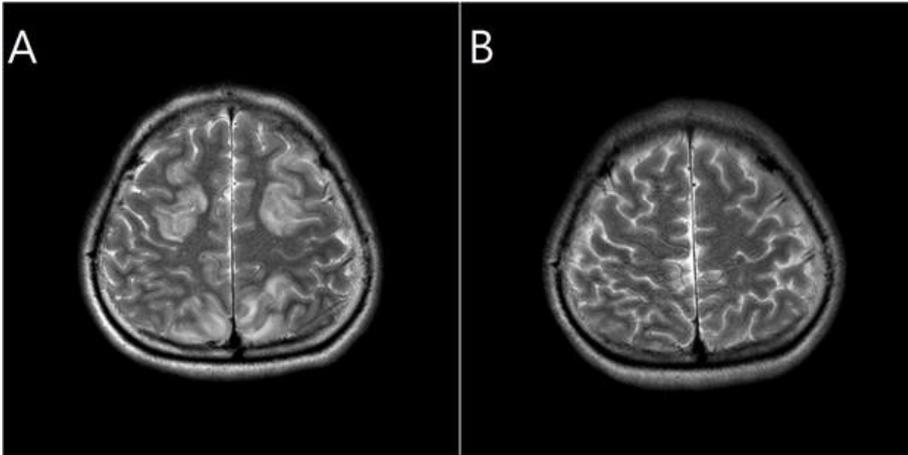


Figure 1. Brain magnetic resonance imaging performed on the POD 10(A), POD 21(B). Axial T2-weighted images of POD 10(A) revealed both frontal and parietal cortex and subcortical white matter signal intensity change. POD 21 images(B) revealed complete remission.

Single-center Experience of Intraneural Ganglion Cyst: a Clinical Review

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Purpose

Intraneural ganglion cysts are occurred within sheaths of peripheral nerves. Recently, the treatment and mechanism of development of intraneural ganglion cysts have been clarified. In the present study, we assessed the clinical, electrophysiological, imaging findings, treatment and prognosis of eight patients with intraneural ganglion cyst.

Method

We retrospectively investigated eight patients with intraneural ganglion cysts who visited to the outpatient clinic of Samsung Medical Center from 2007 to 2018. The diagnosis of intraneural ganglion cyst was confirmed by MRI.

Results

The localization of intraneural ganglion cysts is as follows: one for ulnar nerve, one for superior gluteal nerve, three for peroneal nerve and three for sciatic nerve. The average age of patients is 48 (± 13.5) years old. Neuropathic or arthralgic pain was the first symptom in all patients. Motor weakness occurred in 86% of patients, and motor weakness developed on average 33 days (± 66.1) after the onset of pain. Electrophysiologic study was performed in six patients. Decreased motor action unit potential (MUAP) recruitment in the involved muscles was the most common finding, and was found in all patients. Denervation potential in involved muscles appeared at 80% of patients, and abnormal findings of compound muscle action potential (CMAP) or sensory nerve action potential (SMAP) appeared at 83% of patients. Deep peroneal nerve involvement was more severe than superficial peroneal nerve involvement in the cases of intraneural ganglion cysts in peroneal nerve. In addition, peroneal division involvement was more severe than tibial division involvement in the cases of intraneural ganglion cysts in sciatic nerve. MRI findings of intraneural ganglion cysts were including multilobulated and elongated cysts though the involved nerve, articular branch which is small nerve branch connecting ganglion cyst and joint cavity and edematous change of denervated muscles. For treatment, one patient underwent ganglion cyst excision and nerve transposition, other patient underwent ganglion cyst decompression, two patients underwent arthroscopic synovectomy and ganglion cyst decompression, and four patients did not undergo any surgery or procedure. In the cases of ganglion cyst excision and observation, there was no improvement in symptoms. In addition, ganglion cyst recurred in the case of cyst decompression, and ultrasound guided cyst aspiration was performed several times after surgery. On the other hand, pain and neuropathic symptoms including motor weakness and hypesthesia were improved when arthroscopic synovectomy was performed.

Conclusion

In Conclusion, intraneural ganglion cysts could expand along the nerve and develop the neuropathic symptoms. MRI is the most useful diagnostic tool to find the articular branch. Dissection of articular branch and disarticulation are important to prevent recurrence.

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Rhabdomyolysis Involving Gluteal Compartment Followed by Sciatic Neuropathy and CRPS: A Case

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Introduction

Sciatic neuropathy is a rare complication of rhabdomyolysis around the hip region. We experienced a complicated sciatic neuropathy after rhabdomyolysis involving gluteal compartment and reported it.

Case

A 44-year-old man visited the emergency room with right buttock pain and leg weakness. His buttock was tense and tender. His serum showed creatine kinase level of 30,719 IU/L. No myoglobinemia was detected. Hip MRI showed followed: 1) edematous swelling of right gluteus maximus with suspicious necrosis and hemorrhage, 2) diffuse edematous swelling of the right sciatic nerve from pelvis to visible proximal thigh level.(Fig 1) Electrodiagnostic study showed incomplete injury of right sciatic nerve. Ultrasonography of sciatic nerve showed nerve swelling with increased cross sectional area.(Fig 2) He was diagnosed rhabdomyolysis involving gluteal compartment associated sciatic neuropathy. 10 days later, he complained of newly onset pain on the right sole with allodynia. 3-phase bone scan elicited increased radio-uptakes on the right foot and ankle.(Fig 3) We diagnosed complex regional pain syndrome type 2 on the right leg. Oral steroid therapy with prednisolone 60mg for 4 days started and tapering for 11 days. After first therapy, foot pain gradually aggravated, then the second steroid therapy was done with the same regimen. After steroid therapy, his pain was controlled with some analgesics (gabapentin, tramadol) and could ambulate without any aid.

Conclusion

Rhabdomyolysis invading gluteal compartment may make complicated sciatic neuropathy. It is a kind of gluteal compartment syndrome.

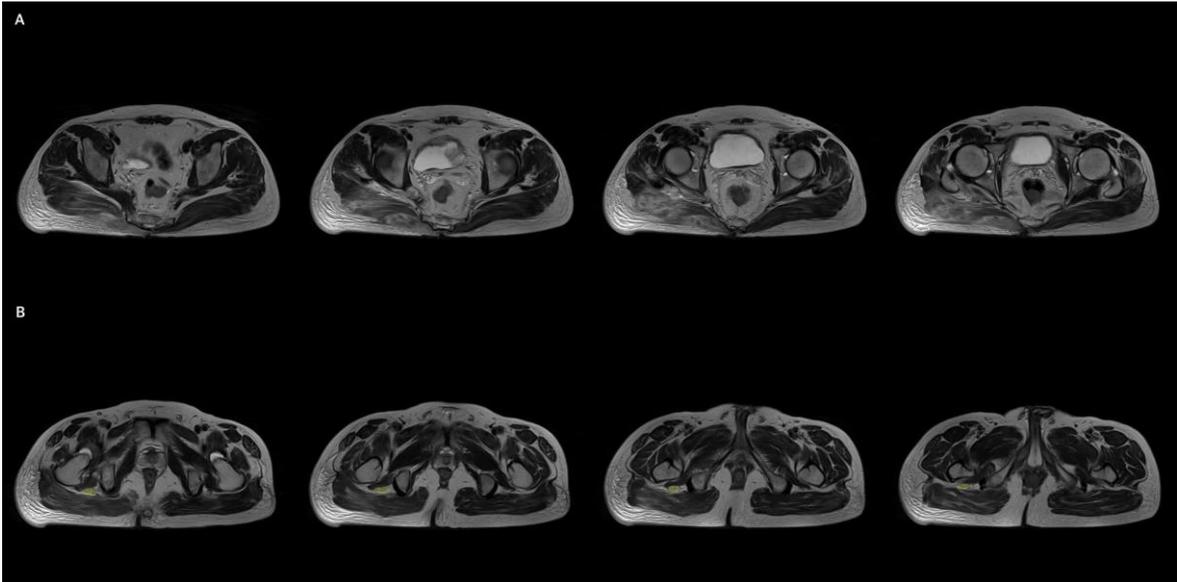


fig1. T2WI of hip MRI. Edematous swelling of right gluteus maximus(A) with diffuse swelling of right sciatic nerve(B)

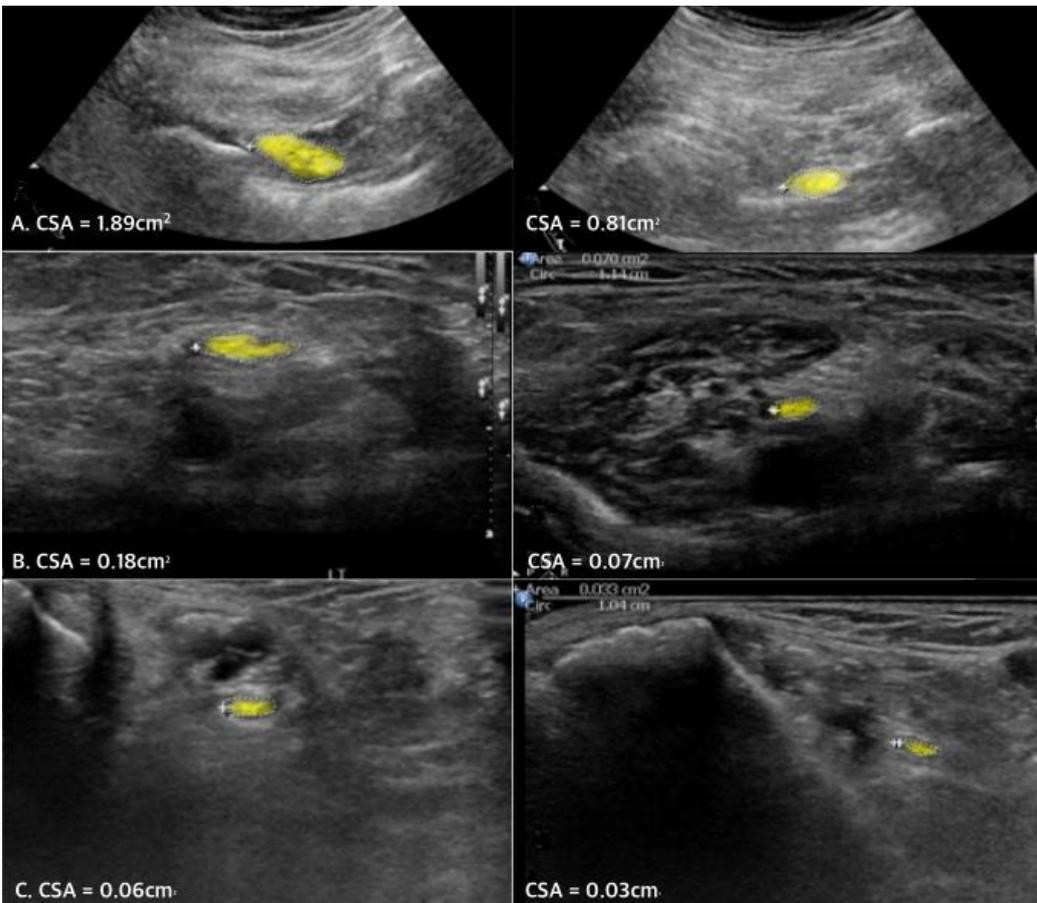


fig2. Ultrasonography of Sciatic nerve at the gluteal fold(A), popliteal fossa(B) and the ankle(C). CSA of right sciatic nerve is larger than the left.

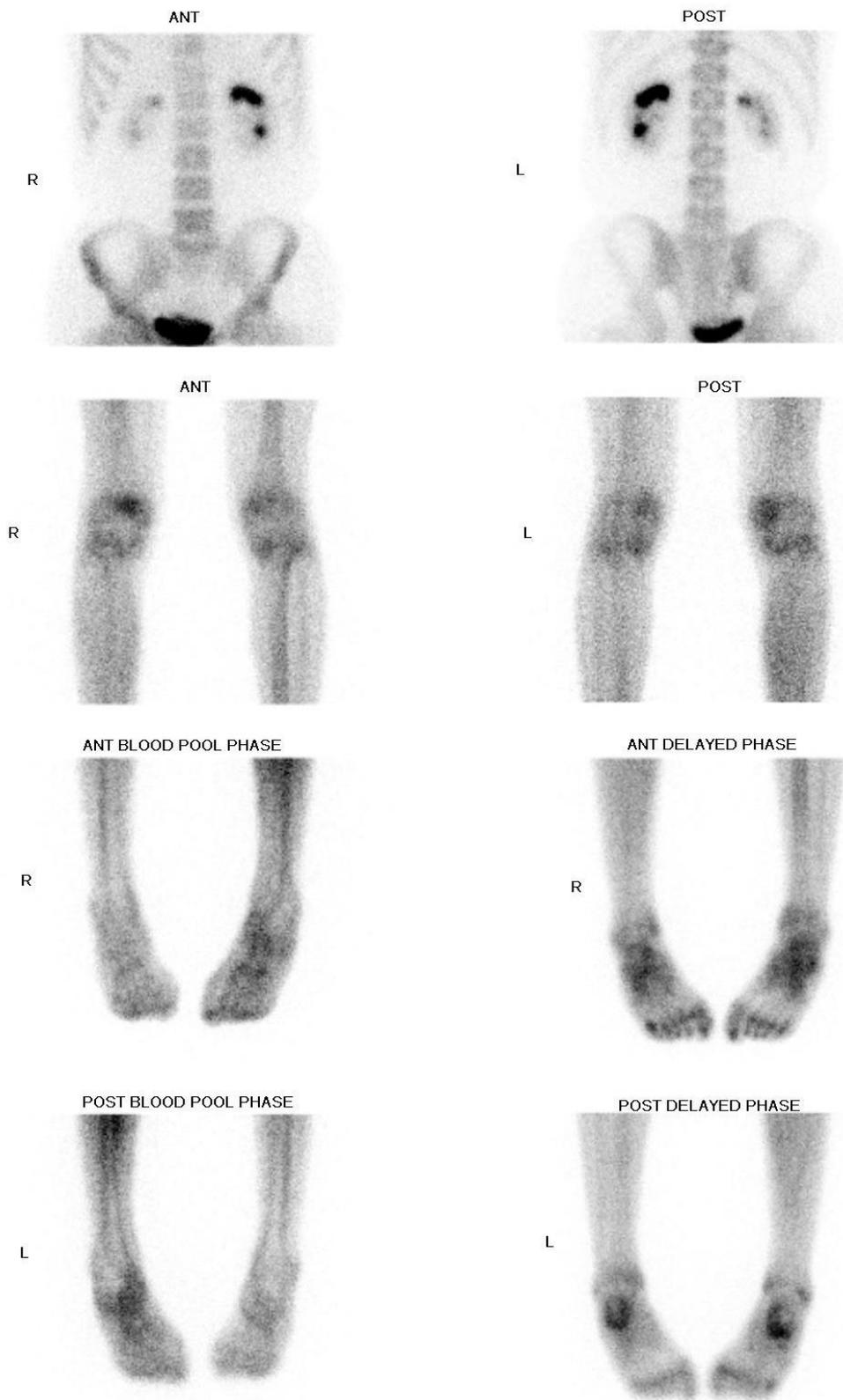


fig3. 3-phase bone scan. Increased uptake at the blood pool and delayed phase at the left knee and ankle.

Case report : The effect of steroid on atypical presentation of dermatomyositis

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Introduction

Symmetrical proximal weakness and characteristic dermatologic manifestations are important in the diagnosis of dermatomyositis. It is known that most of the dermatologic manifestations occur at the same time as the proximal weakness, but the period between the symptoms of weakness and skin lesions may be variable, especially in previous steroid user. We report a case of atypical presentation of dermatomyositis due to previous steroid use and also report steroid-induced myopathy which may occur from steroid administration during the course of treatment.

Case report

A 77-year-old man visited emergency room presenting progressive proximal muscle weakness. He had a history of taking prednisolone 10mg once a day for the treatment of dermatitis for 2 years and stopped medication 2 weeks ago. He has presented erythematous papule on face and anterior chest but no heliotrope rash and Gottron's papules were observed. Manual muscle test(MMT) revealed a muscle power of grade 4 in his proximal upper and lower extremity. The serum creatine kinase level was 2,281 units/liter and Antinuclear antibody was positive at a titer of 1:80 with a speckled pattern. On Lower extremity MRI, high signal intensities were detected at bilateral gracilis, sartorius, vastus intermedius in T2 weighted images. Electromyography (EMG) revealed typical myopathy pattern in proximal limb muscle(right rectus femoris and right biceps brachii). The muscle biopsy confirmed dermatomyositis. During the hospital stay, he was treated with oral prednisolone 30mg twice a day and it improved patient's symptom. No evidence of accompanying malignancy was found on abdominal or chest CT. Two weeks after discharge, the symptoms of the proximal weakness got worse. MMT revealed a muscle power of grade 2 in his both hip flexor. Determination was necessary, whether the new weakness is secondary to an increase in disease activity or is attributed to steroid-induced myopathy, which may occur from steroid administration. EMG showed decreased amplitude of muscle action potential without spontaneous activity, that was suggestive of the development of steroid induced myopathy. An increase in muscle strength can be observed within 4 weeks after tapering of the glucocorticoid. The Result of EMG and clinical improvement after tapering steroid indicated that steroid-induced myopathy was the main reason of declined muscle strength.

Conclusion

Dermatomyositis is an idiopathic inflammatory myopathy characterized by cutaneous findings. In previous steroid users, presentation may be nonspecific or delayed, leading to late diagnosis. Early identification of symptom allows not only early diagnosis but also prompt treatment. During the treatment course, it is important to be aware of steroid-induced myopathy which may mimic a worsening dermatomyositis. In this case, steroid should be tapered to improve muscle strength.

Table 1. Results of the Needle Electromyography

Muscle	Spontaneous		MUAP		Recruitment pattern
	Fib	PSW	Duration	Amplitude	
INITIAL STUDY					
Tibialis anterior, Right	None	None	Normal	Normal	Normal
Vastus lateralis, Right	None	None	Normal	Normal	Normal
Rectus femoris, Right	3+	3+	Decreased	Decreased	Early
1 st dorsal interosseous, Right	None	None	Normal	Normal	Normal
Biceps brachii, Right	3+	3+	Decreased	Decreased	Early
FOLLOW UP STUDY					
Tibialis anterior, Right	None	None	Normal	Normal	Normal
Vastus medialis, Right	None	None	Decreased	Decreased	Early
Rectus femoris, Right	None	None	Decreased	Decreased	Early
1 st dorsal interosseous, Right	None	None	Normal	Normal	Normal
Biceps brachii, Right	None	None	Decreased	Decreased	Early

Fib: Fibrillation, PSW: Positive sharp wave, MUAP: Motor unit action potential



Fig. 1. (A) Edematous erythema on the face including the upper palpebrae (B) erythematous rash on the upper chest

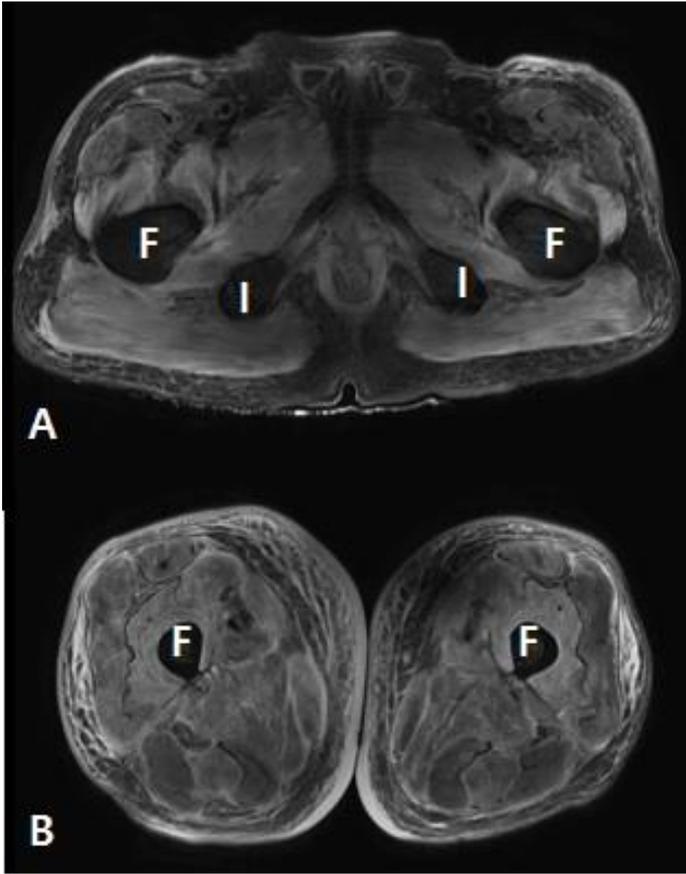


Fig. 2. Transverse T2-weighted fat-saturated MR images of lower extremity muscles. (A) Below femoral head level (B) Mid-thigh level. The MR confirmed the clinical suspicion of dermatomyositis – (A) Severe, extensive bilaterally symmetric edema in the muscles of the pelvic girdle muscles. (B) Subcutaneous edema at medial side of thigh. F = femur, I = ischium.

Rehabilitation of Patient with Ischemic neuropathy after aortic dissection surgery - a Case report

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Introduction

Neurologic complications are often reported after aortic dissection and cardiac surgery, usually leading to cerebral ischemia. Peripheral neuropathy is rare, most of which are accompanied by painless dissection, and few postoperative mononeuropathies are reported. This case study aims to report a rare case with extensive ischemic neuropathy involving unilateral upper and bilateral lower extremities after aortic dissection surgery.

Case report

A 38-year-old male was presented to the emergency department with sudden chest pain and without any weakness. A computed tomography (CT) aortogram was performed, which revealed extensive aortic dissection involving ascending and descending aorta, extending to right common iliac artery and aberrant subclavian artery (Stanford A, DeBakey type I) (Figure 1). The patient was taken to the operation room, where ascending hemi-arch replacement and coronary artery bypass surgery was performed for 15 hours. After surgery, he was managed in the intensive care unit for 10 days and moved to the general ward. Although the general condition of the patient was improved, the weakness of the right upper and both lower extremities remained. Serial brain CT, brain diffusion magnetic resonance imaging (MRI), brachial plexus MRI and spine MRI did not show any evidence for the neurologic deficit. Then the patient was consulted to the department of rehabilitation for further evaluation and proper rehabilitation. On referral, manual muscle test showed distal muscle weakness of affected extremities; fair grade for right wrist extension, finger flexion and abduction, bilateral ankle dorsiflexion, poor grade for bilateral ankle plantar flexion and trace grade for bilateral long toe extension. All the other muscles showed normal strength. Electrodiagnostic test showed diffuse motor and sensory peripheral polyneuropathy with severe axonal injury pattern on the right upper and both lower extremities (Table 1). We considered the neurologic deficit and consequential muscle weakness are most likely due to ischemic neuropathy after long duration open-heart vascular surgery. In this case, extensive aortic dissection also might have affected the surgery outcome. The patient was treated for about 6 weeks in the department of rehabilitation. At discharge, muscle strength showed some improvements; to above fair grade for right hand and bilateral ankles. In addition, improved functional status enabled the patient to endure aerobic exercises using the stairs, treadmill, and ergometer.

Conclusion

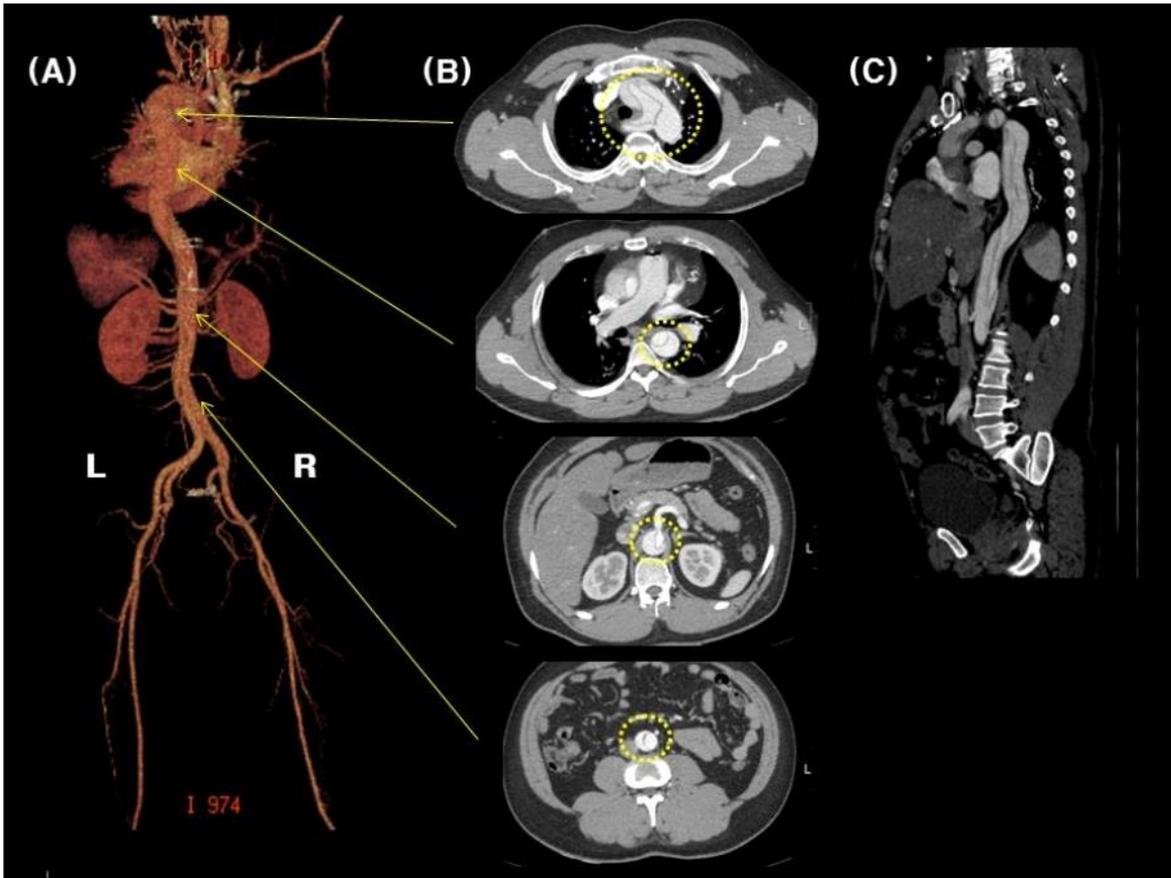
In this case, long duration of vascular surgery and severity of aortic dissection both might have affected the vascular supply and thus, cause extensive distal nerve damage. Therefore, if aortic dissection is severely extended, it would be necessary to keep close attention for the post-op neurologic deficit and seek for early post-op rehabilitation therapy.

Table 1. Nerve conduction study for bilateral upper and lower extremities

Motor nerve	Stimulation - Recording site	Left		Right	
		Latency (msec)	Amplitude (uV)	Latency (msec)	Amplitude (uV)
Median	Wrist - APB	4.1	6.4	11.3	0.4
Ulnar	Wrist - ADM	3.2	6.4	4.3	1.1
Radial	Forearm - EIP	1.9	4.3	1.4	4.7
Axillary	Erb's point - Deltoid	4.4	6.1	4.4	6.9
Musculocutaneous	Erb's point - Biceps brachii	5.2	5.4	6.5	2.2
Peroneal	Ankle - EDB	NR	NR	NR	NR
Tibial	Ankle - AH	5.0	5.6	NR	NR
Femoral	Inguinal area - RF	2.4	0.2	2.8	0.1

Sensory nerve	Stimulation - Recording site	Left		Right	
		Latency (msec)	Amplitude (uV)	Latency (msec)	Amplitude (uV)
Median	Digit - Wrist	3.5	38	NR	NR
Ulnar	Digit - Wrist	3.4	18	NR	NR
Superficial radial	Snuff box - forearm	2.1	60	NR	NR
MABCN	forearm - elbow	2.2	5	2.1	6
LABCN	forearm - elbow	1.7	44	2	25
Sural	Calf - Ankle	NR	NR	NR	NR
Superficial peroneal	Calf - Ankle	NR	NR	NR	NR
Saphenous	Medial shin - Medial shin	NR	NR	NR	NR

Abbreviations; APB, Abductor pollicis brevis; ADM, Abductor digiti minimi; EIP, Extensor indicis proprius; EDB, Extensor digitorum brevis; AH, Abductor hallucis; RF, Rectus femoris; MABCN, Medial antebrachial cutaneous nerve; LABCN, Lateral antebrachial cutaneous nerve; NR, No response
Bold type indicates abnormal values



(A) 3D reconstruction of artery showing extensive dissection line (can be traced following arrowed lines) involving ascending and descending thoracic/abdominal aorta, extending to right common iliac artery (B) axial cuts of contrast-enhanced scan showing the dissected aorta (dotted circle) at different levels (C) sagittal scan of contrast-enhanced scan showing dissection at the descending aorta
Figure 1. Pre-operative CT aortogram

A Young Man with Gait Disturbance Caused by Posttraumatic Orthostatic Tremor of Unknown

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Objective

Orthostatic tremor (OT) is a tremor of lower body activated during standing or weight bearing, absent while seated or lying. OT is a rare disease and predominantly affects female seniors with neurodegenerative diseases such as Parkinsonism and restless leg syndrome. OT can be divided into classical OT (13 to 18 Hz) and slow OT (< 13 Hz) depending on the frequency. There have been few cases of slow OT without underlying diseases or causes, especially after trauma. We report our therapeutic experience in a young man presenting with gait disturbance caused by slow OT occurred after traumatic event.

Case Description

An 18-year-old man complained of the tremor on the left lower limb while standing and walking. The symptom appeared after a traffic accident occurred nine months ago. He had no past history of diseases or hospitalization. At the time of the traffic accident, he did not show loss of consciousness or fractures. When he visited our clinic, he just complained of gait disturbance by orthostatic tremor without pain. Muscle strength of the left lower limb was good on Manual Muscle Test. Spasticity was not checked. Deep tendon reflex was normoactive. Balance was decreased due to the tremor of the left lower limb while walking, which increased the risk of falls. The tremor of the left lower limb occurred only under certain conditions such as standing and the stance phase of gait cycle, but not sitting or lying. He can walk independently without gait aid on the flat but cannot go up and down the stairs without support. Brain MRI revealed nonspecific findings and lumbar spine MRI did not show any abnormal findings other than spondylolysis of L5. Nerve conduction studies and needle electromyography (EMG) were nonspecific. Surface EMG recordings were performed on the left anterior and posterior leg muscles and slow OT of 5-6 Hz was confirmed during the stance phase (Figure 1). Caudal block was conducted, but no effect. After tibial nerve block and sciatic nerve block with lidocaine, tremors of the left lower limb decreased in amplitude but the effect was temporary. He was treated with botulinum toxin injection on the left gastrocnemius. The amplitudes of tremor examined by surface EMG were declined. Clinical functional exams such as Berg balance scale, timed up and go test, and 10-meter walking test showed some improvement (Table 1). Currently, the patient is on beta-blocker and symptoms are being observed on outpatient basis.

Conclusion

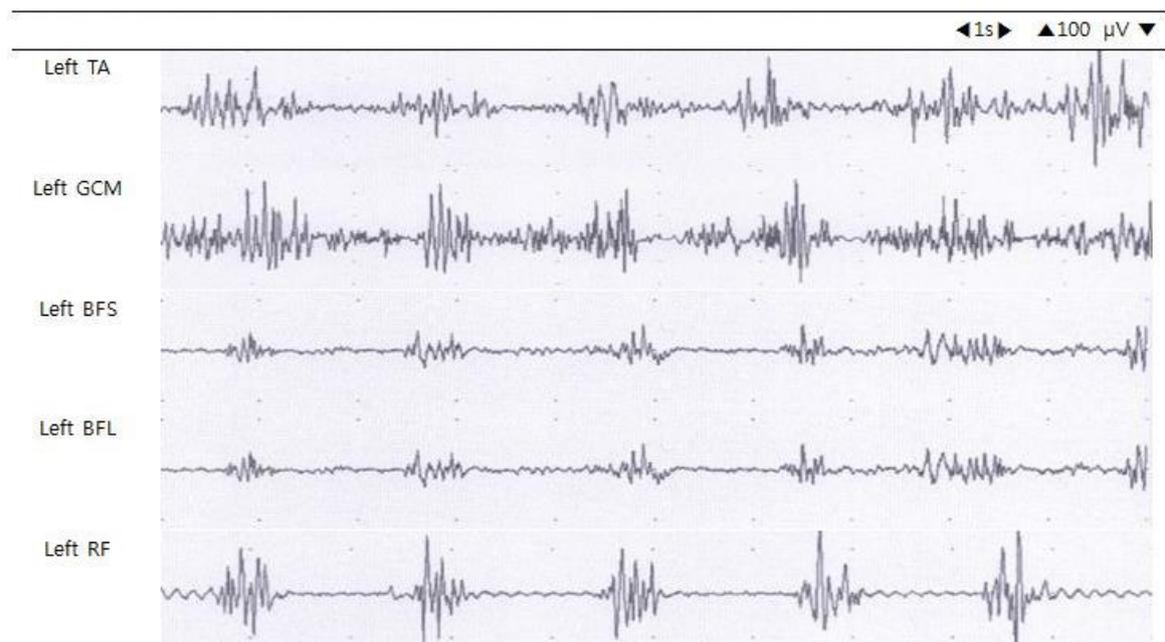
We report a rare case of young man with posttraumatic OT of unknown origin and OT was somewhat improved by multiple therapeutic approaches.

Table 1. Change of functional parameters after therapeutic management

	A		B	
MMT (Right/Left)	U/E(N/N)	L/E(N/G)	U/E(N/N)	L/E(N/G)
Berg balance scale	44		51	
Timed up and go test (sec)	13.49		9.94	
10-meter walking test (m/sec)				
comfortable	0.87		0.67	
fast	1.13		0.89	

(A) Before botulinum toxin injection, (B) At 5 months after botulinum toxin injection

MMT: Manual muscle test, U/E: Upper extremities, L/E: Lower extremities



TA, Tibialis anterior; GCM, Gastrocnemius medial head; BFS, Biceps femoris short head; BFL, Biceps femoris long head; RF, Rectus femoris

Fig 1. Surface electromyography findings in a patient with orthostatic tremor

Application of electrodiagnostic Methods to differential diagnosis of HFS and Meige's syndrome

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Introduction

Bilateral hemifacial spasm (HFS) and Meige's syndrome are very confusing because they have similar clinical symptoms. HFS occurs mostly unilaterally but rarely bilaterally. The pathogenesis of HFS is not clear, but may be caused by tumors and vascular compression that stimulate the facial nerve. The cause of Meige's syndrome is thought to be an abnormality of upper brain stem and basal ganglia, or overactivation of midbrain and basal ganglia. Bilateral HFS is characterized by contraction of involuntary facial muscles that are sequential but not simultaneously, and Meige's syndrome is characterized by contraction of both facial muscles in synchronization. Both disorders have no abnormality on facial nerve conduction and blink reflex, but lateral spread response (LSR) can be observed in HFS. It is important to distinguish between the two disorders because of the different pathogenesis and treatment Methods.

Case report

A 62-year-old man was admitted to the hospital due to involuntary contraction of bilateral facial muscles including orbicularis oculi and oris about 3 years ago. He was diagnosed with blepharospasm in the ophthalmology department and received medication and several botulinum toxin injections, but the symptoms did not improve. He visited neurosurgery for surgical treatment and was referred to the rehabilitation department for differential diagnosis of HFS and Meige's syndrome. The following tests were performed for the accurate diagnosis of the patient. First, brain MRI was performed to identify other abnormalities including CPA tumor. Facial nerve conduction and blink reflex, LSR were performed to confirm the abnormality of the facial nerve. During LSR, stimulation was performed in the zygomatic and mandibular branches of the facial nerve, respectively, and then recorded in the orbicularis oculi and mentalis muscles. Multichannel sEMG was applied to confirm synchronization of contractions in both orbicularis oculi and oris (Fig 1). There was no abnormality on brain MRI. Both facial nerve conduction and blink reflex were normal, and LSR was not observed on both sides (Fig 2). In the sEMG performed in the resting state, synchronization of contraction was confirmed in both sides, and the same Result was confirmed in repeated trial (Fig 3). Based on these findings, the patient was diagnosed with Meige's syndrome rather than HFS.

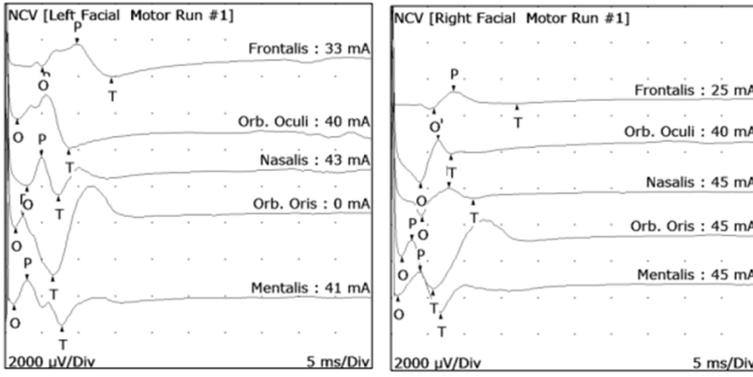
Conclusion

HFS can be treated through surgical treatment of microvascular decompression (MVD), but Meige's syndrome is not an indication for MVD. sEMG and LSR are effective Methods to differentiate between two disorders, and an accurate differential diagnosis prevents unnecessary surgery.

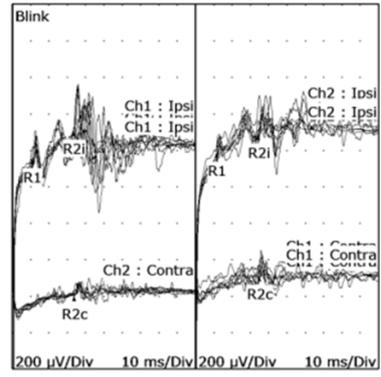


Fig 1. Recording sites of surface electromyography (BTS FREEMG 1000, BTS Bioengineering, Milano, Italy). Four electrodes were attached bilaterally over bilateral orbicularis oculi and orbicularis oris muscles.

A. Nerve conduction study



B. Blink reflex



C. Lateral spread response

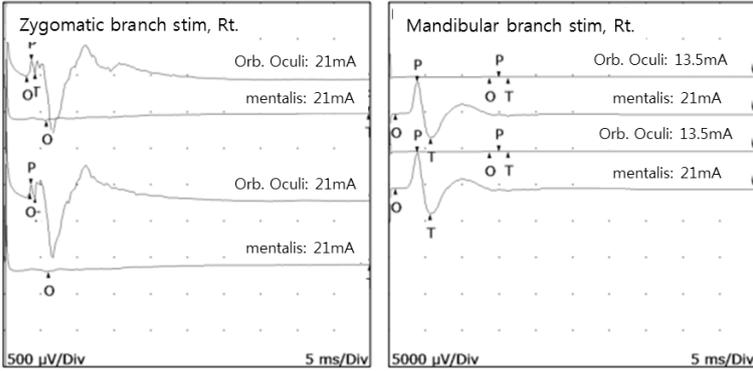


Fig 2. Results of electrodiagnostic studies. Nerve conduction studies (A) of facial nerve and blink reflex (B) were normal. Lateral spread response (C) was not observed on both side.

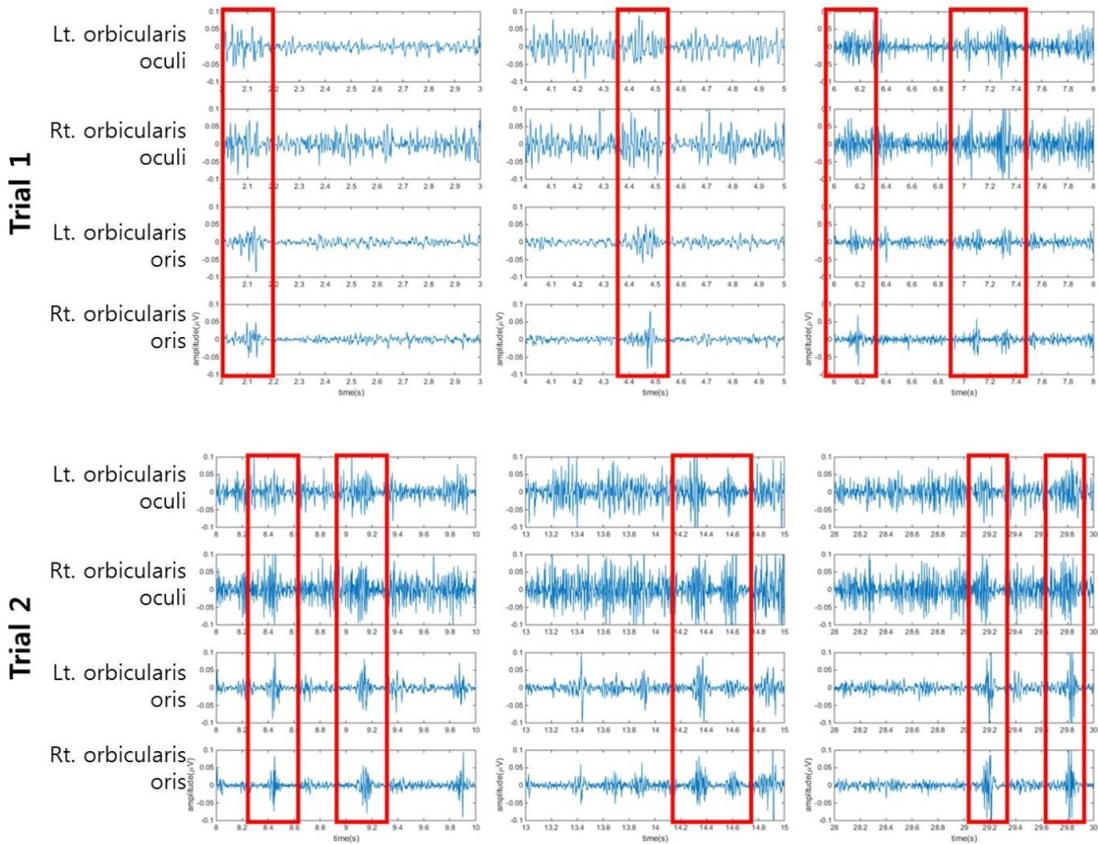


Fig 3. Surface electromyography (sEMG) manifestations in patient with Meige syndrome. sEMG signals showed synchronous contraction of bilateral orbicularis oculi and orbicularis oris muscles.

A Case report of ulnar neuropathy at the elbow with double ulnar-to-median nerve anastomoses

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Korea University Anam Hospital, Department of Physical Medicine & Rehabilitation¹

Introduction

There are various anomalous communications between the ulnar and median nerve in both forearm and hand. Nevertheless, since many anastomosis are asymptomatic, they are often undiscovered until nerve injuries occur. Marinacci anastomosis, the unification of ulnar nerve and median nerve at forearm and Riche-Cannieu anastomosis, communication between the deep branch of ulnar nerve and the recurrent branch of median nerve in the hand, are some of the examples of rare anomalies. This Case report describes electrophysiological feature of ulnar neuropathy at the elbow in patient with double ulnar-to-median nerve anastomoses.

Case presentation

A 75-year old male was referred for electrodiagnostic study (EDX) with chief complaints of paresthesia in the medial aspect of the right forearm. The symptom started 2 months ago and there was no history of trauma or neck pain. On physical examination, there was sensory loss in the right forearm along the ulnar sensory nerve distribution. Tinel sign was positive at the right cubital tunnel and strengths of all the upper extremity muscles, including right hand were intact. In the nerve conduction study, low amplitudes were shown in compound muscle action potential (CMAP) of the right ulnar nerve with abductor digiti minimi muscle recording and sensory nerve action potential (SNAP) of the right ulnar and dorsal ulnar cutaneous nerves. In needle electromyography (EMG), fibrillation potentials and positive sharp waves (F&P) and polyphasic motor unit action potentials (MUAP) with reduced recruitment patterns were noted in the right ulnar nerve innervated muscles. Findings were compatible with right ulnar neuropathy at the elbow. However, further electrophysiologic findings were suspicious of anomalous communication between the ulnar and median nerve. Amplitude of the right median CMAP was very low while amplitude of the right median SNAP was within normal limit. In needle EMG, F&P but normal MUAP were noted in the flexor pollicis longus, pronator quadratus and abductor pollicis brevis (APB) muscles. No F&P were noted in other median nerve innervated muscles and C8 myotomes. In ulnar nerve stimulation with APB recording, CMAP without initial positive deflection was obtained in both wrist and below-elbow stimulations. The possibility of median neuropathy, cervical radiculopathy or brachial plexopathy were ruled out and the patient was finally diagnosed as incomplete ulnar neuropathy at the elbow with ulnar-to-median anastomosis. Based on electrophysiologic findings, we assumed that there would be two communication branches, one in the forearm (connection to anterior interosseous nerve) and the other in the hand (connection to recurrent branch of the median nerve), respectively.

Conclusion

The presence of these anastomosis may complicate the interpretation of electrophysiological findings and Result in misdiagnosis, coexisting anterior interosseous neuropathy and median neuropathy at the wrist.

Table 1. Nerve conduction study

Motor		Stimulation site	Recording site	Latency (msec)	Amplitude (mV)	NCV (m/sec)	F wave (msec)
Side	Nerve						
Right	Median	wrist	APB	3.4	2.9*	53	28.35
	Ulnar	wrist	ADM	3.0	6.8*	53	28.24
		below elbow	ADM	6.4	6.1*	53	
		above elbow	ADM	8.3	6.0*		
	Ulnar	wrist	FDI	4.0	13.1	55	
		below elbow	FDI	7.3	12.0	53	
		above elbow	FDI	9.2	11.6		
Left	Ulnar	wrist	ADM	3.1	10.7	59	
		below elbow	ADM	6.0	10.1	56	
		above elbow	ADM	7.8	9.7		
Sensory		Stimulation site	Recording site	Latency (msec)		Amplitude (uV)	Distance (cm)
Side	Nerve			Onset	Peak		
Right	Median	wrist	III digit	2.8	3.6	24.9	14
		palm	III digit	1.6	2.2	37.5	7
	Ulnar	wrist	V digit	2.6	3.4	7.3*	14
	DUCN	forearm	4th web space	2.3	2.8	6.3	10
	*MABCN	elbow	forearm	2.1	2.6	5.3	10

APB, abductor pollicis brevis; ADM, abductor digiti minimi; FDI, first dorsal interossei; DUCN, dorsal ulnar cutaneous nerve; MABCN, medial antebrachial cutaneous nerve
Abnormal values are represented with asterisk

Table 2. Needle electromyography

Side	Muscle	Insertional activity	Spontaneous activity	Motor unit action potentials			Interference pattern
				Polyphasia	Amplitude	Duration	
Right	Pronator teres	N	-	N	N	N	Full
	Flexor carpi radialis	N	-	N	N	N	Full
	Pectoralis major (sternal head)	N	-	N	N	N	Full
	Extensor indicis proprius	N	-	N	N	N	Full
	Flexor carpi ulnaris	N	-	Polys	Large (7mV)	Long	Reduced
	First dorsal interossei	IIA	F&P(+++)	Polys	Large (8mV)	Long	Reduced
	Abductor digiti minimi	IIA	F&P(+++)	Polys	Large (7mV)	Long	Reduced
	Flexor pollicis longus	IIA	F&P(++)	N	N	N	Full
	Pronator quadratus	IIA	F&P(++)	N	N	N	Full
	Abductor pollicis brevis	IIA	F&P(+++)	N	N	N	Full

N, normal; F, fibrillation potentials; P, positive sharp waves

Acute Flaccid Myelitis in a Korean Adult

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Acute flaccid myelitis (AFM) is a rare myelitis subtype characterized by acute flaccid paralysis owing to spinal cord gray matter involvement of various viruses including poliovirus. Recently, AFM garnered global attention due to the fear of polio recurrence in polio-free countries. In Korea, to our knowledge, there has been no reports of AFM in adult. A previously healthy 28-year-old woman presented with one-day history of sudden onset quadriparesis. Two weeks earlier, she had severe gastrointestinal symptoms of vomiting and diarrhea and a fever as high as 38.3°C. Cervical spine magnetic resonance imaging (MRI) at three hours of symptom onset revealed no definite abnormal findings (Fig. 1A). Neurologic examination revealed near complete motor weakness in the upper limb. Cerebrospinal fluid (CSF) study revealed mild pleocytosis (12/mm³) and proteins were in the normal range. CSF samples for common neurotropic virus were negative as determined using polymerase chain reaction. A nerve conduction study at 3 days revealed normal sensory nerve conduction and decreased motor nerve conduction amplitude. She was presumptively diagnosed with Guillain-Barré syndrome and was treated with 5 days of intravenous immunoglobulin (IVIG). Seven days after IVIG treatment, her arm weakness was markedly improved. Contrary to initial evaluation, DTRs in the upper limb were slightly increased. Owing to unusual upper motor signs, cervical spine MRI was re-examined. MRI showed T2 hyperintensity in the anterior cord between C3 and C7 with ventral root enhancement (Fig. 1B-F). Considering acute upper limb paralysis with involvement of the anterior horn cell on MRI, a diagnosis of acute flaccid myelitis (AFM) was made. Intravenous methylprednisolone (1g/day) was administered for 5 days. Two years later, strength improved to near normal, but asymmetric weakness of C5 myotome on right and C7 myotome on left remained. In Conclusion, clinicians should consider AFM in patients presenting with acute flaccid paralysis following respiratory or gastrointestinal symptoms.

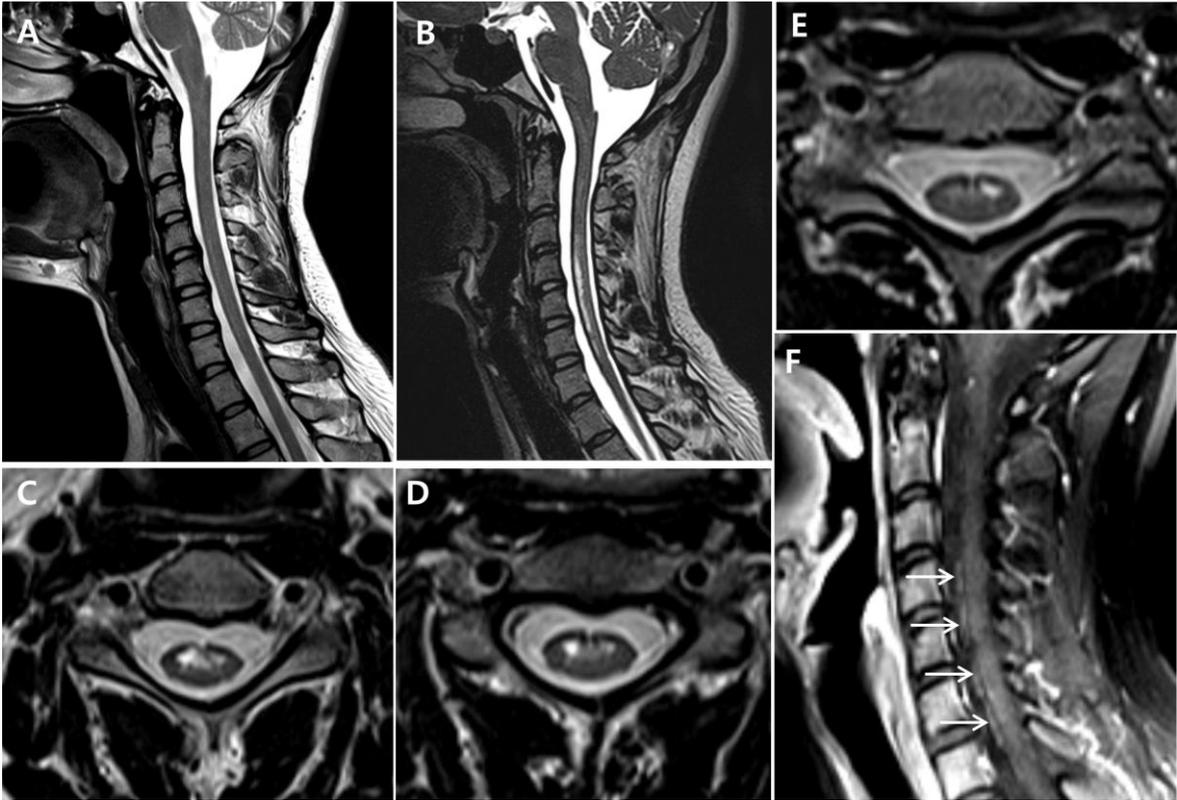


Fig. 1. Magnetic resonance imaging (MRI) findings. (A) MRI scans within three hours of symptom onset revealed no definite abnormalities in cervical cord. (B) At 2 weeks after the onset of neurological symptoms, cervical spine MRI revealed T2-hyperintensity within the anterior spinal cord. (C-E) Axial T2 weighted image revealed prominent anterior horn cell involvement at C4 and 5 level on right and C6 level on left. (F) Gadolinium-enhanced T1 weighted image showed ventral root enhancement over C4-7 vertebral levels on paracentral area (arrow).

Deep peroneal neuropathy probably due to neglected anterior compartment syndrome

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Introduction

Compartment syndrome is a condition in which increased compartment pressure within a confined space compromises the viability of enveloping tissues. It remains emergencies in traumatology since it has a high risk of associated limb morbidity if left untreated. We examined a patient suffering the right foot drop after painful swelling of the right anterior tibial area. This is, to our best knowledge, the first case revealing the long-term complicated sequelae of neglected anterior compartment syndrome.

Case report

A 38-year-old male patient visited the clinic and complained of the right foot drop. The patient had no underlying disease but could quite clearly memorize the traumatic injury of his right lower leg about 15 years ago. When playing soccer, he had accidentally kicked a hard stuff with his anterior leg and it soon became swollen with severe pain. The symptom gradually improved after applying long-leg cast, but the right ankle dorsiflexor weakness then commenced and progressed. The manual muscle testing and calf circumference measurement represented remarkable side-to-side discrepancy. The patient then underwent electromyography (EMG). The right peroneal motor response with extensor digitorum brevis (EDB) muscle recording was of decreased velocity at the fibular head stimulation while that at the ankle stimulation was normal. Additional exploration could not locate accessory peroneal nerve innervating EDB. The right deep peroneal sensory response was unobtainable. In needle EMG of the right tibialis anterior (TA) and extensor hallucis longus (EHL) muscles, only 1 or even no motor unit potential was identifiable. On the other hand, parameters of the right EDB were within normal limits. Here we could diagnose incomplete deep peroneal neuropathy with the necrosis of the right TA and EHL, which is enveloped in the anterior tibial compartment.

Discussion

The “6 Ps” have been widely used to describe clinical manifestation of compartment syndrome. When it comes to “paralysis”, injury of the enveloped nerve causes its innervating muscle weakness but physicians should also focus on the possibility of direct damage on the enveloped muscles. In this case, EMG findings suggested deep peroneal neuropathy around the leg sparing EDB, which is located below the injured area. TA and EHL are both innervated by deep peroneal nerve as EDB is, but they are anatomically placed in a confined area called anterior compartment while EDB lies distal to those muscles. Since there was no evidence of accessory peroneal nerve innervation, we could deduce that excessive swelling of the patient’s anterior tibial area pressed the soft tissue

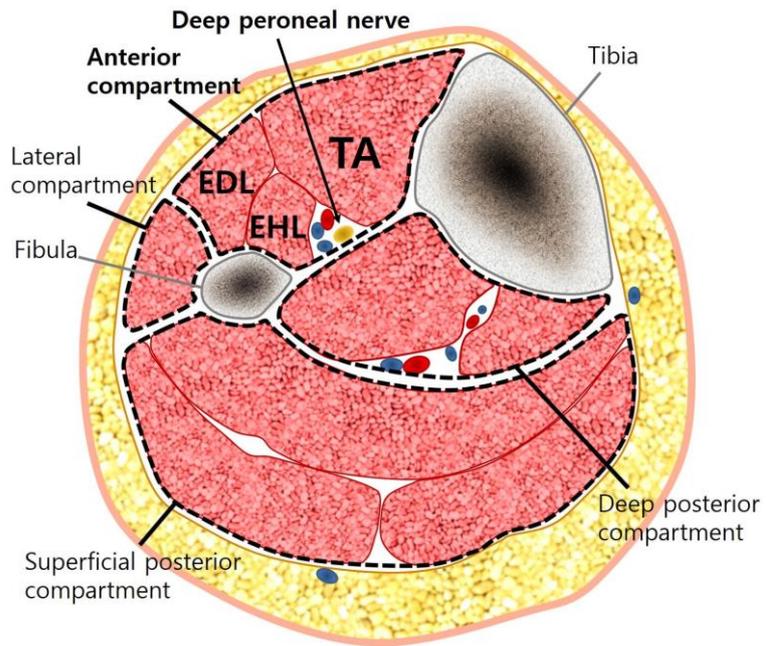
in the anterior compartment, and the relevant muscle necrosis with neuropathy progressed while the patient was untreated. This case implies that physicians must check symptoms of compartment syndrome at the time of not only the first diagnosis but also the serial medical follow-up.

Motor nerve conduction study							
Nerve / Sites	Latency (ms)	Amp.1-2 (mV)	Dur. (ms)	Area (mVms)	Distance (cm)	Lat Diff (ms)	Velocity (m/s)
R TIBIAL (KNEE) – AH							
1. Ankle	5.05	18.9	5.65	54.6		5.05	
2. Knee	13.80	16.1	6.10	52.8	40	8.75	45.7
R COMM PERONEAL – EDB							
1. Ankle	5.65	5.0	5.50	12.8		5.65	
2. Fib Head	14.30	4.8	8.25	14.9	27	8.65	31.2*
3. Knee	15.80	4.5	8.05	14.2	8	1.50	53.3
Sensory nerve conduction study							
Nerve / Sites	Rec. Site	Latency (ms)	Lat. 2 (ms)	Amp.1-2 (µV)	Resp.	Lat Diff (ms)	
R SURAL – Lat Malleolus							
1. Calf	Lat Malleolus	2.85	3.75	21.8		2.85	
R SUP PERONEAL – Foot							
1. Lateral Leg	Foot	2.55	3.45	17.6		2.55	
R DEEP PERONEAL – Foot							
1. Dorsum	First web					No*	
L DEEP PERONEAL – Foot							
1. Dorsum	First web	1.95	2.70	6.3		1.95	

Motor and sensory nerve conduction study Results of the patient's right upper and lower extremities.

Needle electromyography								
	IA	Spontaneous			MUAP			Recruitment
		Fib	PSW	Fasc	Amp	Dur	PPP	Pattern
R. TIB ANTERIOR	Decreased	None	None	None				1 MUAP
R. EXT HALL LONG	Decreased	None	None	None				No Activity
R. EXT DIG BREVIS	N	None	None	None	1+			Reduced
R. PERON LONGUS	N	None	None	None	N	N	N	Sl. reduced
R. VAST LATERALIS	N	None	None	None	N	N	N	Normal
R. T FASCIA LATA	N	None	None	None	N	N	N	Normal
R. TIB POSTERIOR	N	None	None	None	N	N	N	Normal
R. GASTROCN (MED)	N	None	None	None	N	N	N	Normal
R. GLUTEUS MAX	N	None	None	None	N	N	N	Normal
R. L4 PSP	N	None	None	None				
R. L5 PSP	N	None	None	None				
R. S1 PSP	N	None	None	None				

Needle electromyography Results of the patient's right lower extremity and lumbosacral paravertebral muscles.



Axial section of the lower leg. Abbreviations: TA, tibialis anterior; EHL, extensor hallucis longus; EDL, extensor digitorum longus

Practical gait analysis using IMU sensors in a complete femoral nerve-injured patient: A Case report

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Background

Conventional kinematic gait analysis requires facilities with motion capture cameras, which is not affordable in many hospitals. With improvement of engineering technology, an alternative Method using inertial measurement unit (IMU) sensors for each lower-limb joints can be more practical.

Case presentation

An 28-year-old female received the operation for removal of schwannoma encasing left femoral nerve. After the operation, she experienced left knee extensor weakness. The electromyography was performed about 3 weeks after the operation, which revealed abundant abnormal spontaneous activities in all left quadriceps muscles with no recruitment of motor unit. The muscle power of left knee extensor is nearly zero, and has not been improved. Although the gait velocity is low, she can walk with or without single cane, and go up and down stairs without alternation. The 3-dimensional gait analysis system with 7 IMU sensors (Human Track™, RBiotech) revealed mild left genu recurvatum (about 3° of knee hyperextension) in sagittal plane from initial to terminal stance phase. She complained left knee pain due to strenuous gait training by herself, which improved with intermittent rest between walking. After 4 week-period of gait training, the follow-up gait analysis showed improved knee motion in the coronal plane without deterioration of genu recurvatum in sagittal plane.

Conclusion

The kinematic gait analysis system with IMU sensors may be reliable and feasible in neurological and musculoskeletal disorders. Initial and follow-up gait analysis with the practical wearable sensor system may provide relevant rehabilitation strategies.



The 3-dimensional gait analysis system with IMU sensors

Missed Diagnosis of CIDP in a Patient with Cervical Myelopathy Due to OPLL

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In the current study, we report a missed diagnosis of combined chronic inflammatory demyelinating polyneuropathy (CIDP) in a patient with a cervical spinal cord lesion. At 3.5 months after the onset of symptoms, a 60-year-old female with mild motor weakness and significant weight loss underwent a surgical operation for decompression of the cervical spinal cord. However, her motor weakness was severely aggravated despite the surgical treatment, and she could not walk independently at 10 months after symptom onset. Based on the Results of electrophysiological and cerebrospinal fluid tests, we diagnosed her with CIDP. Considering her medical history and the Results of our evaluations, we think our patient's neurological symptoms before the surgical operation were attributed, at least in part, to CIDP. Our study shows that clinicians should consider the possibilities of other lesions in different areas even when patients have a definite lesion in the cervical spinal cord or cervical spine.

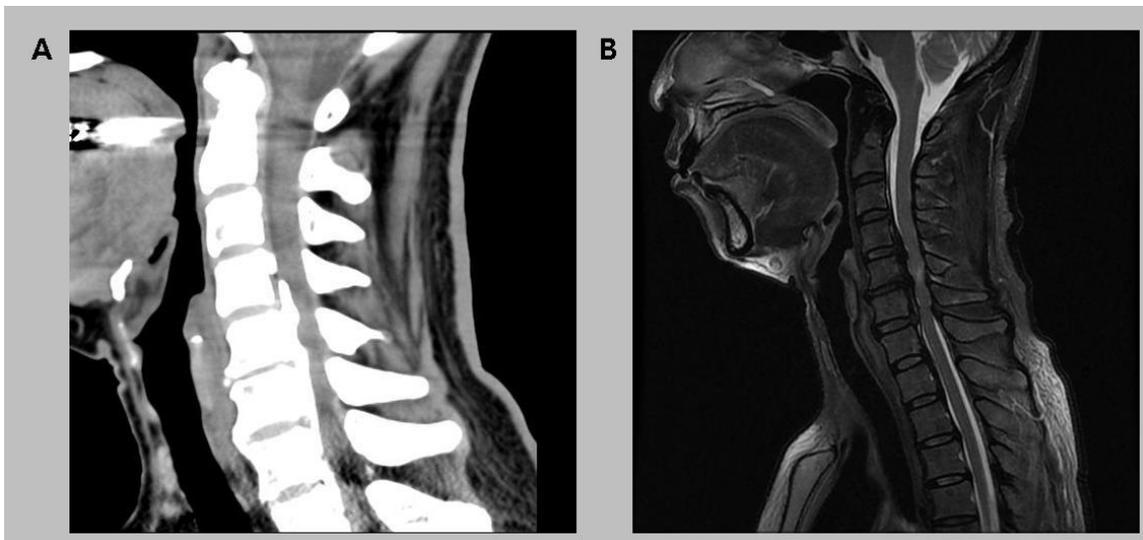


Fig. 1. The sagittal CT (A) and T2-weighted cervical spine MRI (B) at 3 months after symptom onset showed ossification of the posterior longitudinal ligament at the level of C3-T1 with cervical cord compression and high signal intensity in the cervical spinal cord at the C5-6 disc space level.

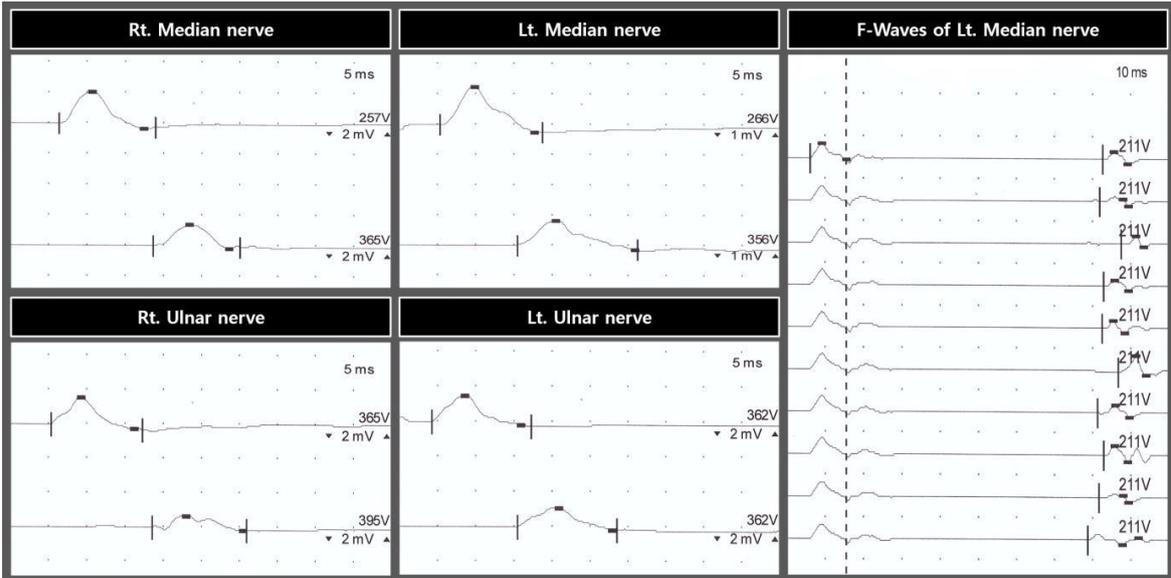


Fig. 2. Median and ulnar motor nerve conduction responses at 10 months after onset showed delayed latency, decreased conduction velocity, and low amplitude of compound motor action potential. In addition, F wave on the left median nerve showed delayed latency

Brachial plexopathy after deep sleep

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Introduction

Lying on the side while falling asleep deeply after drinking or taking a sleeping pill can cause compressive neuropathy. We report a case of medial cord plexopathy after deep sleep.

Case presentation

A 70 - year - old man visited our clinic with symptoms of numbness and tingling sensation at the medial side of the left upper extremity ever since 10 days ago. On the day before the symptom started, he took a sleeping pill and slept on a lateral decubitus position. When the patient woke up, he felt pain and numbness on the left arm. His past medical history was unremarkable except hypertension. On physical examination, bruise was found on the medial side of the left arm 5 cm below the axilla (Figure 1). Hoffman sign was negative and deep tendon reflexes of biceps and triceps jerk were normoactive. Motor examination showed the left finger flexor and abductor weakness (3/5 MRC scale). Sensory examination showed hypoesthesia and paresthesia in the medial side of the left arm and the palmar side of left hand in the light touch and pin prick test. First electrodiagnostic study (EDx) was performed 12 days after the initial visit. The amplitudes of sensory nerve action potentials (SNAPs) of the left median and ulnar were decreased. Medial antebrachial cutaneous nerve was unobtainable in both sides. F-responses were unobtainable with the left median nerve stimulation and prolonged with the left ulnar nerve stimulation. The needle electromyography in the first EDx study is shown in Figure 2. Second EDx study was performed 47days after the initial visit. The SNAP amplitudes of median and ulnar nerves were decreased even more. However, F response of median nerve was normalized. Based on the above findings, we concluded that the EDx findings are compatible with left brachial plexopathy at the medial cord lesion. Plain radiographs of the left shoulder and elbow were unremarkable. Ultrasonography showed no space occupying lesions along the peripheral nerves and brachial plexus. However, diffuse swelling of nerve fascicles of median and ulnar nerves distal to brachial plexus were noted (Figure 3). On the initial visit, oral prednisolone and vitamin B complex for supplementary treatment were prescribed. Analgesics including NSAIDs, acetaminophen/tramadol and pregabalin were also prescribed to manage severe pain. He was instructed to perform finger flex/abduction strengthening exercise. Six months after the initial visit, motor function of finger flexor and abductor (4/5) and paresthesia (70%) were improved.

Discussion

The mechanism of the injury might be compression and traction of brachial plexus. In addition, based on the evidence of compression and EDx findings (especially decreased median SNAP), we thought that combined peripheral neuropathy around the

compression site mainly involving sensory fiber of median, ulnar or medial antebrachial nerve may be possible. Conservative management was sufficient to treat brachial plexopathy.



fig1. Bruise on the medial side of the left arm 5 cm below the axilla

	Muscle	Insert. act.	Spont. act. (F&P)	Motor unit action potentials			
				Phase	Amplitude	Duration	Recruitment
Lt.	Biceps brachii	N	-	N	N	N	F
	Pronator teres	N	-	N	N	N	F
	Triceps brachii	N	-	N	N	N	F
	Extensor indicis proprius	N	-	N	N	N	F
	Flexor carpi ulnaris	N	-	N	N	N	R
	Abductor digiti minimi	N	-	N	N	N	R
	1 st dorsal interosseus		+	N	N	N	R
	Abductor pollicis brevis		+	N	N	N	R
Lt.	C6/7 PVMs	N	-				
	C7/T1 PVMs	N	-				

fig2. Needle electromyography in the first electrodiagnostic study

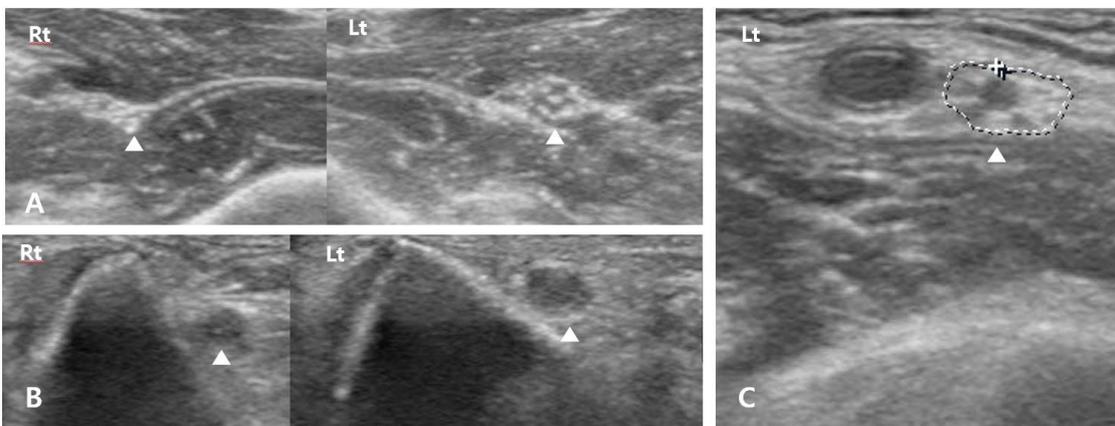


fig3. Enlarged nerve fascicles of left median nerve at the mid forearm level (A), ulnar nerve at the elbow level (B) and median nerve at the mid arm level (C)

Unusual isolated distal spinal accessory nerve palsy in weight lifter : a Case report

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Introduction

Spinal accessory nerve injury is well-documented complication of surgical procedures in the posterior cervical triangle of neck. However, the insidious spinal accessory nerve palsy is considered a few instances in the literature. We present an unusual case study of isolated distal spinal accessory nerve palsy only involved mid to lower trapezius in a young male weight lifter.

Case presentation

A 30-year-old male presented with asymmetric muscle contractions in inter-scapular area. His career is a body builder, and he did a heavy lifting exercise every day. There were no history of traumas, falls or any precipitating events. The onset of his symptoms occurred 2 months ago with a right-sided upper back pain while he was putting down a heavy dumbbell with one hand after the benchpress exercise. He described the pain as intermittent and dull, ranging from 3 to 4 out of 10 on a numeric pain rating scale. Pain improved after a few days with NSAID. A few weeks later, he came to our hospital after feeling asymmetry of upper back during shoulder retraction exercise. On physical examination there was no sensory loss, but the scapular dyskinesia during the arm elevation and the atrophy localized in the right-sided inter-scapular area were observed (Fig. 1). His past medical history was unremarkable. On the ultrasonography, the rhomboid and upper trapezius muscles were symmetrical on both sides, but the right muscle thickness of trapezius muscles in the mid to lower part were decreased (Fig. 2). Spinal accessory nerve conduction studies demonstrated that low amplitude compound muscle action potential recording mid to lower segment of the right trapezius with normal distal latency. But upper trapezius findings were normal. A needle electromyography of the mid to lower trapezius muscles revealed signs of remarkable denervation potentials and markedly decreased motor unit action potential recruitment in volition. The upper trapezius, rhomboid and sternocleidomastoid muscles showed no signs of denervation. On T2-weighted magnetic resonance imaging(MRI) identified no space occupying lesions except mild diffuse atrophy with signal change of right lower trapezius muscle (Fig. 3). Consequently, we diagnosed the incomplete lesions of isolated distal branch of spinal accessory nerve spontaneously involved mid to lower trapezius. The cause is unknown, but it might be related to traction-type injury based on patient's past history .

Conclusion

We report a case of unusual isolated distal branch of spinal accessory nerve palsy involved mid to lower trapezius muscles in a young weight lifter. In this case, the nerve

lesion occurred spontaneously during self-exercise without a definite trauma. Although the peripheral nerve lesion should be confirmed by electromyography, ultrasonography could be used helpful for localization of lesions at initial diagnostic approach for asymmetrical weakness.



Fig. 1. Physical examination of the patient reveals severe atrophy of the right mid to lower trapezius muscle (arrows).

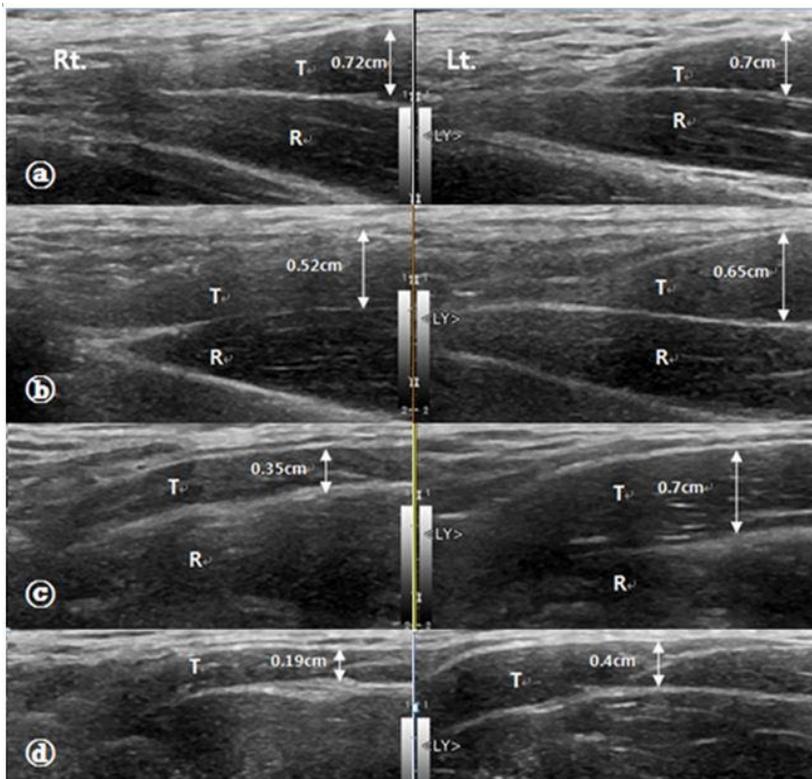


Fig. 2. Ultrasonography showed atrophy of middle and lower component of the trapezius.

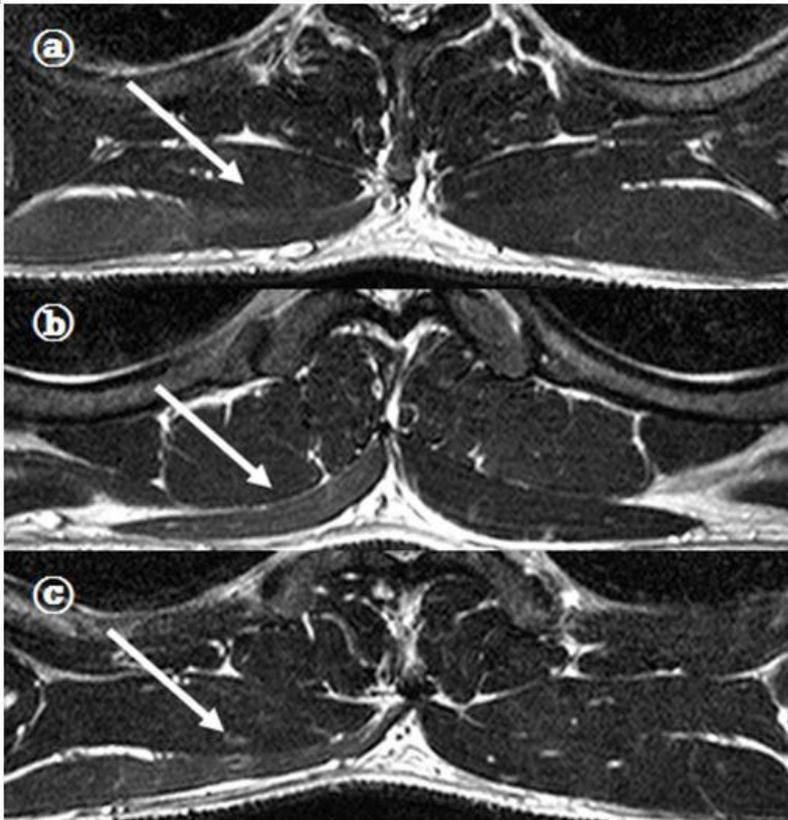


Fig. 3. Transverse views of T2-weighted magnetic resonance imaging(MRI) reveal marked wasting in the muscle bulk of mid to lower part of the right trapezius (arrows). (a) T2 level, (b) T4 level, (c) T7 level.

Unusual Painful Guillain-Barre Syndrome Associated with Scrub Typhus: A Case report

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Introduction

Guillain-Barre syndrome (GBS) is an illness characterized by areflexic ascending paralysis with minimal sensory involvement. Most cases are sporadic. Two-thirds of patients have previous infection due to *C. jejuni*, cytomegalovirus, Epstein Barr virus or *M. pneumoniae* within previous 6 weeks. Few cases of GBS associated to scrub typhus infection and one case of Miller-Fisher syndrome have been reported. However, there was no Case report of GBS associated with scrub typhus and neuropathic pain. In this Case report, we present progression and recovery course of painful GBS associated to scrub typhus infection with electrodiagnostic follow up.

Case report

A 66-year old man was referred to the department of infection, Daejeon St. Mary`s hospital due to poor oral intake, general weakness, hematuria, and elevate liver enzymes. One week earlier, he had visited the local clinic due to myalgia and was clinically suspected as scrub typhus. He had taken doxycycline for 4 days. In the history taking, he had been going to the countryside to pick up the persimmon ten days before. On physical examination, dark colored rashes were on his chest, and an eschar was found on the medial thigh of right leg. In initial laboratory Result, serum *O. tsutsugamushi* antibody titer was positive (1:5120). Manual muscle test (MMT) revealed right upper extremity, 4/5; left upper extremity, 5/5; both lower extremities, 4/5. However, initial brain computed tomography and magnetic resonance imaging Results showed no acute infarction or hemorrhage. On the evening of hospital day (HD) 2, tetraplegia was worsening (MMT; right upper extremity, 2-/5; in left upper and both lower extremities, 2/5). Intravenous immunoglobulins (IVIG) were administrated for five days (30g, 400mg/kg/day). On HD 19, electrodiagnostic study revealed demyelinating peripheral neuropathy, clinically acute inflammatory demyelinating polyradiculoneuropathy (Table 1, 3). The patient complained tingling sensation on all extremities, and started to be treated gabapentin 600 mg. On HD 28, his motor power gradually improved (MMT; both upper extremities, 5/5; both lower extremities, 4/5), and he was able to walk under supervision. On HD 29, however, his neuropathic pain was getting worse. The total dose of gabapentin increased to 1200 mg. On HD 40, he was discharged with mild gait disturbance and neuropathic pain. 2 weeks after discharge, the second follow up of electrodiagnostic study showed significant improvements (Table 2, 3). 2 months after discharge, numbness still remained on the fingertips of left hand and gabapentin was maintained. 4 months after discharge, the patient was fully recovered from weakness and neuropathic pain disappeared completely.

Conclusion

We report a rare case of painful GBS related to the scrub typhus with describing the detailed electrodiagnostic study as well as clinical manifestation.

Table 1. First NCS and F wave study (onset after 20 days)

Nerve	Stimulation	Right			Left		
		Latency (ms)	Amplitude (mV)	CV (m/s)	Latency (ms)	Amplitude (μV)	CV (m/s)
Motor							
Median APB	Wrist	9.2 ↑	1.0 ↓	-	6.7	1.4 ↓	-
	Elbow	15.5 ↑	0.8 ↓	35.7 ↓	13.0	1.0 ↓	36.0 ↓
Ulnar ADM	Wrist	3.7 ↑	2.0 ↓	-	6.4	1.0 ↓	-
	Below elbow	6.6 ↑	1.0 ↓	39.2 ↓	12.4	0.7 ↓	37.5 ↓
Peroneal EDB	Ankle	16.2 ↑	0.2 ↓	-	No response		
	Fibular head	43.8 ↑	0.1 ↓	11.3 ↓	No response		
Peroneal TA	Ankle	9.4 ↑	0.4 ↓	-	7.6	0.9 ↓	-
	Knee	14.0 ↑	0.1 ↓	34.8 ↓	11.4	0.4 ↓	27.6 ↓
Tibial	Ankle	17.6 ↑	0.4 ↓	-	10.0	0.4 ↓	-
	Popliteal fossa	32.3 ↑	0.2 ↓	25.7 ↓	24.7	0.2 ↓	23.8 ↓
F wave							
Median APB		59.6 ↑	-	-	43.6 ↑	-	-
Ulnar ADM		50.8 ↑	-	-	49.2 ↑	-	-
Tibial AH		79.2 ↑	-	-	99.0 ↑	-	-
Nerve	Stimulation	Right			Left		
		Latency (ms)	Amplitude (μV)	CV (m/s)	Latency (ms)	Amplitude (μV)	CV (m/s)
Sensory							
Ulnar	wrist	4.5 ↑	4.2 ↑	-	Not evoked		
Sural	Calf	4.4 ↑	4.0 ↑	-	4.1 ↑	6.7 ↓	-
Superficial peroneal	Lateral leg	Not evoked			Not evoked		

CV, conduction velocity; APB, abductor pollicis brevis; ADM, abductor digiti minimi; EDB, extensor digitorum brevis; TA, tibialis anterior; and AH, abductor hallucis

Table 2. Second NCS and F wave study (onset after 2 months)

Nerve	Stimulation	Right			Left		
		Latency (ms)	Amplitude (mV)	CV (m/s)	Latency (ms)	Amplitude (µV)	CV (m/s)
Motor							
Median APB	Wrist	4.8 ↑	3.1 ↓	-	5.4 ↑	3.6 ↓	-
	Elbow	10.1	2.8 ↓	43.2 ↓	9.8	3.4 ↓	50.0
Ulnar ADM	Wrist	3.5 ↑	4.3 ↓	-	4.9 ↑	1.4 ↓	-
	Below elbow	7.9	2.7 ↓	51.1	9.6	0.9 ↓	44.8 ↓
Peroneal EDB	Ankle	8.8 ↑	0.3 ↓	-	No response		
	Fibular head	20.6	0.3 ↓	22.9 ↓	No response		
Tibial	Ankle	8.6 ↑	1.4 ↓	-	10.3 ↑	0.5 ↓	-
	Popliteal fossa	17.3	1.0 ↓	40.2	20.9 ↑	0.3 ↓	25.5 ↓
F wave							
Median APB		35.8 ↑	-	-	38.4 ↑	-	-
Tibial AH		69.4 ↑	-	-	66.4 ↑	-	-
Nerve	Stimulation	Right			Left		
		Latency (ms)	Amplitude (µV)	CV (m/s)	Latency (ms)	Amplitude (µV)	CV (m/s)
Sensory							
Ulnar	Palm	Not evoked			Not evoked		
	wrist	Not evoked			Not evoked		
Sural	Calf	4.4 ↑	3.5 ↓	-	4.1 ↑	4.1 ↓	-
Superficial peroneal	Lateral leg	Not evoked			Not evoked		

Table 3. Electromyographic Results

Muscle	IA	FIB	PSW	MUAP	Interferential pattern
First electromyography (onset after 20 days)					
Right biceps brachii	Normal	None	1+	Normal	Reduced
Right flexor carpi radialis	Normal	2+	1+	Polyphasic	Reduced
Right first dorsal interosseous	Normal	None	1+	Normal	Reduced
Right abductor pollicis brevis	Normal	None	None	Normal	Reduced
Right gluteus maximus	Normal	None	None	Normal	Reduced
Right gluteus medius	Normal	None	None	Normal	Reduced
Right vastus medialis	Normal	None	None	Normal	Reduced
Right tibialis anterior	Normal	None	1+	No MUAP	No MUAP
Right Gastrocnemius (medial)	Normal	None	1+	No MUAP	No MUAP
Left biceps brachii	Normal	None	1+	Normal	Reduced
Left flexor carpi radialis	Normal	None	1+	Normal	Reduced
Left first dorsal interosseous	Normal	None	None	Normal	Reduced
Left abductor pollicis brevis	Normal	None	1+	Normal	Reduced
Left gluteus maximus	Normal	None	None	Normal	Reduced
Left gluteus medius	Normal	None	None	Normal	Reduced
Left vastus medialis	Normal	None	None	Normal	Reduced
Left Tibialis anterior	Normal	None	1+	No MUAP	No MUAP
Left Gastrocnemius (medial)	Normal	None	1+	No MUAP	No MUAP
Second electromyography (onset after 2 months)					
Right biceps brachii	Normal	None	None	Normal	Reduced
Right flexor carpi radialis	Normal	None	None	Polyphasic	Reduced
Right extensor digitorum communis	Normal	None	None	Normal	Reduced
Right first dorsal interosseous	Normal	None	None	Normal	Reduced
Right iliopsoas	Normal	None	None	Normal	Reduced
Right gluteus medius	Normal	None	None	Normal	Reduced
Right vastus medialis	Normal	None	None	Normal	Reduced
Right tibialis anterior	Normal	None	1+	7mV, 15-20ms	Reduced
Right Gastrocnemius (medial)	Normal	None	1+	3mV, 15ms	Reduced

IA, insertional activity; FIB, fibrillation; PSW, positive sharp wave; and MUAP, motor unit action potential.

Lateral pectoral nerve neuropathy after endoscopic thoracic sympathectomy

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Introduction

Lateral pectoral nerve neuropathy can be diagnosed by the clinical presentation, electromyography (EMG) and nerve conduction study (NCS). In the few reported cases of such injuries, the cause was trauma to this region or postoperative complications.

Presentation of case

A 61-year-old male who underwent bilateral endoscopic thoracic sympathectomy due to hyperhidrosis. The left 6th midaxillary line was inserted with 5mm troca, and the left upper lobe was detached by using endopeanut, endograsper, ligasure. He underwent incidental laceration of left 4th intercostal artery and underwent clipping with endoclips. His chief complaints were left anterolateral chest wall tingling pain, tenderness, paresthesia and weakness over 8 weeks. He came to our clinic at 8 weeks after surgery, EMG and NCS were performed immediately.

Discussion

If the lateral pectoral nerve is injured or removed, it can result in total denervation of the pectoralis major muscle with severe atrophy and fibrosis of this muscle. Figure 1 shows significant atrophy of the left pectoralis major muscle. Figure 2 showed difference of latency bilaterally upon testing of the lateral pectoral nerve (Right – 2.1 msec, Left – 3.5 msec) and the amplitude of the response on the left was substantially lower than the right (Right – 5.2mv; Left – 3.6 mv). NCS of the median, ulnar, radial, and EMG of the biceps was normal and unlike usual results, right pectoralis major muscle was normal.

Conclusions

If a patient complains of local atrophy of the pectoral muscle or unilateral tingling sense or paresthesia, the patient should be suspected of lateral pectoral nerve neuropathy. EMG and NCS can confirm localized abnormal findings in specific muscle and an isolated lesion of the lateral pectoral nerve, so it will be helpful in the diagnosis of lateral pectoral nerve neuropathy.

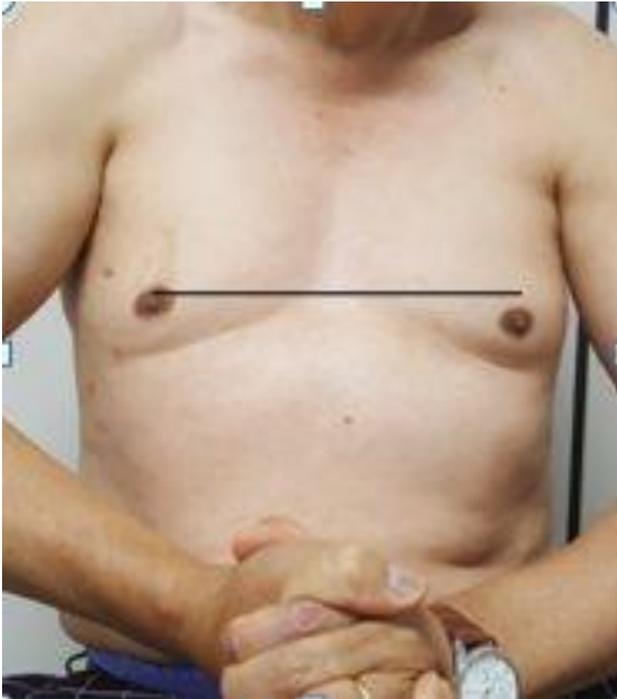


Figure 1. A 61-year-old man with an atrophy of the left pectoralis major muscle Result in difference of areolar level.

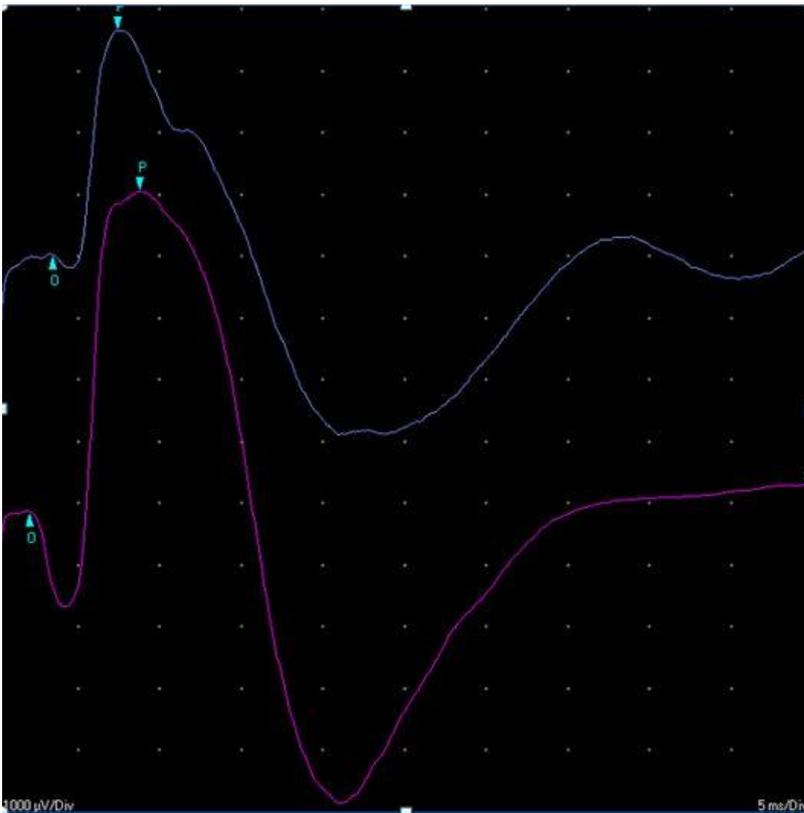


Figure 2. Motor conduction study of bilateral lateral pectoral nerve. Right-purple line, Left-blue line.

Recurrent motor neuropathy of the median nerve: electrophysiologic and ultrasonographic findings

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Introduction

Recurrent motor nerve is a branch of the median nerve which innervates the thenar muscles, and recurrent motor neuropathy (RMN) of the median nerve is considered as a variant type of the carpal tunnel syndrome (CTS) with the rare incidence. In this Case report, we present a case with recurrent motor neuropathy of the median nerve, describing the clinical features, the electrophysiologic and ultrasonographic findings, and the management of recurrent motor neuropathy.

Case report

A 56-year-old female visited to our hospital, presenting with a thenar area pain and a weakness in the dominant right hand. Clinical examination revealed a severe paresis of thumb abduction (0/5) and thumb opposition (0/5), and atrophy in the right thenar area was found. There was no hypesthesia in the right hand. Nerve conduction studies found that the sensory studies of the median, ulnar and radial nerves were normal. No motor response was recorded in the median nerve to the right abductor pollicis brevis, but no other abnormality was found in the motor studies of the both hands. Electromyography test of the right abductor pollicis brevis Resulted no motor unit action potential as well as no abnormal spontaneous abnormal activity. The test of the other muscles showed no definite abnormal findings. Sonographic evaluation revealed a radially originating, extraligamentously coursing, and thickened recurrent motor branch of the median nerve (1.56mm² vs. 0.75mm² on the left). The median nerve distal to the transverse carpal ligament was also enlarged (11.43mm² vs. 7.29mm² on the left) with swollen motor fascicles within the radial side of the median nerve. There was no evidence of the thenar muscle atrophy.

Conclusion

Recurrent motor neuropathy of the median nerve is a rare form of the carpal tunnel syndrome, which does not have the characteristic features of the carpal tunnel syndrome such as sensory symptoms. To diagnose the carpal tunnel syndrome, the nerve conduction study and the electromyography are commonly used. In this Case report, the ultrasonographic evaluation was also taken to diagnose the recurrent motor neuropathy of the median nerve. We suggest that the ultrasonographic findings are beneficial for the evaluation of the RMN when using with the electrophysiological studies.

Table 1. Motor Nerve Conduction Studies

Nerve / Sites	Latency (ms)	Amplitude (mV)	Velocity (m/s)
RIGHT MEDIAN - APB			
Wrist			No response
Elbow			No response
LEFT MEDIAN - APB			
Wrist	2.50	22.5	
Elbow	5.99	22.2	60.2
RIGHT MEDIAN - 2nd L-2nd DI			
Median	2.60	5.2	
Ulnar	2.76	13.4	
LEFT MEDIAN - 2nd L-2nd DI			
Median	2.55	6.8	
Ulnar	2.60	10.5	
RIGHT MEDIAN - PQ			
Elbow	3.02	8.8	
LEFT MEDIAN - PQ			
Elbow	2.60	5.3	
RIGHT ULNAR - ADQ			
Wrist	2.08	13.6	
Elbow	5.31	12.6	65.0
LEFT ULNAR - ADQ			
Wrist	2.29	15.8	
Elbow	5.31	15.7	66.2

APB = abductor pollicis brevis; L = lumbrical; DI = dorsal interosseous;
PQ = pronator quadratus; ADQ = abductor digiti quinti

Table 2. Sensory Nerve Conduction Studies

Nerve / Sites	Latency (ms)	Amplitude (mV)	Velocity (m/s)
RIGHT MEDIAN - Digit II			
Finger-Wrist	2.81	16.9	46.2
Wrist-Elbow	4.17	52.0	51.6
Palm-Wrist	1.98	74.5	42.9
LEFT MEDIAN - Digit II			
Finger-Wrist	2.66	24.4	48.9
Wrist-Elbow	3.91	50.2	53.8
Palm-Wrist	1.88	67.3	45.3
RIGHT ULNAR - Digit V			
Finger-Wrist	2.50	12.8	46.0
Wrist-Elbow	4.22	25.8	52.1
LEFT ULNAR - Digit V			
Finger-Wrist	2.55	16.7	47.0
Wrist-Elbow	3.59	18.9	52.9
RIGHT ULNAR - vs Median Dig IV			
Median	3.07	34.5	45.6
Ulnar	3.07	18.6	45.6
LEFT ULNAR - vs Median Dig IV			
Median	3.02	36.3	46.3
Ulnar	3.02	31.3	46.3
RIGHT RADIAL - superficial			
Forearm	2.40	33.8	41.7
Forearm	2.45	32.5	40.9
LEFT RADIAL - superficial			
Forearm	2.45	38.5	40.9
Forearm	2.40	42.1	41.7

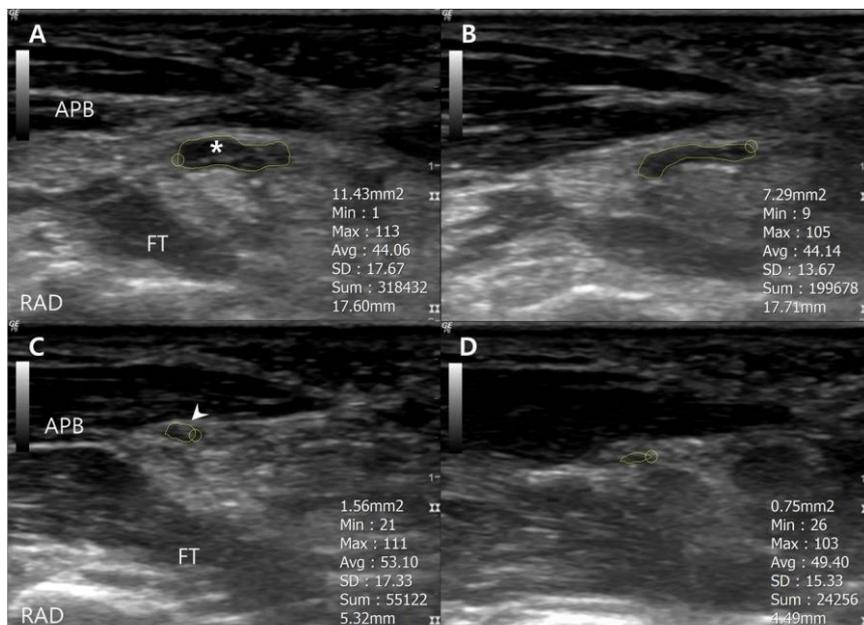


Figure 1. Ultrasound findings of the median nerve and the recurrent motor branch. Right median nerve (A) is enlarged just distal to the transverse carpal ligament compared to left median nerve (B). Swollen radial-side motor fascicles (asterisk) within the median nerve are observed. (C) Thickened recurrent motor branch (arrow head) of right median nerve is found while the median nerve branches distal to the transverse carpal ligament. (D) Left recurrent motor branch of the median nerve at the same level.

Delayed Radiation induced Lumbosacral Radiculoplexopathy 10 years After Radiation Therapy

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Introduction

Complications after radiation therapy include skin irritation, intestinal discomfort, fibrosis, lymphedema, radiation enteropathy, and radiation-induced polyneuropathy. In radiation-induced plexopathy, initial onset of symptoms may occur as early as 2 to 3 months after radiation therapy and the median onset is approximately 5 years. We report a rare case of lumbosacral radiculoplexopathy 10 years after radiation therapy with cervical cancer.

Case report

14 years ago, a 48-year-old female patient was diagnosed with cervical cancer stage 2b, and 28 radiation therapies were performed. 4 years ago, without any special event, weakness of bilateral lower extremities occurred, and there were no other complications. On physical examination, general atrophy of bilateral lower limb and lumbosacral paraspinal muscles was observed. Manual muscle test showed motor grade 4 in both lower extremities. Sensory deficit did not appear, and deep tendon reflex at both knees and ankles were absent. The muscle strength of upper extremity and deep tendon reflex were normal. Laboratory studies such as complete blood count, aldolase, myoglobin, lactate dehydrogenase, creatine kinase, and tumor markers showed no abnormal findings and cerebrospinal fluid analysis was within normal range. In magnetic resonance imaging, atrophy of lower lumbosacral paraspinal muscles and bone marrow depletion of the L5 and sacrum were observed, but there were no evidence of spinal stenosis, compression of the nerve root, herniated nucleus pulposus, degenerative changes of lumbosacral vertebrae, cancer recurrence or metastasis (Figure 1). The first nerve conduction studies of both upper and lower extremities showed normal findings. On needle electromyography(EMG), myokymic discharges, positive sharp waves and high amplitude motor unit action potentials(MUAP) were seen in gluteus medius, tibialis anterior, gastrocnemius and lumbosacral paraspinal muscles. The follow-up study was performed 3 years after the weakness onset. There were reductions in amplitude of sensory nerve action potentials(SNAP) in the sural nerves and SNAP of lateral femoral cutaneous nerves was absent compared with the previous test. H-reflex were absent. In needle EMG, the insertional activity was decreased. Myokymic discharges were observed, and decreased recruitment, long-duration, high-amplitude MUAP were observed in peroneal, tibial, and femoral nerve innervated muscles. A positive sharp wave was also observed in the lumbosacral paraspinal muscles. The muscle strengths of both lower extremities was worse than before and there was numbness of both soles. We diagnosed as delayed radiation induced lumbosacral radiculoplexopathy 10 years after radiation therapy.

Conclusion

We experienced a rare case of delayed radiation-induced lumbosacral radiculoplexopathy 10 years after radiation therapy and suspected delayed radiation-induced lumbosacral radiculoplexopathy when bilateral limb muscle weakness occurred.

Table 1. Nerve conduction study and electromyography on both lower extremities.

Nerve conduction study		Amplitude(μ V) Distal/Proximal	Conduction Velocity(ms)	Distance(cm)	Latency		
Nerve Stimulation (Record)	Distal/Proximal						
Motor							
Rt. Tibial (APB)		21800/16100	46	38	4.2/12.4		
Rt. Peroneal (EDB)		3900/3800	44	32	3.8/11.1		
Rt. Femoral (VM)		6100			6.2		
Lt. Tibial (APB)		21500/16100	43	38	4.8/13.7		
Lt. Peroneal (EDB)		4100/3900	44	33	3.8/11.3		
Lt. Femoral (VM)		5700			5.8		
Sensory							
Rt. Supf Peroneal (ankle)		9	46	12	2.6/3.2		
Rt. Sural (ankle)		6	42	10	2.4/3.2		
Rt. Saphenous (knee)		6	43	14	3.4/3.9		
Rt. Lat Fem Cutan		0					
Lt. Supf Peroneal (ankle)		8	44	12	2.8/3.3		
Lt. Sural (ankle)		6	41	11	2.7/3.4		
Lt. Saphenous (knee)		6	42	14	3.6/4.1		
Lt. Lat Fem Cutan		0					
Needle EMG							
		Insertional activity	Spontaneous activity		Motor Unit Action Potential		
Muscles			Fib	Fas	Recruitment	Dur/Amp	Phases
Rt	Gluteus maximus	Decreased	Myokymic discharges		Decreased	Long	Inc
	Iliopsoas	N	0	0	Decreased	Long	Inc
	Tensor fascia latae	Decreased	Myokymic discharges		Decreased	Long	Inc
	Vastusmedialis	N	0	0	Decreased	Long/High	Inc
	Tibialis anterior	N	0	0	Decreased	Long	Inc
	Gastrocnemius	N	0	0	Decreased	Long	Inc
	Biceps femoris short head	N	0	0	Complete	N	Inc
Lt	Gluteus maximus	Decreased	0	0	Decreased	Long	Inc
	Iliopsoas	N	0	0	Decreased	Long	Inc
	Tensor fascia latae	N	Myokymic discharges		Decreased	Long	Inc
	Vastusmedialis	N	0	0	Decreased	Long/High	Inc
	Tibialis anterior	Decreased	0	0	Decreased	Long	Inc
	Gastrocnemius	Decreased	0	0	Decreased	Long	Inc
	Biceps femoris short head	N	0	0	Slightly Decreased	Long	Inc
Rt	Lumbosacral paraspinal	N	++	0			
Lt	Lumbosacral paraspinal	N	+	0			

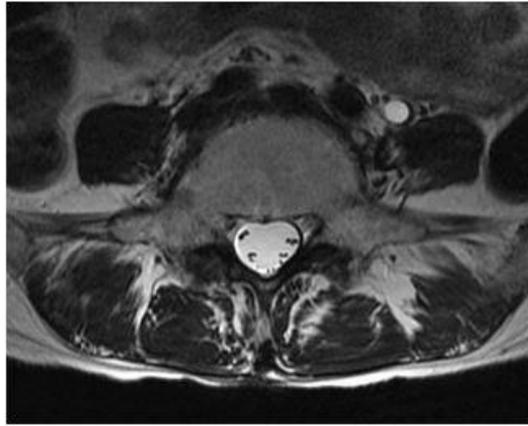


Figure 1. Lumbosacral T2-weighted MRI in sagittal view and axial view with bone marrow depletion and fatty changes in the vertebral bodies with subcutaneous atrophy.

Bilateral sciatic neuropathy following rhabdomyolysis : case-report

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Introduction

Rhabdomyolysis is a pathological condition caused by skeletal muscle cell damage that affects the integrity of the cell membrane, leading to the release of toxic intracellular components into plasma. The muscle damage is often due to trauma, extreme physical exercise, ischemic injury, drugs, alcohol, infections, metabolic disorder, and hyperthermia. The clinical features are often non-specific and may include muscle pain, fatigue, dark urine, and swelling of the affected muscles. In some cases, the swelling of the damaged muscle leads to local compression of a peripheral nerve, which may result in neurological complications. Some studies have reported peripheral nerve injury following rhabdomyolysis. However, bilateral sciatic nerve injuries following rhabdomyolysis are rare. This case study follows a patient who experienced rhabdomyolysis which led to bilateral sciatic neuropathy.

Case

A 42-year-old woman with no past medical history, who slept on an electric heating pad after drinking alcohol, visited the emergency department the next day with complaints of bilateral calf pain, redness, burning sensation, and weakness of the lower extremities. She denied ingesting any drug that can induce rhabdomyolysis and had no history of excessive exercise or trauma. Blood urea nitrogen, creatinine, and creatinine kinase were elevated in the blood test. She was diagnosed with acute kidney injury secondary to rhabdomyolysis and was admitted for treatment of rhabdomyolysis. After aggressive hydration, the rhabdomyolysis improved but the pain and weakness of the lower extremities persisted. Spine magnetic resonance imaging (MRI), cerebrospinal fluid (CSF) analysis, magnetic resonance angiography (MRA) of a lower extremity, and electrodiagnostic study were performed. There was no abnormal finding in spine MRI and CSF analysis. MRA showed multifocal edema and enhancement of the bilateral lower extremity muscles. Sensory nerve conduction study (NCS) revealed decreased amplitude of sensory nerve action potentials of both superficial peroneal and sural nerves. In the motor NCS, the right peroneal and both tibial nerves showed low compound motor action potential and the left peroneal nerve showed no response. The electromyography (EMG) test revealed abnormal spontaneous activities and decreased interference patterns in the biceps femoris, gastrocnemius, tibialis anterior, and peroneus longus muscles. The patient was diagnosed with bilateral sciatic neuropathy secondary to rhabdomyolysis.

Conclusion

Peripheral nerve damage is a rare complication of rhabdomyolysis. This is a rare case of bilateral sciatic neuropathy following rhabdomyolysis. Peripheral neuropathy could be caused by compression and inflammation associated with rhabdomyolysis. To minimize neurological complications, early diagnosis and intervention are needed.

Radial nerve palsy caused by compression garment for lymphedema - Case report

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Introduction

Lymphedema is a condition of localized fluid retention and tissue swelling caused by a compromised lymphatic system. Upper extremity lymphedema is common complication in breast cancer patients. Complex decongestive physical therapy is a primary tool in lymphedema management consisting of manual lymphatic drainage, compression bandaging and therapeutic exercise. Complex decongestive physical therapy is comfortable therapeutic Methods for lymphedema, however we experienced side effect after application compression garment.

Case

A 66-year-old woman was diagnosed with left breast cancer (invasive ductal carcinoma with metastatic left axillary lymph node, supraclavicular fossa, and left mediastinum) and she underwent a modified radical mastectomy. Two months after the surgery, the patient visited the outpatient clinic in the Department of Physical Medicine and Rehabilitation with the complaint of left upper extremity swelling. The swelling and pitting edema in left upper extremity was observed and circumferential difference between right and left upper extremities were 3 centimeters(cm), 2 cm, 2 cm and 1 cm from the elbow crease to above 10 cm, above 5 cm, below 5 cm and below 10 cm. The patient was treated for lymphedema with complex decongestive physical therapy such as manual lymphatic drainage, compression bandaging, and therapeutic exercise. Follow-up measurement of arm circumference was carried after 2 weeks, a circumferential difference between right and left arm were 2 cm, 1.5 cm, 2 cm and 0.5 cm from the elbow crease to above 10 cm, above 5 cm, below 5 cm and below 10 cm. It is considered that complex decongestive physical therapy is effective and compression garment was applied to the patient. After 2 weeks, a circumferential difference between right and left upper extremities were decreased, but she complained of weakness of left elbow and wrist extension power. On the Medical Research Council (MRC) Scale for grading muscle strength in her left upper-limb, she scored 4/5 for left elbow extension and 2/5 for left wrist extension. She underwent electromyography to confirm radial nerve compression. In the EMG study, it showed decreased amplitude of sensory nerve action potential in the left radial nerve and abnormal spontaneous activities in left brachioradialis, extensor digitorum communis, extensor carpi radialis, extensor carpi ulnaris and extensor indicis proprius muscles. She was diagnosed with left radial nerve injury. After that, she discontinued application of compression garment and was started on strengthening exercise for the weakness of left elbow and wrist extension with manual lymphatic drainage and therapeutic exercise.

Conclusion

Compression garments are a common therapeutic Method for breast-cancer-related lymphedema. Compression garments are generally safe and effective therapeutic tools for lymphedema. However, this Case report suggests that compression garment therapy may cause nerve injury.

A family with AR Hereditary spastic paraplegia due to compound heterozygous mutations of SPG11

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Introduction

The hereditary spastic paraplegias (HSP) are a heterogeneous group of neurodegenerative disorders mainly characterized by progressive spasticity and weakness in the lower limbs and are inherited in autosomal dominant, autosomal recessive or X-linked patterns. To date, more than 40 HSP-related genes have been identified. About 27 genes are known to be inherited in an autosomal recessive pattern. Among the many autosomal recessive forms, SPG11 appears to be one of the most frequent.

Case report

A 21-year-old male (patient 1, proband) with healthy nonconsanguineous parents presented with progressive stiffness and weakness of both legs. He had normal motor and mental developments in early childhood, but developed progressive spasticity and weakness of both legs, mild dysarthria and mental decline at the age of 13 years. A 18-year-old patient's sister (patient 2) also presented with a progressive weakness of both legs. At the age of 15 years, she began to have progressive gait disturbance, mild dysarthria, and mild cognitive impairment. Brain magnetic resonance imaging of the two patients revealed extreme thinning of corpus callosum. Two pathogenic heterozygous c.5989_5992del (p.Leu1997Metfs*60) and c.3291+1G>T variants of SPG11 on the basis of the reference sequence NM_025137.3 were identified using the TruSight One Sequencing Panel (Illumina, San Diego, CA, USA) at Green Cross Genome (Yongin, Republic of Korea). This variant was confirmed by Sanger sequencing of samples from the family. His father and mother were heterozygous for the c.3291+1G>T and c.5989_5992del (p.Leu1997Metfs*60) variant, respectively.

Conclusion

We report here the Korean family with HSP due to SPG11. SPG11 should be suspected in patients with isolated or recessive HSP, thin corpus callosum and cognitive impairment.

Painful Brachial Plexopathy Due to Esophageal Cancer Metastasis: a Case report

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Introduction

Brachial plexopathy (BP) due to metastatic esophageal cancer is rarely reported. Initial clinical manifestations of BP are mostly pain and then hypesthesia and weakness. Treatment for the patients with painful BP due to neoplasm can be diverse depending on the location and severity of cancer invasion.

Case presentation

A 78-year-old man visited the Physical Medicine and Rehabilitation outpatient clinic due to severe arm pain (numeric rating scale 9) with swelling at right upper extremity for 4 months. He also complaint progressively weakness of right arm and dyspnea. He had been diagnosed esophageal cancer 2 years ago and treated with chemoradiation therapy. One year after the treatment, the follow-up endoscopy and spiral chest computerized tomography (CT) showed complete resolution and stable stage of known lesions without adjacent lymph nodes enlargement, respectively. Physical examination revealed right shoulder subluxation with atrophic change at proximal upper extremity muscles and swollen forearm (Figure 1). Electrodiagnostic test detected right brachial plexopathy at whole trunk level. In imaging studies, we found severely invaded regional tumor at right supraclavicular lymph nodes with complete occlusive thrombosis in internal jugular vein (Figure 2, 3). We treated with opioid, paracetamol and gabapentin for his pain, and the patient's pain was improved by half.

Conclusion

We report a severe and unique case of unilateral brachial plexopathy caused by esophageal metastatic cancer with internal jugular vein thrombosis.



fig1. In physical examination, right shoulder subluxation and atrophic change of proximal muscle (A), winged scapula (B), and forearm swelling (C)

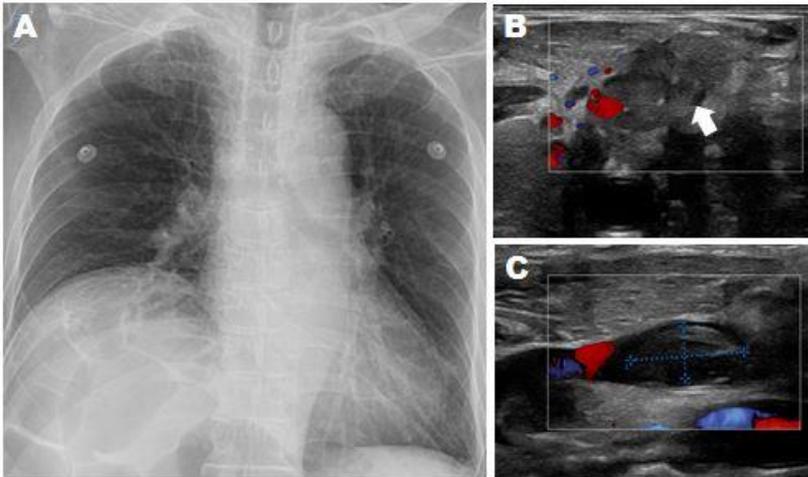


fig2. Chest X-ray showed right diaphragmatic palsy (A), Neck sonography showed heterogeneous mass like lesion at right suprascavicular fossa (B, while arrow) and 0.87 x 0.81cm sized thrombosis in internal jugular vein (C)

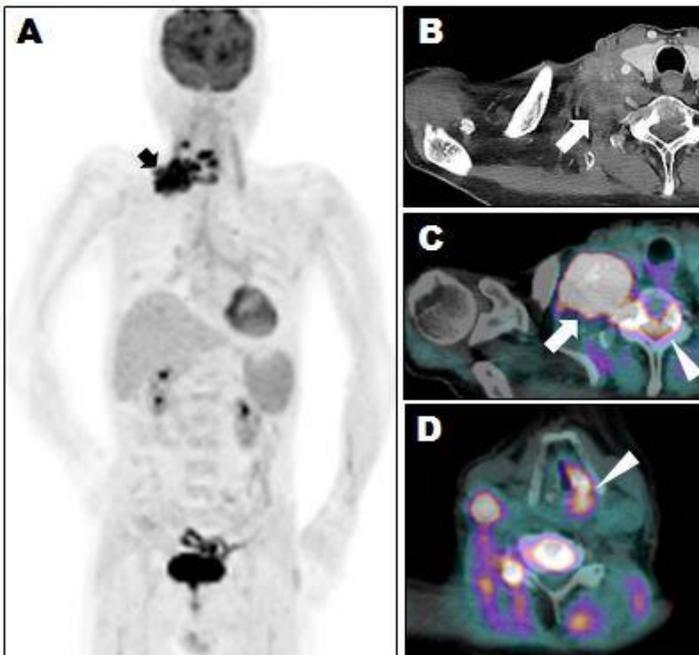


fig3. PET/CT confirmed metastatic cancer at right supraclavicular lymph node with adjacent structures (A, B), cervical vertebrae at C6 and 7 (C), and vocal cord invasion (D)

Lateral Cutaneous Nerve Injury of Common Peroneal Nerve: a Case report

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INTRODUCTION

Sensory symptoms in the lateral aspect of the calf can be occurred by several causes. The most common cause is L5 radiculopathy, but rarely injury of lateral cutaneous nerve (LCN) of common peroneal nerve has been reported. LCN is a cutaneous branch which leaves the common peroneal nerve at the popliteal fossa proximal to the fibular head. We present a case with injury of LCN of common peroneal nerve.

CASE REPORT

A 42-year-old woman complained of sensory change on the proximal lateral side of the right leg after sitting for a long time, which was worsened when walking. She had no history of trauma, diabetes mellitus or other systemic diseases. Manual muscle testing of the right lower extremity was normal. Sensation was decreased on the proximal lateral leg (Fig. 1). Tinel sign around the lateral side of knee was negative. Nerve conduction studies of the right lower extremity was normal except unobtainable LCN response (Table 1). LCN conduction study was performed with orthodromic technique: recording site, 4 cm proximal to fibular neck; stimulating site, 8 cm distal to fibular neck (proximal lateral leg). Needle electromyographic examinations of the right lower extremity were no abnormal spontaneous activities and normal motor unit action potentials in muscles tested. Ultrasonographic examination demonstrated swelling of the right LCN 4cm above the fibular neck (Fig. 2). After symptomatic conservative treatment such as gabapentin and capsaicin cream, her symptom was slightly improved.

CONCLUSION

LCN of common peroneal nerve is difficult to evaluate because of its small size and anatomical variation. Although antidromic technique to evaluate LCN was reported. orthodromic technique was performe. Our case is the first case of LCN injury of common peroneal nerve with the swelling of the LCN on ultrasonography. The LCN injury is rare but should be considered when there are sensory symptoms in the lateral aspect of the calf. The patient's symptoms are the most important for diagnosis, but ultrasonography may help diagnosis.

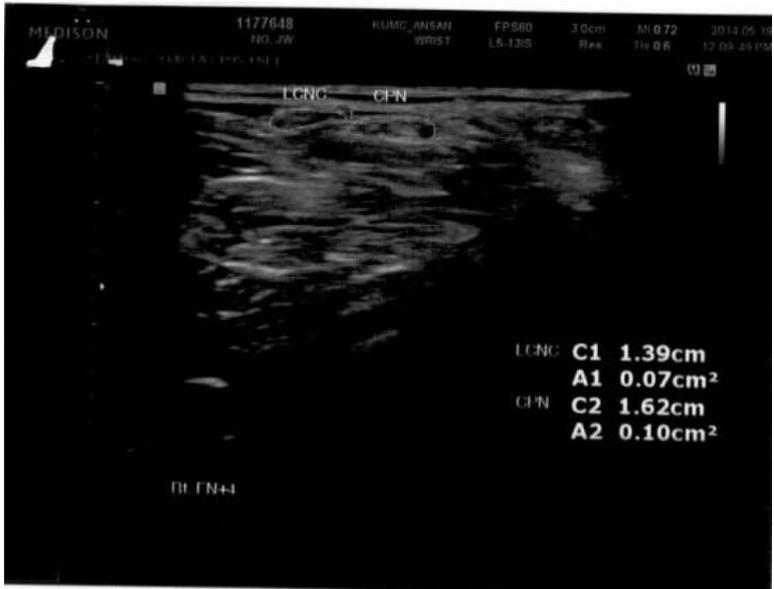


Fig1. Ultrasonographic evaluation showed swelling of the right LSCN observed 4cm above the fibular neck

Distal Type of Neuralgic Amyotrophy Presenting with Multifocal Motor Neuropathy : A Case report

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Introduction

A distal form of neuralgic amyotrophy in which weakness is limited to the forearm and hand muscles is rare and not explicitly mentioned in many neurological textbooks. We report a case that shows left hand motor weakness without any sensory symptom and diagnoses of distal type neuralgic amyotrophy.

Case presentation

Fifty eight-year-old male presented with nuchal pain with radiating pain to left upper extremity. On his first visit, he also showed general motor weakness of left upper extremity including shoulder and elbow. The symptoms started from 20 days earlier. Motor weakness of left hand and wrist was prominent with MRC grade 2 finger abductor and wrist extensor, respectively. Additionally, he had atrophy of left hand intrinsic muscles. However, there was no sensory abnormalities on left upper extremity. He had no specific past, personal, and family history on any muscle weakness. The patient underwent cervical spine magnetic resonance image to rule out cervical spinal cord injury or possibility of cervical radiculopathy. It showed disc space narrowing of multiple cervical intervertebral segments. Electrodiagnostic study was performed and it showed decreased amplitude of left median, ulnar, and radial compound muscle action potentials recording at Abductor pollicis brevis, Abductor digiti minimi, and Extensor indicis proprius respectively. There was no abnormality of sensory nerve action potentials and median F-wave. On needle electromyography, abnormal spontaneous activities were found in left Abductor pollicis brevis, Abductor digiti minimi, Extensor carpi radialis longus, First dorsal interosseous, Flexor carpi ulnaris, Triceps, and Extensor indicis proprius muscles. The patient started physical therapy of left upper extremity including electrical stimulation therapy and strengthening exercise of left hand. The pain improved, but motor weakness and hand intrinsic muscles atrophy still remained. At 9 month follow-up, there were no specific changes in his symptom and electrodiagnostic study.

Conclusion

This case initially shows nuchal pain with radiating pain to left upper extremity, follows by weakness and muscle atrophy on left wrist and hand. He is diagnosed as distal type of neuralgic amyotrophy via clinical history and electrodiagnostic study. This case implies that a clinician should aware of this type of neuralgic amyotrophy and diagnose it properly based on careful history taking, image, and electrodiagnostic study.

Variation of Anterior Interosseous Nerve Syndrome: A case series

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Introduction

The anterior interosseous nerve (AIN) is a pure motor branch from the median nerve and runs deep in the forearm. It innervates three muscles in the forearm; the flexor pollicis longus, the flexor digitorum profundus of the index and middle fingers, and the pronator quadratus. An isolated palsy of these muscles is rare and known as AIN syndrome. Variations of AIN syndrome has been reported a few cases, who were involved pronator teres muscle. We reported two cases of AIN syndrome involved the pronator teres and the flexor carpi radialis muscle.

Case presentation

Case 1: A 40-year-old male who could not flex his left interphalangeal (IP) joint of the thumb and the distal IP joint of the index finger after slip down injury, and visited our hospital 7 months later. Manual muscle test (MMT) of the thumb IP flexion in and index finger distal IP flexion was grade 0, and the index finger proximal IP flexion was grade 3. Light touch sensation was slightly decreased in the left forearm, and medial and radial sides of the hand. Muscle atrophy was detected on the left abductor pollicis brevis and flexor carpi radialis muscles. Typical "OK" sign was seen in the left hand. Electrodiagnostic study was revealed as follows: 1) Normal compound muscle action potential (CMAP), sensory nerve action potential (SNAP) and normal latency in the left median, ulnar nerves and the bilateral radial nerves, 2) Abnormal spontaneous activities at the left pronator quadratus, flexor carpi radialis, flexor pollicis longus, flexor digitorum superficialis, pronator teres were seen in the needle electromyography. Case 2: A 37-years old male who had weakness on his right thumb flexion after developing forearm pain 4 months ago. He had received unknown injection in his right elbow from local clinic, and the forearm pain was improved without any improvement of the weakness. The muscle power of right thumb flexion was grade 2, and the touch sensation of right lateral forearm was decreased. The muscle atrophy of right flexor carpi radialis was obvious compared to the left side. Typical "OK" sign of the right hand was also seen. Electrodiagnostic Results were as follows: 1) Normal CMAP, SNAP and normal latency in the left median, ulnar and musculocutaneous nerves, 2) Decreased SNAP amplitude in the lateral antebrachial cutaneous nerve, 3) Abnormal spontaneous activities at right biceps brachii, flexor pollicis longus, flexor carpi radialis, pronator quadratus and pronator teres muscles were seen in the needle electromyography.

Conclusion

We reported two cases with the anterior interosseous nerve variation, which is rarely involved the flexor carpi radialis muscle.

Systematic Review of Cardiac Rehabilitation Outcomes Studies following Acute Myocardial Infarction

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Introduction

It is believed that cardiac rehabilitation (CR) improves long term clinical outcomes in survivals after acute myocardial infarction (AMI). There are several systematic reviews (SR) on the impact of cardiac rehabilitation (CR) on outcomes in ischemic heart disease but most of them include old studies published before 2000 and there has been no SR on the impact of CR on post-discharge outcomes limited to survivors after AMI. The purpose of this study is to investigate the SR on the prognostic effect of CR on clinical outcomes in the modern era of AMI treatment.

Subjects and Methods

The key question was whether CR beneficial in improving post-discharge outcomes in survivors after AMI. Table 1. shows the contents of PICOTS-SD. Key words for searching strategies were 'myocardial infarction', 'percutaneous coronary intervention', 'angioplasty', 'stent', 'coronary artery bypass graft surgery', 'cardiac rehabilitation' and etc. Starting with the year 2000, the following bibliographic databases were used: Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE, EMBASE, CINAHL, KoreaMed, and KMBASE. Two review authors independently screened all identified studies for inclusion and exclusion criteria. We assessed the evidence of the outcome measures of CR, which were all-cause mortality, cardiac related mortality, recurrence, re-admission, and repeat revascularization. When quantitative addition of studies was possible, meta-analysis was done and heterogeneity was verified, and when addition was not possible, quality compatibility evaluation was done.

Results

Out of the selected 14 studies, two were RCTs, and 12 were cohort studies. The publication year, number of participants, duration of follow up, and outcome measures are presented in Table 2. When meta-analysis was done on two RCTs with application of random effect model, all-cause mortality was lower in the CR group compared to the controlled although it was not statistically significant, and there was no difference between the two groups regarding re-hospitalization rates. In the 14 cohort studies, heterogeneity was high among studies regarding all-cause mortality, so qualitative addition was done instead of quantitative addition, and in all studies, mortality of CR group was reported to be lower than the control group. In the CR group, the rate of AMI recurrence and major adverse CV event (MACE) occurrence was significantly lower, and

while the rate of repeat revascularization and re-admission was lower in the CR group, the difference was not statistically significant.

Conclusion

In this SR of studies on the prognosis of AMI patients after discharge, after year 2000, there was no difference between CR and the control group in mortality and re-admission rate in RCTs, but the CR group showed significantly lower mortality, recurrence, and MACE occurrence in cohort studies.

Table 1. PICOT-SD

Population	Survivals after AMI ¹ receiving PCI ² or CABG ³
Intervention	- Exercise-based cardiac rehabilitation
Comparisons	- Usual care (no exercise control)
Outcomes	- Primary outcome: mortality - Secondary outcome: MACE ⁴
Time	- Publication year: ≥ 2000 - Follow up periods: at least one year
Setting	- No limitation
Study Design	- Randomized control trials - Cohort studies

1. Acute myocardial infarction, 2. Percutaneous coronary intervention, 3. Coronary artery bypass graft (CABG) 4. Major adverse cardiac event.

Table 2. Baseline characteristics and overall Results of Selected Studies

Index	Design	Author (year)	No. of subjects	Follow up	Outcome index
1	RCT	Maroto (2005)	180	10yr	Mortality
2		West (2012)	1,813	1yr	Mortality, re-admission
3		Junger (2010)	4,547	1yr	Mortality, MACE [†]
4		Kim (2011)	161	1yr	Mortality, MACE
5		Rauch (2014)	3,560	4-12m	Mortality, MACE
6	Prospective cohort	Lewinter (2014)	EMMACE1: 1,324 EMMACE2: 1,975	1yr	Mortality
7		Coll-Fernandez (2014)	1,043	18m	Mortality, recurrence
8		Meurs (2015)	1,702	1yr	Mortality, re-admission
9		Pouche (2016)	2,894	5yr	Mortality
10		Kureshi (2016)	3,957	7yr	Mortality
11		Boulay (2004)	91	1yr	Re-admission, recurrence
12	Retrospective cohort	Nielsen (2008)	200	1yr	Mortality, MACE
13		Suaya (2009)	25,966	5yr	Mortality
14		Beauchamp (2012)	297	14yr	Mortality

† Major adverse cardiac event: re-admission, recurrence, repeat revascularization

A deep learning approach for wireless Photoplethysmography(PPG) sensor.

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Introduction

Photoplethysmography(PPG) sensor uses the basic idea of measuring instantaneous changes in volume within an organ and provides continuous hemodynamic information of the body. Compared with ECG sensor, it is easier to apply and is less disturbed by movements. However, it has not been suitable as a mobile equipment since it becomes unstable with the position change of the sensor itself and can pick up interrupting signals from the movement of the subjects. We propose that if the equipment can become mobile by applying deep learning classification of wireless PPG equipment, more efficient monitoring of the patients will be possible.

Methods

Noise outside PPG active frequency band, high-frequency noise, direct current noise, and baseline generated by subject's breath were removed using an oscilloscopic biosignal-filtering technology. Input PPG data was obtained by using the principle of artificial neural network, and a meaningful signal period was detected. Devised system consisted of a PPG sensor applied to index finger, a signal transmitter connected to the sensor, a laptop computer with the mentioned program and a signal receiver. Assessments of static and mobile status were carried out in healthy 32-year-old male subjects. For the static status assessment, the subjects wore the device and performed the following four tasks within 10m from the receiver: sitting in a stable position; speaking while resting; repeating sitting and standing on a chair 5 times; and compressing on the radial and ulnar arteries. The mobile status assessment was performed in wards with patients and staffs yet, plenty of space was available for walking in normal speed. The receiver was placed in the nursing station and the subject walked in the halls of 10 different wards while wearing the device and performed the following tasks: continuous 200m walking; and compression of the radial and ulnar arteries at a distance of 100m.

Results

The static status assessment showed 96.1% agreement with the existing wired equipment and the mobile status assessment showed 97.2% agreement. Noise from the movement of the sensor was observed, but noise caused by movement of the subjects was not significant. Although there is only a minor difference in the raw data between the new device and the conventional wired equipment, in the presence of communication obstacles (walls, partitions), the delay of the signal display was as long as 2.4 to 6.5 seconds.

Conclusion.

Despite the importance of cardiovascular monitoring in rehabilitation equipments like ECG is largely affected by movements hence it is difficult to use the device in the actual setting of rehabilitation. Extraction of significant biomedical signals through simple equipment and effective feedback can help to increase compliance and allow patients to actively get involved in rehabilitation.

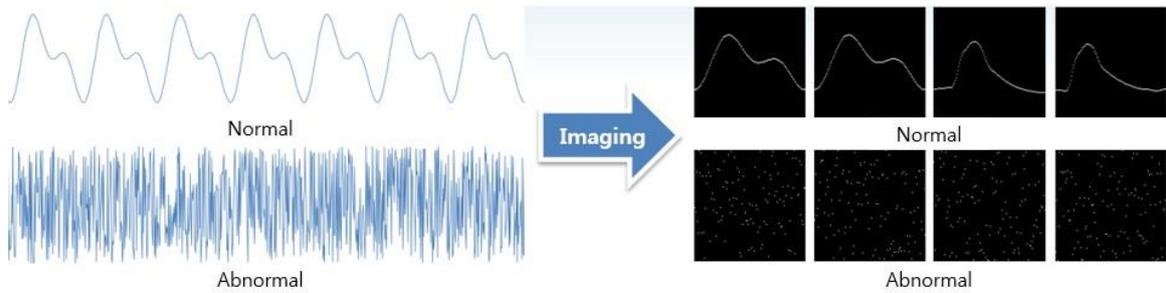


Figure 1. Significant signal segment detection based on deep learning.

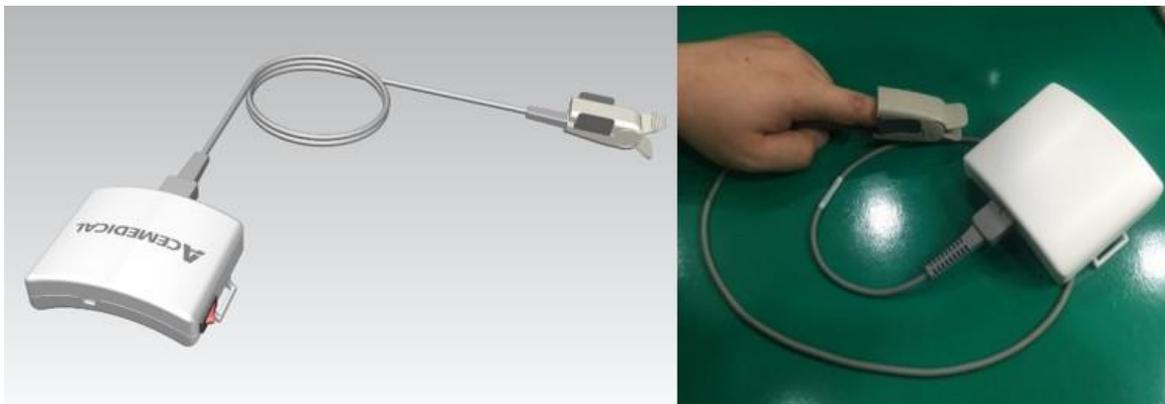


Figure 2. PPG sensor and mobile signal transmitter.

The Design of Cardiopulmonary Exercise Test Protocol using Aquatic Treadmill : A Pilot Study

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Introduction

Cardiac rehabilitation (CR) is an integral component of the continuum of care for patients with cardiovascular disease. The core components of CR include patient evaluation. A cardiopulmonary exercise (CPX) test is a key component of the initial assessment made before a patient begins an exercise program. The test is continued while increasing the metabolic equivalent (MET) constantly at regular intervals according to the protocol. Aquatic treadmill (AT) employs underwater treadmill that combines the benefits of water immersion with the advantages of body weight supporting effect due to buoyancy. AT can be used to evaluate exercise capacity in patients with difficulty in standing and walking as an alternative of land treadmill based CPX test. However, currently there is no CPX test protocol yet using AT, and it is necessary to develop a standardized aquatic treadmill CPX test protocol. Therefore, this pilot study was conducted to design a CPX test protocol that can lead a constant change in MET value using AT.

Method

Three male and two female were enrolled in this study. Their mean age was 29.6 ± 5.94 years. The depth of the water pool was set up between xiphoid process and umbilicus. The room temperature was maintained at 25°C – 26°C , while the water temperature was maintained at 28°C – 29°C . The AT test comprised 12 stage at different velocities, at 3-minute duration per stage. The speed of the treadmill started at 0.1km/h in stage 1 and incrementally increased by 0.35km/h in each stage. After the end of the test, individuals walked for additional 5 minutes at a speed of 0.1km/h to cool down. A respiratory gas analyzer (Cosmed CPET, COSMED, Rome, Italy), pulse oximeter (Care vision HP-110, Medical supply, Wonju, Korea) and a treadmill (Aquatrac-2000, Naramed, Gwangju, Korea) were used. At every each stage, peak oxygen uptake ($\text{VO}_{2\text{peak}}$), heart rate (HR) and rate of perceived exertion (RPE) were measured.

Result

For the analysis, all recorded values of each stage were averaged. At stage 4 (1.15km/h), VO_2 value corresponded to approximately 2 METs (VO_2 , 6.94 ± 1.05) in all subjects. 3METs (VO_2 , 10.57 ± 1.09) was measured at stage 8 (2.55km/h). And 3.73METs (VO_2 , 13.06 ± 1.46), 4.42METs (VO_2 , 15.51 ± 1.54) were measured at stage 10 (3.25km/h) and 12 (3.95km/h), respectively. The parameters of AT CPX for each stage are shown in Table 2. As the exercise intensity increased at each stage, HR was incrementally increased.

Conclusion

It was demonstrated that AT walking can spend high METs at lower speed than land treadmill walking. This means that AT walking can be loaded higher exercise intensity at same speeds of treadmill. The development of a standardized aquatic treadmill CPX test protocol may be useful alternative option for evaluating cardiopulmonary function in patients who can not use land treadmill.

Table 1. General characteristics of subjects

Characteristics	Value
Gender	
Male	3
Female	2
Age(yr)	29.6±5.94
Height(cm)	167.4±5.59
Body weight(kg)	68.4±10.76
BMI(kg/m²)	22.52±3
Resting HR(beats/min)	82.2±10.03

Table 2. The parameters of aquatic treadmill cardiopulmonary exercise for each stage

Stage	1	4	8	10	12
HR (beats/min)	86.8 ± 6.8	90.4 ± 6.95	103.6 ± 9.1	113.0 ± 10.07	123.2 ± 11.14
VO2 (ml/min/kg)	5.9 ± 1.15	6.94 ± 1.05	10.57 ± 1.09	13.06 ± 1.46	15.51 ± 1.54
METs	1.69 ± 0.34	1.98 ± 0.30	3.02 ± 0.31	3.73 ± 0.42	4.42 ± 0.47
RER	0.89 ± 0.07	0.85 ± 0.07	0.87 ± 0.09	0.91 ± 0.08	0.96 ± 0.07

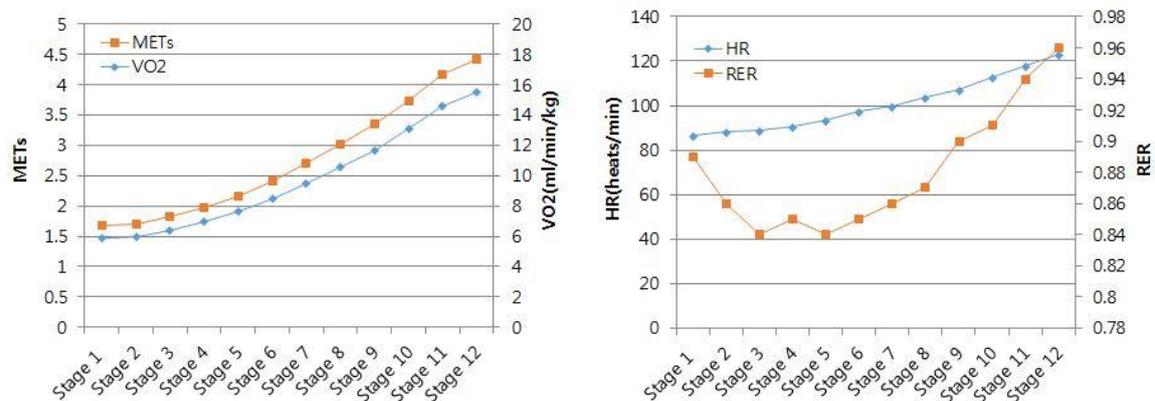


Figure 1. The parameters of aquatic treadmill cardiopulmonary exercise for each stage

P 2-97

Ergometer Elicit Effective Aerobic Exercise in Stroke patients with Slow Speed as much as Treadmill

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Objective

The aim of this study were to confirm the different physiological response between treadmill and cycle ergometer in stroke patients, compared with healthy control and also to determine the predictors of VO₂peak difference between two equipments in stroke according to gait speed. .

Design

Sixty-three stroke survivors were enrolled in this study and were grouped according to the gait speed (low speed group, <0.8 m/s [n=32]; high speed group, ≥0.8 m/s [n=31]). Age- and gender-matched healthy volunteers (n=28) were also included as control. All participants performed exercise stress test with treadmill and cycle ergometer, isometric knee strength test and physical function tests.

Results

VO₂peak difference was 0.63±3.4 (95% CI, -0.58 to 1.85) in the low speed group, 6.97±2.7 (95% CI, 5.98 to 7.96) in the high speed group, and 7.29±4.0 (95% CI, 5.72 to 8.86) in control. Paretic knee extensor strength relative to body weight was 0.75±0.3 (p<0.05) in low speed group, and 1.22±0.5 (p<0.05) in high speed group.

Conclusion

Both cycle ergometer and treadmill could elicit similar peak aerobic capacity in stroke patients with slow speed, while treadmill could revealed higher performance in high speed stroke patients and healthy volunteers. Therefore, the appropriate exercise equipment should be considered in stroke patients according to gait function.

Table 1. General and clinical characteristics among three groups

Variables	Low speed group(n=32)	High speed group(n=31)	Control(n=28)	<i>p</i>
Age(years)	64.8±10.6	61.7±10.0	62.9±10.3	0.473
Female(%)	13(41%)	8(26%)	13(46%)	0.239
Height(cm)	160.9±8.1	164.5±6.9	162.6±6.4	0.168
Weight(kg)	61.9±10.4	66.3±9.7	66.6±10.4	0.131
Body mass index(kg/m ²)	23.9±2.8	24.6±2.8	25.1±2.7	0.252

Data are represented as mean±standard deviation or numbers(%).

p*<0.05. *p*<0.001

Table 2. Clinical characteristics of stroke groups

Variables	Low gait speed group(n=32)	High gait speed group(n=31)	<i>p</i>
Duration after stroke onset(days)	128.8±156.3	98.7±219.3	0.533
Subacute:Chronic	25:7	28:3	0.302
Stroke type			
Ischemic:Hemorrhagic	25:7	23:8	0.774
Paretic side			
Right:Left	15:17	16:15	0.803
Medication			
Beta-blocker	3(9.4%)	5(16.1%)	0.474
Ca ²⁺ channel blocker	16(50.0%)	12(38.7%)	0.450
Angiotensin II receptor blocker	10(31.3%)	10(32.3%)	1.000
Aspirin	21(65.6%)	19(61.3%)	0.797
Comorbidity			
Hypertension	20(62.5%)	14(45.2%)	0.210
Diabetes	7(21.9%)	8(25.8%)	0.774

Data are represented as mean±standard deviation(SD) or numbers(%).

p*<0.05. *p*<0.001

Table 3. Symptom limited exercise test in stroke patients and healthy person

Variables	Low speed group(n=32)	High speed group(n=31)	Healthy person (n=28)	p
Treadmill test				
VO _{2peak} (ml/kg/min)	16.6±3.5 ^{ac}	25.6±5.2 ^{ab}	32.1±7.7 ^{bc}	0.000**
PHR(beat/min)	126.3±19.9 ^c	139.1±26.6	153.4±21.1 ^c	0.000**
% PHR	83.1±15.5 ^c	87.5±18.4 ^b	97.5±12.1 ^{bc}	0.002*
RHR(beat/min)	87.3 ±12.7	87.4±18.4	81.4±13.9	0.194
PSBP(mm Hg)	157.3±21.9 ^{ac}	172.1±21.7 ^a	179.2±22.0 ^c	0.001*
PDBP(mm Hg)	84.5±11.6	81.9±13.1	78.2±12.4	0.157
RSBP(mm Hg)	124.3±13.8	120.9±16.5	124.4±12.9	0.564
RDBP(mm Hg)	77.4±10.7	75.1±11.0	78.6±10.7	0.440
RER	0.94±0.08 ^{ac}	1.00±0.06 ^a	1.00±0.07 ^c	0.001*
Cycle ergometry				
VO _{2peak} (ml/kg/min)	15.9±4.4 ^c	18.6±5.8 ^b	24.8±5.4 ^{bc}	0.000**
PHR(beat/min)	116.7±21.9 ^c	121.6±23.1 ^b	138.0±17.1 ^{bc}	0.000**
% PHR(%)	76.2±14.6 ^c	76.3±15.9 ^b	87.9±9.5 ^{bc}	0.001*
RHR(beat/min)	86.4±15.2	87.7±13.9	85.1±14.7	0.802
PSBP(mm Hg)	162.5±20.5 ^{ac}	178.3±30.7 ^a	192.7±24.4 ^c	0.000**
PDBP(mm Hg)	90.1±13.6	92.6±16.6	96.5±12.7	0.228
RSBP(mm Hg)	124.3±13.1	119.2±21.1	129.7±13.1	0.052
RDBP(mm Hg)	80.5±12.7	80.7±12.2	84.3±10.1	0.364
RER	1.00±0.8	0.99±0.6	1.00±0.5	0.712
Difference of VO_{2peak} between treadmill and cycle ergometry				
DVO _{2peak} (ml/kg/min)	0.63±3.4 ^{ac}	6.97±2.7 ^a	7.29±4.0 ^c	0.000**

* $p < 0.05$. ** $p < 0.001$; a: walking speed < 0.8m/s versus walking speed > 0.8m/s. b: walking speed > 0.8m/s versus control group. c: walking speed < 0.8m/s versus control group.

VO_{2peak}: peak oxygen consumption. PHR: peak heart rate. % PHR: percentage of the age -predicted maximal HR. RHR: resting heart rate. PSBP: peak systolic blood pressure. PDBP: peak diastolic blood pressure. RSBP: resting systolic blood pressure. RDBP: resting diastolic blood pressure. RER: respiratory exchange ratio. DVO_{2peak}: difference of VO_{2peak} between treadmill and cycle ergometry

Table 4.Physical performance in three groups

Variables	Low speed group(n=32)	High speed group(n=31)	Healthy person (n=28)	<i>p</i>
6MWD	135.5±57.7 ^{a,c}	346.1±88.5 ^{a,b}	482.1±63.9 ^{b,c}	0.000**
10MWT	27.69±13.1 ^{a,c}	9.87±2.1 ^a	7.44±1.03 ^c	0.000**
K-BBS	35.8±9.0 ^{a,c}	48.1±6.5 ^{a,b}	56 ^{b,c}	0.000**
K-MBI	60.3±15.1 ^{a,c}	79.1±14.1 ^{a,b}	100 ^{b,c}	0.000**
Paretic Leg MI	50.7±11.9	64.6±13.2	100	0.000**

p*<0.05. *p*<0.001. a:walking speed<0.8m/s versus walking speed>0.8m/s. b:walking speed>0.8m/s versus control group. c:walking speed<0.8m/s versus control group.

6MWD:6 minute walk distance.10MWT:10 -m walk test.K -BBS:Korean version of berg balance scale.K-MBI:Korea version of modified barthel index .MI:motricity index.

Table 5.Isometric knee extension/flexion peak torque

Variables	Low speed group(n=32)	High speed group(n=31)	Healthy	<i>p</i>
Quadriceps _{paretic} (NM)	46.0±19.4	82.0±39.4	-	0.000**
Hamstring _{paretic}	19.8±12.8	41.1±20.8	-	0.000**
Quadriceps _{nonparetic}	76.1±25.7 ^{a,c}	98.7±37.2 ^{a,b}	120.9±37.1 ^{b,c}	0.000**
Hamstring _{nonparetic}	40.4±15.8 ^{a,c}	51.7±20.7 ^{a,b}	75.6±26.4 ^{b,c}	0.000**
RQBW _{paretic}	0.75±0.3	1.22±0.5	-	0.000**
RHBW _{paretic}	0.34±0.2	0.61±0.3	-	0.000**
RQBW _{nonparetic}	1.2±0.4 ^{a,c}	1.46±0.5 ^{a,b}	1.79±0.5 ^{b,c}	0.000**
RHBW _{nonparetic}	0.65±0.2 ^{a,c}	0.76±0.3 ^{a,b}	1.09±0.4 ^{b,c}	0.000**

p*<0.05. *p*<0.001. a:walking speed<0.8m/s versus walking speed>0.8m/s. b:walking speed>0.8m/s versus control group. c:walking speed<0.8m/s versus control group.

Quadriceps_{paretic}:peak torque of paretic quadri cepts.Hamstring_{paretic}:peak torque of paretic hasm string. Quadriceps_{nonparetic}:peak torque of non-paretic quadriceps.Hamstring_{nonparetic}:peak torque of non-paretic ham string .RQBW_{paretic}:peak torque of paretic quadriceps relative to body weight.RHBW_{paretic}:peak torque of paretic ham string relative to body weight.RQBW_{nonparetic}:peak torque of non-paretic quadriceps relative to body weight.RHBW_{nonparetic}:peak torque of non-paretic ham string relative to body weight.

Respiratory characteristics of inhalation burn

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Purpose

Inhalation burn injury and lung complications caused by large surface burns occurring during fire remain serious problems. We performed pulmonary function evaluation in patients with thermal injury in order to study respiratory characteristics of smoke inhalation and large surface burns.

Methods

Forty-four patients who had burn injury were included. Pulmonary function was measured at 95.2 ± 27.86 days after burn injury. Pulmonary function tests including forced vital capacity (FVC), forced expiratory volume during 1 second (FEV1), forced expiratory flow rate between 25 and 75% of the FVC (FEF25-75), FEV1/FVC ratio and peak expiratory flow (PEF), maximum voluntary ventilation (MVV) and respiratory muscles strength (maximal expiratory pressure; MEP, maximal inspiratory pressure; MIP) were done. Values for FVC, FEV1, FEF25-75, MIP and MEP were expressed as percent of predicted values. Values of MVV and PEF are expressed by numerical value. Diaphragmatic mobility was measured by calculating the distance between the diaphragmatic dome in maximal expiration and inspiration for the right and left hemidiaphragms by fluoroscopy.

Results

The values of FVC, FEV1, FVC/FEV1, FEF25-75, MVV, PEF, MIP and MEP were 91.5%, 89.7%, 81.6, 85.4%, 96.2 L/min, 10.4 L/sec, 86.3%, and 67.1%, respectively. Diaphragmatic mobility was measured as 4.95cm on right 4.76cm on left side by fluoroscopy. The pulmonary function test showed mild reduction of pulmonary parameters with restrictive pattern. Among these values, MEP% of predicted value and degree of diaphragmatic mobility were largely reduced compared to other pulmonary parameters.

Conclusions

This study showed that large surface burn and smoke inhalation caused deterioration in pulmonary function, especially in expiratory muscle strength and diaphragm mobility. With this Result, we concluded the pulmonary rehabilitation focusing on improving expiratory muscle function and assisting diaphragmatic movement would be helpful to the patients with large surface burn and smoke inhalation.

Factors associated with the complications after early stage lung cancer: a pilot study

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Introduction

Patients with early stage lung cancer including stage I, II, and IIIA consider lung surgery as a treatment. Patients usually discharge after surgery without any complications, however, postoperative pulmonary complications, such as pneumonia, atelectasis, worsened gas exchange, bronchoconstriction, thromboembolic disease, and respiratory failure, sometimes occur and they lead to admission of intensive care unit (ICU) and increased length of hospital stay. The purpose of this study is to investigate factors associated with the complications after lung surgery in the patients with early stage lung cancer

Method

We reviewed medical record of patients with lung cancer of stage I who received operation in our hospital from March to June 2018. General characteristics including age, sex, hypertension, diabetes mellitus, preoperative pulmonary function, smoking history, type of cancer and operation were reviewed. Furthermore, postoperative consult for increased secretion, duration of operation to discharge, length of hospital stay, event of pneumothorax, admission of ICU, and usage of mechanical ventilation were also reviewed. The factors influencing the length of hospital stay was investigated using multivariate linear regression analysis, stepwise Method.

Result

Twenty eight patients with lung cancer of stage I were enrolled, and characteristics of them are shown in Table 1. The mean age was 64.4 ± 8.6 years, and 10 (36%) patients had abnormal pulmonary function test. There were 5 current smokers, 9 ex-smokers, 14 non-smokers. All of the cancer was primary lung cancer. 18 (64%) patients received lobectomy, and 8 (28%) patients received segmentectomy. After surgery, 20 (71%) patients were admitted to the ICU, however, there were no patients who needed mechanical ventilation or postoperative consult for increased secretion. Mean length of hospital stay was 10.5 ± 6.4 days. The Result of pulmonary function test ($B=-2.03$, $p=0.00$) and type of operation ($B=-2.50$, $p=0.02$) were shown to influence the length of hospital stay.

Conclusion

Although this study has many limitation, the length of hospital stay was affected by the Result of pulmonary function test and type of operation in the patients with early stage lung cancer. These factors should be considered when deciding the need of preoperative

pulmonary rehabilitation to reduce complications of the lung surgery. Further study is needed to generalize the Result.

Table 1. Characteristics of patients with lung cancer of stage I undergoing surgery

Number of patients		28	
Age (years)		64.4 ± 8.6	
Sex (male : female)		11 (39) : 17 (61)	
HTN		15 (54)	
DM		4 (14)	
PFT	FVC (%)	92.8 ± 13.6	
	FEV1 (%)	89.6 ± 19.5	
	Result	Normal	18 (64)
		Obstructive	6 (22)
		Restrictive	2 (7)
Mixed		2 (7)	
Smoking	Current smoker	5 (18)	
	Ex-smoker	9 (32)	
	Non-smoker	14 (50)	
Cancer	Primary : Metastatic	28 (100) : 0 (0)	
	Right : Left	20 (71) : 8 (29)	
Type of surgery	Lobectomy	18 (64)	
	Segmentectomy	8 (28)	
	Wedge resection	1 (4)	
	Others	1 (4)	
Postoperative consult for increased secretion		0 (0)	
Length of hospital stay (day)		10.5 ± 6.4	
Event of pneumothorax		3 (11)	
ICU admission		20 (71)	
Mechanical ventilation		0 (0)	

Values are presented as mean ± standard deviation or number (%).

HTN: hypertension; DM: diabetes mellitus; PFT: pulmonary function test; FVC: maximal inspiratory pressure; FEV1: forced expiratory volume in one second; ICU: intensive care unit;

Table 2. Independent factors affecting the Length of hospital stay

	B	p value	R²
Result of PFT	-2.03	0.00*	0.735
Type of operation	-2.50	0.02*	

Data analyzed with multivariate linear regression analysis, stepwise method.

PFT: pulmonary function test;

* p<0.05

P 2-100

Effect of Cardiac Rehabilitation Exercise Training for High-Risk Cardiac Patients

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Objective

To compare the effect of cardiac rehabilitation (CR) program to cardiorespiratory fitness (CRF), balance, hand grip strength, degree of physical activity between high-risk cardiac patients and participants without high-risk criteria.

Methods

A total of thirty-nine patients who underwent percutaneous coronary interventions for acute myocardial infarction were participated. Nineteen high-risk cardiac patients were recruited as subjects. The high-risk criteria were: advanced heart failure with left ventricular ejection fraction (LVEF) of less than 30%, a recent history of cardiac arrest or dangerous arrhythmia, and cardiac device insertion. Another twenty CR participants without any high-risk criteria mentioned above were recruited as controls. Both groups underwent 8 weeks of CR exercise training.

Outcome Measures

The primary outcome was CRF parameters examined by cardiorespiratory exercise test. The secondary outcome measures were the Results of hand grip strength test, Timed Up and Go (TUG), and the International Physical Activity Questionnaires- Short Form (IPAQ-SF). Outcome measures were assessed before and after completion of the CR program .

Results

The peak aerobic capacity (VO₂peak) ($p=0.001$), the metabolic equivalent ($p=0.001$), hand grip strength ($p=0.001$), and IPAQ-SF ($p<0.001$) also demonstrated significant improvement over time but showed no significant time and group interaction effects. Significant time and group interaction effects were evident in TUG ($p<0.001$).

Conclusions

High-risk cardiac patients who completed a supervised CR program demonstrated significant improvements in CRF parameters, balance, hand grip strength, and physical activity level. The improvement rate was similar to that of control group.

P 2-101

Reliability and validity of the portable dynamometer for knee extensor in a supine position

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Introduction

Intensive Care Unit Acquired Weakness (ICUAW) not only increases the length of stay in the Intensive Care Unit (ICU), but also gait disturbance after discharge. Although manual muscle testing is used to assess muscle strength subjectively and hand held dynamometer (HHD) is used to measure muscle strength Objectively, it is not applicable on supine position for ICU patients., Therefore, in this study, we aimed to develop a portable instrument to measure knee extension strength in a supine position and to establish a reliability and validity of a portable dynamometer for knee extensor in normal population prior to applying with ICU patients.

Methods

A portable dynamometer for knee extensor was used to measure knee extension strength in a supine position (Fig. 1). The strength of the knee extension (Unit : N) of the dominant leg and lever arm length (Unit : m) from knee joint to HHD were evaluated by two different testers. The assessment consists of a total of three sessions and is evaluated three times per session (Fig.2). The first and second sessions were evaluated by one tester and the third was evaluated by another tester. Afterward, we evaluated the knee extensor strength using Biodex in sitting position for a validity assessment. We analyzed intra-rater reliability, inter-rater reliability and validity of the instrument from these strength measurement values.

Results

Fifteen subjects (Men : 8, Women : 7) were initially enrolled and 14 completed the test. One participant was excluded after the first session because of knee pain. Mean age of enrolled subjects is 28.64 ± 4.81 (Mean \pm Standard deviation) years. The Intraclass Correlation Coefficient (ICC) values of intra-rater and inter-rater reliability are 0.989 and 0.985, respectively. The Pearson correlation coefficient between the torque obtained by multiplying the strength (N) by the lever arm length (m) and the Biodex value (N·m) was 0.935.

Conclusions

Inter-rater and intra-rater reliability for knee extensor strength using a portable dynamometer for knee extensor were excellent in normal subjects. This value also showed a strong positive correlation with Biodex. Therefore, we suggest that portable dynamometer for knee extensor can be used for measuring Objective and quantitative knee extension strength in persons with a supine position.



Fig. 1. Portable dynamometer to measure knee extension strength in a supine position.

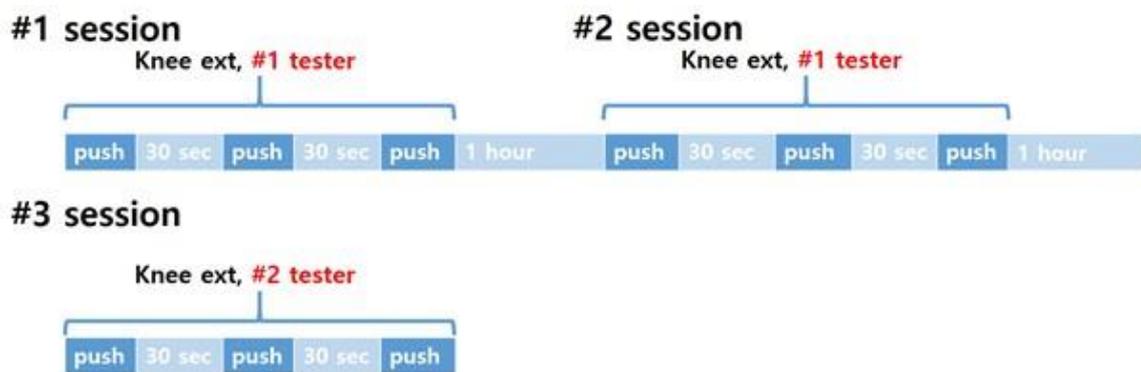


Fig. 2. Study protocol to evaluate the intra-rater and the inter-rater reliability of portable dynamometer for knee extensor

P 2-102

Factors for predicting VO₂max reduction in patients with myocardial infarction

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Introduction

It is known that steady cardiac rehabilitation in patients with heart disease, especially myocardial infarction, improves myocardial blood flow, increases exercise capacity and ultimately reduces heart-related mortality. Before cardiac rehabilitation, it is important to perform an exercise test to determine the cardiopulmonary capacity of the patient, and to prescribe cardiac rehabilitation to the patient by synthesizing the data from the exercise test. The maximum oxygen uptake (VO₂max) has already been used in various studies to assess the cardiopulmonary capacity of an individual, and is a good indicator of whether or not they improve at a later time. In this study, we compared the factors between the group with improved VO₂max and the group with worse outcome with exercise test at 1 month and at 3 months, after myocardial infarction.

Methods

We reviewed patients who underwent myocardial infarction from January 2016 to April 2018, among them, who visited our rehabilitation department for cardiac rehabilitation after discharge and underwent initial exercise stress testing. Patients underwent cardiac rehabilitation at home or on the outpatient clinic, and underwent exercise stress test after 4 to 8 weeks. Several studies have shown that the reliability of VO₂max obtained from exercise testing is at least 5%, so we also divide the variation of VO₂max by 5% into the improved group and the worse group. (Figure 1.)

Results

Of the 90 patients, 44 patients had VO₂max greater than 5% and 24 patients had less than 5% VO₂max. We compared several possible predictors of these two groups and found that Age (p-value=0.016), Ejection Fraction(p-value=0.036), Smoking(p-value=0.002) was a statistically significant and clinically significant factors. (Table 1.)

Conclusion

We found through this study that older age, lower Ejection Fraction, and continued smoking may be associated with a greater likelihood of VO₂max dropping even after cardiac rehabilitation. This led to the Conclusion that this patients may be able to explain the prognosis and that careful and in-depth cardiac rehabilitation is needed.

Table 1. Comparison of Patient's data

	Improved group (n=44)	Worse group (n=24)	Significance (p-value)
Age (yr)	54.7±9.4	60.8±10.2	0.016*
1mon_Resting HR	73.7±12.8	68.2±10.9	0.081
1mon_Maximal HR	147.7±18.7	137.1±27.4	0.100
1mon_Peak VO _{2max}	24.6±5.2	25.0±9.5	0.844
3mon_Peak VO _{2max}	28.3±6.3	20.7±7.1	<0.001
ETT Time(sec)	802.8±170.7	740.2±169.5	0.152
Ejection Fraction group			0.036*
≥50%	42(95.5%)	19(79.2%)	
40≤ <50%	0(0%)	3(12.5%)	
<40%	2(4.5%)	2(8.3%)	
HTN	17(38.6%)	10(41.7%)	0.807
DM	12(27.3%)	9(37.5%)	0.383
HLD	12(27.3%)	5(20.8%)	0.558
Smoking group			0.002*
Non-smoker	15(34.1%)	15(62.5%)	
Ex smoker	22(50.0%)	2(8.3%)	
Current smoker	7(15.9%)	7(29.2%)	
Beta-blocker	37(84.1%)	20(83.3%)	0.935

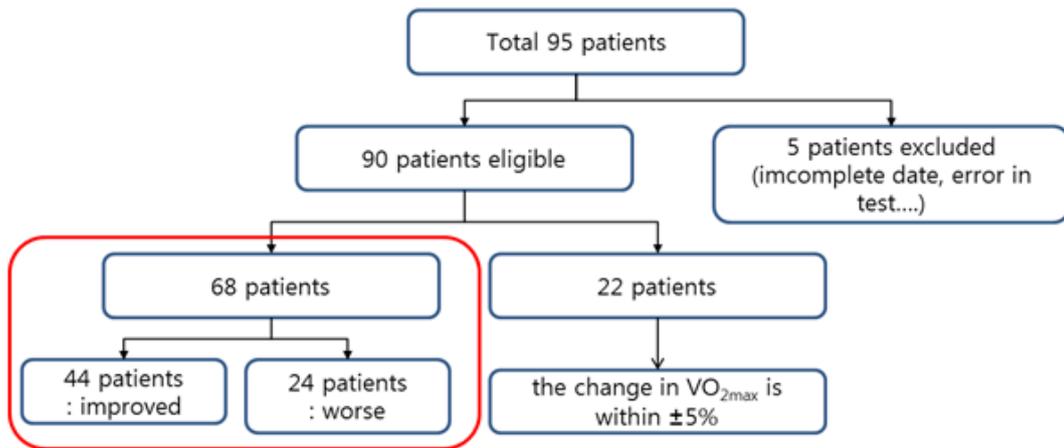


Fig 1. Patients' Flowchart

Comprehensive Evaluation of Integral Cardiac Rehabilitation in Critical Pathway after

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Abstract Backgrounds and Objectives

Cardiac rehabilitation (CR) has recently emerging as an integral component of critical pathway (CP) of acute coronary syndrome (ACS) in Korea. The aims of this study are to establish the comprehensive data about the body composition, presence of sarcopenia, arterial stiffness, leg isometric strength, gait endurance, and cardiopulmonary fitness during subacute phase after percutaneous coronary intervention (PCI) in OO regional cardiocerebrovascular center.

Methods

The evaluations of arterial stiffness (brachial ankle pulse wave velocity; baPWV) and body composition using bio impedance analysis (BIA) were performed during 4-day admission and skeletal muscle index (SMI) were calculated. The demographic, clinical characteristics including age, gender, the classification of myocardial infarction (MI) in the presence of ST-segment elevation (STEMI vs NSTEMI) were evaluated. 6-minute walk test (6MWT) and the mean value of isometric muscular strengths of bilateral quadriceps, hamstrings relative to body weight were measured. Cardiopulmonary fitness was evaluated using an expired gas analyzer.

Results

111 patients underwent PCI after ACS and all were referred (100%) for CR from Jan, 2015 to Mar, 2016. 79 patients (72.2%, 60.0 ± 11.2 years, 65 males) conducted exercise stress test (EST) in outpatient clinic. Compared with previously reported values of healthy persons, there were no significant difference in peak aerobic capacity, isometric muscular strength of lower limb, gait endurance and skeletal muscle index, but mean value of BaPWV was increased.

Conclusion

This present study confirmed the baseline values of the comprehensive evaluations in ACS patients during subacute phase after applying the integral cardiac rehabilitation included in critical pathway. Therefore, further studies should be warranted for the individualized and appropriate cardiac rehabilitation according to categorized cardiovascular diseases.

Table 1. General demographic, clinical characteristics and arterial stiffness

Parameters	Numbers = 79
Age (years)	60.0 ± 11.2
Sex (Male:Female)	65 (72.2):14 (27.8)
Height (cm)	165.1±8.2
Weight (kg)	68.8±10.3
BMI (kg/m ²)	25.3±2.6
Classification of MI (NSTEMI:STEMI)	45(57.0):34(43.0)
Duration between onset and assessment of arterial stiffness (days)	3.7±4.2
BaPWV (m/s)	16.2±3.3

Values are presented as number (%) or mean ± standard deviation.

BMI, Body mass index; NSTEMI, non-ST segment elevation myocardial infarction; STEMI, ST segment elevation myocardial infarction; BaPWV, brachial ankle pulse wave velocity

Table 2. Parameters of Body composition, gait endurance and Isometric muscular strength of Lower extremities

Parameters	Numbers = 79
Body composition	
Muscle mass	48.4±8.4
Fat mass	17.9±5.3
SMI (male: female)	7.6±1.0 (7.8±0.8:6.5±0.8)
6MWT (meters)	425.4±81.4
Isometric muscular strength	
Qceps (PT)	108.9±34.4
Ham (PT)	65.1±23.2
QcepsBW	1.6±0.4
HamBW	0.9±0.3

Values are presented as mean ± standard deviation, *p<0.05

SMI, skeletal muscle index; 6MWT, Six minute walk test; Qceps, quadriceps; PT, peak torque; Ham, hamstrings; QcepsBW, peak torque of quadriceps relative to body weight; HamBW, peak torque of hamstrings relative to body weight

Table 3. Cardiopulmonary parameters in all post-PCI patients

Parameters	Numbers = 79
Duration from onset to ETT (days)	18.3±5.9
Cardiopulmonary parameters	
VO _{2peak}	28.1±6.8
RHR	75.0±13.4
RSBP	120.5±14.9
RDBP	72.8±9.2
PHR	131.7±20.8
PSBP	158.3±25.9
PDBP	74.8±11.8
RPP _{peak}	20810.4±5199.0
ETT duration (seconds)	783.7±232.1
RER	1.0±0.1

Values are presented as mean ± standard deviation, *p<0.05

VO_{2peak}, peak oxygen consumption; RHR, resting heart rate; RSBP, resting systolic blood pressure; RDBP, resting diastolic blood pressure; PHR, peak heart rate; PSBP, peak systolic blood pressure; PDBP, peak diastolic blood pressure; RPP_{peak}, peak rate pressure product; ETT, exercise tolerance test; RER, respiratory exchange ratio

Current Status of Cardiac Rehabilitation Program after applying of Critical Pathway

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Backgrounds and Objectives

Cardiac rehabilitation (CR) has recently emerging as an essential component of critical pathway (CP) of acute coronary syndrome in Korea. However, there are few reports about the current status of CR. Therefore, we aimed to investigate the proportions of patients referred to and attending CR programs in OO regional cardiocerebrovascular center and to provide basic information for CR of ACS patients in Korea.

Methods

Data was retrospectively collected from October 2013 to December 2017. The phase I 4-day CP protocol of ACS is described in Figure 1 which is composed of the patients screening and education for analysis of body components, various risk factors, arterial stiffness, and CR program. The phase II (outpatient) CP protocol consisted of comprehensive assessment of cardiopulmonary exercise (CPX), isometric muscular strength of lower limb, gait endurance (Figure 2). And then, according to risk factor classification, the patients were divided into the center-based CR or the home-based CR. The prescription of aerobic and resistance exercise and the education for the modification of risk factors were conducted at the same day of CPX and the education book and brochure were also provided.

Results

401 patients were referred for phase I CR after percutaneous coronary intervention (PCI). Among them, 266 patients (66.3%) underwent CPX and before the initiation of phase II CR according to CP of CR. And, 160 patients (39.9%) completed in center-based CR or the home-based CR.

Conclusion

We confirmed the basic data about the proportions of patients referred to and attending CR and CP protocol including CR might be beneficial for increasing the CR enrollment and adherence. Therefore, CR should be an essential component of CP of ACS in Korea.

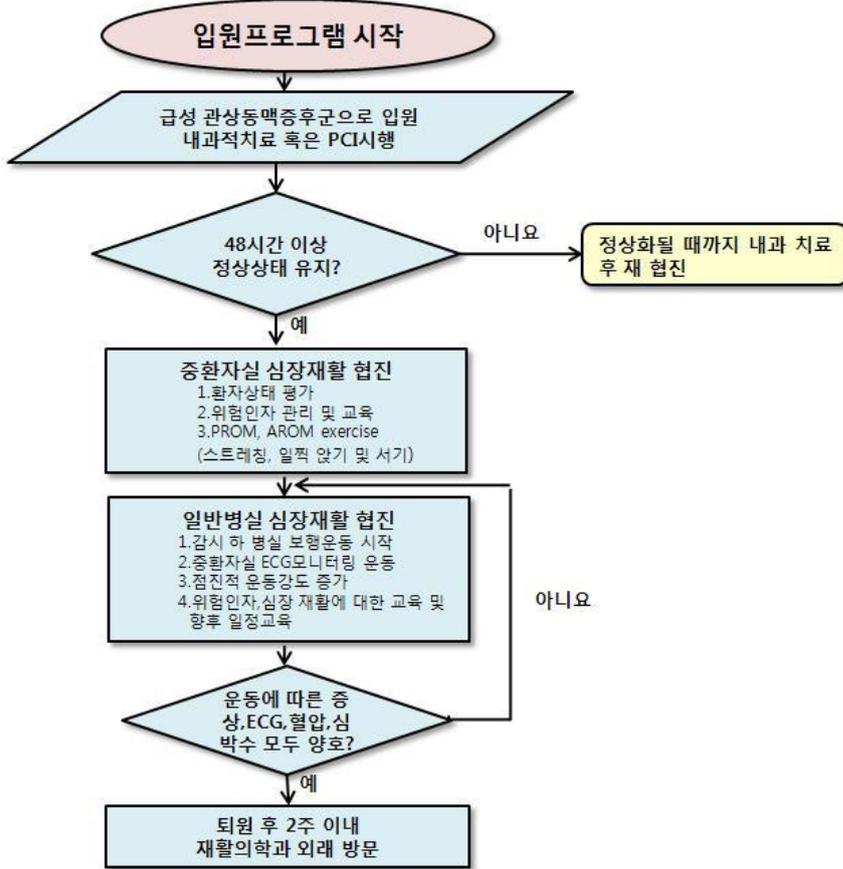


fig1. The phase I inpatient CP protocol

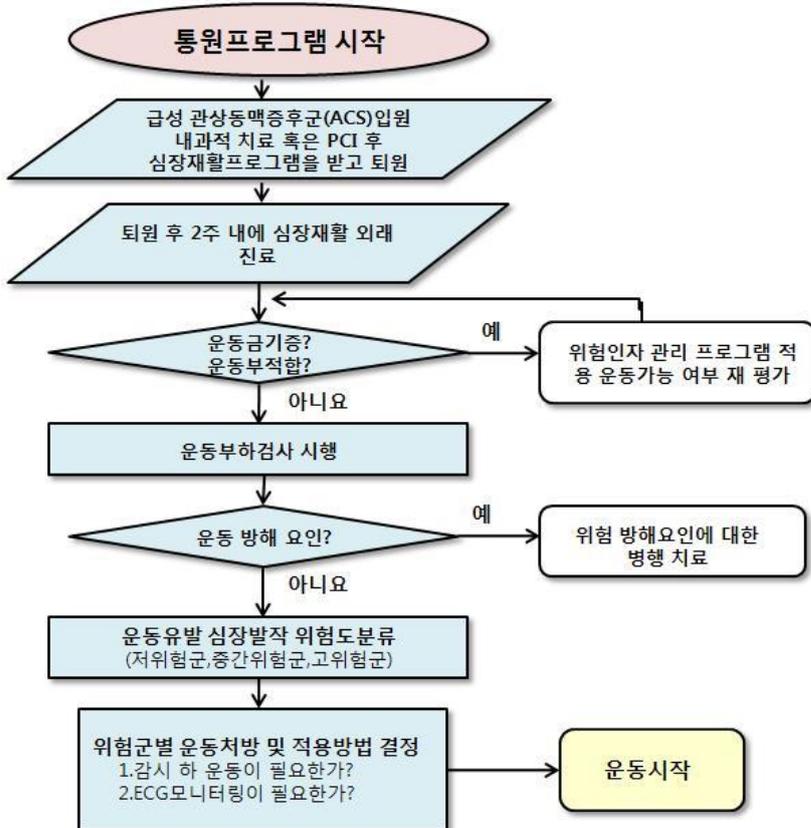


fig2. The phase II outpatient CP protocol

A relation between Serum Creatine Kinase Level and Cardiac Function in Duchenne Muscular Dystrophy

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Introduction

Duchenne muscular dystrophy (DMD) is a progressive disease which gradually affects all voluntary muscles, finally involving cardiac and respiratory muscles in the end stages. Eventually, cardiomyopathy induced heart failure develops which is a major cause of death in DMD patients. In a previous study, serum Creatine Kinase (CK) level was found to have a strong correlation with pulmonary functions. However, there are not enough studies to demonstrate the relationship between cardiac laboratory data and ejection fraction (EF) in patients diagnosed with DMD. This study aims to evaluate the relationship between serum CK level and cardiac EF in DMD patients.

Method

Data were retrospectively collected from medical records of patients diagnosed with DMD who were hospitalized in the Department of Rehabilitation Medicine, Gangnam Severance Hospital from January 1999 to March 2015. DMD patients who took laboratory exams or transthoracic echocardiogram (TTE) were included. Among 185 patients, 72 patients were excluded due to absence of TTE Results. 7 patients were excluded because of insufficient TTE data and 6 other patients were excluded because some of their cardiac laboratory data were missing. For patients with multiple admissions in the period, the only data from first hospitalization period were included in the analysis. As a Result, data from 100 patients were eligible and finally analyzed. Pearson correlation and regression analysis were used to determine the degree of correlation.

Results

EF and serum CK showed no significant correlation on Pearson correlation (correlation coefficient=0.113, p value= 0.139). Furthermore, EF and serum Creatine Kinase-muscle/brain (CK-MB) showed no significant correlation on Pearson correlation (correlation coefficient =0.121, p value= 0.121). However, a weak correlation was observed for Brain Natriuretic Peptide (BNP) and EF (correlation coefficient=-0.290, p value= 0.002). On simple and multiple linear regression study, other various factors (age, weight, height, body-mass-index, CK and CK-MB) showed no significant correlation. However, BNP showed statistically significant explanatory strength for EF in simple and

multiple linear regression analysis ($R^2=0.086$, p value= 0.003 and $R^2 = 0.146$, p value= 0.002 , respectively). Therefore, although the correlation between BNP and EF is weak, BNP rather than CK or CK-MB, may have stronger correlation with EF.

Conclusion

There was no statistically significant relationship between serum CK and EF. However, BNP had weak correlation with cardiac EF. Therefore, to evaluate cardiac function in DMD patients, routine TTE should be emphasized and assessment of laboratory data including BNP could be helpful.

Table 1. Pearson correlation between EF and laboratory cardiac function parameters in DMD patients

Cardiac function	Cardiac marker	Correlation coefficient	P-value
EF	CK	0.122	0.227
	CK-MB	0.135	0.181
	BNP	-0.292	0.003*

EF: ejection fraction; CK: creatine kinase; CK-MB: creatine kinase-muscle/brain; BNP: brain natriuretic peptide
* means statistically significant ($p < .05$)

Table 2. Association between EF and various factors (simple linear regression analysis)

	Mean(\pm SD)	EF	
		B(SE)	p-value
Age	20.480(\pm 4.69)	-0.425(0.347)	0.223
Weight(kg)	41.76(\pm 14.45)	-0.048(0.113)	0.671
Height(cm)	156.92(\pm 9.95)	-0.165(0.164)	0.316
BMI(kg/m ²)	16.83(\pm 5.25)	0.028(0.313)	0.929
CK(U/L)	1054.200(\pm 769.23)	0.003(0.002)	0.227
CK-MB(μ g/L)	22.17(\pm 15.92)	0.138(0.102)	0.181
BNP(μ g/mL)	68.537(\pm 216.54)	-0.022(0.007)	0.003*

EF: ejection fraction; BMI: body mass index; CK: creatine kinase; CK-MB: creatine kinase-muscle/brain; BNP: brain natriuretic peptide; B: β coefficient; SE: standard error; SD: standard deviation

* means statistically significant ($p < .05$)

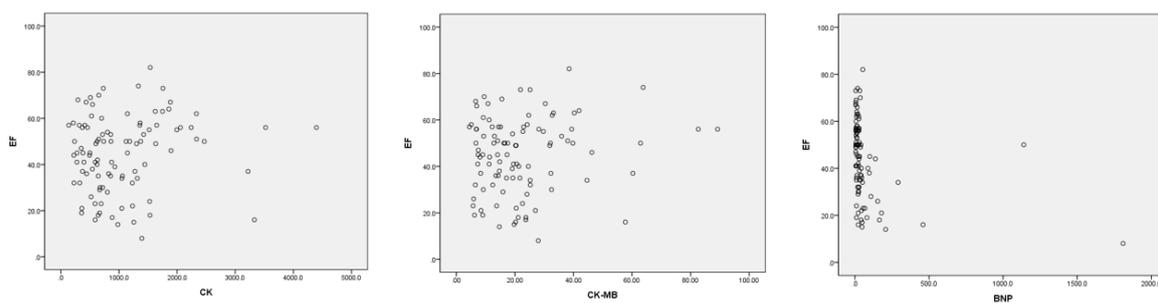


Figure 1. Correlations between EF and laboratory cardiac function parameters (CK, CK-MB and BNP)

Clinical Effect of pulmonary rehabilitation for acute stroke patients

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Introduction

People with a cerebrovascular accident have a greater risk of associated pneumonias, which involve increased morbidity and mortality. A restrictive pulmonary impairment occurs in stroke, because their lung capacity decrease due to respiratory muscle weakness. Nonpharmacological treatment and therapeutic exercise training have been shown to improve cough effectiveness and are essential for the prevention of stroke-associated pneumonia. The aim of this study is to evaluate the effects of pulmonary rehabilitation (PR) on pulmonary function in acute stroke patients.

Method

Twenty-seven subjects with stroke who admitted to stroke rehabilitation center were recruited at OOOO Hospital from August 2016 to May 2018. Eligibility criteria included 1) First onset of acute stroke patients over 18 years of age, 2) Within two weeks onset, 3) Hemiparesis, 4) Normal cognitive function. All subjects were asked to participate in the pulmonary rehabilitation (PR) program after an explanation on the need for PR and the program content. The authors enrolled patients who wanted to participate in the PR program. Patients who underwent PR were classified into PR group (19 patients), those who didn't participate were labeled control group (8 patients). The PR group subjects underwent the PR program 5 days a week, during 4 weeks. The PR program was composed of air stacking exercise, manually assisted cough, inspiratory and expiratory muscle strengthening, cough exercise and respiratory re-education. The control group received conventional stroke rehabilitation. The pulmonary functions were evaluated by various means, before and after one-month PR. Pulmonary function parameters were peak cough flow (PCF), maximal voluntary ventilation (MVV), forced vital capacity (FVC), forced expiratory volume in 1 second (FEV₁), peak expiratory flow (PEF), maximum inspiratory pressure (MIP), and maximum expiratory pressure (MEP). The Korean version of Modified Barthel Index (K-MBI) and hand grip power were also evaluated as tools for evaluating physical function.

Results

Both groups significantly improved in MVV and PCF after 1 month. Although, MVV and PCF had no significant intergroup difference, the change rate in PR group (MVV: 40.47%, PCF: 42.3%) was significantly greater than 30.29% and 28.2% in the control group. FEV₁ showed a trend towards statistically significant improvement only in PR group (p=0.080). And MIP, and MEP had significant intragroup difference only in the PR group.

Conclusion

This study showed that MVV, PCF and strength of respiratory muscle were significantly increased when PR program were performed in stroke patients. In other words, PR can improve lung capacity and cough effectiveness to help patients achieve effective airway excretion, and may help reduce the morbidity of respiratory complications such as pneumonia.

Characteristic		Total (n = 27)	PR (n = 19)	Control (n = 8)
Gender	M	15	10	4
	F	16	9	4
Age		71.30 ± 2.49	72.16 ± 3.14	69.25 ± 4.08
Type of stroke	Ischemic	19	11	7
	Hemorrhagic	12	8	1
MBI		40.78 ± 4.52	34.74 ± 4.99	55.13 ± 7.88
Grip strength	Rt	16.74 ± 2.01	14.14 ± 1.95	23.43 ± 4.44
	Lt	14.86 ± 2.11	12.94 ± 2.22	19.79 ± 4.69
Onset		43.26 ± 15.28	32.58 ± 11.21	68.63 ± 45.02

Table1. Values are presented as mean ± standard deviation unless otherwise indicated. K-MBI, The Korean version of Modified Barthel Index

Variables	PR (n = 19)	Control (n = 8)	Between group p value
MVV			
Baseline	27.48 ± 4.11	42.78 ± 9.25	0.221
4-weeks later	38.60 ± 4.54	55.74 ± 12.45	0.317
Intra-group p value	0.004*	0.025*	
FVC			
Baseline	1.86 ± 0.17	2.26 ± 0.25	0.171
4-weeks later	2.04 ± 0.17	2.50 ± 0.30	0.222
Intra-group p value	0.106	0.123	
FEV₁			
Baseline	1.41 ± 0.14	1.79 ± 0.20	0.130
4-weeks later	1.58 ± 0.14	1.88 ± 0.24	0.243
Intra-group p value	0.080	0.401	
PEF			
Baseline	2.56 ± 0.35	3.42 ± 0.42	0.086
4-weeks later	2.95 ± 0.29	2.91 ± 0.57	0.739
Intra-group p value	0.221	0.293	
PCF			
Baseline	178.82 ± 19.78	212.50 ± 18.49	0.152
4-weeks later	254.47 ± 21.62	272.50 ± 25.41	0.629
Intra-group p value	0.000*	0.030*	
MIP			
Baseline	21.89 ± 4.49	35.06 ± 9.23	0.230
4-weeks later	33.89 ± 4.62	37.31 ± 6.14	0.811
Intra-group p value	0.030*	0.400	
MEP			
Baseline	23.47 ± 4.15	40.44 ± 6.47	0.066
4-weeks later	35.95 ± 5.39	47.56 ± 8.49	0.325
Intra-group p value	0.005*	0.204	

Table2. Values are presented as mean ± standard deviation unless otherwise indicated. PCF, peak cough flow; MVV, maximal voluntary ventilation; FVC, forced vital capacity; FEV₁, forced expiratory volume in 1 second; PEF, peak expiratory flow; MIP, maximum inspiratory pressure; MEP, maximum expiratory pressure; * Significant Results (P<.05)

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Relation between Pulmonary function and Ischemic stroke lesion

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Objective

Pneumonia is major cause of post stroke morbidity. And it is important to predict and minimize the risk for pneumonia in stroke patients. Both supra-tentorial and infra-tentorial lesions are all likely to affect the respiratory function of stroke patients. Respiratory function can be impaired in infratentorial stroke patients by involvement of the Böttinger complex. In supratentorial stroke, respiratory muscle strength can be weakened. For this reason, Respiratory function would depend on the stroke lesion, so we conducted pulmonary function test(PFT) to evaluate difference in pulmonary function between two different lesions, during in-patient rehabilitation following stroke.

Methods

A total of 26 stroke patients who went through in-patient rehabilitation at Kyung-book National University Hospital were selected for this study. Patients were included if they had a clinical diagnosis of ischemic stroke. No distinction was made of age, sex, race. PFT includes FVC, FEV1, FEV1/FVC.

Results

We compared pulmonary function and performed a Mann-Whitney analysis. Results showed that there was overall reduction of respiratory function in stroke patients, regardless of stroke lesion. And there was no relation between pulmonary function and the lesion affected side is whether supratentorial or infratentorial(Table 1).

Conclusion

No significant correlation was found between PFT Result and stroke lesion. It would be helpful to compare peak cough flow which is concerned with expectoration ability for preventing stroke-complication like pneumonia.

Table 1. demonstration there was no relation between pulmonary function and the lesion affected side is whether supratentorial or infratentorial

	Age	FVC _{ref}	FEV1 _{ref}	FEV1/FVC	PEF _{ref}	ERV
Mann-Whitney U	82.000	82.000	80.500	80.000	64.500	34.000
Wilcoxon W	148.000	148.000	200.500	146.000	109.500	125.000
Z	-.026	-.026	-.104	-.130	-.179	-.439
Asymp. Sig. (2-tailed)	.979	.979	.917	.897	.858	.661
Exact Sig. [2*(1-tailed Sig.)]	1.000	1.000	.919	.919	.861	.701

Effect of Edaravone in Patients with advanced Amyotrophic Lateral Sclerosis

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Introduction

In 2017, the FDA approved Edaravone as a neuroprotective agent to slow the progression of Amyotrophic Lateral Sclerosis (ALS). The precise mechanism of Edaravone in the treatment of ALS is not known, but its therapeutic effect is considered to be done by its antioxidant properties. The former clinical trials have been performed on ALS patients in less advanced status only (Japan ALS severity classification grade 1-3; forced vital capacity (FVC) in ratio to normal predicted value (FVCPred%) of $\geq 60\%$). In the previous clinical trials published in 2014, the average change in ALSFRS score was -5.7 ± 0.85 decline, and the next study presented only at the 2016 conference showed a decrease in average ALSFRS score -6.52 ± 1.78 . Therefore we included more advanced ALS patients with a FVCPred% of less than 60% to study the efficacy of Edaravone in these patients.

Case report

Since January of 2017 to June of 2018, 19 patients were enrolled in the Edaravone treatment. 60 mg of Edaravone is administered daily intravenously for the first 14 days which is followed by 14 days of rest. In the second to sixth cycles, the same dose of Edaravone is given for 10 days in every cycle, with a 14-day rest period between each cycles. Eleven patients finished the treatment of 6 cycles, 2 patients were dropped out and 3 patients are still continuing the treatment. Among the 11 patients who finished the total 6 cycles, 7 patients (M:F=5:2, mean age = 58.6 ± 8.8 years) had FVCPred% of less than 60% at initial. These seven patients started the Edaravone infusion approximately 2.17 ± 1.58 years after symptom onset and 0.99 ± 1.02 years after diagnosis. For all subjects, pulmonary function (FVC and peak cough flow), ALS functional rating scale (ALSFRS) and manual muscle test were checked at the beginning and end of the Edaravone infusion for every cycle. We also performed the regular laboratory tests to screen drug-related adverse outcomes. The mean ALSFRS score was 30.1 ± 8.1 at baseline and 24.7 ± 5.4 after 6 cycles of Edaravone administration. The mean change in ALSFRS score from baseline was -7.2 ± 6.6 . The mean baseline FVC Pred% in the sitting position was 36.1 ± 12.4 and it became 25.7 ± 12.7 after therapy. The mean baseline FVC

Pred% and after 6 months of treatment in the supine position was 28.3 ± 5.5 and 22.5 ± 8.9 respectively. Not any major drug-related side effects were found.

Conclusion

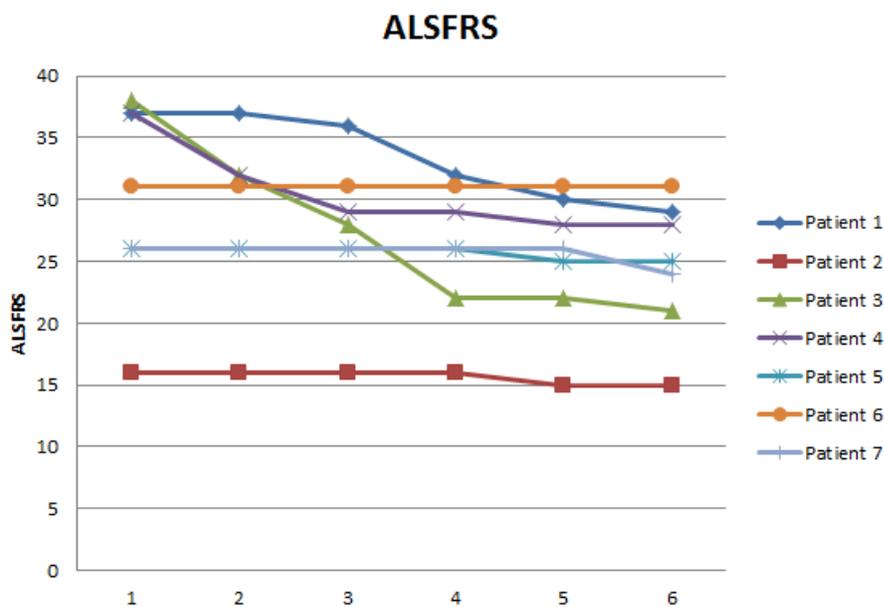
The mean change in ALSFRS scores of patients with more advanced ALS was significantly reduced compared to the values reported in previous clinical trials. We can conclude that Edaravone can be successfully treated in ALS patients with a FVCPred% of less than 60%. Nowadays, we are enrolling more patients, following up serial ALSFRS scores and pulmonary function parameters, aiming to compare the efficacy of Edaravone depending on the types of onset and on the Methods of therapies (combined with exercise therapy Vs. Edaravone alone).

Table 1. FVC and ALSFRS score in each patient under Edaravone therapy

	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7
Age (years) at	65	52	58	63	42	63	67
Sex	F	F	M	M	M	M	M
Type	Limb	Limb	Bulbar	Limb	Limb	Limb	Limb
FVC sitting Pred (%) - initial	56.8	21.0	25.4	27.7	40.0	44.6	37.0
FVC sitting Pred (%) - endpoint	41.6	9.3	23.3	16.7	33.1	40.1	15.8
delta FVC sitting Pred (%)	-15.2	-11.7	-2.1	-11.0	-6.9	-4.5	-21.2
FVC supine Pred (%) - initial	36.7	21.0	25.2	25.4	32.8	31.9	25.2
FVC supine Pred (%) - endpoint	36.8	10.6	20.7	15.7	28.2	27.2	18.0
delta FVC supine Pred (%)	0.1	-10.4	-4.5	-9.7	-4.6	-4.7	-7.2
ALSFRS total - initial	37.0	16.0	38.0	37.0	26.0	31.0	26.0
ALSFRS total - endpoint	29.0	15.0	21.0	28.0	25.0	31.0	24.0
delta ALSFRS total	-8.0	-1.0	-17.0	-9.0	-1.0	0.0	-2.0

Abbreviation : F:Female; M:Male; FVC:forced vital capacity; ALSFRS:Amyotrophic lateral sclerosis functional rating scale

Figure 1. Changes of ALSFRS score at each cycle of Edaravone therapy



Four ALS patients with forced vital capacity (FVC) in ratio to normal predicted value ($FVC_{pred}\%$) of $< 60\%$ finished the Edaravone treatment of total 6 cycles. ALS functional rating scale scores of each patient at each cycle depicted in the figure (mean \pm SD change in ALSFRS score from baseline to after therapy was -7.2 ± 6.6).

Effect of pulmonary rehabilitation on pulmonary function in a stroke patient with COPD: Case report

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Introduction

stroke patients show an exercise capacity that is reduced by about 40% when compared with the control group of the same age and sex, and it may be more severe in the case of underlying pulmonary disease. We report a case of a stroke patient with chronic obstructive pulmonary disease (COPD) who underwent 3 weeks of pulmonary rehabilitation (PR) along with conventional stroke rehabilitation program.

Case

A 71-year-old man with COPD visited the emergency room due to dysarthria and aphasia without motor and sensory change. Brain MRI showed infarction of left middle cerebral artery territory, and he was admitted to the Department of Neurology. He was transferred to the Department of Rehabilitation for rehabilitation treatment focused on aphasia. His baseline characteristics including Modified Medical Research Council scale (mMRC), pulmonary function test (PFT), hand grip power, Korean Modified Barthel Index (K-MBI), and Berg balance scale are shown in Table 1. He also underwent surface electromyography (sEMG) in upper trapezius, sternocleidomastoid, external oblique, and diaphragm muscles. (Figure 1) To measure the activity of the respiratory muscles, muscle activation intensity (%) was calculated: [mean root mean square (RMS) of each muscle/mean RMS of the maximal voluntary contraction] x 100. Since he has COPD, he underwent 3 weeks of PR along with conventional stroke rehabilitation program. The PR program consisted of 60 minutes of aerobic exercise, respiratory muscle strengthening, and stretching exercise. Aerobic exercise is carried out using an ergometer and treadmill. Respiratory muscle strengthening was performed using threshold inspiratory muscle training (IMT) and threshold positive expiratory pressure (PEP) devices. After 3 weeks of the rehabilitation, follow up examinations were performed, and showed mild improvements in forced expiratory volume in one second (FEV1), FEV1/forced vital capacity (FVC), values in sEMG, hand grip power, and K-MBI (Table 1).

Discussion

After 3 weeks of PR, the Results of FEV1 and FEV1/FVC were improved, which suggests an improvement of airway obstruction in a patient with obstructive lung disease. Furthermore, the Results of sEMG showed that PR could increase the use of the primary respiratory muscles (diaphragm, external oblique muscle), and reduce the use of accessory respiratory muscles (upper trapezius muscle, sternocleidomastoid muscle) during breathing. In addition, there was an improvement in hand grip power and K-MBI, but it was considered to be more related to the effect of conventional rehabilitation than that of PR.

Conclusion

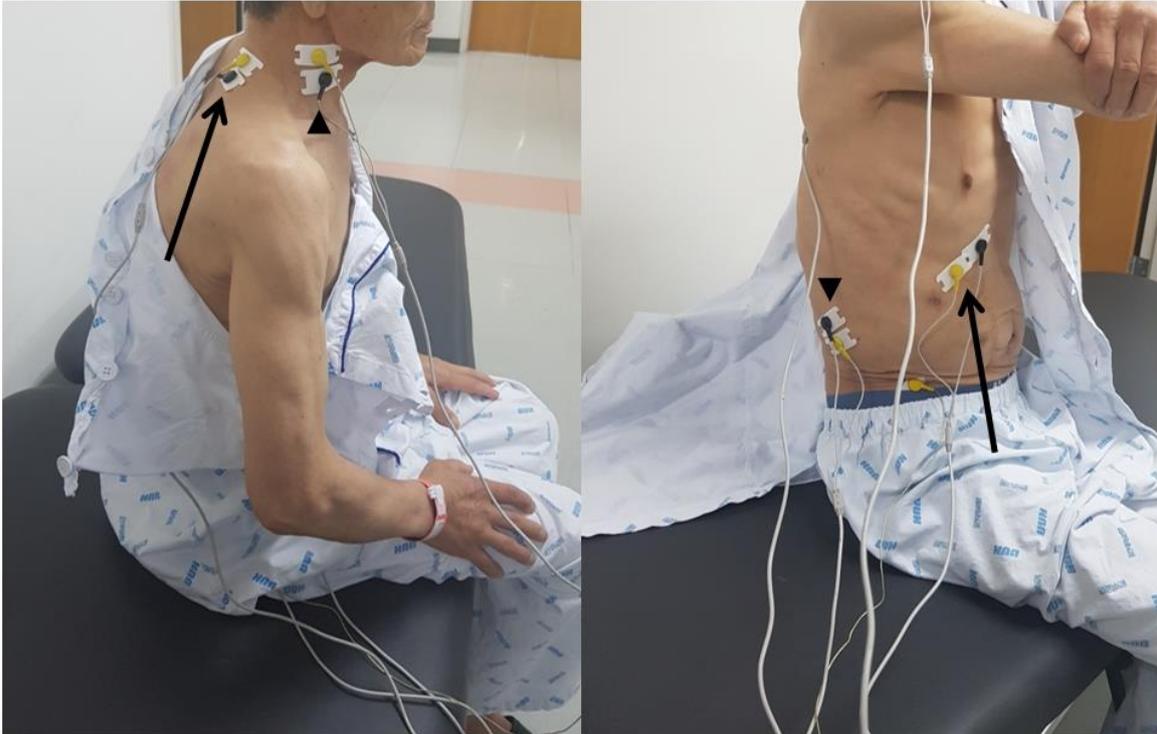
This case shows the effect of 3 weeks of PR on pulmonary function in a stroke patient with COPD. To generalize the Result, further evaluation is required in larger, prospective studies.

Table 1. Comparison of outcome measurements before and after 3 weeks of pulmonary rehabilitation in a stroke patient with chronic obstructive pulmonary disease

		Pre-treatment		Post treatment	
mMRC		3		3	
Pulmonary function test		Pre-bronchodilator	Post-bronchodilator	Pre-bronchodilator	Post-bronchodilator
	FVC (Liters)	2.90 (82)	3.02 (86)	2.89 (82)	2.91 (83)
	FEV1 (Liters)	1.64 (65)	1.85 (73)	1.76 (70)	1.81 (72)
	FEV1/FVC (%)	57	61	61	62
	PI max (cmH2O)	53 (51)		54 (52)	
	PE max (cmH2O)	84 (43)		69 (35)	
Muscle activation intensity (%) in sEMG	Upper TPZ	41		43	
	SCM	63		21	
	EO	41		66	
	Diaphragm	28		85	
Hand grip power (kg)	Right	12.7		14.3	
	Left	12		14.7	
K-MBI		80		90	
BBS		53		53	

Values are presented as number (% when needed).

mMRC: Modified Medical Research Council scale; FEV1: forced expiratory volume in one second; FVC: forced vital capacity; PI max: maximal inspiratory pressure; PE max: maximal expiratory pressure; sEMG; surface electromyography; SCM: Sternocleidomastoid muscle; EO: External oblique muscle; K-MBI: Korean Modified Barthel Index; BBS: Berg balance scale



(a) Right upper trapezius muscle (arrow)

(b) Right sternocleidomastoid muscle (arrow head)

(c) Right diaphragm muscle (arrow)

(d) Right external oblique muscle (arrow head)

Figure 1. The locations of electrodes in surface electromyography of respiratory muscles

Rehabilitation of Combined Heart-liver transplantation recipient : A Case report

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Objective

Combined heart-liver transplantation (CHLT) is a lifesaving procedure for the patients suffering from end-stage heart and liver disease. However, the experience with CHLT is small in Korea because of high-risks during intervention and difficulty of surgical techniques. Acceptance of CHLT grows since additional CHLT indications have been expanded. Despite successful transplantation, it is easy to fall into risk for disability after surgery due to disease severity, side effects of immunosuppressive medication, and cardiovascular deconditioning. Postoperative rehabilitation is essential to prevent deconditioning, but there is little data regarding rehabilitation of CHLT recipients. It is important to share clinical experience for potential cases in the future. We here report a single case with rehabilitation of CHLT recipient in order to help in management after CHLT.

Case

47 years-old female patient who suffered from mitral valve stenosis, tricuspid valve regurgitation, atrial fibrillation, chronic heart failure, and cardiac cirrhosis had dyspnea, so she had difficulty on walking. On September, 26th, 2016, Cardiac arrest developed and ECMO care was taken. Ischemic change on right leg developed during ECMO care. CHLT was performed at Samsung medical center on September, 23th, 2016. After operation, she underwent deconditioning and had a seizure attack on December, 6th, 2016. Brain MRI presented small amount of SDH in Lt. frontal convexity. She needed ICU care more than 2month, and comprehensive rehabilitation for weakened limb, and decreased heart function. Patient was transferred to Kyungpook national university hospital(KNUH) for rehabilitation. After receiving rehabilitation treatment at KNUH from March 17th to April 11th, 2017, she was transferred to Chilgok kyungpook national university hospital on April, 12th. She was hospitalized until June, 9th, 2017. During hospital stay, lower extremity strengthening, sitting balance training, and physical therapy and occupational therapy were performed twice a day. T-cannula was removed at April, 10th. Currently, outpatient treatment is ongoing. Initially, K-MBI was 13 at Samsung medical center on March 3rd, 2017. After transfer to KNUH, initial Berg balance scale (BBS) was 3 and K-MBI was 30 on March 21th, 2017. After 11 weeks of hospitalized rehabilitation, she could walk with minimal assist. BBS and K-MBI improved to 37 and 57 respectively. The patient was discharged on June 9th, 2017. On January, 8th, 2018, about 15 months after surgery, the follow up test showed BBS 44 and K-MBI 92. Timed up and go, 10m gait speed, and 6min

walk test was 12.44s, 13.42s, and 200m respectively. Now she can walk independently and is receiving outpatient treatment.

Discussion

CHLT recipients can easily fall in to deconditioning and be disabled, considering the severity of underlying disease and complexity of procedure. Postoperative rehabilitation would make better prognosis and recover functional ability.

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Cardiac Rehabilitation in Heart Transplant Recipients with Hemiplegic Comorbidity: Two Cases Report

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INTRODUCTION

After heart transplantation (HTPL), patients require lifelong immunosuppression drugs to prevent rejection of the graft. These drugs have potential adverse complications such as diabetes, gout or hypertension together with HTPL-specific atherosclerosis. Cardiac rehabilitation (CR) in HTPL recipients has been documented to be effective in reversing the pathophysiological consequences of cardiac denervation and prevent immunosuppression-induced adverse effects. Ischemic stroke represents the most common cerebrovascular complication after HTPL. We report two cases of successful CR in HTPL recipients with hemiplegic comorbidity.

CASE 1

One year ago, a 59-year-old man was admitted for treatment of exertional dyspnea. His diagnoses were 3-vessel coronary artery disease and dilated cardiomyopathy with LVEF of 10%. After undergoing coronary bypass surgery, his cardiac function worsened and he thus took subsequent HTPL. Two weeks after HTPL, the patient experienced left side weakness due to right anterior cerebral artery infarction. A year after HTPL, this patient was referred to our hospital for cardiac rehabilitation with left foot drop. He then performed ECG-monitored aerobic exercise training and a FES device was applied on the tibialis anterior muscle during gait training. The exercise intensity was set according to the Borg's rate of perceived exertion (RPE) scale of 13-14 for 30 minutes per session, 2 times a day for 12 weeks. After the 12-week program, the patient's VO₂max improved from 11.9 to 15.0 mL/kg/min (3.4 to 4.3 METs). No adverse cardiovascular event was observed throughout the entire CR program.

CASE 2

A 54-year-old woman, who had previously undergone aortic valve replacement and Maze procedure, was diagnosed with right MCA infarction. A year later, she presented at a hospital due to newly developed dyspnea. Echocardiogram showed prosthetic valve failure. Although the valve replacement was performed again, the prosthetic valve failure did not resolve and she thus took subsequent HTPL. She was referred to our hospital a year after and her left side weakness remained sequelae. Since her physical function was not sufficient for treadmill training, she started ECG-monitored aerobic exercise training on a reclined bicycle ergometer and the FES device was used for indoor gait training. The exercise intensity was set at an RPE of 13-14 for 30 minutes per session, 2 times a day for 6 weeks. As a result of the CR program, the speed increased from 30 to 50 RPM and the workload of watts increased from 0 to 2. No adverse cardiovascular event occurred throughout the entire course of the exercise program.

CONCLUSION

Ischemic stroke is a major cerebrovascular comorbidity after HTPL and sequelae of stroke can be a big obstacle to CR and to gaining optimal exercise capacity. In our experience, CR after HTPL can be safe and effective for improving exercise capacity, even in patients with hemiplegic comorbidity.

Multimodal rehabilitative approach to atelectasis in scoliosis patient : a Case report

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Introduction

We experienced one case of atelectasis due to bronchial obstruction after pneumonia and the curve of scoliosis seems to have deteriorated. The Boston brace and the respiratory rehabilitation applied to improve the pneumonia and atelectasis.

Case description

A 20 - year - old female patient with fever and dyspnea was referred for respiratory rehabilitation in order to relieve the obstruction of bronchus. At the time of admission, the body temperature was 38 ° C, oxygen saturation was 92%, white blood cell count was 16.1×10^9 cells/L, and C-reactive protein (CRP) was 22.17 mg/L. Chest CT showed compressing of bronchus by thoracic spine with scoliosis, focal obstruction at right bronchus intermedius, and atelectasis of RML and RLL. A large amount of secretion and near total obstruction were detected in the bronchoscopy toward the right bronchus intermedius. The chest and orthopedic surgeons recommended surgery. Right apex of thoracic curve is 58.2° and left apex of lumbar curve is 24.7° in the Cobb's angle. We performed an External High Frequency Chest Wall Oscillation (HFCWO) with pressing her right apex of scoliosis and made her body to decubitus position to widen right bronchus narrowed by severe scoliosis for facilitating secretion release. And the Boston brace was immediately applied to maintain the open state of the right bronchus. The thoracic curve changed from 58.2° to 53.7° and the lumbar curve was similar after applying Boston brace. Sputum was relieved and the atelectasis of RML and RLL was rapidly improved. After 3 days, WBC was stabilized and 10 days later CRP was stabilized to normal range. After 22 days, pneumonia has been completely resolved.

Conclusion

Personalized rehabilitation approaches, which are pulmonary rehabilitation therapy and brace, are needed for atelectasis with scoliosis patient.



Fig 1. Chest CT 2018.04.16



Fig 2. Chest CT 2018.05.04

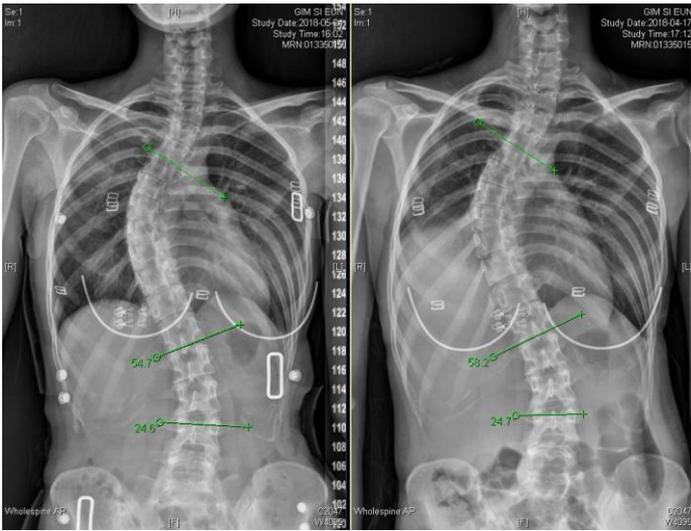


Fig 3. Left) 2018.05.24 Scannogram, Right) 2018.04.17 Scannogram

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The Changes of Cardiopulmonary Function after Robotic Exoskeleton Gait Training in a SCI Patient

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Objective

Spinal cord injury (SCI) Results in various neurological symptoms and may increase the risk of cardiovascular disease, respiratory problems, osteoporosis and psychological problems because of standing or walking issues. Recently, a powered robotic exoskeleton has been developed and used as mobility and gait training devices. There have been few studies on the gait pattern and cardiopulmonary function in chronic SCI patients trained with powered robotic exoskeleton. We report the changes of gait pattern and cardiopulmonary function in a chronic incomplete cervical SCI patient who was trained using the new powered robotic exoskeleton manufactured by domestic firms for incomplete SCI and fragile elderly people.

Case description

A 57-year-old man with chronic incomplete cervical SCI (duration of disease: 3 years) was hospitalized for robotic exoskeleton-assisted gait training. He was able to walk about 10 m using Q-cane. His gait pattern was more like that of hemiplegic patient. Muscle strength of the right upper and lower extremities was good and that of the left upper and lower extremities was poor on manual muscle test. Before participating in our gait training program, he had got conventional rehab (physical therapy and occupational therapy) at a local hospital. We put him through conventional rehab and robotic exoskeleton-assisted gait training program (REP) (Figure 1). REP was done five times per week for 30 minutes per session for 6 weeks. REP consisted of sit to stand, stand to sit and overground walking on the flat aisle, while wearing Angelegs (SG-Robotics, Seoul, Korea) (Figure 1). The gait speed was fit to the patient's pace. A physical therapist evaluated the functional outcome of the patient using Range of Motion (ROM), Manual Muscle Test (MMT), Modified Ashworth Scale (MAS), Korean-Modified Barthel Index (K-MBI), Functional Ambulatory Category (FAC), 3D dynamic posturography system (TecnoBody, PRO-KIN system, TecnoBody Srl, Dalmine BG, Italy), EuroQol-5D (EQ-5D), 10-meter walking test, Timed up and go test, and 3D gait analysis before (T0) and after training (T1). At the time of gait analysis, the patient walked wearing portable gas analyzer (K4B2, COSMED Srl, Rome, Italy) to measure VO₂ and MET. He reported mild skin problem (redness) and musculoskeletal pain during the REP, but no other serious adverse events. After 6 weeks of treatment, balance function somewhat improved and gait speed was slightly faster than before (Table 1). Peak MET and peak VO₂ decreased during the test. Peak VO₂ and peak MET decreased during the test and it means that the patient performed the same activity with less effort and cardiopulmonary function was improved by REP.

Conclusion

Robotic exoskeleton would be a useful gait assistive device in incomplete SCI patients. In our patient, distinctive clinical feature was incomplete tetraplegia like hemiplegia suggesting the widening of application scope of this device.

table1. MMT, manual motor test; MAS, Modified Ashworth Scale; K-MBI, Korean-Modified Barthel index; FAC, functional ambulation category; EQ-5D, EuroQol-5D

Table 1. Changes of gait and cardiopulmonary function

	Before (T0)	After (T1)
Functional assessment		
MMT (right leg/left leg)	(4/4/4) / (2/2/2)	(4/4/4) / (2/2/2)
MAS (right ankle /left ankle)	Gr 1/Gr 0	Gr 1/Gr 0
K-MBI	53	53
FAC	1	1
Balance (average C.o.P. X/C.o.P. Y)		
opened eyes	25/-43	26/-43
closed eyes	45/-55	45/-55
10-meter walking test (sec)		
comfortable	89.00	86.50
fast	76.42	80.12
Timed up and go test (sec)	76.16	77.84
Gait analysis		
cadence (steps/min)	16.4	23.9
speed (cm/s)	6.8	9.7
stride length (cm)	49.5	49.4
right / left stride length (cm)	48.3/50.7	48.8/50.0
right / left step length (cm)	25.7/24.5	26.9/22.6
step width (cm)	15.9	14.0
Cardiopulmonary function		
peak MET	4.6	4.1
peak VO ₂	1208.1	1077.9
EQ-5D	12	11

MMT, manual motor test; MAS, Modified Ashworth Scale; K-MBI, Korean-Modified Barthel index; FAC, functional ambulation category; EQ-5D, EuroQol-5D



Figure 1. Robotic exoskeleton-assisted overground walking training

(A) Schematic structure of Angelegs; (B), (C) Gait training wearing Angelegs; (D) 3D gait analysis wearing portable gas analyzer.

Differences in the Oral Health Status and Oral Hygiene Practices According to Post Stroke Sequelae

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Introduction

Oral health and hygiene are crucial parameters in stroke patients. However, few studies has evaluated the oral health status and oral hygiene practices according to the level of function in stroke patients. The aim of the present study was to evaluate the oral health status and oral hygiene practices according to ambulation and personal hygiene levels in patients with stroke.

Methods

Data from the fifth (2010-2012) and sixth (2013-2015) editions of the Korea National Health and Nutrition Examination Survey (KNHANES) for 6 years combined. 700 stroke patients were enrolled in our study. The patients' general characteristics are presented in Table 1. Table 2, 3 shows the Results of hierarchical logistic regression analysis adjusted for certain variables (age, gender, monthly household income, living arrangement, diabetes, stroke duration) that was performed to identify the effects of the ambulation level and functional independence on the oral health status and oral hygiene practices.

Results

Subjective oral health was significantly poorer in patients who experienced a moderate problem with walking [adjusted OR (AOR), 1.68; 95% CI, 1.21-2.33] and bed-bound patients (AOR, 2.92; 95% CI, 1.01-8.44) than in patients who could walk without difficulty. Patients who were unable to bathe or dress independently exhibited a significantly higher risk of dental caries than did those who could perform the same activities unassisted. The probability of brushing teeth ≥ 2 times daily was 69% lower in bed-bound patients (AOR, 0.31; 95% CI, 0.11-0.87) than in patients who could walk without difficulty, and 76% lower in patients who were unable to bathe or dress independently (AOR, 0.24; 95% CI, 0.09-0.62) than in those who could perform the same activities without difficulty.

Conclusion

There were differences in oral health status and oral hygiene practices, according to ambulation level and functional independence, in the stroke patient group. These Results indicate the need for oral care for stroke patients who exhibit ambulatory and functional limitations.

Table 1. General characteristics of patients with stroke

	Study subjects [†]	
	Unweighted (n) [‡]	Weighted (%) [‡]
All [‡]	700	100.0
Sex [‡]		
Men [‡]	363	54.8
Women [‡]	337	45.2
Age (years) [‡]		
20-29 [‡]	4	0.6
30-39 [‡]	8	1.1
40-49 [‡]	24	3.4
50-59 [‡]	97	13.9
60-69 [‡]	243	34.8
70+ [‡]	323	46.2
Monthly household income [‡] (10,000 won) [‡]		
<100 [‡]	327	45.6
≥100 - < 200 [‡]	153	21.4
≥200- <300 [‡]	119	16.6
≥300 [‡]	96	16.4
Living arrangement [‡]		
Living with family [‡]	578	83.5
Living alone [‡]	122	16.5
Ambulation level [‡]		
No problem [‡]	358	54.6
Moderate problem [‡]	320	42.3
Unable [‡]	22	3.1
Self care [‡]		
No problem [‡]	522	74.6
Moderate problem [‡]	149	21.3
Unable [‡]	29	4.1

Table 2. Variations in the oral health status according to the level of ambulation and functional independence in patients with stroke

	Subjective oral health ^a		Number of decayed teeth ^a	
	Model 1 ^a	Model 2 ^a	Model 1 ^a	Model 2 ^a
	AOR (95% CI) ^a	AOR (95% CI) ^a	$\beta(t)$ ^a	$\beta(t)$ ^a
Ambulation level^a				
No problem ^a	1.00 ^a	1.00 ^a	1.00 ^a	1.00 ^a
Moderate problem ^a	1.68 (1.21-2.33)** ^a	1.68 (1.21-2.33)** ^a	0.018(0.45) ^a	0.022(0.53) ^a
Unable ^a	3.59 (1.27-10.12)* ^a	2.92 (1.01-8.44)* ^a	0.078(1.99) ^a	0.073(1.83) ^a
Model test ^a	0.679 ^a	0.483 ^a	2.830 ^b	2.329 ^b
Self care^a				
No problem ^a	1.00 ^a	1.00 ^a	1.00 ^a	1.00 ^a
Moderate problem ^a	1.58 (1.07-2.33)* ^a	1.54 (1.04-2.27)* ^a	0.027(0.70) ^a	0.027(0.68) ^a
Unable ^a	1.25 (0.57-2.77)	1.29 (0.57-2.93)	0.157(4.08)*** ^a	0.173(4.43)*** ^a
Model test ^a	0.912 ^a	0.750 ^a	5.000 ^a	4.408 ^a

^aP<0.05, **P<0.01, ***P<0.001^a

AOR: adjusted odds ratio^a

95% CI: confidence interval^a

^aHosmer-Lemeshow test^a

^aF-test^a

Model 1: Adjusted for sex, age, monthly household income, and living arrangement^a

Model 2: Adjusted for sex, age, monthly household income, living arrangement, diabetes, and stroke duration^a

Table 3. Variations in oral hygiene practices linked with ambulation ability and functional independence

	Tooth brushing [†]		Oral exam [†]		Use of dental service [†]	
	Model 1 [‡]	Model 2 [‡]	Model 1 [‡]	Model 2 [‡]	Model 1 [‡]	Model 2 [‡]
	AOR (95% CI) [‡]	AOR (95% CI) [‡]	AOR (95% CI) [‡]	AOR (95% CI) [‡]	AOR (95% CI) [‡]	AOR (95% CI) [‡]
Ambulation level[‡]						
No problem [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]
Moderate problem [‡]	0.72 (0.15-1.03) [‡]	0.75 (0.45-1.22) [‡]	1.01(0.60-1.68) [‡]	1.00 (0.59-1.68) [‡]	0.66 (0.43-1.00) [‡]	0.69 (0.45-1.06) [‡]
Unable [‡]	0.40 (0.15-1.03) [‡]	0.31 (0.11-0.87) ^{*‡}	0.33 (0.04-2.61) [‡]	0.34 (0.04-2.84) [‡]	0.65 (0.23-1.83) [‡]	0.47 (0.15-1.50) [‡]
Model test [‡]	0.761 ^{†‡}	0.842 ^{†‡}	0.433 ^{†‡}	0.256 ^{†‡}	0.370 ^{†‡}	0.215 ^{†‡}
Self care[‡]						
No problem [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]	1.00 [‡]
Moderate problem [‡]	0.72 (0.43-1.19) [‡]	0.72 (0.43-1.19) [‡]	0.97 (0.51-1.82) [‡]	0.98 (0.52-1.83) [‡]	0.98 (0.60-1.57) [‡]	1.01 (0.62-1.63) [‡]
Unable [‡]	0.23 (0.09-0.59) ^{**‡}	0.24 (0.09-0.62) ^{**‡}	0.58 (0.14-2.35) [‡]	0.35 (0.66-1.86) [‡]	0.60 (0.22-1.61) [‡]	0.71 (0.25-2.06) [‡]
Model test [‡]	0.925 ^{†‡}	0.242 ^{†‡}	0.873 ^{†‡}	0.904 ^{†‡}	0.435 ^{†‡}	0.154 ^{†‡}

[†]P<0.05, ^{**}P<0.01, ^{***}P<0.001[‡]

AOR: adjusted odds ratio[‡]

95% CI: confidence interval[‡]

[†]Hosmer-Lemeshow test[‡]

Model 1: Adjusted for sex, age, monthly household income, and living arrangement[‡]

Model 2: Adjusted for sex, age, monthly household income, living arrangement, diabetes, and stroke duration[‡]

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The Current Status of Medical Use According to the Time and Region of Stroke Patients in Korea.

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Introduction

In Korea, hospitals are mainly concentrated in the metropolitan area (Seoul city and Gyeonggi-do). We hypothesized that many stroke patients living in rural areas will be treated not in their local area but in the metropolitan area during the subacute stage. So, in this research, we analyzed the actual use of hospitals in each region according to the time of stroke.

Methods

This research used a sample cohort database from National Health Insurance Service in Korea from year 2008 to 2011, and a total 8408 stroke patients were included. We checked in which hospital and which areas stroke patients received rehabilitation treatment in subacute (stroke onset~6months) and chronic stage (6~24months). We divided the country into 15 regions and analyzed the areas where the stroke first occurred and the hospital where the treatment was received by the time.

Results

In the subacute stage, more than 80% of patients were treated in the same area. In Incheon city and Chungcheongnam-do, more than 10% of patients were treated in the metropolitan area. In the case of Gwangju, 14% of the patients were treated in Jeollanam-do, and in Gangwon-do, more than 5% of patients were treated in Chungcheongbuk-do or metropolitan area. In the chronic stage, the rate of treatment in the same area was higher than in the subacute stage, and almost 90% of patients in all regions were treated in the same area.

Conclusion

Based on the Results, most patients were receiving rehabilitation treatment at their local medical facility. This might be due to the fact that regional rehabilitation hospitals built by the government were established in each region, and a large number of private rehabilitation hospitals and nursing hospitals were established within a decade.

The Aspect of Cachexia and Weight Change following Rehabilitation Treatment in Spinal Cord Injury

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Introduction

Cachexia is a loss of lean tissue mass, involving a weight loss greater than 5% of body weight in 12 months or less. It is prevalent in most major diseases and is related with mortality and morbidity as well as poor quality of life. Many patients with spinal cord injury (SCI) experience rapid weight loss after injury, which might be associated with increased metabolic demand from severe trauma. Respiratory failure, decreased caloric intake related with swallowing difficulty and psychological factors may also contribute to weight loss after SCI. However, in these rehabilitation processes, the importance of weight management is frequently neglected. Therefore, this study aims to reveal the prevalence of cachexia in adults with SCI and weight changes and its associated factors following intensive rehabilitation therapy.

Methods

The medical chart of SCI patients who were admitted to tertiary university hospital for rehabilitation treatment from 2016 to 2017 was reviewed. Patients within 6 months after the onset, with available records of initial and follow-up body weight and body composition analysis by bioelectrical impedance were included. Finally 114 SCI patients were included. Patients were divided into 3 groups by disease chronicity: acute (≤ 2 weeks), subacute (between 2-8 weeks), and chronic (> 8 weeks). Participants were also classified into 3 groups based on the weight change after the injury by comparing body weight prior to and after the injury at admission. The groups were defined as follows: cachexia, weight loss $\geq 5\%$ body weight; precachexia, weight loss $< 5\%$, and no weight loss. The prevalence of cachexia and precachexia, weight change after rehabilitation and its associated factors were analyzed.

Results

About 60% of subacute (63.7%) and chronic (59.3%) SCI patients and 25.0% of acute SCI patient within 2 weeks after onset showed cachexia (Fig. 1). After an intensive rehabilitation treatment including nutritional care, cachexia group showed significant weight change (gain) compared to both precachexia and no-wt. gain groups ($p < 0.01$). In cachexia group, percentage of weight change (weight gain) was negatively associated with the initial body weight ($r = -0.412$, $p = 0.001$) and BMI ($r = -0.482$, $p = 0.000$), and significantly positive association with the percentage increase of skeletal muscle mass ($r = 0.370$, $p = 0.002$).

Conclusions

The percentage of cachexia was consistently high in all groups of SCI. These Results imply more concern on nutritional supplement is necessary in SCI patients depending on their metabolic demand in relation to physical condition and intensity of rehabilitation therapy. Further studies with more patients with various features of SCI injury (level, severity and chronicity) are necessary to demonstrate the risk factors of cachexia and related factors for better outcome.

Characteristics	Cachexia	Precachexia	No weight loss
Age	48.3±16.3	53.1±15.1	50.3±20.6
Sex (%)			
M/F	59/7(89.4/10.6)	12/5(70.6/29.4)	19/12(61.3/38.7)
Level of Injury (%)			
Tetra/Para	45/21(68.2/31.8)	11/6(64.7/35.3)	19/12(61.3/38.7)
ASIA(%)			
A/B/C/D	23/7/17/19 ^{††} (34.8/10.6/25.8/28.8)	6/2/4/5 (35.3/11.8/23.5/29.4)	5/0/7/19 (16.1/0.0/22.6/61.3)
Severity of injury			
Complete/Incomplete (%)	23/43(34.8/65.2)	6/11(35.3/64.7)	5/26(16.1/83.9)
Disease duration (day)	61.6±48.6	41.2±30.9	58.3±50.9
Disease chronicity			
Acute/Subacute/Chronic (%)	4/37/25(6.1/56.1/37.9)	3/11/3(17.6/64.7/17.6)	9/10/12(29.0/32.3/38.7)
Body weight (kg)			
Before injury	70.0±13.4	71.1±8.6	64.2±11.4
Initial at admission	62.3±11.5	68.8±8.5	66.4±11.3
F/U at discharge	63.8±11.1	68.3±8.9	64.9±10.6
Weight change			
After injury (kg)	-7.8±3.7	-3.3±0.4	+0.2±0.3
After injury (%)	-10.7±4.1 ^{**††}	-3.1±1.1 ^{††}	+3.6±3.9
After rehabilitation (kg)	+1.5±2.7 ^{**††}	-0.5±2.3	-1.5±3.9
After rehabilitation (%)	+2.7±5.1 ^{**††}	+0.7±3.5	-1.9±5.7
BMI			
Before injury	24.1±3.2 [†]	25.2±2.4 ^{††}	22.7±2.8
Initial at admission	21.5±2.9	24.4±2.3	23.5±2.7
F/U at discharge	22.0±2.6	24.2±2.3	23.0±2.5

p<0.05 compared with precachexia*, No-Wt loss[†]

P<0.01 compared with precachexia**, No-Wt loss^{††}

The demographic and clinical characteristics of participants

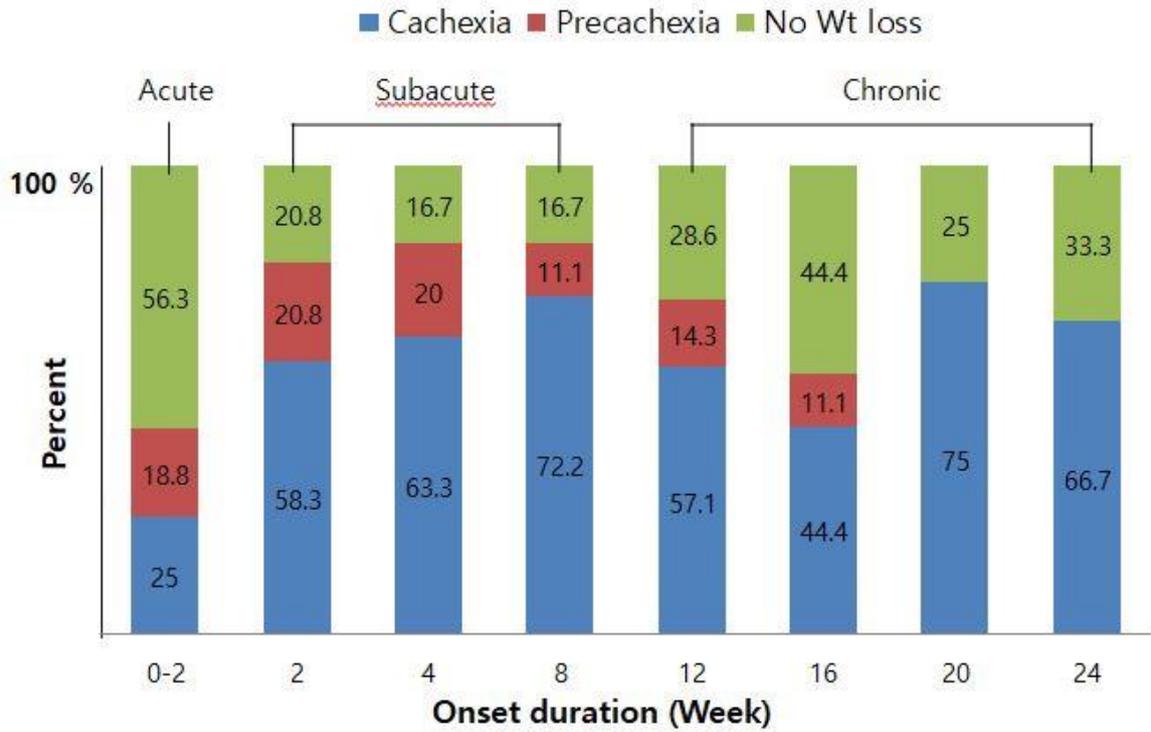


Fig 1. Frequency of cachexia and precachexia according to duration after the spinal cord injury

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Quantification of risk factors for cervical OPLL in Korean populations: A nationwide cohort study

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Objective

Ossification of the posterior longitudinal ligament (OPLL) is a pathological calcification of the posterior longitudinal ligament of the spine. The prevalence of cervical OPLL has been shown to differ between ethnic groups and is known to be higher in Asians than in other ethnic groups. Because of the ethnic differences in prevalence, risk factor studies including genetic factors and habitual status have been performed. OPLL progression can cause spinal cord injury that Result in disability. Considering neurologic deficits and disability caused by OPLL, identifying OPLL risk factors for early prediction have important health benefits. The Objective of this study was to quantify risk factors for cervical OPLL using a large nationwide cohort in Korea, a country with a high prevalence of OPLL.

Materials & Methods

The nationwide population-based matched cohort study was conducted using the Korean National Health Insurance Service cohort data. We selected patients with a primary diagnosis of OPLL involving cervical lesion (ICD-10 code: M48.82, M48.83) between 2002 and 2015. To ensure diagnostic validity, we only included individuals who had visited clinics with a diagnosis of OPLL more than three times. A matched cohort without cervical OPLL was enrolled by randomly matching patients by sex, age, year of diagnosis, and residential area to the OPLL group with a ratio of 1:9. Logistic regression analyses were performed to identify risk associated with OPLL development using Odds Ratios and 95% confidence intervals. $P < 0.05$ was considered statistically significant. The statistical software SAS System for Windows, version 9.4 (SAS Institute Inc, Cary, NC) was used to perform the statistical analyses.

Results

In total, 7,450 patients were enrolled in the study: 745 in the OPLL cohort and 6,705 in the matched control cohort. No significant differences in age, sex, year of diagnosis, or residential area were noted between the two groups; as these variables were used for sample matching, this finding indicates that the matching was performed appropriately. After adjusting for age, sex, residential area, and household income, co-morbidities, such as hypertension (OR = 1.283, 95% CI 1.071-1.538), ischemic stroke (OR = 1.386, 95% CI 1.017-1.889), diabetes mellitus (OR = 1.331, 95% CI 1.098-1.615), hypothyroidism (OR = 1.562, 95% CI 1.165-2.094), and osteoporosis (OR = 1.456, 95% CI 1.151-1.842) were significantly associated with the prospective development of OPLL.

Conclusions

After adjustment for age, sex, residential area, and household income, co-morbidities such as hypertension, ischemic stroke, diabetes mellitus, hypothyroidism, and osteoporosis were found to be significantly associated with OPLL occurrence. Our findings can provide useful information for OPLL prediction and offer important health benefits. Additional risk factor studies to elucidate the pathophysiological mechanism of OPLL are recommended.

Table 1. Unadjusted and Adjusted association between Ossification of the Posterior Longitudinal Ligament and Co-morbidities and Demographics

Variable	Unadjusted OR			Adjusted OR		
	OR	95% CI	<i>p</i> value	OR	95% CI	<i>p</i> value
Co-morbidities						
Hypertension	1.405	1.182-1.670	0.0001	1.283	1.071-1.538	0.0070
Ischemic stroke	1.482	1.097-2.002	0.0104	1.386	1.017-1.889	0.0387
Hemorrhagic stroke	0.716	0.346-1.479	0.3664	0.562	0.268-1.179	0.1272
Ischemic heart disease	1.130	0.665-1.918	0.6516	0.897	0.524-1.537	0.6923
Diabetes mellitus	1.464	1.215-1.765	<0.001	1.331	1.098-1.615	0.0036
Hyperthyroidism	1.381	0.996-1.913	0.0526	1.117	0.796-1.567	0.5212
Hypothyroidism	1.748	1.316-2.321	0.0001	1.562	1.165-2.094	0.0029
Hyperparathyroidism	1.000	0.127-7.893	1.000	0.738	0.091-5.994	0.7766
Hypoparathyroidism	1.500	0.181-12.459	0.7074	1.142	0.135-9.654	0.9029
Osteoporosis				1.456	1.151-1.842	0.0017
Breast cancer	-			-		
Endometrial cancer	-			-		
Ovarian cancer	-			-		
Colorectal cancer	1.452	0.564-3.733	0.4393	1.651	0.637-4.276	0.3018
Gastric cancer	0.420	0.154-1.149	0.0912	0.407	0.148-1.118	0.0811
Income Level (Quartiles)						
Q1 (lowest)	1.000			1.000		
Q2	1.006	0.789-1.283	0.9615	1.008	0.790-1.287	0.9466
Q3	1.039	0.827-1.304	0.7443	1.023	0.814-1.286	0.8449
Q4 (highest)	1.122	0.895-1.406	0.3192	1.087	0.866-1.365	0.4702

Changes of the diffusion metrics in cervical myelopathy after laminoplasty

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Introduction

Cervical myelopathy (CM) is a serious condition, which can cause deleterious impact on the quality of life. Although recent advancement in technology, there are still no good biomarker in the spinal cord for monitoring its function. Development of sophisticated analysis software for the spinal cord integrity may give opportunity to diagnose and monitor their injury in cervical myelopathy (CM) patients, although it has not been investigated much. Moreover, there are only few studies published when it comes to the effect of laminoplasty, how it can influence to the plastic changes of the spinal cord in CM patients. In order to find out the laminoplasty induced changes in the spinal cord, we obtained pre- and post-operative diffusion tensor imaging (DTI) and its behavioral measurement using modified Japanese Orthopedic Association (mJOA) score, whether there are some changes diffusion metrics as well as in comparison to controls.

Methods

We recruited twelve CM patients (mean age 55.2 ± 18.2 years) having spine surgeries and twelve healthy volunteers (mean age 35.4 ± 5.4 years) without a history of neurologic deficits for this study. Spinal cord DTIs of both groups were acquired, which showed different tract in white matter of the spinal cord. Mean diffusivity (MD), axial diffusivity (AD), radial diffusivity (RD), and fractional anisotropy (FA) were measured at the lesion area of each patient. The clinical status of CM were classified by mJOA score. For the additional physiological measure, we obtained also the motor evoked potentials (MEP) amplitude. For the group comparison between CM patients and controls, independent t-test was conducted and for the comparison of pre- and post-operative diffusion metrics, paired t-test was done For comparison of diffusion metrics and mJOA score, we did Pearson correlation analysis.

Results

1. In group comparison, right FA of the corticospinal tract (CST) and bilateral FA, RD, and left RD of the spinal lemniscus tract (SLT) were significantly different between controls and CM patients ($p < 0.005$). 2. In comparison between pre- and post-operation, right MD and bilateral RD of the fasciculus gracilis tract (FGT), fasciculus cuneatus tract (FCT), and CST were significant ($p < 0.005$). The right RD of the rubrospinal tract (RST) and SLT were also statistically significant ($p < 0.005$) with significant changes in mJOA score ($p < 0.05$). 3. In correlation analysis, there were a positive correlation between the mJOA and left RD of the CST ($r = 0.705$, $p < 0.05$) and right FA of the RST ($r = 0.603$, $p < 0.05$).

Conclusion

In this study, we found significant changes in spinal cord integrity 2 weeks after laminoplasty. Among those changes observed in multiple tracts at post-operative condition, only the CST showed significant correlation to behavioral outcome. Sophisticated analysis technique of the spinal cord would have a clinical significance as a biomarker for the functional recovery in CM patients.

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Changes of Respiratory Function with Rehabilitation Treatment in Spinal Cord Injury Patients

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Introduction

Respiratory complications are leading causes of morbidity and mortality in the spinal cord injury (SCI) population Resulting from denervation of inspiratory and expiratory respiratory muscles. In previous studies, respiratory muscle training Resulted in significant improvement of respiratory muscle strength and endurance and less respiratory complications. However, few studies monitored the changes of respiratory muscle function according to SCI characteristics. Therefore, this study aims to reveal respiratory function changes to identify factors associated with respiratory function improvement in SCI patients after intensive rehabilitative treatment.

Method

The medical records of 133 SCI patients admitted to a tertiary university hospital for a short-term (4-8 weeks) rehabilitation from 2016 to 2017 were reviewed (Table 1). Among them, those with available Results of initial and follow-up pulmonary evaluation including vital capacity in supine (VCsup) and sitting (VCsit) position and peak cough flow (PCF) were included. The percentage of predictive value (%pre) was calculated using age and height of each patient. Past medical history, cause of injury, level and severity of injury were obtained from the chart review. Participants were classified by injury level as tetraplegia and paraplegia, by injury severity as complete and incomplete and by disease duration as acute, subacute and chronic. The change of pulmonary function was analyzed in association with patient's characteristics.

Result

Finally, total 104 SCI patients were included. The demographic and clinical characteristics are shown in table 1. At initial evaluation, patients showed compromised pulmonary function; VCsup as 62.0 %pre and VCsit as 57.5 %pre. Tetraplegia patients had more compromised pulmonary function than paraplegia ($p<0.01$). At follow-up after short-term pulmonary rehabilitation, absolute value and %pre of VCsup ($p<0.01$), VCsit ($p<0.01$), and PCF ($p<0.01$) were significantly improved in both tetraplegia and paraplegia groups (figure 1). The improvement of VCsup, VCsit and PCF showed significant correlation with initial values of %pre VCsup, %pre VCsit and PCF ($p<0.01$). The subacute group showed significant improvement of pulmonary function in VCsup, VCsit and PCF compared to acute and chronic groups ($p<0.05$).

Conclusions

Short-term rehabilitation treatment including pulmonary care Resulted in improvement of pulmonary function in all patient groups. It is likely that all patients, especially subacute and chronic groups did not experience enough pulmonary care before participating in our rehabilitation program. In SCI rehabilitation, pulmonary care should be emphasized. Further studies with large number of SCI patients with various features (level, severity, and duration) of injury are needed to find the factors related with pulmonary function improvement and ultimate effect on rehabilitative outcome.

Table 1. Demographics and clinical characteristics

Characteristics	N=104
Age (year, range)	48.7±17.5 (15-84)
Sex: M/F (%)	78/26 (75.0/25.0)
Tetraplegia/Paraplegia (%)	65/39 (62.5/37.5)
ASIA: A/B/C/D (%)	21/7/30/46 (20.2/6.7/28.8/44.2)
Complete/Incomplete (%)	21/83 (20.2/79.8)
Disease duration (day, range)	97.4±139.2 (7-993)
Acute/Subacute/Chronic (%)	14/45/45 (13.5/43.3/43.3)
Height (cm, range)	168.3±8.8 (129-186)
Body weight (kg, range)	64.6±11.4 (24-95)
Body mass index (kg/m ² , range)	22.7±3.2 (13.9-33.4)

Values are mean ± standard deviation.

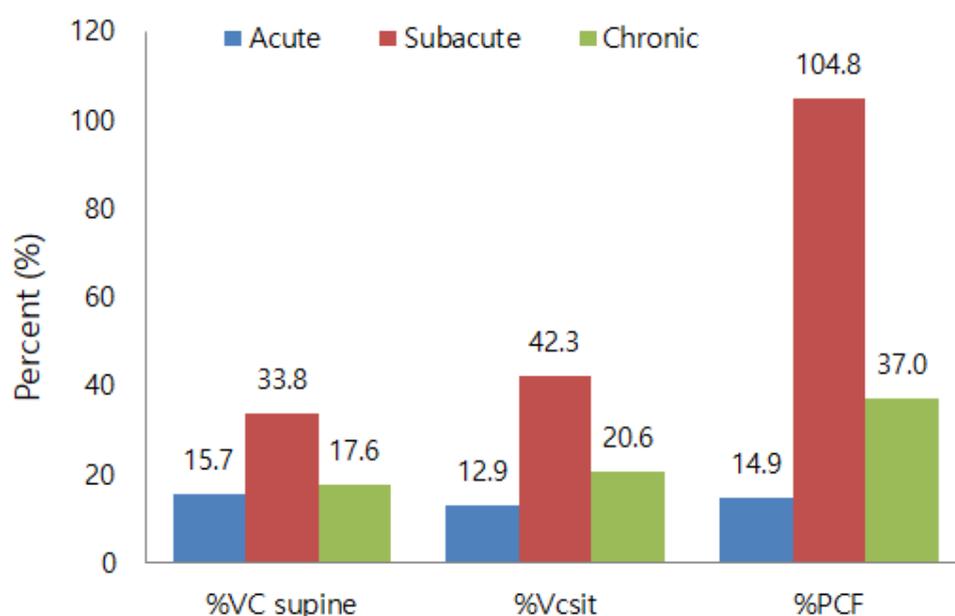


Figure 1. Percent change of pulmonary function after short-term rehabilitation treatment according to disease duration

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Low skeletal muscle mass and spasticity in male patients with spinal cord injury

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Introduction

It is well-known that spasticity and loss of skeletal muscle mass occur after spinal cord injury. Both spasticity and muscle atrophy restrict activities of daily living and impairs quality of life, but there are few studies about their relationship. Therefore, the Objective of this study is to investigate the association between skeletal muscle mass and spasticity in Korean patients with spinal cord injury.

Methods

Fifty six male patients with spinal cord injury were included. Spasticity was assessed using spasticity sum score and Penn spasm frequency test. Low skeletal muscle mass was defined by appendicular skeletal muscle mass divided by height squares. Laboratory tests including hemoglobin, albumin, creatinine, fasting glucose, and cholesterol were performed.

Results

Mean age was 42.3 years and 37 patients (66.1%) were complete injury (ASIA A). Forty seven patients (83.9%) showed low skeletal muscle mass. They showed significantly lower body mass index (BMI), waist circumference, serum creatinine level, and spasticity than patients with normal skeletal muscle mass. Low skeletal muscle mass was significantly correlated with decreased spasticity score. BMI was the only significant variable in logistic regression analysis for low skeletal muscle mass.

Conclusions

Low skeletal muscle mass is prevalent in patients with spinal cord injury. Low skeletal muscle mass was significantly correlated with decreased spasticity.

Key words

spinal cord injury; sarcopenia; spasticity; muscle atrophy

Table 1. Demographics[Ⓢ]

	Spinal cord injury patients (n = 56) [Ⓢ]
Age [Ⓢ]	42.3 ± 3.0 [Ⓢ]
Tetraplegia [Ⓢ]	39 (69.6%) [Ⓢ]
Complete injury (ASIA A) [Ⓢ]	37 (66.1%) [Ⓢ]
Body mass index [Ⓢ]	22.06 ± 0.92 [Ⓢ]
Waist circumference [Ⓢ]	86.6 ± 3.0 [Ⓢ]
Body fat percentage [Ⓢ]	31.3 ± 2.4 [Ⓢ]
Appendicular skeletal muscle mass [Ⓢ]	5.47 ± 0.26 [Ⓢ]

[Ⓢ]**Table 2.** Characteristics of spinal cord injury patients with low skeletal muscle mass[Ⓢ]

	Low skeletal muscle mass (n = 47) [Ⓢ]	Others (n = 9) [Ⓢ]	p-value [Ⓢ]
Age [Ⓢ]	43.0 [Ⓢ]	39.0 [Ⓢ]	0.346 [Ⓢ]
Tetraplegia [Ⓢ]	32 (68.1%) [Ⓢ]	7 (77.8%) [Ⓢ]	0.562 [Ⓢ]
Complete injury (ASIA A) [Ⓢ]	33 (70.2%) [Ⓢ]	4 (44.4%) [Ⓢ]	0.135 [Ⓢ]
BMI [Ⓢ]	21.2 [Ⓢ]	26.4 [Ⓢ]	0.000* [Ⓢ]
Waist circumference [Ⓢ]	84.3 [Ⓢ]	98.7 [Ⓢ]	0.000* [Ⓢ]
Body fat percentage [Ⓢ]	30.8 [Ⓢ]	34.1 [Ⓢ]	0.117 [Ⓢ]
Spasticity sum score [Ⓢ]	1.28 [Ⓢ]	2.44 [Ⓢ]	0.001* [Ⓢ]
Penn spasm frequency test [Ⓢ]	1.11 [Ⓢ]	2.56 [Ⓢ]	0.001* [Ⓢ]
Laboratory test [Ⓢ]			
Hemoglobin [Ⓢ]	14.4 [Ⓢ]	15.1 [Ⓢ]	0.279 [Ⓢ]
Albumin [Ⓢ]	4.15 [Ⓢ]	4.24 [Ⓢ]	0.474 [Ⓢ]
Creatinine [Ⓢ]	0.56 [Ⓢ]	0.73 [Ⓢ]	0.001* [Ⓢ]
Fasting glucose [Ⓢ]	92.8 [Ⓢ]	104.1 [Ⓢ]	0.271 [Ⓢ]
HbA1c [Ⓢ]	5.22 [Ⓢ]	5.46 [Ⓢ]	0.254 [Ⓢ]
Total cholesterol [Ⓢ]	172.9 [Ⓢ]	178.8 [Ⓢ]	0.640 [Ⓢ]
HDL [Ⓢ]	40.0 [Ⓢ]	38.3 [Ⓢ]	0.544 [Ⓢ]
LDL [Ⓢ]	106.0 [Ⓢ]	115.4 [Ⓢ]	0.345 [Ⓢ]
ApoB [Ⓢ]	98.7 [Ⓢ]	100.9 [Ⓢ]	0.794 [Ⓢ]
hsCRP [Ⓢ]	0.70 [Ⓢ]	0.30 [Ⓢ]	0.330 [Ⓢ]

Table 3. Spearman's correlation between skeletal muscle mass and spasticity

	Skeletal muscle mass ^o	Spasticity sum score ^o	Penn spasm ↓ frequency test ^o
Skeletal muscle mass ^o			
Spasticity sum score ^o	$r = 0.430^o$ $p = 0.001^o$		
Penn spasm ↓ frequency test ^o	$r = 0.487^o$ $p = 0.000^o$	$r = 0.874^o$ $p = 0.000^o$	

Table 4. Logistic regression for low skeletal muscle mass^o

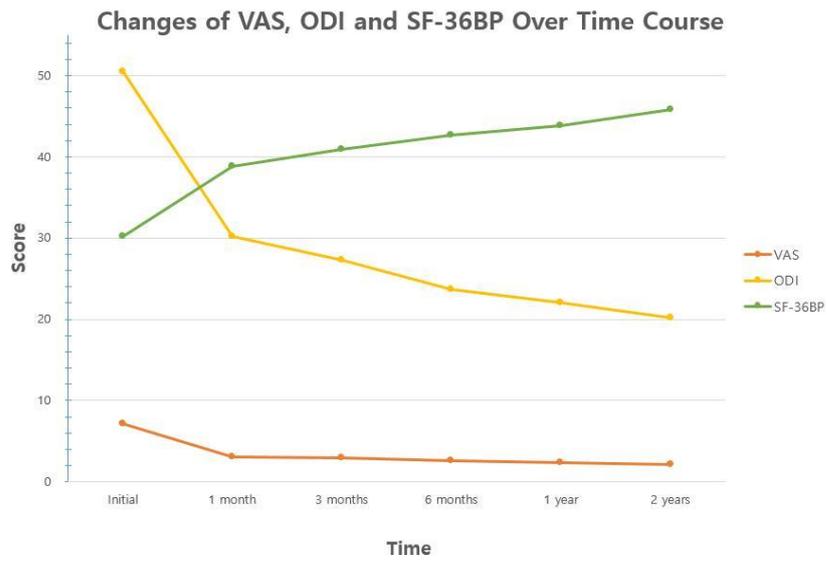
	B ^o	OR ^o	95% CI ^o	p-value ^o
Body mass index ^o	-0.767 ^o	0.464 ^o	0.289 – 0.745 ^o	0.001 ^o
Constant ^o	20.134 ^o			

Nucleoplasty with navigable radiofrequency catheter as treatment of elderly lumbar disc herniation

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Low back pain Resulting from herniated nucleus pulposus (HNP) is one of the most common problems in the aging society. Open discectomy is recommended for the treatment, but it is pre-cautious for the elderly, who are prone to physiologic, pharmacologic and psychologic challenges. Some research has proved that advanced age as an isolated variable increases the surgical morbidity. Nucleoplasty using navigable radiofrequency catheter is one option to treat the herniated disc in spine clinic. The aim of this study is to assess the clinical efficacy of the procedure in geriatric patients with lumbar disc herniation. From March 2010 to April 2014, 219 patients visited our spine clinic with low back and lower extremity pain but 53 patients were excluded due to procedure refusal or follow-up loss. Of the remaining 166 patients, 97 were male and 69 were female with a mean age of 43.0 years ranging from 18 to 79 years. The targeted discs were L1/2 in one patient, L2/3 in six patients, L3/4 in 18 patients, L4/5 in 96 patients, L5/S1 in 71 patients. 21 patients received multiple level disc decompression. Outcome was assessed using the visual analogue scale(VAS), Oswestry Disability Index(ODI) and bodily pain scale of the Short Form 36 version 2(SF-36 BP). The VAS rates pain severity as a score from zero to 10. The ODI assesses low back pain-related disability: the higher the score, the more severe the disability. The bodily pain scale is a patient-reported subscale of the SF-36 BP: the lower the score, the greater the disability. Initial data, one, three, six months, one and two years follow-up data were included. The correlation of age and VAS, ODI and SF-36 BP were analyzed using Pearson's correlation test. Before the procedure, VAS, ODI and SF-36 BP scores were 7.0 ± 1.7 , 50.5 ± 16.8 , 38.9 ± 8.4 , and after two years, the scores were 2.0 ± 1.9 , 20.2 ± 14.6 , 45.8 ± 9.4 subsequently. All three measures showed overall improvement, and VAS score and ODI showed steady improvement with time. The correlation between age and VAS, ODI and SF-36 BP scores were measured with the Pearson correlation test and the coefficients were 0.1028 for VAS, 0.0078 for ODI, and -0.0124 for SF-36 BP. No correlation between age and clinical efficiency. Thus, age is not an independent risk factor for assessing clinical prognosis when performing nucleoplasty using navigable radiofrequency catheter. Even with scrupulous preoperative assessments, it is challenging for surgeons to perform surgery in the geriatric population. However, according to our data, age does not limit clinicians from performing nucleoplasty. Given that removing a very little amount of herniated tissue significantly improves pain, locomotion and quality of life, nucleoplasty using navigable radiofrequency catheter can be a safe and effective treatment for lumbar disc herniation in the elderly. A larger sample size and longer follow-up, and a more deliberative analysis of post-procedural complication needs to be done.



Changes of VAS, ODI and SF-36BP Over Time

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The bladder wall thickness measured by ultrasound in patients with spinal cord injuries

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Introduction

Spinal cord injury (SCI) causes permanent neurologic deficits and leads to damage across all body systems including bladder function. Increased bladder wall thickness (BWT) can be useful parameter to evaluate the voiding dysfunction. Diagnosis of dysfunctional voiding is possible from bladder volume-pressure data such as parameters of cystometry. However it is bothersome for the patient, time-consuming, and associated with a considerable morbidity. Therefore, noninvasive test such as ultrasound measurement of BWT has recently been a growing interest. Our aim was to investigate whether measurement of BWT correlates with parameters of cystometry and compare the BWT in SCI groups according to the ASIA classification.

Methods

Twenty one patients with SCI were enrolled in the study. The manual cystometry was performed by infusion of a room temperature saline solution and intravesical pressure was measured. Patients were divided into 3 groups (underactive, normoactive, and overactive bladder) according to the intravesical pressure. Overactive bladder was defined as a phasic pressure change of more than 15cmH₂O in filling phase. Underactive bladder was defined as no urgency until 500ml of saline infusion. The anterior bladder wall was measured by ultrasound on midway between the anterior wall midline and the lateral bladder wall. The bladder wall was represented by all 3 layers: mucosa/submucosal, detrusor and adventitia, and we defined BWT to the thickness of detrusor layer (Figure 1). The ultrasound was performed when the patients felt the desire to void or just before the CIC was performed. We analyzed the following 3 points. First, we classified the patients to motor-complete (ASIA-A and -B), and motor-incomplete (ASIA-C, and -D) groups, and evaluated the difference of BWT between the 2 groups. Second, we evaluated the difference of BWT in underactive, normoactive, and overactive bladder groups. Third, we analyzed the correlation between BWT and bladder compliance.

Results

Of 21 patients, 6 were in motor-complete group and 15 were in motor-incomplete group. According to intravesical pressure, 9 were in underactive, 5 were in normoactive, and 7 were in overactive bladder group. The mean BWT was 19.07mm and significantly higher in patients with motor-complete group ($p<0.05$) (Table 1) and overactive bladder group ($p<0.05$) (Table 2). Negative correlation between BWT and bladder compliance (Pearson's $r = -0.88$) was shown, however it was not statistically significant ($p=0.704$).

Conclusion

This study reveals that increased BWT present in patients with motor-complete SCI and overactive bladder. In patients who are difficult to be performed by invasive tests such as urodynamic study, the noninvasive ultrasound measurement of BWT could give information of voiding function to physicians.

Table 1. Comparison of the BWT of motor-complete (ASIA-A and –B) vs motor-incomplete (ASIA-C, and –D) groups

Variables	Motor-complete (ASIA-A, ASIA-B)	Motor-incomplete (ASIA-C, ASIA-D)	p-value
Number	5	16	
BWT	24.80±7.03	17.28±6.11	0.031*

Values are mean ± standard deviation.

* $p < 0.05$: comparison of 2 groups in student's t-test.

Table 2. Comparison of the BWT of underactive, normoactive, and overactive bladder groups

Variables	Underactive bladder	Normoactive bladder	Overactive bladder	p-value
Number	9	5	7	
BWT	18.91±6.56	13.52±3.72†	23.22±7.05†	0.048*

Values are mean ± standard deviation.

* $p < 0.05$: comparison of 3 groups in one-way ANOVA

† $p = 0.040$: comparison of overactive bladder group and underactive bladder group in post analysis (Tukey's HSD test)

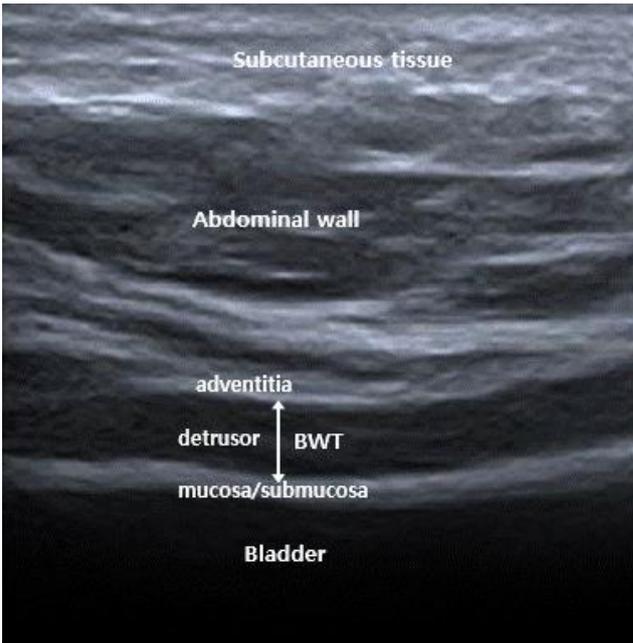


Figure 1. Ultrasonographic measurement of BWT of the anterior bladder wall

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Spinal Cord Injury after Infectious Spondylitis: a Preliminary Study

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Introduction

Infectious spondylitis consists of intervertebral discitis, perivertebral abscess, vertebral osteomyelitis, epidural or intradural infections and others. Sometimes infectious spondylitis aggravated to spinal cord injury and its clinical manifestations and recovery patterns are variable. Because its etiology is various including direct invasion of infection to spinal cord, inflammation of spinal cord and external compression of the abscess. We investigated spinal cord injured patients secondary to infectious spondylitis from medical records and report it.

Methods

Patients who admitted to the Department of Physical Medicine and Rehabilitation for comprehensive rehabilitation of spinal cord injury after infectious spondylitis were included. We investigated medical records and find control group with a matching of sex, age, level of neurological injury (NLI) and completeness. For these people, we found the records of gait function (functional ambulatory category, FAC), mobility (modified Rivermead mobility index, MRMI), activity of daily living (ADL) and motor function using sum of motor score (of ASIA Impairment Scale) Mann-Whitney U tests were done using IBM SPSS 20.0.

Results

8 patients with SCI after infectious spondylitis were included. For the control group, another 8 patients with traumatic spinal cord injury patients were found. Demographic features were noted in Table 1. They showed no differences between the groups for the gain of FAC, MRMI, ADL percent and motor score. (Table 2)

Conclusion

There seem to be no differences in functional gain during comprehensive rehabilitation program between infectious spondylitis and traumatic spinal cord injury group.

Table 1. Demographics

	Infectious Spondylitis Group (N=8)	Control Group (N=8)
Age	65.0 [60.0;75.5]	61.0 [52.5;71.5]
Sex		
- Female	2 (25.0%)	2 (25.0%)
- Male	6 (75.0%)	6 (75.0%)
NLI		
- cervical	2 (25.0%)	2 (25.0%)
- lower thoracic	1 (12.5%)	2 (25.0%)
- upper lumbar	5 (62.5%)	4 (50.0%)
Completeness		
- motor complete (AIS A, B)	1 (12.5%)	1 (12.5%)
- motor incomplete (AIS C, D)	7 (87.5%)	7 (87.5%)
Onset from injury(months)	84.5 [39.0;99.5]	41.0 [23.5;102.0]
Hospital days	39.5 [28.5;46.5]	34.0 [26.5;41.0]

Table 2. Functional gain between the groups.

	Infectious Spondylitis Group (N=8)	Control Group (N=8)	p
FAC gain (score)	0.75 [0; 2]	1 [0; 3]	0.680
MRMI gain (score)	5.0 [2.0; 8.0]	5.0 [4.0; 7.0]	0.927
ADL gain (percent)	7.0 [3.0;16.5]	7.0 [4.2;11.1]	0.954
Motor score gain (score)	0.0 [0.0; 3.0]	2.5 [1.5; 6.0]	0.087

* statistic analysis was done by Mann-Whitney U test

* FAC: Functional Ambulatory Category

* MRMI: Modified Rivermead Mobility Index

* ADL gain: gain of the percent of ADL evaluation (MBI and SCIM II)

* Motor score: sum of motor score of ISNCSCI (ASIA Impairment Scale)

Effects of mirabegron in blood pressure for patients with spinal cord injury at the level above T6

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Objective

Patients with spinal cord injury (SCI) usually have disturbed function of lower urinary tract. Antimuscharinic medication for neurogenic detrusor overactivity (NDO) is frequently discontinued due to side effects or lack of efficacy. Mirabegron is the adrenergic beta-3 receptor agonist for use in neurogenic bladder. It mediates relaxation of the detrusor muscle during the storage phase, thus increases bladder storage capacity. This study aims to observe the changes in urodynamic factors in patients with spinal cord injury at the level of T6 and above who do not present autonomic dysreflexia under treatment of mirabegron.

Method

Medical records of 7 patients with chronic SCI at the level of T6 and above admitted to the one single spinal cord center, South Korea, from April 2015 to April 2018 were collected and reviewed retrospectively. We included all consecutive 7 adults with chronic SCI at the level of T6 and above who did not have autonomic dysreflexia before and during first UDS, treated with mirabegron 50mg for a period of at least 6 months between first UDS and second UDS. Dermographic data, type of bladder management, previous NDO therapy and urodynamic Results before and after treatment, and blood pressure during UDS were evaluated. Descriptive statistical analysis were performed with SPSS version 20.

Results

Among 7 SCI patients, regarding the American Spinal Injury Association (ASIA) impairment scale, 3 patients are complete injury (AIS-A) and 4 patients are incomplete injury (AIS-B,C,D). Mean duration of injury is 83.9 months. All of them had no autonomic dysreflexia in first UDS and after the study they are treated with mirabegron for the reasons such as leakage, low capacity, VUR, etc. Table 1 summarizes the characteristics of the study group. We observed a significant increase of highest systolic BP (systolic BP from 115.0 to 152.7mmHg, P=0.028, diastolic BP from 76.6 to 101.0, P=0.028). Increase of BP above 20mmHg from basal BP was shown in 6 patients out of 7 patients. The maximum capacity of bladder increased from 364 to 437ml, P= 0.128, the compliance increased from 15.4 to 51.6 ml/cmH₂O P=0.345. Maximal detrusor pressure decreased from 36.4 to 22.4, P=0.176. Noxious stimulus such as ingrowing toenails, pressure ulcers, UTI is not presented in the study group.

Conclusion

The measured BP during UDS was significantly increased after the use of mirabegron despite of the improvements in urodynamic parameters such as compliance of bladder, maximal detrusor pressure. This inconsistency between the changes of UDS parameters and that of BP may be attributed to the use of mirabegron based on this study. Placebo-controlled studies are necessary to verify these Results.

Subject number	Age, yr	Sex	Duration of Injury, mo	Level of injury	ASIA grade	Medication (pre)	Medication (post)	Reason for medication change
1	60	M	96	C3	C	Propiverine	Propiverine, Mirabegron	High Pdet Max Leakage
2	57	M	44	T4	A	Fesoterodine	Propiverine, Mirabegron	Leakage
3	26	M	40	T1	A	Tolterodine	Mirabegron	Leakage
4	48	M	208	C4	C	Propiverine Oxybutynin Trosipium	Propiverine Oxybutynin Mirabegron	VUR
5	18	M	47	T3	B	Oxybutin, Solifenacin Tolterodine	Oxybutin, Solifenacin Propiverine, Mirabegron	Leakage Low capacity
6	58	F	52	T3	B	Fesoterodine, Propiverine,	Solifenacin, Propiverine, Mirabegron	Leakage Low capacity
7	47	F	100	C4	A	Propiverine, Imipramine	Propiverine, Mirabegron Imipramine	Leakage

	pre	post	P
Presence of elevation of systolic BP > 20mmHg during UDS	0	6	*0.031
Basal systolic BP (mmHg)	115.6 (89-135)	112.6 (89-132)	0.345
Basal diastolic BP (mmHg)	73.7 (58-99)	76.6 (53-95)	0.866
highest systolic BP during UDS (mmHg)	115.0 (61-136)	152.7 (121-173)	*0.028
highest diastolic BP during UDS (mmHg)	76.6 (58-90)	101.0 (74-125)	*0.028
Leakage (n)	3	1	0.500
Capacity of bladder (ml)	364.7 (85-550)	437.1 (319-550)	0.128
Compliance of bladder (ml/cmH ₂ O)	15.4 (2.8-33.8)	57.6(12.2-252.8)	0.345
Maximal detrusor pressure (cmH ₂ O)	36.4	22.3	0.176

Quality of Life in Adults with Spinal Cord Injury: Comparisons with Stroke populations.

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OBJECTIVE

To assess the quality of life (QoL) of adults with spinal cord injury (SCI) and those with stroke.

METHODS

Data was collected using the WHOQOL-bref and a questionnaire of sociodemographic variables. Eighty-seven adults with SCI (65 men, 22 women; mean age 51.8±12.0 years) and 69 adults with stroke (49 men, 20 women; mean age 53.7±12.1 years) were included in this study. Adults with complete injury (AIS A) were 29 (33.3%), and incomplete injuries (AIS B, C, D) were 58 (66.7%). Forty-seven of the adults with SCI were tetraplegia (54.0%), 40 adults with SCI were paraplegia (46.0%). The subjects with stroke in this study were ambulatory hemiplegics with normal cognition. The domains of QoL were compared between the groups of stroke and SCI and between the groups of tetraplegia and paraplegia.

RESULTS

Most Participants (73.7%) are unsatisfied with their QoL, and the physical, psychological and environmental domains showed a higher correlation with QoL. There was no significant difference in QoL total score and subdomains between the SCI and the stroke group. Within the SCI group, tetraplegia group experienced a lower satisfaction in physical and environmental domains compared to the paraplegic group ($P<0.05$). Educational level had the highest correlation with QoL ($P<0.01$), and duration of disease showed no significant correlation. When participants divided into four groups based on education level and disease (low-educated SCI; high-educated SCI; low-educated stroke; high-educated stroke), low-educated SCI group showed lower satisfaction of psychological domain compared to the other three groups.

CONCLUSIONS

Spinal cord injury and stroke were negatively associated with QoL and there was no significant difference in QoL according to the diseases. The development of a QoL instrument specifically targeted to SCI would be required for more effective analysis and evaluation of QoL deficit in adults with SCI. Further longitudinal studies to assess the impact of injury level, injury completeness as well as socioeconomic status on SCI QoL are also needed.

Table 1. Demographic data of the subjects

	SCI (n=87)	Stroke (n=69)	P
Sex ratio (M / F)	65 / 22	49 / 20	0.61
Married / Single	61 / 26	51 / 18	0.05
Age	51.83(11.96)	53.71(13.08)	0.35
Education (years)	11.63(3.17)	12.30(3.88)	0.24
Duration (months)	63.68(93.0)	4.06(6.57)	0.00**

NOTE: SCI, spinal cord injury

* $p < .05$, ** $p < .01$

Table 2. QOL, SCI vs. Stroke

	SCI (n=7)	Stroke (n=69)	P
QOL total score	68.77(15.84)	71.23(13.22)	0.18
Physical domain	16.85(4.82)	17.20(4.41)	0.20
Psychological domain	16.61(4.67)	17.70(3.73)	0.13
Social domain	8.27(2.23)	8.87(2.25)	0.12
Environmental domain	21.75(5.22)	22.16(4.75)	0.51

NOTE: QOL, quality of life; SCI, spinal cord injury

* $p < .05$, ** $p < .01$

Table 3. QOL, T-SCI vs. P-SCI vs. Stroke group

	T-SCI (n=47)	P-SCI (n=40)	Stroke (n=69)	P	Tukey
QOL total score	64.77(12.86)	73.48(17.78)	71.23(13.22)	0.01*	P-SCI, Stroke>T-SCI
Physical domain	15.55(3.91)	18.38(5.38)	17.20(4.41)	0.02*	P-SCI>T-SCI
Psychological domain	15.83(4.09)	17.53(5.16)	17.70(3.73)	0.05	
Social domain	8.21(2.22)	8.38(2.26)	8.87(2.25)	0.26	
Environmental domain	20.17(4.34)	23.60(5.61)	22.16(4.75)	0.01**	P-SCI>T-SCI

NOTE: QOL, quality of life; SCI, spinal cord injury; T-SCI, Tetraplegic SCI; P-SCI, Paraplegic SCI

* $p < .05$, ** $p < .01$, *** $p < .001$

Sleep quality in patients with spinal cord injury

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Introduction

Sleep disturbance is a common problem in patients with spinal cord injury (SCI). According to literature, SCI individuals are at high risk of sleep disturbance including snoring, difficulty in initiating and maintaining sleep, often awaking in the early morning and difficulty in falling asleep again, and easy tiredness during daytime. Factors that aggravate the quality of sleep in tetraplegic patients include pain, spasm, paresthesia, tendency to sleep in supine position, sedative usage or sleep apnea. However, only a few studies have focused on the quality of sleep in SCI population in Korea. The purpose of this study is to investigate the current status of sleep quality in patients with SCI.

Methods

The Nordic Sleep Questionnaires (NSQ) is widely used questionnaire for assessing the quality of sleep, consisting of 21 questions that are quantitative, ordinal or open question. The questionnaire asks the individuals to describe their sleep tendency for the last three months. We handed out the NSQ to patients with SCI as inpatients or outpatients. We also gathered demographic data, neurologic level of injury and severity of pain using the Numeric Rating Scale (NRS). Question 13 and 14 about the time going to bed and waking-up were not analyzed. The collected data were analyzed by descriptive statistic Method.

Results

A total of 61 questionnaires from 46 males and 15 females were returned. Twenty six patients were paraplegic while the others were tetraplegic. Mean duration of injury was 11.13 ± 11.63 years. Mean NRS score was 5.03 ± 2.26 . Other demographic data are shown in Table 1. Forty four patients (72.1%) reported difficulties in falling asleep, and they needed 39.84 ± 31.25 minutes to fall asleep. Fifty eight (95.1%) subjects answered they wake up during the overnight sleep, and especially more than half of them said it happens every day. Fifty five participants (90.2%) reported that they have not been slept well in last 3 months at various degree with 6.62 ± 2.40 hours of sleeping time, while they needed 7.74 ± 1.91 hours. Twenty one patients (34.4%) needed sleep medications to fall asleep. Distributions of the answers to each question are listed in Table 2 and 3. Twenty five patients reported various sleeping problems in answer to question 21, such as voiding or gastrointestinal problems (20.0%), shallow sleep (28.0%), pain (24.0%), position change (8.0%) and spasm (12.0%).

Conclusion

This study showed current state of sleep quality of patients with SCI. Pain, spasm, position change and voiding or gastrointestinal problem were reported as factors that

interfere the sleep. Sleep quality of patients with SCI can be improved by managing these factors. Further study with larger participants will be needed to determine the modifiable factors affecting the quality of sleep.

Table 1. Demographic characteristics of the participants

Characteristics	Value
Age (year)	53.93±11.66
Sex	
Male	46 (75.5%)
Female	15 (24.5%)
Duration of injury (year)	11.13±11.63
Functional status	
Paraplegia	26 (42.6%)
Tetraplegia	35 (57.4%)
AIS scale	
A	28 (45.9%)
B	4 (6.6%)
C	7 (11.5%)
D	21 (34.4%)
E	1 (1.6%)
Form of residence	
Home	54 (88.5%)
Rehabilitation center	7 (11.5%)

Table 2. Distribution of the answers to the questions on the Nordic Sleep Questionnaire with a 5-point ordinal scale

Question	Answers in number of participants (%)				
	1	2	3	4	5
Q1. Have you had difficulties in falling asleep?	17 (27.9%)	4 (6.6%)	9 (14.8%)	7 (11.5%)	24 (39.3%)
Q3. How often do you awaken at night?	4 (6.6%)	9 (14.8%)	7 (11.5%)	8 (13.1%)	33 (54.1%)
Q4. How many times do you usually wake up in one night?	3 (4.9%)	10 (16.4%)	21 (34.4%)	20 (32.8%)	7 (11.5%)
Q5. How often have you awakened very early in the morning without being able to fall back to sleep again?	17 (27.9%)	7 (11.5%)	12 (19.7%)	10 (16.4%)	15 (24.6%)
Q6. How well have you been sleeping?	6 (9.8%)	14 (23.0%)	12 (19.7%)	13 (21.3%)	16 (26.2%)
Q7. Have you used sleeping pills (by prescription)?	40 (65.6%)	1 (1.6%)	3 (4.9%)	5 (8.2%)	11 (18.0%)
Q8. Do you feel excessively sleepy in the morning after awakening?	19 (31.1%)	10 (16.4%)	11 (18.0%)	10 (16.4%)	11 (18.0%)
Q9. Do you feel excessively sleepy during the daytime?	12 (19.7%)	8 (13.1%)	17 (27.9%)	14 (23.0%)	10 (16.4%)
Q10. Have you suffered from irresistible tendency to fall asleep while at work?	21 (34.4%)	10 (16.4%)	11 (18.0%)	10 (16.4%)	9 (14.8%)
Q11. Have you suffered from irresistible tendency to fall asleep during free time (leisure time)?	18 (29.5%)	12 (19.7%)	11 (18.0%)	12 (19.7%)	8 (13.1%)
Q15a. How often do you have a nap during the daytime?	19 (31.1%)	11 (18.0%)	12 (19.7%)	11 (18.0%)	8 (13.1%)
Q16. Do you snore while sleeping (ask other people)?	20 (32.8%)	9 (14.8%)	8 (13.1%)	12 (19.7%)	12 (19.7%)
Q17. In what way do you snore (ask other people)?	18 (29.5%)	21 (34.4%)	10 (16.4%)	3 (4.9%)	9 (14.8%)
Q18. Have you had breathing pauses (sleep apnea) during sleep (have other people noticed that you have pauses in respiration when you sleep)?	46 (75.4%)	3 (4.9%)	7 (11.5%)	1 (1.6%)	4 (6.6%)

Answer-alternatives of question 1, 3, 5, 7, 9, 10, 11, 15a, 16 and 18 are as follow: 1, never or less than once per month; 2, less than once per week; 3, on 1-2 days per week; 4, on 3-5 days per week; 5, daily or almost daily.
 Answer-alternatives of question 4 are as follow: 1, usually I don't wake up at night; 2, once per night; 3, two times; 4, 3-4 times; 5, at least five times per night.
 Answer-alternatives of question 6 are as follow: 1, well; 2, rather well; 3, neither well nor badly; 4, rather badly; 5, badly
 Answer-alternatives of question 17 are as follow: 1, I don't snore; 2, my snoring sounds regular and it is of low voice; 3, it sounds regular but rather loud; 4, it sounds regular but it is very loud (other people hear my snoring in the next room); 5, I snore very loudly and intermittently (there are silent breathing pauses when snoring is not heard and at times very loud snorts with gasping)

Table 3. Distribution of the answers to the quantitative questions in the Nordic Sleep Questionnaire

Question	Answers in percent	
	Mean	SD
Q2. For how long a time (how many minutes as an average) do you stay awake in bed before you fall asleep (after lights out) (minutes)	39.84	31.25
Q12. How many hours do you usually sleep per night? (hours)	6.62	2.40
Q15b. If you take a nap, how long does it usually last? (minutes)	67.97	46.66
Q19a. If you snore at least 1-2 times per week, how many years have you been snoring? (ask other people if you don't know)? (years)	4.82	6.44
Q20. How many hours of sleep do you need per night (how many hours would you sleep if you had the possibility to sleep as long as you need to)? (hours)	7.74	1.91

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Relationship Between Injury Severity and Electrophysiological Changes of PNS in subacute SCI

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Objective

To investigate the characteristics of patients with and without electrophysiological abnormalities of the peripheral nervous system after spinal cord injury and factors affecting such differences, and to determine whether they affect the patient's functional prognosis.

Subjects & Methods

We conducted retrospective chart review of 151 patients who underwent electrodiagnostic study to diagnosis cervical & thoracic myelopathy in our rehabilitation facility from January 2014 to June 2018. Patients 18 years of age or older with complete or incomplete limb paralysis due to spinal cord injuries and had an injury level higher than T10 were included. Patients who had undergone a test for less than 21 days or more than 180 days after the injury, who had history of cancer, who had insufficient test Results, or who had no suspicion of myelopathy during MRI imaging studies were excluded. Patients with denervation potential in three or more myotomes on bilateral limbs were classified as generalized denervation potential(GDP) group (27 patients), and those with denervation potential in two or less myotomes on uni- or bilateral limbs were classified as non-GDP group (28 patients). The functional status and electrodiagnostic data of the peripheral nervous system were compared between two groups in order to confirm the relationship between the electrophysiological abnormality of the peripheral nervous system and the function and prognosis of the patients.

Results

Subject ages ranged from 25 to 85 years with a mean (SD) of 59.21(12.53) years and the average time since injury to test (SD) was 58(38) days. There was no statistically significant differences in age, sex, level of injury, average time from injury to electrodiagnostic evaluation and history of trauma. Patients with abnormal electrical physiologic change in peripheral nerves showed clinically severe spinal cord injury scale, and low Korea version of spinal cord independence measure score. (Table 1) In comparison of electrodiagnostic data between two groups, the amplitude of peroneal, tibial, and sural nerve in GDP groups were statistically significantly low, and latency of the tibial nerve was significantly delayed. (Table 2). The number of patients showing an absent response as a Result of motor evoked potential study and somatosensory evoked potential study in the GDP group was significantly higher.

Conclusion

The Results showed that generalized denervation of the lower limbs occurred in the group with severe spinal cord injury. This study shows that central nervous system injury can also affect the peripheral nervous system, which is thought to be proportional to the severity of central nervous system injury. This overlapping nervous system abnormality is thought to be a factor that may interfere with the functional recovery of the patient.

Table 1. Demographic and clinical characteristics

	non-GDP group (27)	GDP group (28)
Sex (n)	M:18 F:9	M:20 F:8
Age (years)	61.74±12.43	56±12.36
BMI (Kg/m ²)	22.89±2.85	21.77±3.82
Height (meter)	1.64±0.87	1.66±0.84
Level of Injury	C:20 T:7	C:17 T:11
ASIA impairment scale	A : 0 B : 0 C : 5 D : 22	A : 10 B : 3 C : 13 D : 2*
K-SCIM	50.89±28.70	20.57±15.54*
Average time from injury to electrodiagnostic evaluation (days)	59.78±34.11	75.82±39.21
Presence of Diabetes Mellitus (n)	7	6
History of Trauma (n)	19	23

GDP, Generalized denervation potential; C, Cervical myelopathy; T, Thoracic myelopathy; ASIA, American Spinal Injury Association; K-SCIM, Korea version of spinal cord independence measure score; *, P-value < 0.05

Table 2. Data of electrophysiological evaluation

		non-GDP group (27)	GDP group (28)	
NCS	Peroneal nerve	Latency	3.96 ± 0.84	4.22±0.86
		Amplitude	2.79 ± 1.76	1.32 ± 1.23*
	Tibial nerve	Latency	3.53 ± 0.86	4.20±1.02*
		Amplitude	9.56 ± 4.05	4.30±2.43*
Sural nerve	Latency	2.58 ± 0.48	2.68 ± 0.52	
	Amplitude	9.93 ± 5.15	6.15 ± 2.83*	
SEP	Presence of evoked potential	42	11*	
MEP	Presence of evoked potential	41	8*	

The case was measured at twice the number of patients by evaluating the patient's denervation potential and evoked potential in both lower limbs. GDP, Generalized denervation potential; NCS, nerve conduction study; SEP, somatosensory evoked potential; MEP, motor evoked potential; * p-value < 0.05

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Long-term efficacy of mirabegron add-on therapy to antimuscarinic agents in patients with SCI

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Study design

Retrospective chart analysis.

Objectives

To evaluate the long-term efficacy of mirabegron add-on therapy in patients with spinal cord injury based on urodynamic study (UDS).

Methods

The study included patients with SCI who underwent two consecutive UDS between April 1, 2015 and April 1, 2018. After adding 50 mg of mirabegron once a day to pre-existing antimuscarinic agents for a period of at least 6 months, the following variables were analyzed: change in cystometric capacity (ml), change in bladder compliance (ml/cm H₂O), change in maximal detrusor pressure (cm H₂O), change in reflex volume (ml) and presence of significant leakage during filling cystometry.

Results

A total of 31 patients with a mean age of 40.61 years (SD ± 14.50) were included in the analysis. Significant increase in cystometric capacity (mean, 362.32 to 423.65 ml, P = 0.026), reflex volume (mean, 251.23 to 328.55 ml, P = 0.018) and bladder compliance (median, 11.80 to 17.50 ml/cm H₂O, P = 0.039) were observed. The presence of leakage during filling CMG were also significantly reduced (29.0% to 9.7%, P = 0.031). The change in maximal detrusor pressure decreased from mean of 31.48 to 27.48 cm H₂O, but did not reach statistical significance (P = 0.385).

Conclusion

Adding mirabegron to conventional AMs further improved urodynamic parameters in chronic SCI patients and the efficacy sustained in long term use.

Table 1 Characteristics of the participants, N=31 Abbreviation : SD, standard deviation; NLI, neurological level of injury; AIS, ASIA(American Spinal Injury Association) Impairment Scale; CIC, clean intermittent catheterization; IQR, interquartile range

Variables	Values
Age, mean (SD)	40.61 (14.50)
Gender, n (%)	
Male	20 (64.5%)
Female	11 (35.5%)
NLI, n (%)	
Cervical	16 (51.6%)
Thoracic	
Upper (T1-T6)	10 (32.3%)
Lower (T7-T12)	4 (12.9%)
Lumbar	1 (3.2%)
AIS classification, n (%)	
A	22 (71.0%)
B	5 (16.1%)
C	4 (12.9%)
D	0 (0%)
Etiology, n (%)	
Trauma	25 (80.6%)
Others	6 (19.4%)
Voiding method, n (%)	
CIC	20 (64.5%)
Indwelling catheter	
Transurethral	8 (25.8%)
Suprapubic	3 (9.7%)
Duration of injury, median, months	47 (IQR 32-69)

Abbreviation : SD, standard deviation; NLI, neurological level of injury; AIS, ASIA(American Spinal Injury Association) Impairment Scale; CIC, clean intermittent catheterization; IQR, interquartile range

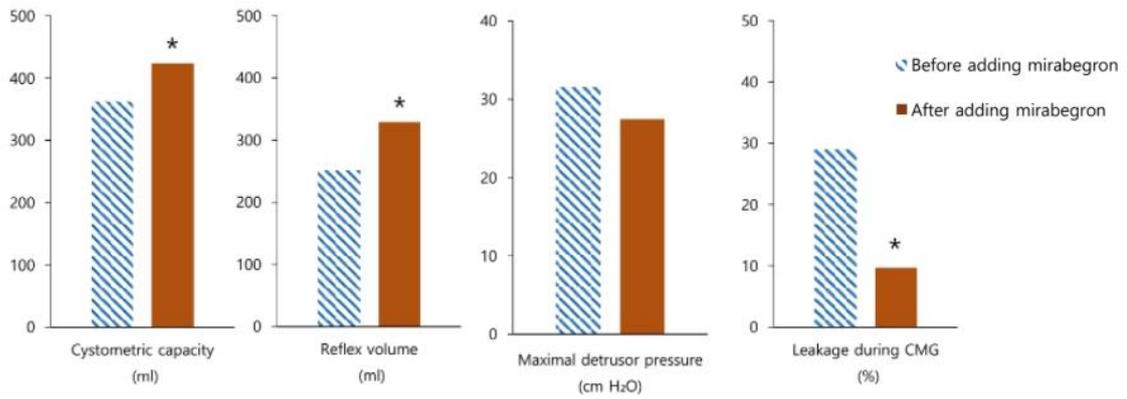


Figure 1 Change in cystometric capacity, reflex volume, maximal detrusor pressure and leakage during CMG after adding mirabegron 50mg a day in SCI patients. * P < 0.05

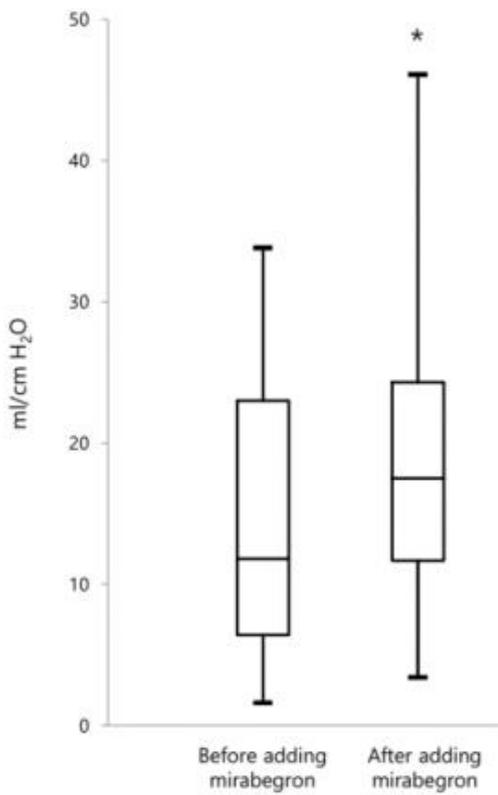


Figure 2 Box plots of compliance (ml/cm H₂O) before and after adding mirabegron 50mg a day in SCI patients. * P < 0.05

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Spontaneous Spinal Subdural Hemorrhage after taking Clopidogrel : A Case report

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Introduction

Recently, the use of anti-platelet drugs such as aspirin and clopidogrel to prevent arterial thrombotic diseases has increased. Clopidogrel works by blocking platelets from sticking together and prevents them from forming harmful clots. Bleeding can be occurred as the side effect after taking clopidogrel. The cases with spinal cord injury by bleeding have not been reported so far. We report a patient with paraplegia due to spinal cord injury by spinal subdural hemorrhage (SDH) after taking clopidogrel.

Case presentation

A 69-year-old female was admitted to our rehabilitation center on January 18, 2018 after experiencing lower back pain from 3 days ago, gait difficulty and progressive right lower extremity weakness from 1 day ago. The patient was taking antihypertensive drugs for hypertension in his past history. In 2016, the patients visited the cardiologic department for chest tightness. The patient was found to have mild coronary disease in coronary angiogram and started taking clopidogrel for prophylaxis. Magnetic resonance imaging (MRI) scan was performed on admission to the patient and showed compressive myelopathy by SDH in T12-L1 level. (Figure 1) So the patient underwent T11,12 total laminectomy and intradural hematoma removal. We suspected that spinal SDH occurred spontaneously due to platelet dysfunction by taking clopidogrel. So, We performed platelet aggregation test (PAT) to identify platelet dysfunction. The PAT revealed reduced aggregation to collagen and epinephrine. The patient stopped taking clopidogrel at end of January, 2018. Clopidogrel may exhibit a reduced aggregation response for some agonists until 3 months after discontinuation of the drug. The follow up PAT performed every a month. The second and third test revealed that the aggregations to collagen and epinephrine are reduced persistently. (Table 1)

Conclusion

The PAT is recommended to perform periodically to identify platelet function of a person who are taking antiplatelet agents because of increased bleeding risk. In addition, if a person taking antiplatelet agents such as aspirin and clopidogrel or anticoagulants such as warfarin suddenly has weakness or paralysis, the clinician should suspect hemorrhage of nervous system and should perform futher evaluation and manegement on it.

Table 1. Results of platelet aggregation test performed after stopping taking clopidogrel

	ADP(%)	Epinephrine(%)	collagen(%)	ristocetin(%)
2018.03.13	80	49	51	99
2018.04.11	82	48	54	100
2018.05.09	52	26	62	68
Reference(%)	63-100	54-100	61-100	60-100



Figure 1. L-spine Magnetic resonance imaging showing hemorrhage at the level of T11 to T12-L1 of the spinal cord in sagittal T1-weighted images (arrow) and compressive myelopathy in the spinal cord due to hemorrhage in the axial T2-weighted image (triangle)

Subacute combined degeneration with vitamin E deficiency cause spinocerebellar ataxia: Case report

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Subacute combined degeneration(SCD) is degeneration of posterior and lateral columns, which may include limb numbness, weakness, and gait disturbance. It is usually caused by vitamin B12 deficiency, but it is rarely caused by vitamin E deficiency. We present a rare case of SCD with vitamin E deficiency associated with severe malabsorption. A 50-year-old woman had adhesive intestinal obstruction in China and underwent surgical treatment such as adhesiolysis and small intestinal suture 4 months ago. After surgery, decreased consciousness and fever continued, therefore intensive treatment was performed. Although consciousness level was recovered to alert, ataxia, limb weakness and dysarthria occurred, Resulting in bed-ridden state for 5 weeks. She came to Korea and was admitted to our hospital for curing the unknown disease 3 months ago. At the physical examination, cranial nerves were intact. Ocular movement, hearing, tongue movements were normal. Facial sensation and symmetry were intact but severe dysarthria was observed. Muscle strength of bilateral upper extremities was MRC grade 2/5 in proximal and 3/5 in distal muscles and bilateral lower extremities was 2/5 in both proximal and distal muscles. Both upper extremities were hyperreflexic, but both lower extremities were areflexic and seemed decreased proprioception. Cerebellar examination showed bilateral positive findings in finger-to-nose testing and alternative rapid movements. Bilateral limb and truncal ataxia were observed. Whole spine MRI showed T2 high signal in bilateral posterior and lateral horn of spinal cord at the C5 level. <figure1> Nerve conduction studies showed lower extremities dominant sensorimotor polyneuropathy and delayed P40 latency in somatosensory evoked potentials, suggesting cervical myelopathy. BMI was 14.45 kg/m² and severe malabsorption could be suspected. Laboratory tests revealed serum vitamin B of 649mg/dl (normal: 197~771) and vitamin E of 3.7mg/dl (normal: 5.0~20.0mg/dl). Finally, it was diagnosed to SCD associated with vitamin E deficiency. She underwent a 400mg vitamin E capsule 3 times a day, followed by physical and occupational therapy. The vitamin E level improved to 17.34mg/dl on follow up 3 weeks later. Functional level was improved and moderate assisted walker gait was possible. This case was diagnosed as SCD associated with vitamin E deficiency. The Chinese doctors did not find the cause for 5 weeks and she was improved with vitamins E supplementation and rehabilitation. Early diagnosis could have been possible if the micronutrient level, including vitamin E, was examined early in the symptoms. It is important because prompt replacement can stop disease progression and improve cerebellar syndrome. In Conclusion, patient with tetraplegia who do not know the cause need appropriate imaging test and if the cause is due to SCD, it is necessary to detect the deficiency of micronutrients like vitamin B12 and E.

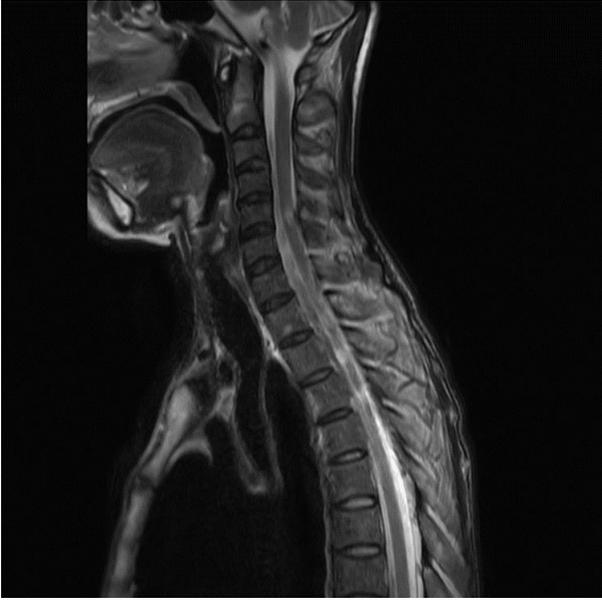


Fig 1. Whole spine MRI - T2 high signal in bilateral posterior and lateral horn of spinal cord, C5 level.

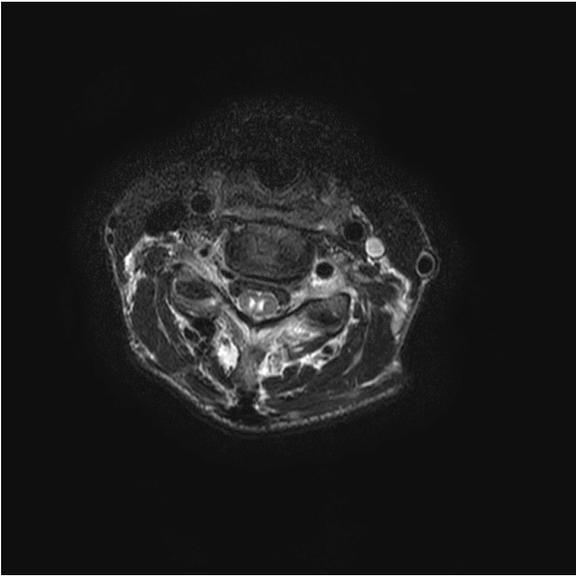


Fig 2. Whole spine MRI - T2 high signal in bilateral posterior and lateral horn of spinal cord, C5 level.

The Effect of Rehabilitation on Spontaneous Hematomyelia Patient without Surgery : A Case report

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Objective

Spontaneous intramedullary spinal cord hemorrhage (hematomyelia) is a rare disease. A small number of cases reported the post-operative effect on spontaneous hematomyelia, but few cases reported the effectiveness of rehabilitation. We report on efficacy of rehabilitation on spontaneous hematomyelia patient without surgical resection.

Materials and Methods

A 79-year old female visited our emergency department complaining of sudden-onset back pain on thoracic level, weakness and sensory disturbance in both lower legs, voiding difficulty, which had started 2 weeks ago prior to her visit. At initial neurological examination, her Berg Balance Scale(BBS) score was 13 and Korean version of Modified Barthel Index(K-MBI) score was 60. Her Manual Muscle Test(MMT) marked fair plus for right leg and poor plus for left leg, and she was unable to walk independently. Sensation was decreased below the T4 dermatome. Her anal tone was decreased, and voiding was not possible. She had no history of trauma and had been taking an antihypertensive medication from the past. Laboratory test were within normal limits. Whole spine magnetic resonance imaging(MRI) revealed an hematomyelia at the C7-T3 level, which showed as a high signal in a T1 weighted image and a low signal in a T2 weighted image. However, showing variable intensities in the T1 weighted, T2 weighted image is associated with acute and subacute phase hemorrhage, and preoperative diagnosis was hemorrhagic spinal cavernous malformation. Many neurosurgeon advocated that surgical treatment is the most effective and most cases reported on effects after a surgical resection. However, in this case, the patient was considered to have a low benefit of surgical resection due to the facts that she was an old age and weakness of lower extremities no longer progresses. So, she just started rehabilitation.

Results

Two weeks after visiting the emergency department, she was transferred from the neurosurgery department to the rehabilitation department and started physical therapy twice a day. Urodynamic study was performed for voiding dysfunction. The Result was obstructive pattern and residual urine was checked with 300cc and foley catheter was reinserted. After that, the patient underwent bladder training along with medication. After 3 months of physical therapy, Numeric pain rating scale(NRS) of back pain decreased from 6 to 3, and BBS score improved to 43 from 13 and K-MBI score 77 from 60. Her MMT marked good from fair plus for right lower extremity and fair plus from

poor plus for left lower extremity. At discharge, she was able to walk independently using a high-walker. In addition, she was able to void and the residual urine was checked below 100cc using a bladder scanner. So, she was discharged home with the foley catheter removed.

Conclusion

We report that early rehabilitation for patient with hematomyelia with low surgical benefit such as old aging is an effective treatment for improving function.

table1. Initial MRI revealed an hematomyelia from C7-T3 level. A T2 weighted sagittal image showing low signal intensity (A). A T1 weighted sagittal image showing high signal intensity (B). Compared to a non-enhanced T1 weighted axial image (C), subtle enhancement was observed in the enhanced T1 weighted axial image (D).

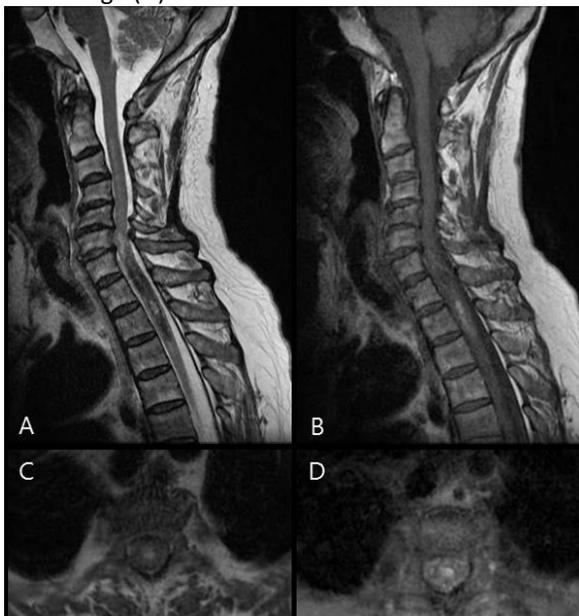
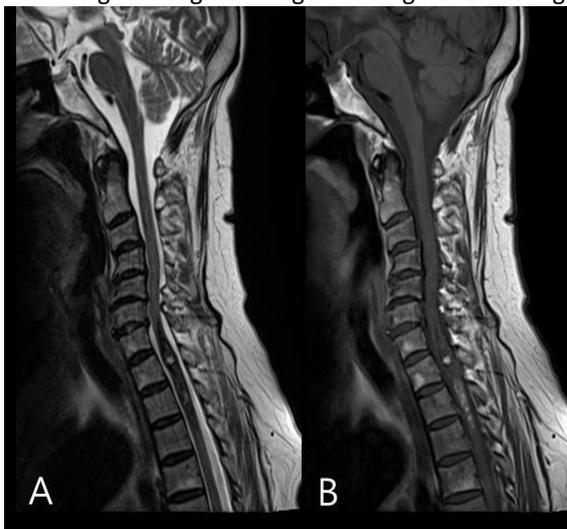


table2. 2 month later MRI revealed that increased low signal intensity on T2 weighted sagittal imaging (A), A T1 weighted sagittal image showing increased high signal intensity (B).



Brown-Séquard typed Paraplegia due to Spinal Cord Infarction after Bronchial Artery Embolization

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Introduction

Bronchial artery embolization (BAE) is a well-established minimally invasive procedure in the management of massive hemoptysis. There are significant procedural complications including technical failure with continued hemoptysis, cerebral and spinal cord infarctions. We report a rare case of paraplegia mimicking Brown-Sequard syndrome due to spinal cord infarction following BAE.

Case report

A 52-year-old man with previous Tuberculosis was admitted with recurrent hemoptysis. Thoracic computed tomography (CT) showed consolidative lesion in LUL with atelectasis, and he underwent BAE. Selective angiography showed that left upper intercostal artery, left mid intercostal artery, left supraclavicular artery, internal mammary artery, subscapular artery were hypertrophied along with abnormal parenchymal stain and systemic pulmonary shunt. These abnormal arteries were embolized with microcoils (Fig. 1). Following BAE, he complained of weakness of the left legs. On physical examination, his left leg was motor grade 4 strength. But The next morning, the patient complained chest pain and after chest pain was subsided, his left leg was flaccid with grade 0/5 strength. DTR absent in both lower limbs, decreased light touch sensory loss below T2 level, pain and temperature sensations were decreased in the both legs below T4 level. An magnetic resonance imaging (MRI) of the brain was normal. And MRI of the whole spine revealed abnormal T2 high signal at the anterior spinal cord at T1-T2 levels (Fig. 2). He was started on intravenous methylprednisolone. After 2 weeks, he was transferred to department of Rehabilitation medicine. At that time, motor grade 0/5 strength in the left leg and motor grade 4/5 strength in the right leg. Pain sensations were decreased in the both leg but right more severe and light touch and temperature sense was decreased in the both leg, below T4 level. Somatosensory Evoked Potentials (SSEP) Study has done, left Posterior Tibial nerve latency was delayed. And, MEP of left Tibialis anterior muscles is not evoked (Table 1). Patient was managed symptomatically and all the rehabilitation modalities. After three months, it revealed improvement in left leg motor strength (Grade 3) and in right leg motor strength (Grade 5). And follow up Posterior Tibial nerve SSEP, latency was much improved. And follow up MEP was unchanged. He could walk with mono-cane.

Conclusion

BAE is an important treatment for hemoptysis. Spinal cord infarction is a rare complications, Results from embolization of the anterior spinal artery. We experienced a

rare case of spinal cord infarction after BAE. Because this case is quite similar to Brown-Séquard syndrome due to spinal cord infarction after BAE, we report it. And we wish to emphasize the importance of informing the patients about the potential complications prior to performing BAE.

Table 1. Somatosensory Evoked Potentials (SSEP) Study and Motor Evoked Potentials (MEP) Study.

Somatosensory Evoked Potentials (SSEP) Study								
Nerve	Right side				Left side			
	2018.03.31		2018.05.29		2018.03.31		2018.05.29	
	Latency (ms)	Amplitude (mV/uV)						
Post. tibia	42.7	0.9	39.9	1.4	45.8*	0.7	42.7	0.9

Motor Evoked Potentials (MEP)								
TA	Initial (2018.04.05)				F/u (2018.06.16)			
Motor Evoked potential (130% RMT)	Rt.		Lt.		Rt.		Lt.	
	Latency (ms)	Amplitude (mV/uV)	Latency (ms)	Amplitude (mV/uV)	Latency (ms)	Amplitude (mV/uV)	Latency (ms)	Amplitude (mV/uV)
	34.0	1093	Not evoked*		32.0	1553	Not evoked*	
CMCT	7.5		Not evoked*		9.3		Not evoked*	

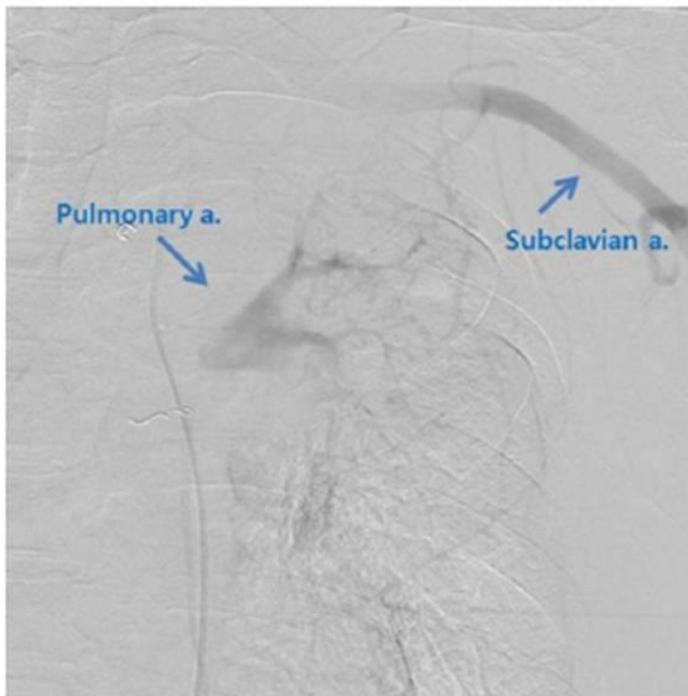


Fig. 1. Catheter angiography showing systemic-pulmonary arterial shunt.

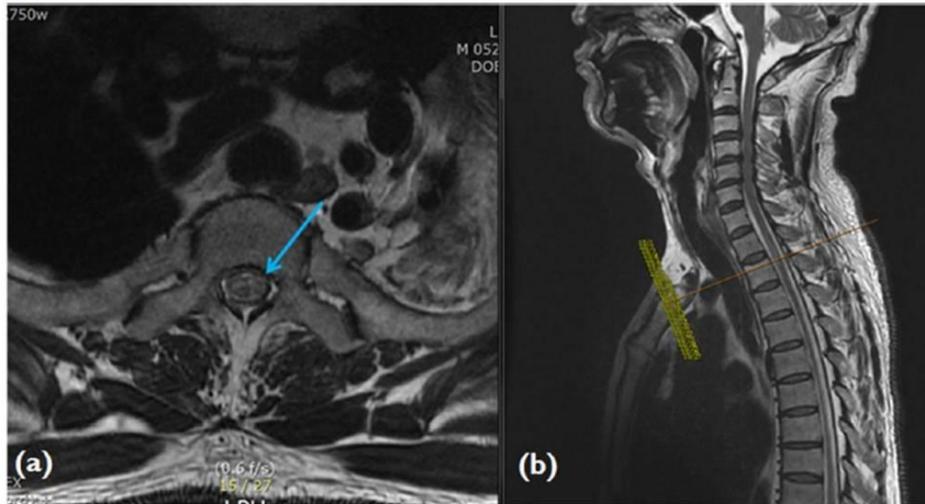


Fig. 2. Whole spine MRI revealed abnormal T2 high signal at the anterior spinal cord at T1-T2 levels. (a) T2 high-resolution axial weighted image at T2 level (b) T2 high-resolution sagittal weighted image at T2 level

Transverse Myelitis in an Ankylosing Spondylitis Patient

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Ankylosing spondylitis (AS) is generally considered to be an inflammatory disease of the spine with few extra-articular manifestations. Among them, transverse myelitis is very rare extra-articular manifestation in patients with AS. We have experienced a case of a young man with an AS who developed longitudinal transverse myelitis. A 20-year-old male patient with 1-year history of AS presented with insidious onset of numbness on right upper extremity. He was not complaining of any muscular weakness, imbalance, disturbance of gait, urinary or bowel incontinence or any change in mental status. On neurological examination there was hypoesthesia noted on the right side of the dermatome below fourth cervical (C4) level. The application of neck extension combined with ipsilateral rotation and lateral flexion exacerbated the pain and numbness of the right upper limb. Deep tendon reflexes were normoactive in all extremities. Laboratory studies revealed a positive HLA-B27. Both pelvic magnetic resonance imaging (MRI) and bone scan findings demonstrated typical abnormalities of AS at the sacroiliac joints (Fig. 1). On Spine MRI revealed a high signal intensity at cervical (C4-C6) levels (Fig. 2) and thoracic (T3-4) levels (Fig. 3) on T2-weighted images. Cranial MRI, visual evoked potentials, and sensory evoked potential were normal. In the cerebrospinal fluid examination, no oligoclonal band formation or cell was found. Short-term high-dose steroid pulse treatment was effective in slight symptom improvement, but mild residual symptoms remained. We here report a case of AS patient who developed transverse myelitis, a rare neurological complication of AS.

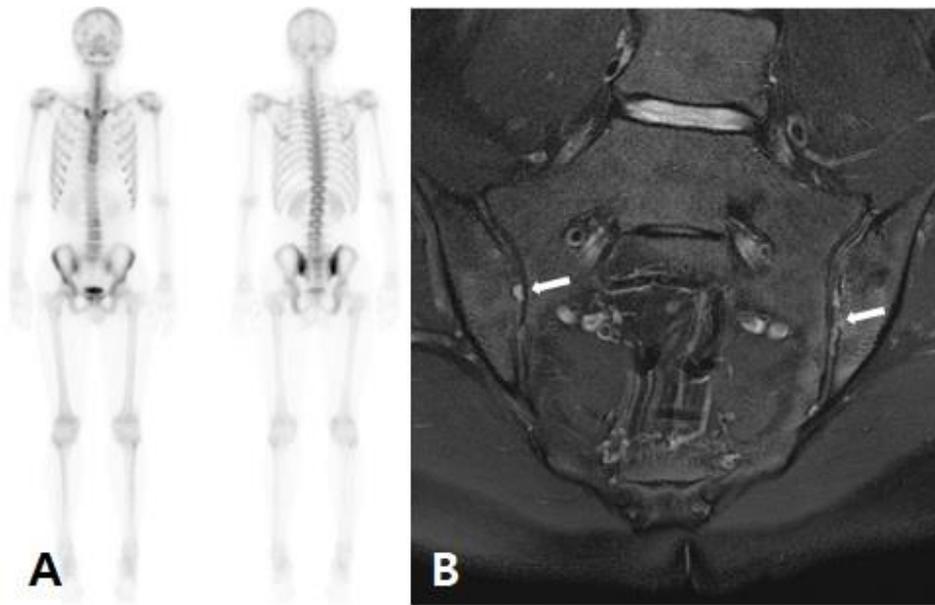


Fig 1. Whole body bone scan and pelvic MRI of a 20-year-old male patient with ankylosing spondylitis. (A) Whole body bone scan exhibiting increased radioisotope uptake at both sacroiliac joints. (B) Coronal T2 fat suppression MRI of pelvis showing mild bone erosion and bone marrow edematous changes at both sacroiliac joints (white arrows)

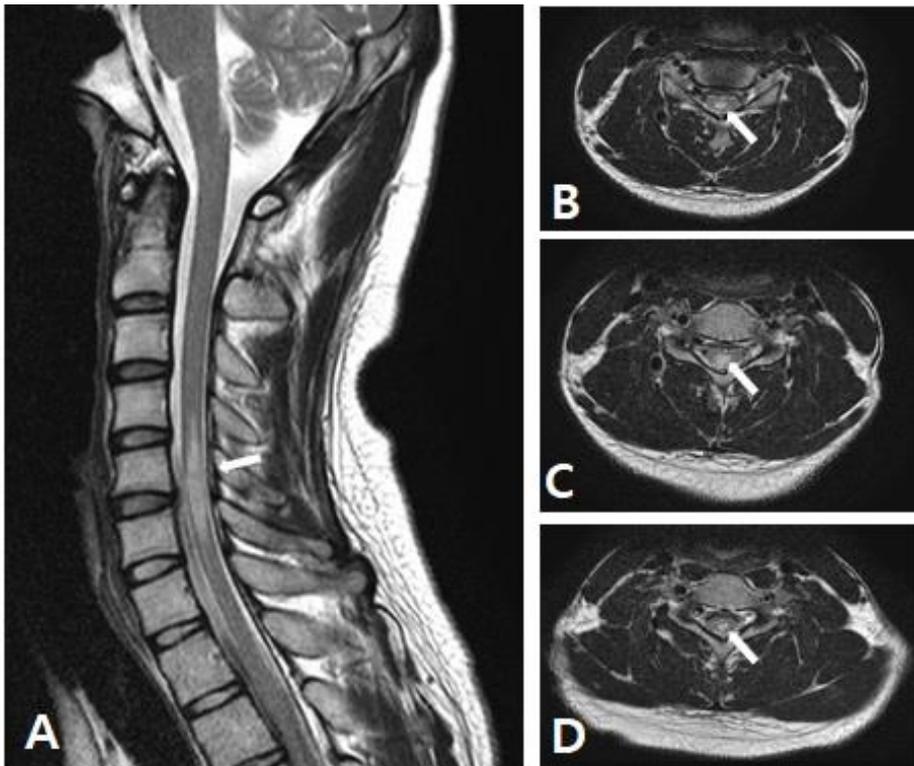


Fig 2. Magnetic resonance image (MRI) of cervical spinal cord. (A) High signal intense area (white arrow) of demyelination is seen at cervical spinal cord on T2-weighted sagittal image. (B-D) High signal intense area (white arrows) of demyelination is seen at fourth (B), fifth (C), and sixth (D) cervical levels of spinal cord on T2-weighted axial images



Fig 3. Magnetic resonance image (MRI) of thoracic spinal cord. High signal intense area (white arrow) of demyelination is seen at third and fourth thoracic levels (T3-T4) of spinal cord on T2-weighted sagittal image.

Simultaneous Multiorgan Complications in Subacute Stage of Cervical Spinal Cord Injury

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Background

Cervical spinal cord injury (SCI) can cause dysfunction in various organs and higher morbidity. Knowing about complications of cervical SCI is important as it can be life-threatening. During acute phase, cardiovascular complications such as bradycardia, hypotension, deep vein thrombosis and pulmonary embolism, gastrointestinal complications such as gastric ulcer (GU) bleeding, endocrine complications such as SIADH and adrenal insufficiency are common. Among these, we experienced a case of simultaneous multiorgan complications in a patient with cervical SCI which required intensive care.

Case report

A 82-year-old woman visited other hospital by both arms and legs weakness after falling down and hitting forehead to floor. In cervical MRI, it showed signal change at the level of C3-5 (Figure 1) that she got anterior cervical discectomy and fusion between C3-5. After then, she got enoxaparin to prevent deep vein thrombosis (DVT). Two weeks later, she was transferred to our hospital for rehabilitation accompanied by right leg swelling and skin wound with bleeding caused by extravasation. For wound control, we considered to stop enoxaparin, so we tried venous CT. However, we had to take duplex sonography instead of venous CT due to poor venous condition. It showed no evidence of DVT that we stopped enoxaparin. However, three days later, her left leg began to swell with fever and CK, LDH, D-dimer elevation. So, we extended APCT range including iliac and proximal femoral vein which was performed to search fever focus. There was DVT in those veins that we started enoxaparin again (Figure 2). At the same time, systolic blood pressure (BP) fell down to 65mmHg regardless of diet and position. So, we started inotropics but, it didn't work. Then we performed labs evaluating adrenal functions and it showed low level of cortisol with 3.99ug/dL and hyponatremia with 133mEq/L. Endocrinologist diagnosed adrenal insufficiency and recommended steroid. However, she suddenly showed hematemesis, melena that hemoglobin fell down abruptly from 8.2g/dL to 6.6g/dL in a day. So, we did emergent endoscopy and performed ablation on multiple GU to stop bleeding (Figure 3). After then, we had to stop enoxaparin and delay steroid due to risk of further GU bleeding. Fortunately, her BP recovered naturally without steroid and GU bleeding didn't recur. So we restarted enoxaparin 1 month later.

Conclusion

Patients with spinal cord injuries are at risk for many complications and most of them can be controlled with appropriate medical intervention. However, if serious multiorgan complications occur simultaneously, it could be life-threatening that physicians must pay

attention to it all the time. Also, even though duplex sonography is gold standard to diagnose DVT, venous CT can be more beneficial if DVT is located in proximal veins. Moreover, if BP drops regardless of diet and position, physicians need to evaluate adrenal functions to check adrenal insufficiency.

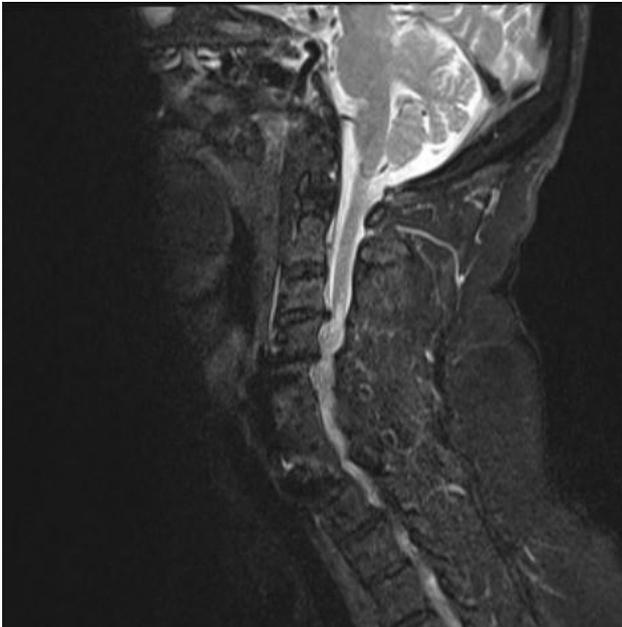


Figure 1. Initial T2-weighted cervical spine MRI



Figure 2. DVT in Lt common iliac vein in APCT

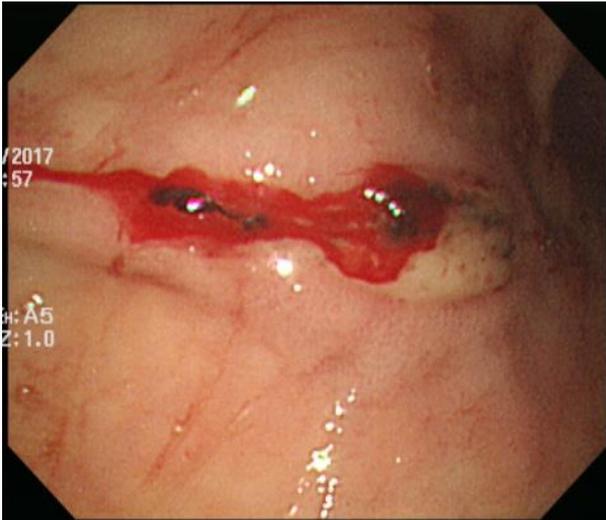


Figure 3. Gastric ulcer bleeding in EGD

ESWT to Treat Refractory Neurogenic Heterotopic Ossification in Patient with Spinal Cord Injury

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Abstract

Neurogenic heterotopic ossification (NHO) is a common complication in central nervous system injuries including spinal cord injury (SCI), and significant pain can reduce the quality of life. Here, we reported the case of a 55-year-old male with C4 [S(C7/C7), M(C4/C4)] ASIA Impairment Scale A SCI due to cervical myelopathy, who experienced painful NHO around the right hip joint. His pain had been treated with medications (aceclofenac 100mg twice a day and disodium etidronate 600mg once a day) and physical modalities during a minimum of 3 weeks, however, he still exhibited severe pain with a Numeric Pain Rating Scale score of 7 to 8. In addition, because of his severe pain, he could not sit on the wheelchair at all. Ultrasound-guided extracorporeal shock wave therapy (ESWT) was administered to the area of NHO a total of 7 times, intensity of 6-7, weekly. After treatments, his pain reduced to VAS 3 and he also could sit on wheelchair more than 10 hours, although the size of NHO remained unchanged. In addition, these therapeutic effects of ESWT for NHO lasted for 6 months. To the best of our knowledge, this is the first Case report for treatment of NHO using ESWT in patients with SCI. Therefore, the application of ESWT would constitute a possible alternative to other treatment techniques for treatment of NHO in patients with SCI.



Figure 1 Sagittal T2 magnetic resonance image demonstrating spinal cord injury with focal high signal intensity spinal cord lesion

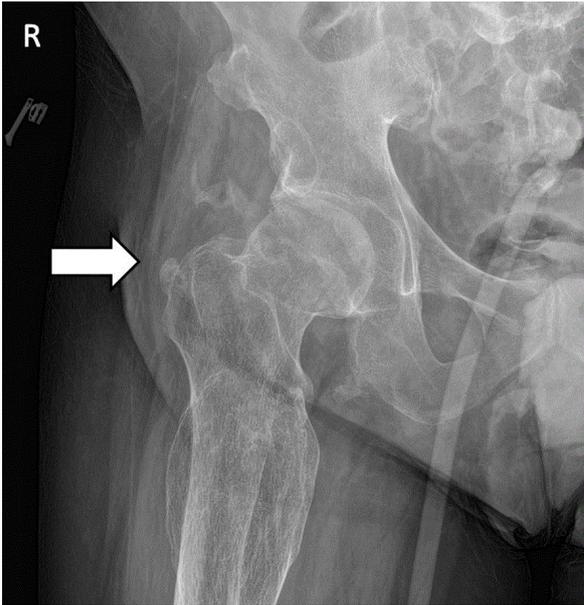


Figure 2 Radiograph of the hip showed neurogenic heterotopic ossification before extracorporeal shock wave therapy treatment

Cauda Equina Syndrome by Disc Herniation with Posterior Limbus Vertebra : A Case report

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Introduction

Fracture of the limbus vertebra is an uncommon diagnosis and is thought to Result from herniation of the nucleus pulposus through the ring apophysis prior to fusion isolating a small segment of the vertebral rim. The most common site for the presence of limbus vertebra is the anterior margin of the vertebral body usually at the superior anterior margin in the lumbar vertebrae. Therefore, Posterior limbus vertebra is an uncommon finding. Clinical signs usually limit those of lumbar disc herniation, and include a history of low back pain and/or leg pain. We report a case of posterior limbus vertebra Resulting in cauda equina syndrome.

Case

After returning from the Taekwondo academy, An 11-year-old man has been suffering from lower back pain. 3 days later, when he went down the stairs, he felt tingling sensation in both soles and weakness of both legs was developed, and he visited our emergency department. On neurologic examination, motor examination of lower extremities revealed bilateral ankle dorsiflexor, long toe extensor and ankle plantarflexor 1/5 with intact reflexes. Plain radiography showed a bony fragment projecting posteriorly from the body of the fourth lumbar vertebra (Figure 1). The magnetic resonance imaging(MRI) of the lumbar spine revealed compression of cauda equina (Figure 1). The patient received emergent decompressive laminectomy of L4 without post-operative complication. After 2 weeks from operation, he was transferred to department of rehabilitation medicine for comprehensive rehabilitation. A follow up examination, at transfer, 2 and 4 weeks after transfer, revealed improved motor power in both lower extremities (Table 1). According to motor recovery, Korean version of Spinal cord Independent measure(KSCIM) improved from 66 to 85. At the day of transfer, the patient's functional ability was limited to standing with both arm assist. Through the comprehensive rehabilitation, the patient's functional status was improved, as a Result, he was able to gait with monocane with supervision on discharge.

Conclusion

This case suggested that cauda equina syndrome could be occurred by posterior fracture of limbus vertebra. The patient shows good prognosis compared with other cases of disc herniation with limbus vertebra, because of the his young age, emergent operation and early comprehensive rehabilitation.

Table 1. Manual muscle testing at admission, transfer, 2 weeks follow up and 4 weeks follow up after transfer

	At admission		At transfer		2 weeks follow up		4 weeks follow up	
	Right	Left	Right	Left	Right	Left	Right	Left
Elbow flexor	N	N	N	N	N	N	N	N
Wrist Extensor	N	N	N	N	N	N	N	N
Elbow extensor	N	N	N	N	N	N	N	N
Finger flexor	N	N	N	N	N	N	N	N
Finger abductor	N	N	N	N	N	N	N	N
Hip flexor	N	N	N	N	N	N	N	N
Knee extensor	N	N	N	N	N	N	N	N
Ankle dorsiflexor	T	T	F-	P+	F-	P+	F+	F
Long toe extensor	T	T	P+	P+	P+	P+	F-	F-
Ankle plantaflexor	T	T	P+	P+	F-	F-	G	G



Figure 1. Pre-operative plain radiography (arrow; a small segment of limbus vertebra), Post-operative plain radiography, Pre-operative T2-weighted magnetic resonance image.

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Rehabilitation of Cervical Spinal Cord Injury by Os Odontoideum in a Patient with Cerebral Palsy

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Introduction

Os odontoideum (OO) is an independent ossicle separated from the odontoid process and its etiology remains controversial. There are few reports of cervical spinal cord injury by OO in a patient with cerebral palsy and is no consensus on rehabilitation. We provided intensive rehabilitation therapy for a cervical spinal cord injury patient by OO with an athetoid dystonic cerebral palsy and gained neurological and functional recovery after four weeks of treatment.

Case presentation

History : A 32-year-old man with an athetoid dystonic cerebral palsy presented to the hospital with a 3-month history of neuropathic pain, bilateral weakness on upper and lower limbs and functional loss. He had been independent in activities of daily living (ADL) and had been able to walk in a crouch gait with intact cognitive function. Cervical spine dynamic x-ray revealed atlantoaxial instability (Figure 1A). Cervical spine 3D CT and MRI showed compressive myelopathy on C1-2 level with OO (Figure 1B, C). The patient underwent posterior atlantoaxial fusion(Figure 2) and 8 days later, was referred to the department of physical medicine & rehabilitation (PMR). **Initial Examination :** Neurologic examination revealed tetraplegia affecting the most on left upper limb (right upper limb grade 2-3, left upper grade 1-2, both lower grade 2-3 on MRC grade). Hypesthesia was shown below C2/C3 dermatome and hypoalgesia was shown below C4/C4 dermatome. (ASIA impairment scale D) Modified Ashworth scale (MAS) of 1-1+ was checked with ankle clonus. Bulbocavernosus reflex, perianal, and deep anal sensation were preserved. Berg balance scale (BBS) scored 2 and Spinal Cord Independence Measure III (SCIM III) scored 25. Jebsen-Taylor hand function test (JHFT) was uncheckable due to poor trunk control ability and impaired fine motor skills. He suffered from severe orthostatic hypotension symptoms. **Comprehensive Rehabilitation Program :** He had one hour of physical therapy and occupational therapy at gym daily including tilt-table training, sitting balance training, standing balance training, gait training, gross and fine motor training for upper limbs, and basic ADL training. He also practiced sitting, ADL, and bilateral hand training in his patient room after training session. **Post-Rehabilitation and Treatment Outcomes :** After four weeks, he was discharged from hospital with improvement. At discharge, MRC grades were 2-3 on upper limbs and 3-4 on lower limbs. He could stand alone more than 2 minutes and ambulate about 20 meters with maximal assist. SCIM III

scored 43 and BBS scored 26. It was still uncheckable in JHFT with left hand, however, he could finish the task with right hand without time limit.

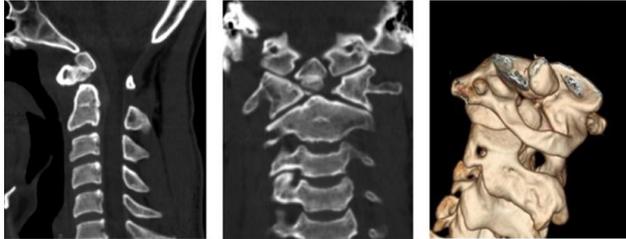
Conclusion

We report a case of cervical cord injury due to OO in a patient with athetoid dystonic cerebral palsy. Prompt and adequate intervention with well-designed rehabilitation program may lessen disabilities and Result in good prognosis.

A. Cervical Spine Radiography



B. Cervical Spine CT



C. Cervical Spine MRI

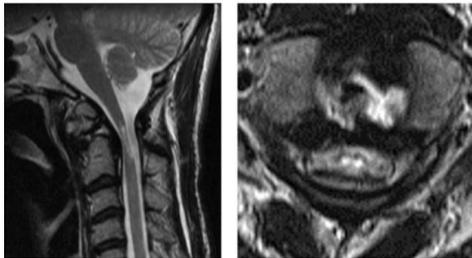


Figure 1. Cervical spine radiographs (A) and cervical spine CT (B) images showing an os odontoideum. Flexion and Extension radiographs (A) demonstrating an C1-C2 instability (Red circle). Cervical spine MRI (C) images showing an unstable C1-C2 region and spinal cord compression at C1-C2 level.

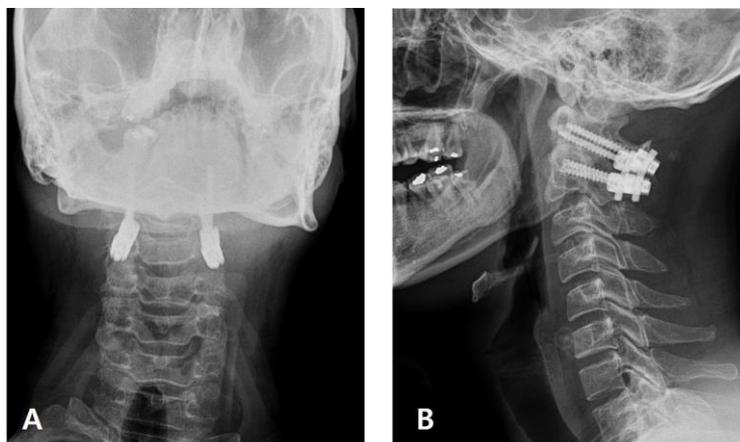


Figure 2. Cervical spine radiography images at 6 weeks postoperatively. The patient underwent posterior fusion on C1 and C2 vertebrae.

Acute Spinal Subdural Hematoma after Long-needle Acupuncture: A Case report

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Introduction

Acupuncture is a very popular treatment modality for patients with musculoskeletal disorders. Regardless of the efficacy of acupuncture, associated complications remained as an issue of debate. Spinal subdural hematoma (SSDH) is a very rare entity, and mostly it is associated with coagulation abnormalities. SSDH may also occur after trauma and iatrogenic procedures including spinal anesthesia. In this report, we present an atypical case of SSDH after long-needle acupuncture which is a rare iatrogenic complication.

Case report

A 46-year-old man came to the emergency room with paresthesia in the bilateral upper and lower extremities. We were informed that five days before visiting emergency room he had undergone a session of long-needle acupuncture in the posterior cervical region to treat chronic cervical pain. Exact acupuncture procedure was unknown, but the patient described that tens of needles were inserted in bilateral paracervical area and the depth of needle insertion was unclear. Right after the acupuncture, he had tingling sense and pain in the right arm and symptom was getting worse to spread over entire body. At the time of admission to neurosurgery department, neurological examination revealed weakness of the right upper limb as Medical Research Council grade 4, accompanied by the impairment of light and pinprick sensation in the bilateral upper and lower extremities. The last neurologically intact level was C4 bilaterally. The control and sensation of the urinary sphincter were intact but he complained of urinary dysfunction. A whole-spine magnetic resonance imaging (MRI) scan (Fig 1) revealed the presence of SSDH extending from C5 to the coccyx level, which was compressing subtly and displacing the posterolateral aspect of the cervical spinal cord to the left side of the spinal canal. A corticosteroid therapy was immediately administered intravenously. The severe symptom improved gradually, however, tingling sense, clumsy hand, and urinary hesitancy were remained. Ten days after the admission, a follow-up whole spine MRI was performed and revealed a reduction of SSDH. The patient was transferred to the department of rehabilitation medicine. He was undergone stair gait training, hand fine motor training, and physical modalities for pain control. Medications for pain relief and neurogenic bladder treatment were prescribed. The patient was discharged after one month of hospitalization. By the three months of follow-up, he returned to his normal activities and a whole spine MRI scan showed negative findings.

Conclusion

The acupuncture, if not correctly practiced, may be harmful to the cervical structures, which can cause SSDH as a major complication. Although SSDH is a very rare disease, it can lead to serious consequences Resulting from injuries to the spinal cord and nerve roots. It is essential to perform cervical MRI when a patient does not show an improvement in the neurologic deficit after acupuncture.



Fig 1. A whole-spine magnetic resonance imaging scan revealed the presence of spinal subdural hematoma extending from C5 to the coccyx level.

Spinal Cord infarction after Cervical Transforaminal Epidural Steroid Injection : A Case report

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Introduction

Cervical transforaminal epidural steroid injection (TFESI) is commonly performed to provide symptomatic relief of pain in radiculopathy. But there are some risks of cord infarction exist. Intra-arterial injection of particulate steroid suspension or direct needle injury can lead to spinal artery embolism or thrombosis. Also there is a possibility of vascular spasm. To our knowledge, this is the first reported case of spinal cord infarction that occurred after TFESI with non-particulate steroid in Korea.

Case report

A 47-year-old female patient with 6-month history of right upper arm pain visited local pain clinic. She was diagnosed as cervical radiculopathy (C7) by electrodiagnostic study. The patient underwent C7 TFESI. Injected materials were dexamethasone and mepivacaine. Right after the intervention, she felt weakness and decreased sensation in whole extremities and body and mild respiratory difficulty. Cervical spine magnetic resonance image (MRI) was checked and it showed no signal change in spinal cord (Fig. 1). After 10 hours from the onset of the symptom, the weakness of lower extremities and respiratory difficulty disappeared. But the patient continued to complain of weakness in upper extremities and decreased sensation on both arms and hands. On physical examination, she had decreased sensation from C4 to T2 dermatome in light touch and pin-prick test. Proprioception and vibration were intact. The motor grades of upper extremities were grade 1. And whole muscles in lower extremities were normal. She could contract anus voluntarily with intact power. Thus, her condition met the criteria for spinal cord injury ASIA D. Cervical and thoracic spine MRI was checked again for further evaluation after 5 days of symptom onset. High signal intensity was noted from C2 to T1 level in T2-weighted image (Fig. 2). Diffusion-weighted image and apparent diffusion coefficient image showed long extension of spinal cord infarction from C2 to T1 level (Fig. 2). When the patient was referred to rehabilitation unit, activity of daily living was impossible with upper extremities. She could stand and walk on even surface under supervision. But she couldn't change the position from lying to sitting by herself, and moderate assist was needed. Bladder and bowel function was normal. She was treated with ROM exercise, therapeutic electrical stimulation, occupational therapy for daily activities, matt exercises for body balance. And she kept taking aspirin and atorvastatin for the prevention of re-infarction. After six months, her condition improved. The motor grades of both elbow flexor, wrist extensor and elbow extensor improved to Grade 3. But both finger flexors, finger abductors were still grade 1. She needed moderate assistance

for the activities such as washing, toileting, bathing and clothing due to poor strength of distal parts of upper extremities.

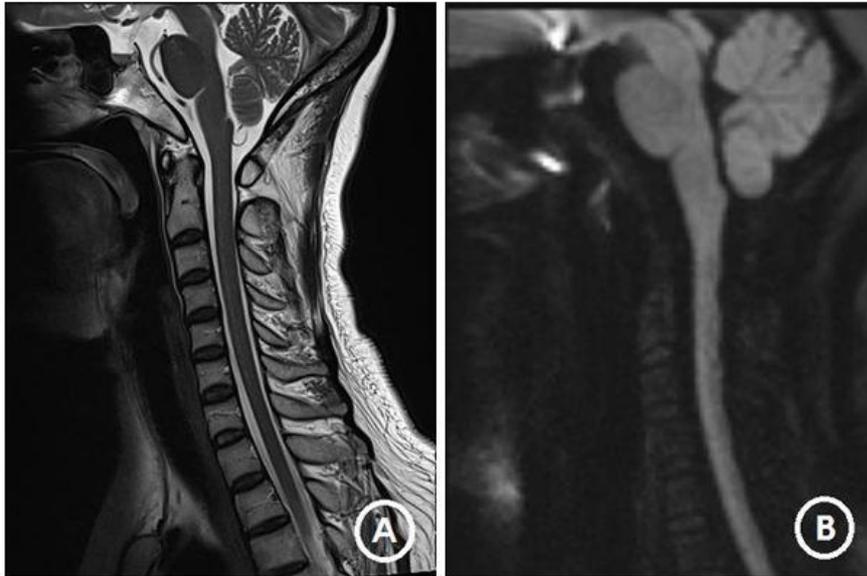


Fig. 1. Cervical MRI was taken about an hour after the symptom onset. (A) T2-weighted image and (B) Diffusion-weighted image showed no signal change throughout the cervical spinal cord.

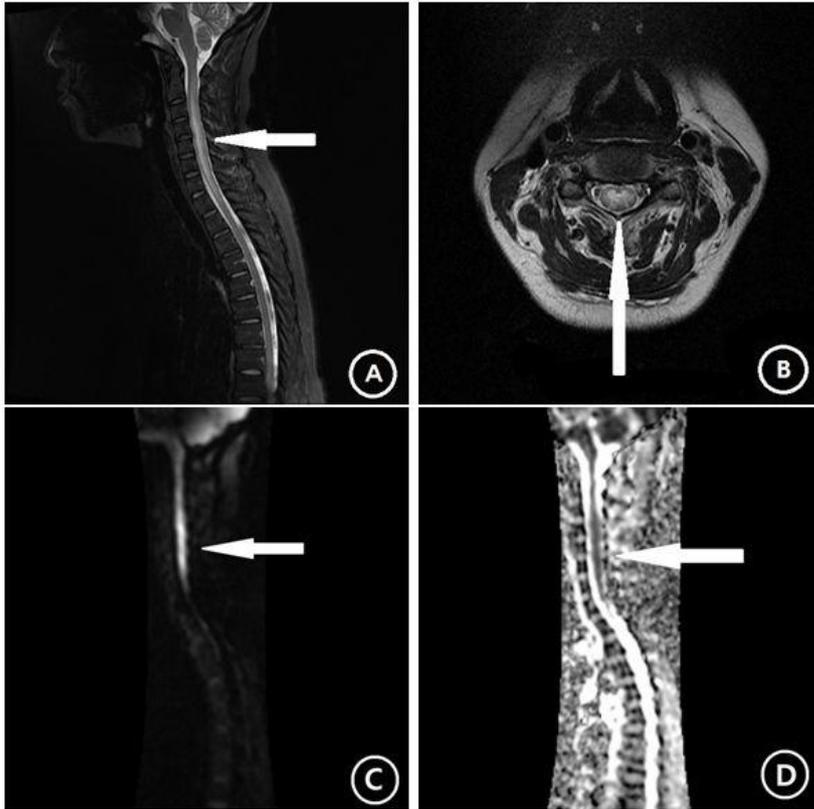


Fig. 2. Cervical MRI was taken 5 days after the symptom onset. There are spinal cord lesions in cervical and upper thoracic level (Arrows). (A) In sagittal view, T2-weighted image showed high signal intensity from C2 to T1 level. (B) In axial view, T2-weighted image showed high signal intensity in bilateral areas of spinal cord on C4 level. (C) Diffusion-weighted image and (D) apparent diffusion coefficient image showed long extension of spinal cord infarction from C2 to T1 level.

A case of postprandial painful abdominal spasm in SCI patient with severe thoracic lordoscoliosis

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INTRODUCTION

It is common for spinal cord injury (SCI) in early childhood to progress into severe thoracolumbar kypholordosis or scoliosis with growth spurt. This affects not only the cardiopulmonary function or the gastrointestinal function, but also various pains. The case we are reporting is about postprandial spastic pain of the abdomen in a SCI patient with severe thoracic lordoscoliosis (Fig 1.), related diagnostic processes, and treatments for the problems.

CASE REPORT

A 39-year-old female is a patient with T4 AIS A since thoracic spine fracture due to a fall from seven meters height at nine years old. Patient complains of the postprandial epigastric discomfort with subsequent spasm of abdominal muscles. The spasm and pain of the abdomen extend to her back and posterior neck and it persists postprandially over 2 or 3 hours. She had been taken many medications for the pain and spasticity, and the polypharmacy led unexpected constipation. The patient has been spending all days in prone position for over 20 years with no wheelchair use, Resulting in severe thoracic lordosis and right scoliosis. The lying posture Results a vicious circle including poor oral intake, weight loss, and postprandial abdominal painful spasm. However, cardiopulmonary problems associated with spine deformity are not significant in the parameters. The urodynamic study showed low compliance and severely decreased cystometric vesical volume, but no detrusor overactivity. There was a symptomatic autonomic hyperreflexia with bladder filling at small volume. Symptoms of autonomic dysreflexia disappeared with continuous drainage of the bladder using indwelling Foley catheter. Studies for evaluation of the problem Resulting in postprandial painful spasm of the abdomen were focused to rule out any intraabdominal or intrapelvic pathology. Abdominal ultrasound, computed tomography scan revealed no abnormality relevant to the problems. Upper gastrointestinal (GI) barium test confirmed the stomach obstruction due to compression by the lordotic thoracic spines (Fig 2.). With the suspected diagnosis, most of the medications were discontinued except baclofen 20 mg three times a day. The patient was recommended taking baclofen 30 minutes prior to the meals and sitting or head-up supine lying as her tolerance, with significant improvement of the symptoms.



Fig. 1. Thoracolumbar spine x-ray

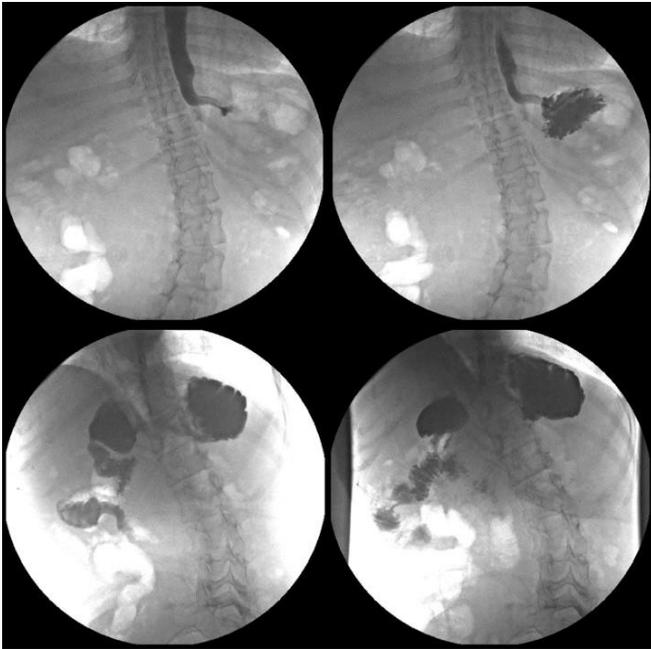


Fig. 2. Upper GI barium study

Neglected old fracture on right distal tibiofibular after robot walking rehabilitation exercise

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The past history and chief complaints

A 56 year old male, had spinal cord injury (ASIA A), S(T9,T10) M(T9,T10) due to T11-T12 vertebrae fracture after the car accident which took place at 2015. He was admitted for the evaluation about swollen right lower leg for 2 months. There were heatness, color change and swelling. Recently he had been to the other hospital for the further comprehensive rehabilitation therapy including robot assisted walking exercise.

Evaluation and final diagnosis

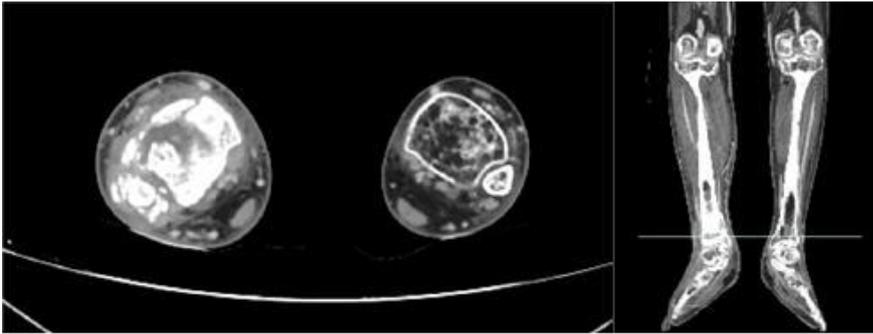
To rule out deep vein thrombosis, the evaluation plan was to do routine laboratory check up including D-dimer and imaging study such as CT venography on lower extremity. The lab Results were increased D-dimer $4.1 \mu\text{g}/\text{mL}$ and mild elevation in ALP level as 157U/L. On CT venography revealed there was no DVT, but a distal tibia fracture and bony callus formation accompanied by adjacent soft tissue swelling on right foot. The unexpected Results seem evident for the cause of the patient's leg swelling, heatness, color change and no therapeutic effect of pneumatic compression.

Management

Consultation with Orthopedic surgery department was done. Distal tibiofibular fracture with angulation needs a surgical management but there were a large amount of callus formation which interfered the reduction trial and operation should need more complicated procedures including osteotomy and osteosynthesis. The patient chose to have cast apply and continue conservative treatment as there would be no difference with his paraplegic state after the operation.

Discussion

In people with SCI, the diagnosis of a fracture in an anesthetic limb can be a challenge. Most patients complain of a recent onset of unilateral leg swelling, not feeling well, and having a low grade fever. When examining a swollen limb with SCI patients, we must rule out a bone fracture as well as lymphoedema and DVT as significant osteoporosis develops in the lower limbs during the first few months after SCI, which makes the bones brittle and prone to fractures and there are increasing fracture incidence for men with complete paraplegia with time after SCI.



CT venography revealed a neglected fracture on Rt. distal tibiofibular bone



Ankle joint x-ray

Superior mesenteric artery syndrome in an adolescent tetraplegic patient: a Case report

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Introduction

Superior mesenteric artery (SMA) syndrome is a rare cause of duodenal obstruction caused by intermittent or sustained compression of the duodenum between the aorta and SMA. Prevalence is rare, ranging from 0.1 to 0.3%. Clinically, it can occur in situations that cause hypermetabolism such as multiple trauma and burns. We report a case of an adolescent patient with acute SMA syndrome after traumatic cervical spine injury.

Case report

The 13th of May, 2018, a 14-year-old girl was diagnosed with C5, 6 dislocation fracture due to a car accident. She was C4 ASIA Impairment Scale grade A. On the day of admission, neurosurgeons underwent C4-7 posterior interbody fusion. On the first day after surgery, rehabilitation was initiated under the direction of the Rehabilitation Department. After 9 days of operation, we changed mechanical ventilator to home ventilator and initiated ventilator weaning. After admission, the patient was feeding through the nasogastric tube. However, from the 10th day after admission, she complained abdominal pain and abdominal distension after feeding through the nasogastric tube, and significant dilatation was observed on the abdominal x-ray performed (Fig. 1.). When abdominal pain was present, drainage was performed through the nasogastric tube, and a large amount of feeding or even bile stained fluid was drained. Abdominal computed tomography showed a transitional zone at the junction of the second portion of the duodenum, which confirmed the possibility of SMA syndrome (Fig. 2.). Therefore, the patient increased the dietary dose by taking left decubitus position before and during meals. In addition to increasing the dietary dose through the nasogastric tube, parenteral nutrition (PN) was also performed. After one week of PN and nasogastric tube, she regained her weight. Even drainage of stained fluid with nasogastric tube, abdominal pain, and abdominal distension were improved. In Conclusion, the symptoms of SMA syndrome were improved by conservative Method without surgical intervention and general hospitalization were possible soon.

Discussion

In the initial spinal shock, loss of reflexes, decreased bowel motility, and ileus are common. In addition, in the acute phase of multiple trauma, the basal metabolic rate increases and weight is easily reduced. It is disadvantageous to the bowel movement because it does not maintain proper sitting posture when feeding. In the intensive care unit, proper communication is often difficult due to sedation and endotracheal intubation. If the patient is young and slender, the symptoms of abdominal distension

and vomiting should be carefully observed and evaluated to consider the possibility of SMA syndrome.

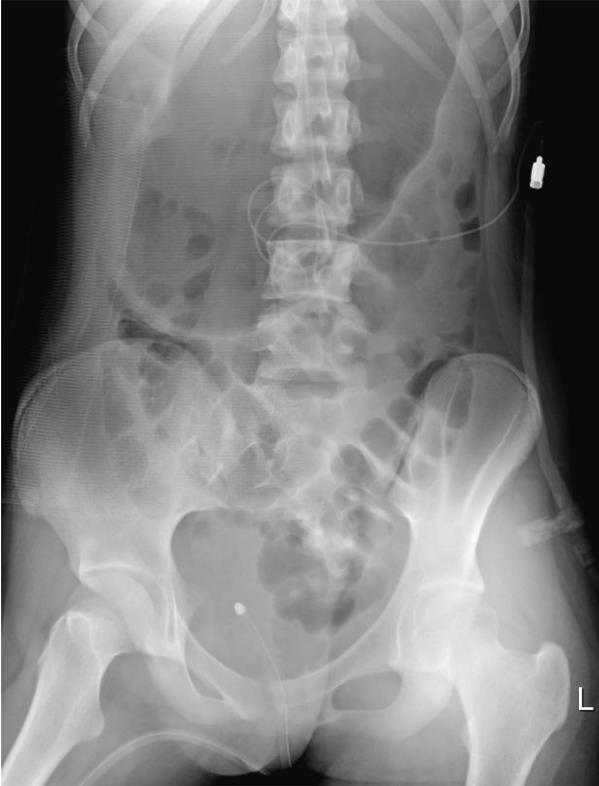


fig1. Abdominal X-ray demonstrating markedly distended stomach

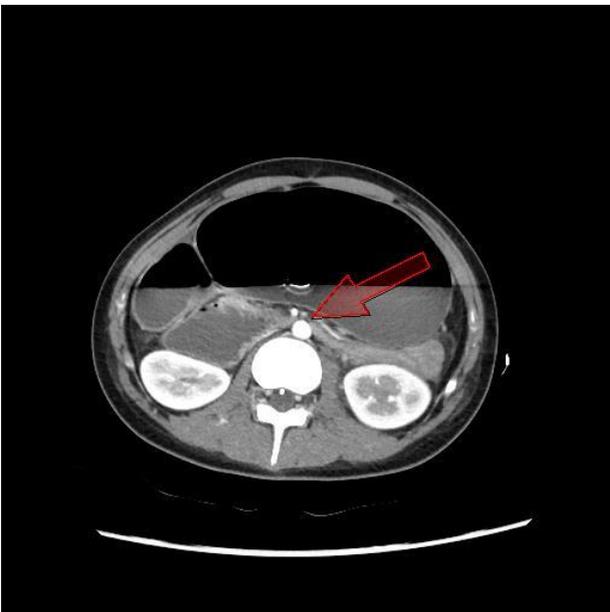


fig2. Contrast CT of the abdomen showing the distance between aorta and SMA (red arrow). Also seen are a dilated stomach and duodenum.

P 2-143

Usefulness of Exoskeleton Rehabilitation Robot in Spinal Cord Injury : Pilot Study

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Usefulness of Exoskeleton Rehabilitation Robot in Spinal Cord Injury: A Pilot Study

Objective

Nowadays exoskeleton rehabilitation robot used in spinal cord injury (SCI) patients, but few study has yet reported the efficacy of exoskeleton rehabilitation robot. The aim of this pilot study is to evaluate the efficacy of exoskeleton rehabilitation robot in SCI patients and to plan the future prospective study.

Patient and Method

Six patients who were diagnosed with SCI did gait training, balance training, direction change training with exoskeleton rehabilitation Robot (ExoAtlet I) between November, 2017 and March, 2018. Patients perform 50 minutes per day Short Form McGill Pain Questionnaire, Beck's depression scale (BDI), Constipation Scoring system were compared between pre- and post-treatment.

Result

Of the 6 patients with SCI, 4 were men and 2 were women. 3 were Asia impairment scale (AIS) A and 3 were AIS C. Mean treatment time is 1641 ± 633 minutes (table 1). Although every mean value of them were improved after treatment, it showed statistically no differences (table 2). No adverse events such as fall down, fracture or weakness were reported after treatment but in one patient pressure ulcer occurred on heel.

Conclusion

This study with 4-month follow up showed no statistically difference. But post treatment showed improvement individually. Further studies are needed to confirm the effect in a larger population and to verify the usefulness of exoskeleton rehabilitation robot.

Table 1 : Characteristics of patients

Gender	Age	Diagnosis	Treatment time (minutes)	Onset
M	45	Tetraplegia d/t C6/7(s), C8/6(m) SCI AIS C	2600	2001.5
M	50	Paraplegia d/t T10(s) SCI AIS A	850	2001.11
M	57	Paraplegia d/t T8/T7(s) SCI AIS C	1550	2009
M	38	Paraplegia d/t T10 SCI AIS A	1600	2017.7
F	31	Paraplegia d/t T3(s) SCI AIS C	2100	2010.5
F	35	Paraplegia d/t T11 SCI AIS A	1150	2012.10

Table 2. Changes in outcome measurements

	Pre-treatment	Post-treatment	<i>P</i> value [†]
BDI	10.66	6.66	0.116
McGill	14.6	13.4	0.344
Constipation	12.83	9.75	0.173

[†] Wilcoxon matched-pair signed rank test was conducted for between-group comparison ($p < .05$).

Rt. leg weakness and Lt. abdominal hypesthesia after injury during push-up diagnosed as MS

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Eulji University Hospital and Eulji University School of Medicine, Department of Rehabilitation Medicine¹

Introduction

Multiple sclerosis (MS) is a chronic inflammatory, neuromuscular degenerative disorder of the central nervous system. It is the most common cause of non-traumatic disability in young adults. MS remains a diagnosis of exclusion. It is important to distinguish and exclude other demyelinating disorders, including neuromyelitis optica, acute transverse myelitis, and acute disseminated encephalomyelitis. MS can present in numerous ways and affects several functional and cognitive systems. Common presenting symptoms in MS include optic neuritis, sensory loss, paresthesias, motor dysfunction, ataxia and weakness. These symptoms may be misconstrued as fatigue caused by other nonmedical factors or other non-neurologic issues. With these characteristics, patients with traumatic events may have difficulty diagnosing MS. Here we report a case of MS in a patient with a traumatic event.

Case report

The patient was a 29-year-old man who had no significant past medical history. On May 28, 2018, he underwent a push up. At that time, someone else ran over the patient with a joke. After the event, right lower limb weakness and foot numbness, sensory abnormalities around right testis and anus occurred. The patient received acupuncture treatment, however, pain developed from the left chest to the central chest, upper back, and posterior upper arm. On June 6, 2018, when he moved leg, abnormal sensation of upper cheek was noted. Therefore, he visited local radiology clinic and took contrast-enhanced cervical spine magnetic resonance imaging (MRI). On the MRI image, abnormal signal intensity was found in T1 level. The patient visited Department of Rehabilitation Medicine, and after detailed history taking and neurologic examination, acute transverse myelitis or multiple sclerosis was suspected. The patient was referred to and admitted to Department of Neurology. On Brain MRI, few transverse-directional patchy high flair signal intensity and heterogeneously enhancing lesions were found. There was no specific finding on the evoked potentials study. Blood tests were performed to differentiate other diseases and no specific findings were observed on the tests. After the evaluation, the patient was diagnosed as MS and discharged with medication.

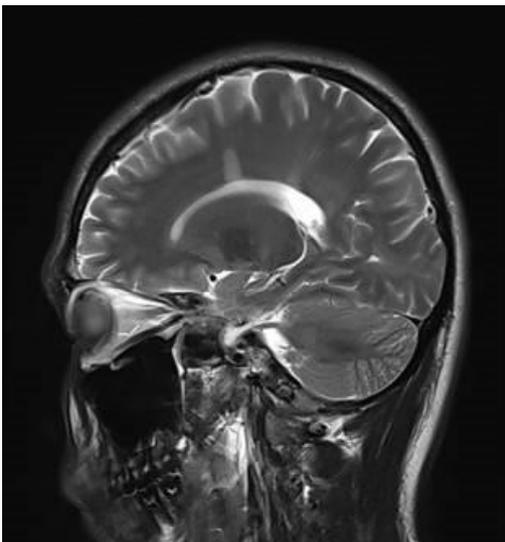
Conclusion

The incidence of MS is high in white population, and the incidence in Asia is relatively low. Most patients are female except for progressive recurrent MS. However, the peak age of diagnosis is believed to be 20 to 40 years. Severe optic neuritis and transverse

myelitis are common in Asia populations from early onset, and severe inflammation of cerebrospinal fluid is seen. This patient had suspicion of cervical spinal cord injury due to trauma before the onset of symptoms, but he was suspected of multiple sclerosis due to detailed history taking and MRI findings. Even with a recent traumatic event, patients with atypical symptoms like this patient should be evaluated thoroughly to exclude MS.



Cervical spine MRI showed heterogeneously enhancing lesion in the cord of T1 level.



Brain MRI showed a few transverse-directional patchy high FLAIR signal intensity.

Rehabilitation of Neuromyelitis Optica : a Case report

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Jeju National University, Department of Rehabilitation Medicine¹

Neuromyelitis optica(NMO, Devic syndrome) is a central nervous system demyelinating disease, classified by myelitis and optic neuritis. This clinical manifestation could be mischaracterized as multiple sclerosis(MS). Unlike MS, NMO has a severe clinical course and more acute progression disorder. Although several studies have demonstrated the effects of rehabilitation programs on MS, few cases that on NMO. In this article, we present two cases presenting with a rehabilitation program adapted for two NMO patients.

CASE 1

A 65-year-old woman confirmed NMO was admitted to our department for chronic onset left hand weakness and dystonia for one year ago. Neurological assessment according to the international standards for neurological classification of SCI(ISNCSCI) revealed C4 incomplete ASIA-D. Her grip & pinch power dynamometer was 11.8/5.4 kg, box & block test was 21/8 and nine-hole test was 31.97/64.33 seconds. Spinal Cord Independence Measure(SCIM) was estimated seventy-nine. We planned for focusing on left hand fine motor training through occupational therapy by strengthening and stretching muscle using E-link(Biometrics Ltd, EP21 System, H500) during one month. After rehabilitation, manual muscle testing was improved to grade 2/5 to 3+/5 in left upper limb specifically. Also, SCIM was improved seventy-nine to eighty-eight. Functional gains were made in bathing, upper extremity dressing and using chopsticks independently. Her grip & pinch power dynamometer was improved 15/7 kg, box & block test was 21/12, and nine-hole test was 28.27/42.21 seconds.

CASE 2

A 41-year-old woman diagnosed NMO in 2008 was admitted to our neurology department for developing weakness. Neurological work-up confirmed that she relapsed NMO. After caring for NMO, she transferred our rehabilitation department. At the time of transfer, neurological assessment according to the ISNCSCI, revealed C1 incomplete ASIA-C, and SCIM was estimated forty-two. She was able to walk a short distance using a rolling walker, and berg balance scale(BBS) revealed twenty-two. Her physical performance test estimated 6-minute walk test (6MWT) was 110m, timed up and go (TUG) test was 31.7 sec. She received strengthening lower extremity and gait training using a lower-body positive pressure (LBPP) treadmill (AlterG Anti-Gravity Treadmill). After one month, her manual muscle testing improved to grades 1-2/5 to 3-4/5 generally, and ASIA scale improved C5 incomplete ASIA-D. SCIM was improved to by allowing walking independently and increasing lower-extremity dressing and toileting ability. BBS was improved to fifty, 6MWT was to 260m, TUG test was to 8.6 sec.

Conclusions

We concluded that the intensive rehabilitation therapy Resulted in neurological and functional gains in patients with NMO. Therefore, further studies are needed to validate rehabilitation protocols and effects.

A Case report of spinal cord injury without radiologic abnormality after lumbar neuroplasty

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Ulsan University Hospital, Department of Rehabilitation Medicine¹

Spinal cord injury without radiologic abnormality (SCIWORA) is the spinal cord injury characterized by clinical findings of spinal cord dysfunction with apparently normal x-ray images. SCIWORA is rare in adults, and typical cause of adult SCIWORA is trauma like falls, sports injury and vehicle collisions. However, we reported a case of SCIWORA following neuroplasty that is not associated with trauma. A 28-year-old man presented with L5-S1 lumbar disc extrusion, and discectomy was performed but there was no improvement in symptoms. Then neuroplasty was also performed because of additional radiating pain of both lower limbs. However, immediately after neuroplasty, paraplegia and sensory impairment was occurred. Initially the bilateral lower motor was a trace but voluntary anal contraction was preserved. The last intact level of sensory corresponded to T7. There was no specific finding on the lumbar and thoracic magnetic resonance imaging (MRI) including diffusion weighted images. Nerve conduction studies and evoked potential studies also showed no specific abnormalities. In the needle electromyography, no abnormal spontaneous activity was observed. In addition, cervical and brain MRI, and cerebrospinal fluid analysis was done, but there was no specific abnormalities. Symptoms persist without improvement even after 4 months of onset. It is impressive that young men without degenerative change had SCIWORA regardless of trauma. Further studies on the mechanism of SCIWORA are warranted.



Fig 1. Lumbar saggital image of T2 weighted magnetic resonance image of the patient



Fig 1. cervicothoracic saggital image of T2 weighted magnetic resonance image of the patient

Detrusor-sphincter dyssynergia in lumbosacral radiculopathy : A Case report

Sung Woon Baik^{1*}, Gi-Wook Kim^{1,2}, Yu Hui Won^{1,2}, Sung-Hee Park^{1,2}, Myoung-Hwan Ko^{1,2}, Jeong-Hwan Seo^{1,2†}

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Introduction

The bladder function is controlled by central and peripheral nervous systems by manage to storage and voiding urine. The pathophysiology of detrusor-sphincter dyssynergia in neurogenic bladder is represented by disruption of spinobulbospinal tract between the pontine micturition center(PMC) and Onuf's nucleus. And, Injury to either the sacral cord or cauda equina Results in detrusor hypoactivity/areflexia with sphincter weakness.

Case

A 59 year-old female presented to our department with the symptoms of voiding difficulty and perianal numbness. Spinal magnetic resonance image showed lumbar disc herniation at L4/5/S1 with thecal sac compression. Also, there were neural foramen stenosis in the left at L4/5, and in the right at L5/S1. Pudendal nerve somatosensory evoked potential study stimulating clitoris and recording from scalp showed absent evoked potentials in right side and acceptable range of P1 and N1 latency in left side. BCRL study stimulating clitoris and recording from bulbocavernous muscles showed prolonged onset latency in right side and acceptable values in left side. Urodynamic study showed hyposensitive, normotonic, hypoactive, no-reflexic type bladder with detrusor-sphincter dyssynergia.

Conclusion

We report a patient who had an unusual Result of urodynamic study which presented detrusor-sphincter dyssynergia with areflxic type bladder in lumbosacral radiculopathy. Despite the urodynamic study shows detrusor-sphincter dyssynergia which suggests spinobulbospinal tract impairment, this patient has no evidence of central cord lesion in neither electrodiagnostic study nor spinal magnetic resonance image. Thus, we should consider secondary reason like psychogenic cause or pain during urodynamic study to provide more precise diagnosis and treatment plan for neurogenic bladder.

POSTER SESSION 3

게시 및 질의응답 일시 : 2018 년 10 월 27 일(토) 08:30-12:30/11:00-11:30

장소 : 3F 그랜드볼룸

P 3-1

Alterations in Brain Network Topology between Supra- and Infra-tentorial Stroke Patients

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Samsung Medical Center, Sungkyunkwan University School of Medicine, Department of Physical and Rehabilitation Medicine, Center for Prevention and Rehabilitation, Heart Vascular Stroke Institute¹, Kyungpook National University Medical Center, Department of Physical and Rehabilitation Medicine², Sungkyunkwan University, Department of Health Sciences and Technology, Department of Medical Device Management & Research, Department of Digital Health, SAIHST³, Korea Advanced Institute of Science and Technology, School of Electrical Engineering⁴, Pusan National University Yangsan Hospital, Department of Rehabilitation Medicine, Pusan National University School of Medicine, Research Institute for Convergence of Biomedical Science and Technology⁵

Objective

In recent stroke studies, connectivity-based approaches have been widely used to investigate recovery-related indicators of network structure. However, most of previous studies were performed in heterogenous stroke patients with different types and lesion locations. In addition, there is a lack of research on infratentorial stroke (ITS) and very few comparative studies between supratentorial stroke (STS) and ITS. We investigated the differences in alteration of motor networks between STS and ITS in ischemic stroke patients.

Materials and Methods

Forty subcortical ischemic stroke patients were recruited within two weeks after their stroke onset. There was no significant differences in demographic and clinical characteristics between STS group (12 males and 9 females, age 57.8±11.2 years, initial motor function FMA 44.5±19.7) and ITS group (13 males and 6 females, age 59.7±12.0 years, initial motor function FMA 44.8±22.1). All patients underwent resting-state functional MRI scans twice (2 weeks and 3 months after stroke onset). Healthy subjects participated as an age-matched healthy control group (14 males and 10 females, age 58.4±10.4 years). To investigate the altered connectivity during recovery and compare between groups, various Methods (interhemispheric connectivity, network symmetry, and graph theoretical analysis related to global network characteristics) that were used in existing studies were used.

Results

Stroke onset significantly disrupted interhemispheric balance in the STS group only. Contrary to the STS group, drastic disruptions of these measures did not occur in the ITS group. During recovery, measures related to interhemispheric balance were significantly changed in the ITS group, whereas measures related to global network reorganization were significantly changed in the STS group (Figure 1). The altered network measures in each group were correlated with their motor functions. Cortico-cerebellar connectivity interacted with interhemispheric cortical connectivity only in the ITS group (Figure 2).

Conclusions

These Results revealed that changes in the motor network and recovery-related network measures differ according to lesion location. Recovery after ITS occurred through restoration of interhemispheric balance contributed by the cortico-cerebellar connectivity. In contrast, recovery after STS occurred through global network reorganization. These findings may indicate that characteristic motor network dynamics during recovery phase of stroke Result from different interactions between cortico-cortical and cortico-cerebellar connectivity dependent to lesion location. These may also give an implication for establishing neurorehabilitation strategies in terms of target site determination by non-invasive brain stimulation.

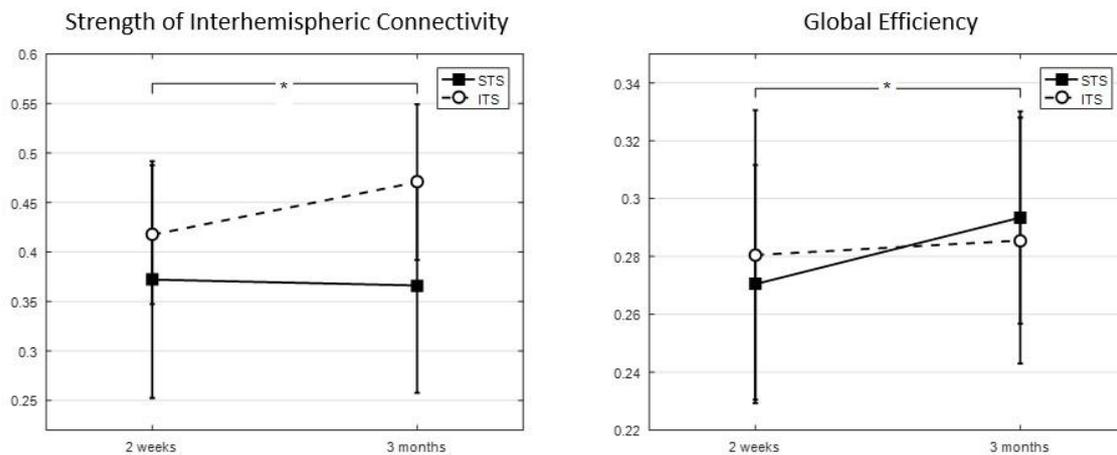


Figure 1. Changes in interhemispheric connectivity and global efficiency during recovery. Interhemispheric connectivity increased in the ITS group only. Global efficiency decreased significantly during recovery in the STS group only (* $p < 0.05$).

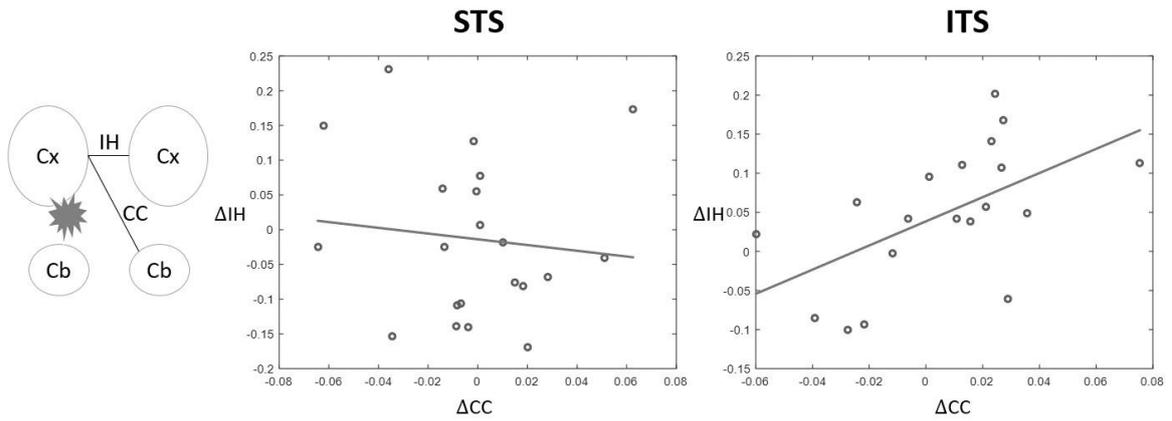


Figure 2. Relationship between interhemispheric cortical connectivity and cortico-cerebellar connectivity. A change of interhemispheric cortical connectivity and a change of cortico-cerebellar connectivity in the STS and the ITS groups. A change of interhemispheric connectivity was correlated with a change of affected cortico-cerebellar connectivity in the ITS group only ($p=0.0127$). Cx, cerebral cortex; Cb, cerebellum; IH, interhemispheric connectivity; $\Delta IH = IH$ (three months) – IH (two weeks); CC, cortico-cerebellar connectivity; $\Delta CC = CC$ (three months) – CC (two weeks).

P 3-2

Relationship between corpus callosum injury and impaired consciousness in hypoxic-brain injury

Sung Ho Jang^{1†}, You Sung Seo^{1†}, Jong Bum Kim^{1*†}

Yeungnam University Medical Center, Department of Rehabilitation Medicine¹

Objectives

We investigated the relationship between injury of the corpus callosum and impaired consciousness in patients with hypoxic-ischemic brain injury (HI-BI) by using diffusion tensor tractography (DTT).

Methods

We recruited 18 patients with HI-BI who showed impaired consciousness and 20 normal control subjects. The fractional anisotropy (FA) and fiber number (FN) values were estimated for the entire corpus callosum (CC) and for each of the five regions within the CC (regions I, II, III, IV, and V). Patients' scores on the Glasgow Coma Scale (GCS) and the Coma Recovery Scale-Revised (CRS-R) were also evaluated.

Results

The FA and FN values for the entire CC and for the five regions of the CC in the patient group were lower than those of the control group ($p < 0.05$). No correlations were detected between GCS or CRS-R scores and the FA or FN DTT parameters of the CC (entire CC and regions I, II, III, and IV) ($p > 0.05$), or between GCS scores and the FA value of region V ($p > 0.05$). However, there was a strong positive correlation between GCS score and the FN value of CC region V ($r = 0.723$, $p < 0.05$). In addition, there was a moderate positive correlation between CRS-R score and FA value ($r = 0.598$, $p < 0.05$) and a strong positive correlation between CRS-R score and FN value ($r = 0.734$, $p < 0.05$) in CC region V.

Conclusions

We detected a close relationship between injury of region V (splenium) of the CC and impaired consciousness in patients with HI-BI. Our Results suggest that an injured splenium of the CC could be an appropriate target for neurointervention or neurorehabilitation in patients with impaired consciousness following HI-BI.

Table 1. Demographic data of the patient and control groups.

	Patient group	Control group
Number (male:female)	18 (12:6)	20 (10:10)
Mean age (years)	45.12 ± 17.07	51.21 ± 10.23
GCS	9.22 ± 3.19	
CRS-R	14.88 ± 7.65	
Mean duration from HI-BI onset to DTI (months)	6.29 ± 5.39	

Values indicate mean ± standard deviation, HI-BI: hypoxic-ischemic brain injury, GCS: Glasgow Coma Scale, CRS-R: Coma Recovery Scale-Revised, DTI: diffusion tensor imaging.

Table 2. Comparison of diffusion tensor tractography parameters for the entire corpus callosum and for each of the five regions of the corpus callosum.

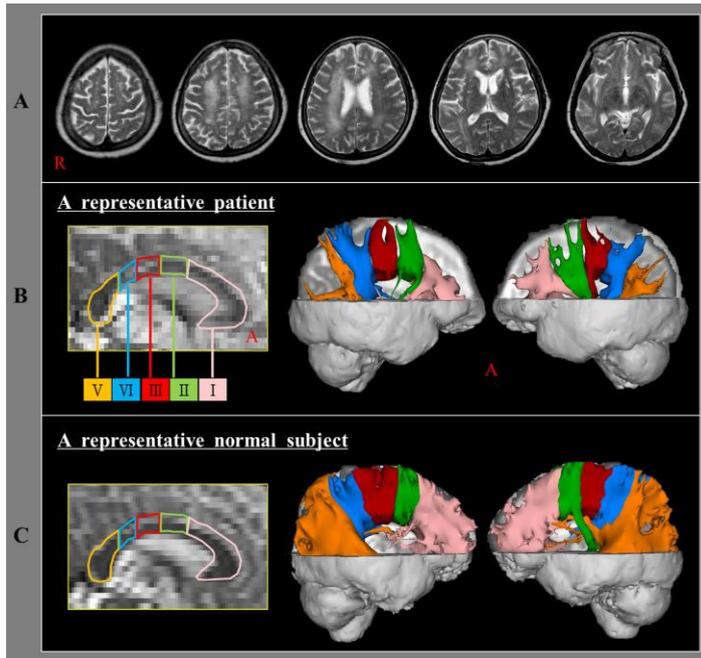
	DTT parameters	Patient group	Control group	<i>p</i> value
Entire CC	FA	0.30 ± 0.06	0.49 ± 0.02	0.01*
	FN	10985.67 ± 3310.88	12835.91 ± 1639.41	0.03*
R I	FA	0.28 ± 0.06	0.42 ± 0.02	0.01*
	FN	3280.88 ± 1178.27	6524.41 ± 927.16	0.01*
R II	FA	0.28 ± 0.06	0.43 ± 0.02	0.01*
	FN	1770.24 ± 818.00	2171.13 ± 1144.03	0.01*
R III	FA	0.29 ± 0.06	0.45 ± 0.02	0.01*
	FN	1736.65 ± 679.01	2763.31 ± 409.81	0.01*
R IV	FA	0.30 ± 0.08	0.45 ± 0.02	0.01*
	FN	2077.47 ± 892.32	3276.21 ± 760.69	0.01*
R V	FA	0.30 ± 0.08	0.50 ± 0.02	0.01*
	FN	3260.94 ± 1106.37	5042.95 ± 962.88	0.01*

DTT: diffusion tensor tractography, CC: corpus callosum, FA: fractional anisotropy, FN: fiber number,

R: region.

Values indicate mean ± standard deviation

*: indicates a significant difference between the patient and control groups, $p < 0.05$



(A) T2-weighted brain magnetic resonance images of a representative patient (45-year-old male) at one month after hypoxic-ischemic brain injury onset. (B, C) Results of diffusion tensor tractography (DTT) for the entire corpus callosum (CC) and each of the five regions of the CC (region I, pink; II, green; III, red; IV, sky blue; V, orange) of (B) the same patient and (C) a normal subject (49-year-old male). All five regions of the CC in both hemispheres of the patient show the presence of injury when compared to the Results for the normal subject.

P 3-3

Relationship between duration cardiac arrest and injury of the ARAS

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Yeungnam University Medical Center, Department of Rehabilitation Medicine¹

Objectives

We investigated the relationship between the duration of cardiopulmonary resuscitation (CPR) and the severity of injury of the ascending reticular activating system (ARAS) in patients with hypoxic-ischemic brain injury (HI-BI) after cardiac arrest by using diffusion tensor tractography (DTT).

Methods

Fifteen consecutive patients with HI-BI after cardiac arrest and 15 control subjects were recruited. Clinical status was evaluated by determining Glasgow coma scale (GCS), coma recovery scale-revised (CRS-R), and mini-mental state examination (MMSE) values. Three portions (lower dorsal, lower ventral, and upper portions) of the ARAS were reconstructed via DTT, and fractional anisotropy (FA) and tract volume (TV) values were determined.

Results

The FA and TV values for the three portions of the ARAS were significantly different between the patient and control groups ($p > 0.05$). CPR duration was significantly negatively correlated with GCS ($r = -0.629$, $p < 0.05$), moderately negatively correlated with CRS-R ($r = -0.597$, $p < 0.05$) and moderately negatively correlated with MMSE ($r = -0.526$, $p < 0.05$). In contrast, among the DTT parameters, only the TV value of the lower dorsal ARAS showed a moderately negative correlation with CPR duration ($r = -0.464$, $p < 0.05$).

Conclusions

We detected close relationships between CPR duration and injury severity in the lower dorsal ARAS in patients with HI-BI after cardiac arrest. Our Results suggest that DTT-based analysis of the ARAS could be useful in patients with HI-BI after cardiac arrest.

Table 1. Demographic characteristics of the patient and control groups.

	Patient group	Control group
Age	40.8 ± 15.1	44.4 ± 12.7
Sex (Male:Female)	9:6	8:7
Time	20.1 ± 13.8	
GCS	10.00 ± 5.07	
CRS-R	13.67 ± 9.59	
MMSE	8.27 ± 11.35	

Values are presented as numbers or as means ± standard deviation; GCS: Glasgow coma scale; CRS-R: coma recovery scale-revised; MMSE: mini-mental state examination.

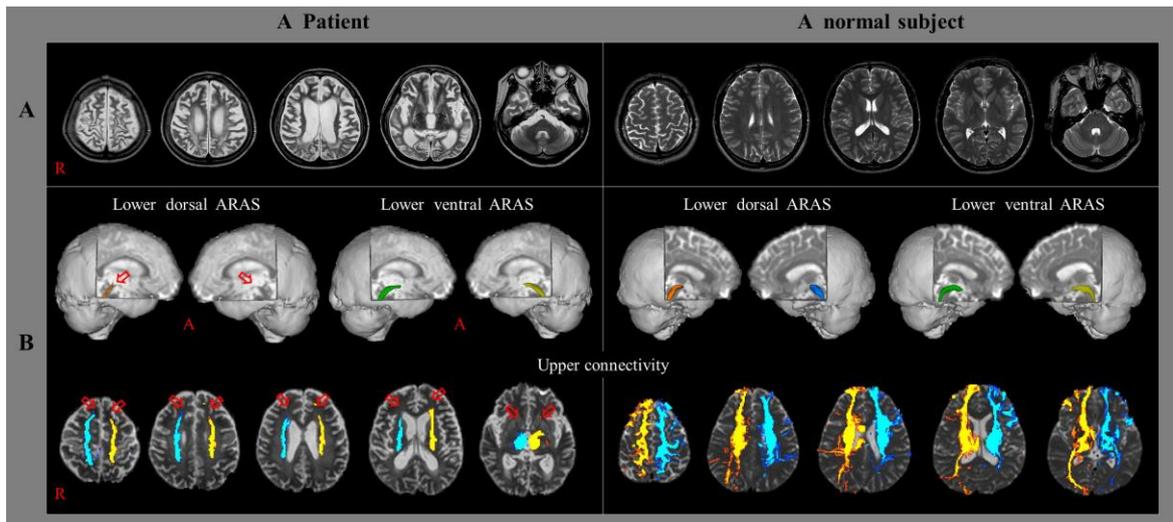
Table 2. Comparison of diffusion tensor tractography parameters in the patient and control groups.

Duration of cardiopulmonary	Clinical scores		
	GCS	CRS-R	MMSE
		DTT parameters	<i>p</i> value
Lower dorsal ARAS	FA	0.40 ± 0.04 (0.44 ± 0.03)	0.001*
	TV	220.48 ± 66.07 (351.39 ± 99.49)	0.000*
Lower ventral ARAS	FA	0.39 ± 0.04 (0.41 ± 0.03)	0.014*
	TV	95.71 ± 67.62 (207.93 ± 84.40)	0.000*
Upper ARAS	FA	0.28 ± 0.06 (0.34 ± 0.05)	0.000*
	TV	5513.25 ± 2322.32 (12024.18 ± 4935.95)	0.000*

DTT: diffusion tensor tractography, ARAS: ascending reticular activating system, FA: fractional anisotropy, TV: tract volume.

Values represent mean ± standard deviations for patients; control means ± standard deviation are enclosed in brackets.

*: significant differences between patient and control groups, $p < .05$.



(A) T2-weighted brain magnetic resonance images of one representative patient (42-year-old male) who show hypoxic-ischemic brain injury lesions at one month after cardiac arrest and a representative normal subject (49-year-old male) (B) Results of diffusion tensor tractography (DTT) for the ascending reticular activating system (ARAS) of the same patient and normal subject. The lower dorsal and upper ARAS reveal injury (red arrows) in both hemispheres of the patient compared to those (red arrows) of the normal subject.

Morphological brain network of mild traumatic brain injury patients: a structural T1 study

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Introduction

Morphological brain network represents mathematical correlation across brain regions using morphological features of brain such as cortical thickness and voxel intensity of gray matter. This approach has been successfully applied to the clinical research data such as schizophrenia and deaf adults. The aim of this study was investigating morphological brain network of mild traumatic brain injury (mTBI) patients using gray matter density of the structural T1 images, and comparing the network with the controls to examine the changes of morphological brain network after mTBI.

Methods

Twenty-two individuals with mTBI (53 ± 4.6 years) and thirty control subjects (56.1 ± 10.8 years) were included in this study. Table 1 summarized the characteristics of the individuals with mTBI. 3D T1 images were acquired through a 3T GE scanner. The raw image data was preprocessed by the SPM12 (Statistical Parametric Mapping) software. Gray matter density maps were obtained in each individual by the voxel-based morphometry (VBM) with DARTEL (Diffeomorphic Anatomical Registration Through Exponentiated Lie algebra) tool. After obtaining the maps, we generated the morphological network in each group, respectively. The number of nodes were 90 in this study, defined by the automated anatomical labeling (AAL) template excluding the cerebellum. The gray matter density of voxels within a node was averaged, and Spearman's correlation matrix (i.e., the morphological brain network) was constructed across the 90 nodes with age and total intracranial volume as nuisance variables. A nonparametric permutation test was performed to determine whether the morphological network of the two groups differed significantly ($P < 0.001$).

Results

Figure 1A-B showed the morphological brain network of control and mTBI groups. We thresholded the matrices and compared the positive correlation ones (Figure 1C-D) between the groups. The mTBI group showed the increased connectivity in between the left superior temporal and right fusiform areas, and in between the right

parahippocampal and angular areas (Figure 2). There was no significantly decreased connectivity of mTBI group compared to the controls.

Conclusion

The increased connectivity was observed in between the brain regions where have responsible for the diverse symptoms of the mTBI, such as hallucination and memory. According to these findings, we may suggest that plastic changes occurred in mTBI group, due to their traumatic brain injury.

Table 1. Characteristics of patients I.

ID	Diagnose	Gender	Age	GCS (<24hr)	Loss of Consciousness	Posttraumatic Amnesia	Duration	RPCSQ	GOSE	GOAT	MMSE-K
P01	Mild	F	46	15	< 30 minutes	< 30 minutes	1 month 26 days	17	-	-	-
P02	Mild	F	53	15	(+) a few minutes	1 hour	6 months 21 days	37	6	-	26
P03	Mild	F	53	NA	(+) but no details available	(+) but no details available	29 months 3 days	-	-	93	27
P04	Mild	F	60	15	(+) but no details available	(+) a few minutes	5 months unknown days	39	6	100	29
P05	Mild	F	54	15	(+) but no details available	(+) but no details available	3 months 17 days	56	5	88	27
P06	Mild	F	56	NA	< 30 minutes	6 hours	46 months	-	-	-	-
P07	Mild	F	49	NA	5-10 minutes	3-5 minutes	1 month 16 days	-	-	98	22
P08	Mild	F	69	NA	-	(+) but no details available	1 month 20 days	-	-	-	29
P09	Mild	M	47	NA	-	-	4 months 10 days	21	7	-	-
P10	Mild	F	41	NA	-	-	1 month 4 day	45	5	85	-
P11	Mild	M	54	NA	(+) but no details available	(+) but no details available	1 month 6 days	30	5	98	30
P12	Mild	M	68	NA	-	-	6 months 12 days	42	6	89	-
P13	Mild	F	54	NA	(+) a few minutes	(+) but no details available	3 months 18 days	49	5	-	29
P14	Mild	F	56	NA	-	-	1 month 5 days	21	5	99	29
P15	Mild	M	36	NA	(+) but no details available	(+) but no details available	5 months 12 days	28	5	90	-
P16	Mild	F	50	NA	< 30 minutes	(+) but no details available	2 months 6 days	26	6	100	-
P17	Mild	M	45	NA	(+) but no details available	(-)	2 months 15 days	46	5	80	27
P18	Mild	F	58	NA	(+) 1 minute	-	1 months 11 days	59	5	96	22
P19	Mild	F	31	-	-	-	26 days	-	-	-	28
P20	Mild	F	46	NA	unclear	> 30 minutes	1 month 27 days	-	-	-	30
P21	Mild	F	31	NA	(+) but no details available	(+) but no details available	1 month 15 days	34	5	100	30
P22	Mild	F	24	NA	(+) but no details available	(+) a few minutes	25 days	36	6	93	28

Abbreviations: GCS, Glasgow Coma Scale; RPCSQ, Rivermead Post-Concussion Symptom Questionnaire; GOSE, Extended Glasgow Outcome Scale; GOAT, Galveston Orientation and Amnesia Test; MMSE-K, Korean version of the Mini-Mental State Examination; P, Patients; F, Female; M, Male; NA, not available. NA for GCS indicates "not available" because the patients visited outpatient clinic in post-acute phases.

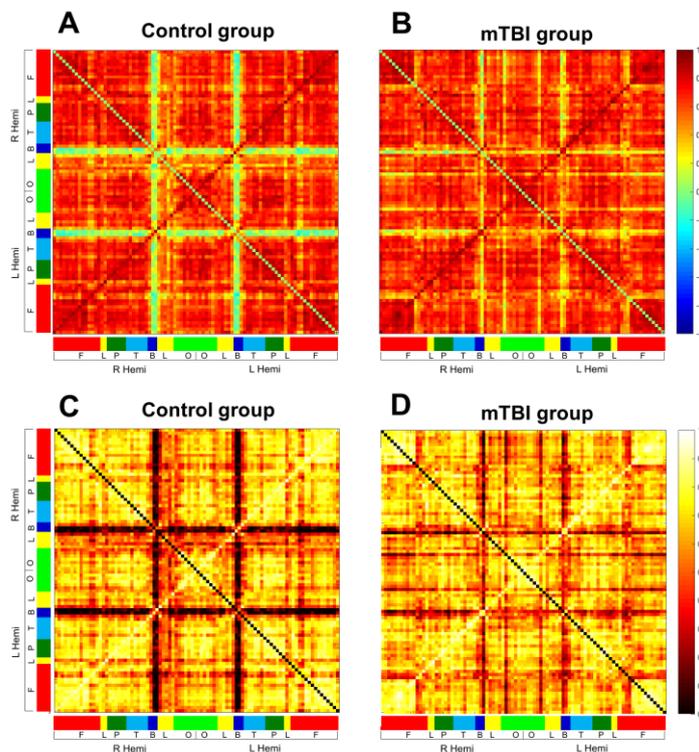


fig1. Morphological brain network of (A) control and (B)mTBI groups, and the positive one of the (C) control and (D) mTBI groups, respectively.

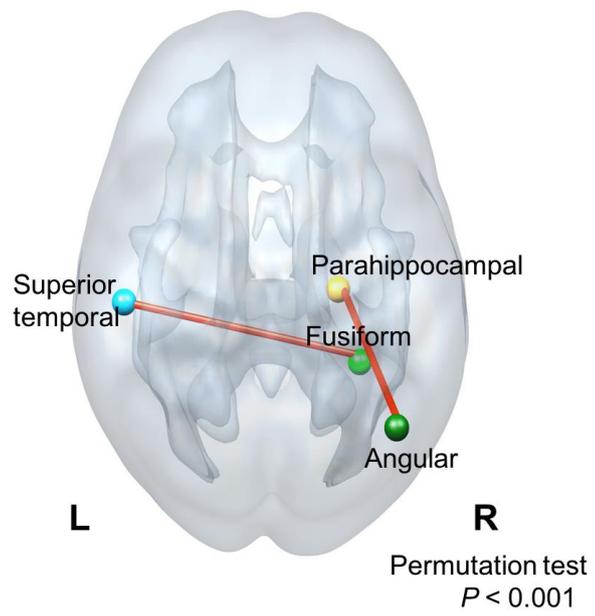


fig2. The significantly increased connectivity observed in the mTBI group.

Relationship between Swallowing parameter and Pulmonary Function in Stroke Patients

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Objective

Many stroke patients have difficulty in protecting airway, which affects swallowing and coughing. Conventional treatments such as bolus modification, airway protective maneuvers, and pharmacological interventions, as well as other treatments such as expiratory muscle strength training, thermal-tactile stimulation, electrical stimulation have been used to manage dysphagia in patients. However, the long-term effects have yet to be verified. Previous studies have suggested that there is a correlation between the pulmonary function and dysphagia, but the specific relationship is not well understood. This study aimed at identifying the relationship between the pulmonary function tests and the elements of swallowing function in stroke patients with dysphagia.

Subject & Method

Total 36 patients with stroke, diagnosed with dysphagia, and who admitted to the clinic of the Department of Rehabilitation Medicine from June 2017 to October 2017 were recruited. They all underwent pulmonary function tests and VFSS simultaneously. Pulmonary function tests included vital capacity (VC) using %, which calculated from measured vital capacity divided by age-related prediction value, and peak cough flow (PCF). Swallowing parameters including Videofluoroscopic dysphagia scale (VDS) were evaluated by Videofluoroscopic swallowing study (VFSS) and diet types at admission and at discharge were evaluated. The relationship between dysphagia scales and pulmonary function tests was analyzed using ANOVA, T-test, and Pearson's correlation.

Results

The Results showed statistically significant tendency of correlations between VC(%) and diet type at first, between VC(%) and diet type at discharge, and between PCF and diet type at first (Table 1.). Comparison of the VFSS subgroups revealed significant differences in VC(%) among those assigned to groups based on posterior food propelling, elevation of larynx, and existence of aspiration. Also, it revealed significant differences in PCF among those assigned to groups based on cricopharyngeal dysfunction (Figure 1). The correlation analysis of VC(%) and VDS scores with liquids showed a moderately significant correlation ($r = -0.367$, $p = 0.016$, Figure 2)

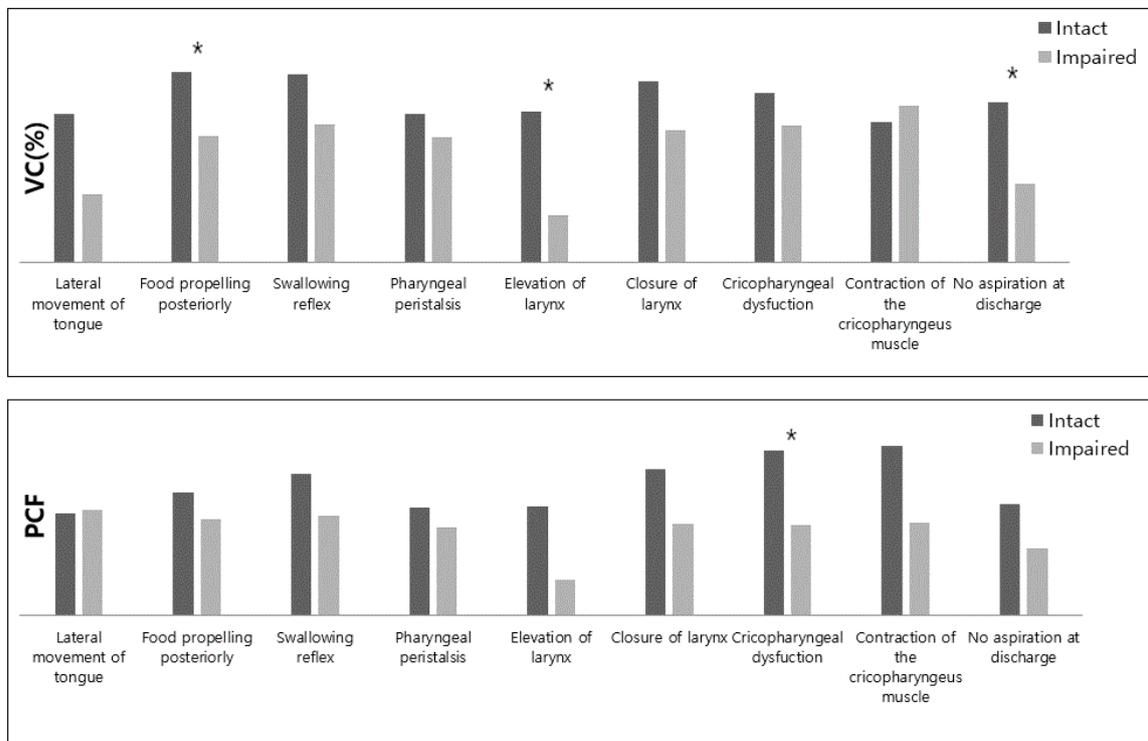
Conclusion

In this study, there were relationships between pulmonary function and some critical parameters of clinical dysphagia scales. Therefore, the clinical importance of pulmonary function test in Stroke patients with dysphagia should be emphasized. Overall, there is a need for large-scale, well-designed, prospective studies in order to correlate pulmonary function with swallowing-related elements, as well as determine the short- and long-term effects of pulmonary rehabilitation on dysphagia.

Table 1. Comparison of VC(%) and PCF in Diet subgroups

	Diet level (Initial)	Diet level (discharge)
VC (%)	0.001 *	0.017 *
PCF	0.002 *	0.092

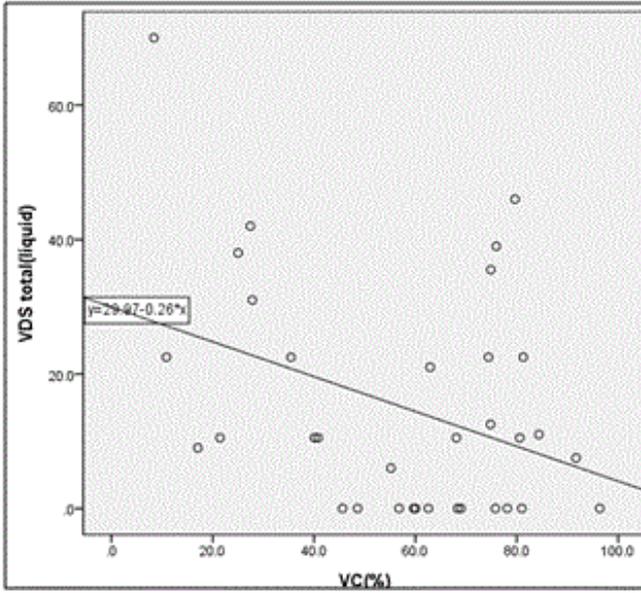
*P<0.05 by one-way analysis of variances among groups



VC, vital capacity; PCF, peak cough flow; VFSS, Videofluoroscopic swallowing study;

*p<0.05 by independent t-test

Figure 1. Comparison of pulmonary function in VFSS subgroups with liquid consistencies



VDS, Videofluoroscopic Dysphagia Scale; VC, vital capacity

Figure 2. Correlation of VDS total score (liquid) with VC(%)

Functional recovery of stroke rats induced mesenchymal stem cells derived microvesicle

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Objectives

to investigate the ability of normal and stroke rat brain extract-treated mesenchymal stem cell (MSC) derived microvesicles (NMB-MVs and SBE-MVs) to attenuate ischemic brain injury induced by permanent middle cerebral artery occlusion (pMCAo) in rats

Method

We extracted the MSC at normal or stroke rat brain. To remove the MSC derived MV, we conducted the centrifugation at 100000g for 1 hour at 4°C and filtering. We found that the cytokine profiles of normal and stroke brain extracts were similar; the extracts contained a number of neurogenic and neurotrophic factors and cytokines that can significantly influence the quality and quantity of MSC-derived MVs. To examine the therapeutic benefits of MVs of brain extract-treated MSCs in an ischemic stroke model, intracarotid MV injections (0.2 mg/kg) were administered to Sprague-Dawley rats 2 days after pMCAo.

Result

Our Results demonstrated that NBE-MSC-MVs and to a lesser extent SBE-MSC-MVs ameliorated ischemic brain injury with improved functional recovery. Immunohistochemical analyses showed that NBE-MSC-MVs reduced inflammation, enhanced angiogenesis with increased endogenous neurogenesis in rat brain. To obtain mechanistic insights into the therapeutic effect of these MVs, we performed an integrative mass spectrometry-based proteomics analysis and found that the NBE-MSC-MV proteome is highly enriched for vesicular proteins. Finally, using a systems biology approach, we reconstructed a network of NBE-MSC-MV therapeutic factors linked to anti-inflammation, angiogenesis, neurogenesis, and apoptosis; this network may represent a proteome system stimulated by brain extract.

Conclusion

The treatment of ischemic rats with NBE-MSC-MVs promotes the functional recovery of damaged stroke brain via modulation of anti-inflammation, angiogenesis and neurogenesis.

Clustering of Recovery Patterns after First-ever Stroke Using Artificial Intelligence

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Objective

There have been trials to perform the cluster analysis of functional recovery pattern and predictors of functional outcome in stroke patients. However, there was no report to achieve the clustering with multi-facet functional recovery patterns with longitudinal follow up of stroke patients. The Objective of this study was to apply the clustering approach of multi-facet functional recovery pattern with bid data of in the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) using artificial intelligence, and to provide valuable prediction models for clinically use.

Materials and Methods

This study was an interim analysis of the KOSCO designed as 10 years long-term follow-up study of stroke patients. All patients who admitted to the representative hospitals in 9 distinct areas of Korea with their acute first-ever stroke (from August 2012 to May 2015) were recruited. In this study, we analyzed data of participants who completed functional assessments from 7 days to 12 months year after stroke onset. Functional assessments

included Korean modified Barthel Index (K-MBI), Korean Mini-Mental State Examination (K-MMSE), Fugl-Meyer Assessment (FMA), Functional Ambulatory Category (FAC), the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale (ASHA-NOMS), and Short Korean Version of Frenchay Aphasia Screening Test (Short K-FAST). The cluster analysis using artificial intelligence was performed for multi-facet functional recovery patterns of independency, motor, ambulation, cognition, language, and swallowing functions. After the cluster analysis, a group of rehabilitation specialists reviewed the clinical meaningfulness with clustered population, whether the groups had high homogeneity and representativeness of the clinical stroke recovery patterns. After these clustering approaches, a prediction model using deep learning was performed. The accuracy of classification of this prediction model was evaluated by comparing how much the prediction was equivalent to the actual clustering Result.

Results

After the deep learning in supervised manners on artificial intelligence, multi-facet functional recovery patterns after stroke could be classified into ten groups. Each group showed a different multi-facet functional recovery pattern from 7 day to 12 months, and this clustering showed a clinically acceptance. In addition, the accuracy in classification with clinical characteristics at 7 days showed more than 73.0%. This Result showed a higher prediction value compared with Results of conventional statistical analysis.

Conclusion

The Results of this study demonstrated the potentials of the clustering and predicting functional recovery patterns of stroke patients using artificial intelligence. These Results might be useful for establishing patient-tailored rehabilitation strategy after stroke.

P 3-8

Occurrence and risk factors of post-stroke Complex Regional Pain Syndrome

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Objective

To report occurrence and identify clinical features and risk factors of post-stroke CRPS(Complex Regional Pain Syndrome) in patients with first-ever stroke in acute rehabilitation center Design : Retrospective single center study Participants : First-ever stroke patients(N=377) who discharge acute rehabilitation center from Jan 2015 to Apr 2018 Main Outcome measurement : Occurrence and risk factors of CRPS diagnosed by 3-Phase bone scan on the basis of clinical suspicion in first-ever stroke patients Statistics : Chi-square test, Mann-Whitney U-test were used to determine significant differences in occurrence of CRPS in respect to demographic, clinical features. Multivariable logistic regression analyses were performed to identify variables associated with occurrence of post-stroke CRPS. P-value<0.05 was considered to indicate statistical significance. All statistical analyses were done with IBM SPSS Statistics 24.

Results

The study population included 377 participants(173 women and 204 men). Occurrence of post-stroke CRPS in first-ever stroke patient is 30/377 (7.95%). The mean age of the CRPS group was 69.60 and 56.7% of the women were predominant. CRPS occurred after an average of 72.10 days after stroke. The interval between the stroke onset date and the rehabilitation start date did not show a significant difference between CRPS groups. In univariable analysis, there's significant difference between two groups(CRPS group versus Non-CRPS group) for (Mann-Whitney U test) MMSE(P=0.014), K-MBI(P<0.001), FMA-UE(P<0.001), FMA-LE(P<0.001), Grip strength(P<0.001), Albumin(P=0.042), AST(P=0.023), D-Dimer(P=0.006). But, in multivariable logistic regression analysis, associated factors was only FMA-UE([OR]0.946 [CI] 0.897-0.998).

Conclusion

Post stroke CRPS occurred in 7.95% of first-ever stroke patients, which is not uncommon. Initial FMA-UE was related to the development of CRPS. For accurate prevalence and risk factor identification, multicenter prospective surveillance is required.

Table 1. Demographic, clinical and laboratory features of patients with CRPS(CRPS +) or without CRPS(CRPS -)

	CRPS (+) (n=30)	CRPS (-) (n=347)	p-value
Age (years)	72(62.25-77)	68(56-77)	0.184 ^{a)}
Sex			0.217 ^{b)}
Male	13(43.3%)	191 (55%)	
Female	17(56.7%)	156(45%)	
Time elapsed to rehabilitation facility(days)	15(10.75-27.00)	16(12-24)	0.957 ^{a)}
Height(cm)	160(155-163.5)	162(155-170)	0.066 ^{a)}
Weight(kg)	57.0(50.5-67.3)	62(53-70.85)	0.131 ^{a)}
BMI(kg/m ²)	22.77(20.61-24.90)	23.37(20.98-26.15)	0.495 ^{a)}
Stroke			0.353 ^{b)}
Ischemia	17(56.7%)	226(65.1%)	
Hemorrhage	13(43.3%)	121(34.9%)	
DM	7(23.3%)	97(28.0%)	0.587 ^{b)}
HTN	19 (63.3%)	194(55.9%)	0.431 ^{b)}
NIHSS	6(4-14)	5(3-9)	0.102 ^{a)}
MMSE	18.5(9-22)	21(14-25)	0.014^{a)}
K-MBI	14(5.5-38)	42(22-60)	<0.001^{a)}
FMA UE	48(37-65)	102.5(58-122)	<0.001^{a)}
FMA LE	53(46-70)	80(62.75-91.25)	<0.001^{a)}
Grip strength	0(0-0)	13(0-30)	<0.001^{a)}
WBC(x10 ³ /mm ³)	7.62(5.38-8.86)	7.01(5.73-8.65)	0.81 ^{a)}
ESR(mm/hr)	39(30-53)	33(18-55)	0.318 ^{a)}
Albumin(g/dL)	4.0(3.0-4.0)	4.0(4.0-4.0)	0.042^{a)}
AST(IU/L)	25(20.5-38.5)	22(17-31)	0.023^{a)}
D-Dimer(ng/mL)	1418(700.75-3543)	770(476.5-1488.75)	0.006^{a)}

Values are presented frequency(%) or median(interquartile range).

BMI, Body Mass index; NIHSS, NIH stroke scale; MMSE, Mini Mental Status Evaluation; K-MBI, Korean Modified Barthel Index; FMA, Fugl Meyer Assessment of Motor recovery; UE, Upper extremity; LE, Lower extremity.

a)Mann-Whitney U-test, b)Chi-square test

Table 2. Association between covariates and CRPS occurrence

Covariates	OR (95% CI)	P-value ^{a)}
MMSE	1.040(0.940-1.150)	0.450
K-MBI	0.953(0.904-0.981)	0.083
FMA-UE	0.942(0.904-0.981)	0.004
FMA-LE	1.044(0.992-1.100)	0.101
Grip Strength(kg)	0.949(0.849-1.061)	0.355
Albumin(g/dL)	0.418(0.094-1.859)	0.252
AST(IU/L)	1.016(0.965-1.070)	0.538
D-Dimer(ng/mL)	1.000(0.999-1.001)	0.708

OR, odds ratio; CI, confidence interval; MMSE, Mini Mental Status Evaluation; K-MBI, Korean Modified Barthel Index; FMA, Fugl Meyer Assessment of Motor recovery; UE, Upper extremity; LE, Lower extremity; CRPS, Complex Regional Pain Syndrome.

a)Multivariable logistic regression analysis.

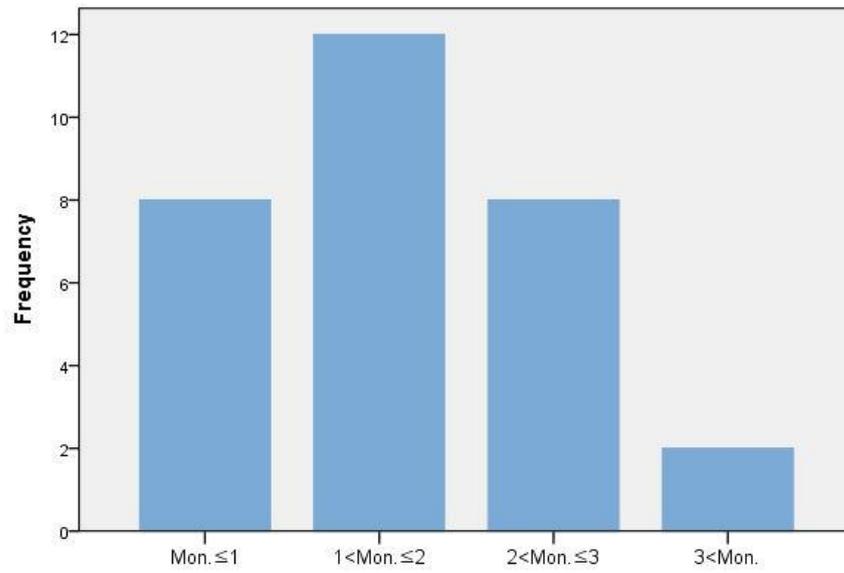


Figure 1. The interval from the point of stroke occurrence to the point of CRPS occurrence (Months)

P 3-9

Detection of Pharyngeal Phases in the Videofluoroscopic Swallowing Study using Deep Learning

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Introduction

Previous computer assisted analysis of videofluoroscopic swallowing study (VFSS) required manual annotation tools to enter several defined anatomical positions and selected time intervals of interest. These processes were still costly and challenging for clinicians.

Objective

In this study, we present a novel approach to detect a pharyngeal phase of swallowing through whole of VFSS video clips using inflated 3D Convolutional Networks (I3D) without additional manual annotations.

Methods

The VFSS data were collected from 144 subjects (44 females, aged 63.3±16.4 years) who complained subjective difficulties of swallowing during diets and visited the inpatient and outpatient clinic in Department of Rehabilitation Medicine. We propose a two-stage process to detect pharyngeal phases in the VFSS video instances. First, we detect intervals of frames having maximal vertical movements. Next stage, we trained I3D networks to classify the interval of video frames with the label whether the interval is in a pharyngeal phase or not. We evaluated I3D networks of single stream such as optical flow (I3D-Flow), RGB (I3D-RGB), and two streams (I3D-Joint).

Results

When the I3D-Flow and the I3D-RBG networks were trained by 10K iterations, the network showed 93.94% and 95.91% accuracy rate, separately. When the I3D-Joint was trained by 30K iterations, the network showed 95.64% accuracy rate which is similar to I3D-RGB.

Conclusion

We have presented a novel framework based on I3D networks to detect a pharyngeal phase during swallowing in whole VFSS video clips. The algorithm is validated on large clinical dataset and achieves the state-of-the-art of human swallowing motion analysis. This study showed that a new framework could classify the pharyngeal phase of swallowing without any manual adjustments and should be a fundamental work for developing software of fully automatic analysis in VFSS.

P 3-10

Motor function in patients with appearance of transpontine fibers from affected CST during recovery

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Objectives

We investigated motor function in patients with the appearance of transpontine fibers from the affected corticospinal tract (CST) during motor recovery following putaminal hemorrhage by using diffusion tensor tractography (DTT).

Methods

Among 41 consecutive patients with putaminal hemorrhage, we examined 12 patients with the appearance of transpontine fibers from the affected CST at the chronic stage that were not observed at the early stage. Motor function was evaluated three times after putaminal hemorrhage onset (early stage [first DTT, 12.7 ± 2.2 days], chronic stage [second DTT, 143.9 ± 141.7 days], and final outcome [297 ± 288 days]) by assessing patients' Motricity Index (MI), Modified Brunnstrom Classification (MBC), and Functional Ambulation Category (FAC).

Result

Motor function at the early stage showed severe impairment with average MI = 5.3, MBC = 0.6, and FAC = 0.0. However, these recovered to average MI = 45.8, MBC = 2.0, and FAC = 2.0 at the chronic stage and MI = 46.1, MBC = 2.2, and FAC = 2.3 at final outcome. Among the 12 patients, only one patient (8.3%) and six patients (50.0%) recovered to a functional state in hand (MBC 5~6) and gait (FAC 3~5) functions, respectively.

Conclusions

We examined the motor function of patients who showed the appearance of transpontine fibers from the affected CST during motor recovery following putaminal hemorrhage. Appearance of transpontine fibers from the affected CST during recovery appeared to be a motor recovery mechanism, although it is related to poor motor function outcome.

Table 1. Demographic characteristics of study patients.

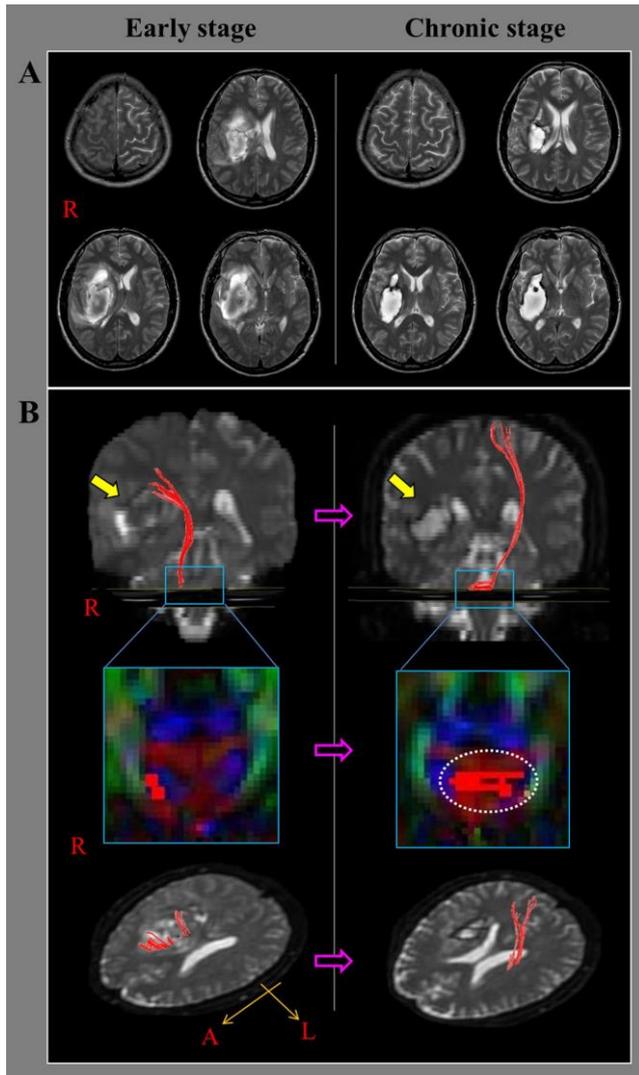
	Patients
Age (years)	53.2 ± 10.2
Sex (male:female)	8:4
Lesion side (right:left)	5:7
Mean duration to 1st DTT from putaminal hemorrhage onset (days)	12.7 ± 2.2
Mean duration to 2nd DTT from putaminal hemorrhage onset (days)	143.9 ± 141.7

Values are presented as means ± standard deviation; DTT: diffusion tensor tractography.

Table 2. Change in motor function according to time from putaminal hemorrhage onset.

	MI score			MBC	FAC
	Upper	Lower	Total		
Early stage	4.7 ± 10.9	5.8 ± 13.9	5.3 ± 12.4	0.6 ± 0.5	0.0 ± 0.0
Chronic stage	43.9 ± 21.2	48.6 ± 17.6	45.8 ± 18.3	2.0 ± 1.2	2.0 ± 0.8
Final outcome	45.1 ± 19.1	47.2 ± 18.9	46.1 ± 17.2	2.2 ± 1.0	2.3 ± 1.0

Values are presented as means ± standard deviation; MI: Motricity Index; MBC: Modified Brunnstrom Classification; FAC: Functional Ambulation Category; DTT: diffusion tensor tractography.



(A) T2-weighted brain magnetic resonance images of one representative patient (47-year-old male) in the right hemisphere at the early (13 days after onset) and chronic (50 days after onset) stages after putaminal hemorrhage. (B) Results of diffusion tensor tractography for the corticospinal tract (CST). In the early stage, the affected (right) CST is discontinued around the hematoma (yellow arrow). However, at the chronic stage, the affected CST is crossed to the unaffected hemisphere via transpontine fibers (white circle) at the pontine level

Effect of Robot-assisted Gait Training on Gait Automaticity in Parkinson's Disease: A Pilot Study

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Purpose

Gait automaticity is known to be reduced in patients with Parkinson's disease (PD) due to impaired habitual control. Robot-assisted gait training (RAGT), which provide training with high intensity and repeatability, has been suggested to improve gait speed and balance in these patients. The aim of this pilot study was to investigate the effect of RAGT on gait automaticity as well as gait speed and balance in patients with PD.

Methods

Patients with idiopathic PD (H&Y stage 2.5 or 3) received 12 sessions of RAGT, 45-min, 3 days a week, for 4 consecutive weeks using an exoskeleton-type gait robot (Walkbot_S; P&S Mechanics, Seoul, Korea). Primary outcome was the percentage of dual-task interference measured by 10 meter walking test (10MWT) under single- and dual-task conditions. Cognitive dual-task walking was measured using Wechsler Forward Digit Span, and physical dual-task walking was measured with a tray with two cups of water. Patients were also evaluated with Berg Balance Scale (BBS) and Korean version of the Falls Efficacy Scale-International (KFES). All outcomes were measured before (T0), after (T1) and 1 month post-treatment (T2).

Results

Eleven patients with idiopathic PD were participated (Table 1). Cognitive dual-task interference was significant increased ($p=.026$) at T1, but not at T2. No significant changes were found for physical dual-task interference at T1 and T2 (Table 2). Single-task gait speed of 10MWT was significantly improved at T1 ($p=.041$), but not at T2 ($p=.445$). On the other hand, there were no significant changes in dual-task walking speed of 10MWT. A significant improvement was also found on the BBS at T1 and T2 ($p.004$ and $p=.024$, respectively), but no significant changes were found on KFES (Table 3).

Conclusion

In this pilot study, the gait automaticity in patients with PD was not improved by RAGT using an exoskeleton-type robot despite improvement in walking speed and balance. Additional therapeutic components may be needed to improve gait automaticity using RAGT in patients with PD.

Table 1. Patients' demographics and baseline characteristics (N=11)

Male/female (n)	5/6
Age (yr)	66.46 ± 5.66
Disease duration (mo)	112.91 ± 50.19
Hoehn & Yahr stage 2.5/3 (n)	8/3
MMSE-K (score)	28.55 ± 0.93

Mini Mental State Examination-Korea; MMSE-K

Table 2. Changes in percentage of dual-task interference (%)

		T0 (n=11)	T1 (n=11)	T2 (n=10)	Within-group comparisons	
					T1 - T0	T2 - T0
Step velocity [†]	Dual task (cognitive)	-15.78 (7.78)	-21.50 (7.62)	-20.75 (6.40)	.026*	.203
	Dual task (physical)	-21.23 (7.42)	-21.10 (5.79)	-23.51 (12.55)	.929	.646

Percentage of dual-task interference; (dual-task performance – single-task performance)/single-task performance, T0; Before treatment, T1; After treatment, T2; 1 month post-treatment, [†]Mean (SD), *p<.05 by Wilcoxon signed-rank test

Table 3. Changes in the outcome variables between T0, T1, and T2

		T0 (n=11)	T1 (n=11)	T2 (n=10)	Within-group comparisons	
					T1 - T0	T2 - T0
10MWT [†] (m/s)	Single task	1.13 (0.23)	1.24 (0.28)	1.17 (0.34)	.041*	.445
	Dual task (cognitive)	0.94 (0.25)	0.98 (0.24)	0.92 (0.26)	1.000	.721
	Dual task (physical)	0.89 (0.22)	0.98 (0.23)	0.90 (0.29)	.075	.721
	BBS ^{††}	52.00 (8.00)	54.00 (4.00)	54.00 (5.25)	.004*	.024*
	KFES ^{††}	28.00 (9.00)	30.00 (13.00)	32.50 (15.75)	.235	.086

T0; Before treatment, T1; After treatment, T2; 1 month post-treatment, 10MWT; 10 Meter Walking Test, BBS; Berg Balance Scale, KFES; Korean version of the Falls Efficacy Scale-International, [†]Mean (SD), ^{††}Median (IQR), *p<.05 by Wilcoxon signed-rank test

P 3-12

Relationship between injured cingulum and impaired consciousness in patients with HI-BI

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Objectives

We investigated the relationship between cingulum injury and impaired consciousness in patients with hypoxic-ischemic brain injury (HI-BI) by using diffusion tensor tractography (DTT).

Methods

We recruited 29 patients with HI-BI and 25 normal control subjects. The patients were classified as intact consciousness (group A, 13 patients) or impaired consciousness (group B, 16 patients). The DTT parameters of fractional anisotropy (FA) and tract volume (TV) were estimated for both cinguli. Glasgow Coma Scale (GCS) and Coma Recovery Scale-Revised (CRS-R) scores were also evaluated.

Results

The FA and TV values of the cinguli in groups A and B were lower than those of the control group ($p < 0.05$), and the FA and TV values of group B were lower than those of group A ($p < 0.05$). The FA and TV values of the cinguli in group A were not significantly correlated with GCS and CRS-R scores ($p > 0.05$); however, the FA correlations with GCS ($r = 0.457$, $p < 0.05$) and CRS-R ($r = 0.494$, $p < 0.05$) and those of TV with GCS ($r = 0.500$, $p < 0.05$) and CRS-R ($r = 0.491$, $p < 0.05$) were moderately positive.

Conclusions

We found a significant relationship between injury of the cingulum and impaired consciousness in patients with HI-BI. Our Results suggest that an injured cingulum could be an appropriate target for neurointervention or neurorehabilitation in patients with impaired consciousness following HI-BI.

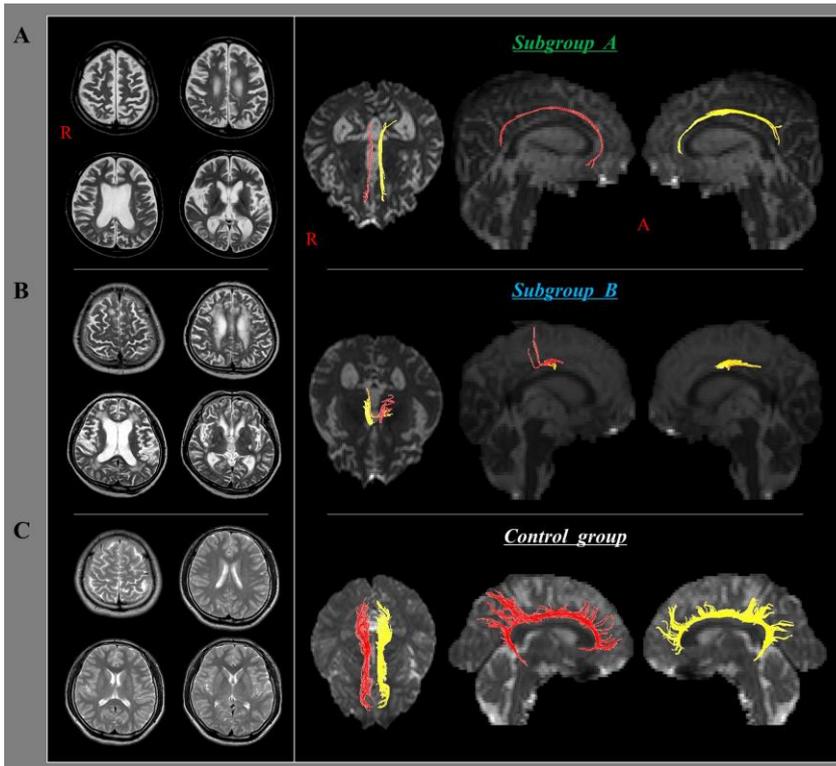


Fig. 1. Results from T2-weighted brain magnetic resonance images and diffusion tensor tractography (DTT) for the cingulum in representative patients from patient groups A and B and the control group. (A) Narrowing of both cinguli in a representative patient of group A (intact consciousness, 53-year-old male); however, the anterior and posterior portions of the cinguli are intact. (B) Non-reconstruction of the anterior and posterior portions of the cinguli in a representative patient of group B (impaired consciousness, 47-year-old male). (C) Images showing the normal cinguli in a representative subject of the control group (46-year old male).

Effect of Extracorporeal Shock Wave Therapy on Hemiplegic Shoulder Pain Syndrome in Stroke Patients

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Objective

Hemiplegic Shoulder Pain Syndrome (HSPS) is one of the common problems after stroke. One pathology alone cannot account for shoulder pain after stroke. In general, the causes of HSP are subluxation of the shoulder, rotator cuff problems, adhesive capsulitis and complex regional pain syndrome. Focused Extracorporeal Shock Wave Therapy (fESWT) has been suggested as a non-invasive and alternative treatment for shoulder pain, and the effects of fESWT on various musculoskeletal disorders have been reported. This study is to evaluate the beneficial effects of fESWT on HSPS in subacute stroke patients.

Methods

This study was designed as a pilot randomized controlled trial. Among the subacute stroke patients, those diagnosed as HSPS were enrolled. They were randomly assigned to one of the two groups study group and control group. Study group received fESWT on 3 separate sites. Treatment sites were anterior-to-posterior direction at anterior shoulder joint lateral to the coracoid process, posterior-to-anterior direction at posterior shoulder joint beneath the lateral border of the scapular spine and a greater tuberosity as the insertion site of supraspinatus muscle. 500 shots were given in each area, with a total of 1,500 shots in one treatment session. The energy density was approximately 0.06mJ/mm². Control group received sham stimulation. The ESWT therapy sessions were applied 1 session per week for 3 weeks. Both group received conventional range of motion exercise therapy for 3 weeks. All enrolled patients were evaluated at before and after the treatment. Spasticity was measured using modified Ashworth scale (MAS). Passive Range Of Motion (ROM) and Manual Muscle Test (MMT) of the shoulder were recorded. Pain was measured using Visual Analogue Scale (VAS) during passive external rotation,. Hand Function Test (HFT) of shoulder in affected side was recorded.

Results

Eight patients were assigned to study group and 10 patients were assigned to sham group. There were no significant differences in baseline characteristics (Table 1). After 3 weeks of treatment, both groups showed significant improvement in ROM. Study group showed significant improvement in MAS and VAS after the treatment (Table 2). When comparing changes between two groups, MAS and VAS and ROM of external rotation and abduction in ROM showed more improvement in the study group (Table 3).

Conclusion

Our Results showed that fESWT can be an alternative and effective treatment for pain, spasticity and ROM in subacute stroke patients with HSPS.

Table 1. Baseline characteristics of subjects at the initial evaluation

	Study (n=8)	Sham (n=10)	p-value
Sex (Male/Female)	5/3	5/5	
Stroke type (Infarction/hemorrhage)	6/2	7/3	
Age (year)	66.25±11.63	65.00±16.83	0.545
Stroke duration (day)	24.03±8.63	26.03±7.85	0.752
MMT on hemiplegic shoulder (MRC)			
0	3	5	
1,2	4	4	
3,4	1	1	
5	0	0	
VAS	6.75±1.28	6.24±1.36	0.698
MAS	1.23±1.14	1.36±1.37	0.379
ROM			
Flexion	135.13±25.24	140.41±28.64	0.886
Abduction	92.54±24.42	95.12±31.17	0.842
External rotation	65.24±11.81	71.15±14.45	0.754
Internal rotation	58.27±10.24	61.26±11.34	0.546
HFT in affected side	4.13±3.73	4.88±3.35	0.682

Values are mean ± standard deviation.

MMT, Manual Muscle Test; MRC, Medical Research Council; VAS, Visual Analogue Scale; MAS, Modified Ashworth Scale; ROM, Range of Motion; HFT, Hand Function Test.

*p<0.05, Mann-Whitney U test for between-group comparison.

Table 2. Changes of measurements after treatment

	Study			Sham		
	pre	post (3wks)	p-value	pre	post (3wks)	p-value
VAS	6.75±1.28	3.85±1.46	0.026*	6.24±1.36	4.53±1.28	0.132
MAS	1.23±1.14	0.43±0.41	0.029*	1.36±1.37	1.13±0.85	0.254
ROM						
Flexion	135.13±25.24	154.08±18.98	0.027*	140.41±28.64	156.04±20.27	0.035*
Abduction	92.54±24.42	111.13±21.99	0.032*	95.12±31.17	108.88±19.73	0.047*
External rotation	65.24±11.81	79.48±13.15	0.028*	71.15±14.45	80.63±12.78	0.041*
Internal rotation	58.27±10.24	69.45±10.24	0.036*	61.26±11.34	71.75±11.74	0.044*
HFT	4.13±3.73	6.23±4.47	0.221	4.88±3.35	6.67±5.21	0.368

Values are mean ± standard deviation.

VAS, Visual Analogue Scale; MAS, Modified Ashworth Scale; ROM, Range of Motion; HFT, Hand Function Test.

*p<0.05, Wilcoxon signed-rank test for within-group comparison.

Table 3. Comparison of changes between two groups

	Study	Sham	p-value
Δ VAS	2.90±1.13	1.70±0.95	0.028*
Δ MAS	0.81±0.21	0.23±0.27	0.045*
Δ ROM			
Flexion	18.75±5.67	15.59±6.02	0.064
Abduction	19.85±4.04	13.67±6.46	0.043*
External rotation	14.26±5.67	9.85±5.67	0.038*
Internal rotation	11.15±4.67	10.85±6.67	0.102
Δ HFT	2.11±1.67	1.85±1.34	0.234

Values are mean ± standard deviation.

VAS, Visual Analogue Scale; MAS, Modified Ashworth Scale; ROM, Range of Motion; HFT, Hand Function Test.

*p<0.05, Mann-Whitney U test for between-group comparison.

Functional Recovery Patterns from 7 Day to 2 Year after the First Strokes in Korea: The KOSCO study

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Objective

There is no definite consensus to when the recovery of stroke function is stagnant, although it is some reports that the activities of daily living and the motor function are 6 months. The Purpose of this study was to analyze the functional recovery patterns from 7 days to 2 year after stroke onset and the time point to reach the plateau of each function for the total, ischemic and hemorrhagic stroke.

Materials and Methods

This study was an interim analysis of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) designed as 10 years long-term follow-up study of stroke patients. All patients who admitted to the representative hospitals in 9 distinct areas of Korea with their acute first-ever stroke (from August 2012 to May 2015) were recruited. Both ischemic and hemorrhagic strokes were included but transient ischemic attacks were excluded. Out of 8,010 patients who agreed with participation, 4,909 patients completed face-to-face assessments at 2 year after stroke onset. Functional assessments included Korean modified Barthel Index (K-MBI), Korean Mini-Mental State Examination (K-

MMSE), Fugl-Meyer Assessment (FMA), Functional Ambulatory Category (FAC), the American Speech-Language-Hearing Association National Outcome Measurement System Swallowing Scale (ASHA-NOMS), and Short Korean Version of Frenchay Aphasia Screening Test (Short K-FAST). We demonstrated the each functional recovery pattern for total, ischemic and hemorrhagic stroke data separately and also for subsets grouped by their baseline stroke severities.

Results

Among 4,909 patients, 79.7% of patients suffered from ischemic and 20.3% hemorrhagic stroke, respectively. Their mean age was 63.8 years and the ratio of male to female was 1.45. Table 1 shows the distribution of the clinical characteristics by stroke type. The multi-facet functional recovery patterns in first-ever stroke patients were different according to the baseline stroke severity. RMANOVA showed a significant interaction effect between time and baseline stroke severity) in K-MBI, FMA, K-MMSE, FAC, ASHA-NOMS, Short K-FAST ($P < 0.05$). K-MBI reached to the plateau at 18 months after ischemic stroke onset in the mild group; however, K-MBI reached to the plateau at 12 months after ischemic stroke onset in the moderate and severe group.

Conclusion

The Results of this study demonstrated that functional recovery should be expected after the first 6 months in the first-ever stroke patients. In addition, the present study showed that there were different recovery patterns according to functional domain and severity at acute phase in stroke patient

Table 1. Distribution of general and clinical patient characteristics

Variables	Total stroke patients (n=4,909)	Ischemic stroke patients (n=3,913)	Hemorrhagic stroke patients (n=996)
	Mean±SD or percentage	Mean±SD or percentage	Mean±SD or percentage
Age, years	63.3±12.8	64.8±12.3	57.7±13.0
Sex, male	59.2%	61.8%	49.0%
Body mass index	23.8±3.3	23.9±3.3	23.4±3.3
Smoking, current	27.2%	28.4%	22.7%
Alcohol, current	40.1%	39.8%	41.3%
Education, years	9.9±4.8	9.7±4.8	10.7±4.6
Medical history			
Hypertension, Yes	53.7%	56.0%	44.2%
Diabetes mellitus, Yes	20.9%	24.2%	10.2%
Coronary heart disease, Yes	5.8%	6.7%	2.9%
Atrial fibrillation, Yes	7.1%	8.7%	1.6%
Hyperlipidemia, Yes	9.3%	11.2%	4.6%
CCAS	5.1±1.7	5.2±1.7	4.7±1.6
Premorbid mRS, score	0.7±1.3	0.6±1.2	0.8±1.6
NIHSS at 7 day	4.0±6.2	3.3±5.1	6.8±8.9
Functional assessments at 7 day			
Fugl-Meyer Assessment	79.2±32.1	82.5±29.2	66.4±38.9
K-MMSE	22.3±8.3	23.2±7.5	18.6±10.2
Functional Ambulatory Category	2.9±1.9	3.2±1.8	1.8±2.0
AHSA-NOMS	6.0±1.9	6.2±1.7	5.1±2.4
Short K-FAST	13.7±6.0	14.3±5.5	11.5±7.3
Neurological aggravation, Yes	3.5%	4.0%	1.7%
Complication during hospitalization			
Thromboembolic disease, Yes	1.4%	1.4%	1.3%
Pneumonia, Yes	2.4%	1.7%	5.2%
Ventilatory insufficiency, Yes	0.6%	0.4%	1.4%
Urinary tract infection, Yes	2.4%	1.8%	4.5%
Number of complications (0-4)			
Duration of hospitalization, days	18.5±24.1	14.5±20.0	34.4±31.4
Intensive inpatient rehabilitation, Yes	20.9%	17.8%	33.1%

Reorganization of Motor Network by Dual-mode Noninvasive Brain Stimulation in Stroke Patients

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Objective

Noninvasive brain stimulation (NBS) using repetitive transcranial magnetic stimulation (rTMS) or transcranial direct current stimulation (tDCS) has recently been adopted for modulating motor function in stroke patients. We investigated the effect of simultaneous dual-mode stimulation using rTMS and tDCS over the bilateral primary motor cortices (M1) to assess its efficacy as compared to single stimulation using rTMS for the recovery of motor function in subacute stroke patients.

Materials and Methods

Twenty-four patients participated; 12 participants were assigned to the dual-mode stimulation group (DSG, 8 males, 56.0±13.4 years) while the other 12 participants were assigned to the single stimulation group (SSG, 9 males, 54.8±15.5 years). We assessed each patient's motor function using the Fugl-Meyer Assessment (FMA) score and acquired their resting-state fMRI data at two times: prior to stimulation and 2 months after stimulation. Healthy subjects participated as an age-matched healthy control group (8 males and 4 females, age 56.1±14.3 years). To investigate the altered connectivity, M1 intrahemispheric and interhemispheric connectivity, and graph measures were used. The alterations in the motor network connectivity were analyzed using MATLAB (Mathworks, Inc.). The repeated measures ANOVA was applied to determine whether there are any significant differences between single and dual-mode stimulations.

Results

There were significant differences in motor network connectivity between groups. The strength of interhemispheric connectivity of the contralesional M1 was drastically increased in the DSG compared to the SSG. Interhemispheric connections significantly increased in the DSG and the change showed a noticeable increase compared that to the SSG (Figure 1). The values of network efficiency in motor networks of the DSG increased

post-stimulation. Moreover, the increase of the network efficiency in the DSG was remarkable compared to that of the SSG (Figure 2).

Conclusions

Our Results could demonstrate a different change of motor network connectivity induced by dual-mode or single stimulation in subacute stroke patients. The interhemispheric connectivity and network efficiency, which are the important indicators of function in the brain network of stroke patients, were significantly increased in the dual-mode compared to the single stimulation group. This evidence may provide insight into multi-site stimulation strategies for enhancing the effects of conventional single site NBS Method for neurorehabilitation of stroke patients.

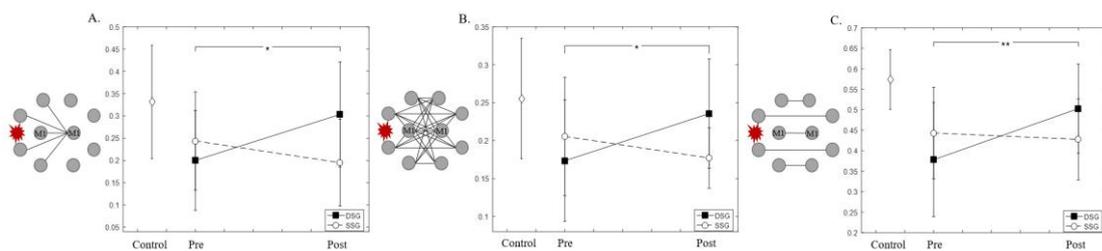


Figure 1. Altered connectivity caused by stimulation. A is the average strength of the interhemispheric connectivity of contralesional M1. B and C are the average strength of the overall interhemispheric connectivity and interhemispheric connectivity of the homotopic regions. Interhemispheric connectivity of the contralesional M1 and, overall interhemispheric connectivity was significantly increased in the DSG compared to the SSG post-stimulation (* $p < 0.05$; ** $p < 0.01$, respectively).

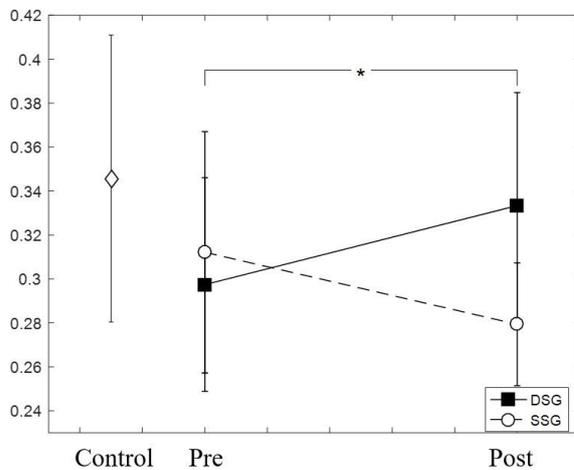


Figure 2. Changes in network efficiencies caused by stimulation. The network efficiency were significantly increased in the DSG compared to the SSG post-stimulation (* $p < 0.05$).

P 3-16

Central pain due to spinothalamic tract injury in post-concussion syndrome

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Objectives

In this study, we investigated the relationship between spinothalamic tract (STT) injury and central pain in patients with post-concussion syndrome (PCS).

Methods

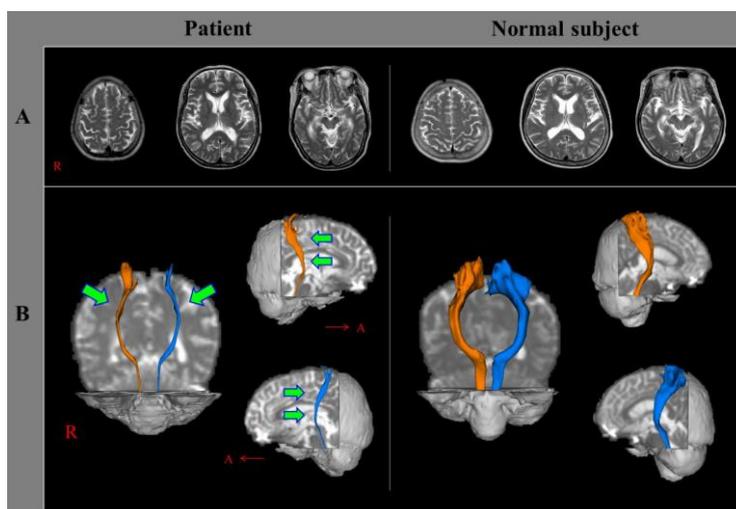
Fifty-six patients with PCS and 42 healthy control subjects were recruited. A visual analog scale (VAS) was used for evaluating central pain. PCS patients were recruited based on the PCS criteria of the International Classification of Diseases-10 (ICD-10). Fractional anisotropy (FA), mean diffusivity (MD), and tract volume (TV) values of the reconstructed STT were determined for both hemispheres.

Results

The TV value was significantly lower in the patient group than the control group ($p < 0.05$). However, significant differences in FA and MD values of the STT were not observed between the patient and control groups ($p > 0.05$). The VAS was not significantly correlated with the TV value ($r = 0.15$, $p > 0.05$) or with the number of PCS symptoms on ICD-10 ($r = -0.02$, $p > 0.05$). In addition, the TV value was not significantly correlated with the number of PCS symptoms on ICD-10 ($r = 0.08$, $p > 0.05$).

Conclusions

We observed that STT injury was associated with central pain in patients with PCS. Our Results suggest that STT injury is a pathophysiological etiology of central pain in PCS.



Brain magnetic resonance (MR) images and diffusion tensor tractography **Results** for the spinothalamic tract in a representative patient and a control subject.

The effect of regard-focused visual exploration therapy for stroke patients with visual field defect

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Introduction

Although the field-of-view(FoV) is a fundamental concept of human vision used to diagnose symptoms of visual field defect(VFD), humans have mobile sensory systems by moving their heads and bodies when viewing their surroundings. Thus, we previously proposed the concept of a human field-of-regard(FoR), which refers to the total area that can be captured by mobile visual systems. In a recent study, we demonstrated the efficacy of regard-focused visual exploration therapy(FORVT) implemented using a head-mounted display(HMD) virtual reality system for hemispatial neglect(HSN) rehabilitation following stroke. To examine the potential applications of FORVT for stroke patients with VFD this time, we applied FORVT for patients with VFD.

Objective

The Purpose of this study was to examine the efficacy of FORVT using HMD for patients with post-stroke VFD.

Methods

Nine right-handed patients who had been diagnosed with VFD after stroke but not with HSN were included. Six patients had left VFD and three patients had right VFD. Patients completed 20 sessions of a FORVT program using a HMD (five daily sessions per week over a period of four weeks). Pre- and post-training conditions were quantified by HMD assessments ; FoV and FoR. The dependent variables for FoV measurement included response time(FoV-RT) and success rate(FoV-SR). The dependent variables for FoR assessments included response time(FoR-RT), success rate (FoR-SR), and head movement(FoR-HM). We used the Wilcoxon signed-ranks test to determine whether there were differences between pre- and post-training conditions.

Results

Results revealed a significant difference in FoR-RT($p = 0.005$) and FoR-SR($p = 0.005$) between the pre- and post-FORVT condition. There was no difference between the pre- and post-FORVT conditions in FoV-RT($p = 0.288$), FoV-SR($p = 0.185$) and FOR-HM($p = 0.240$). (see Table 1)

Conclusion

FORVT improved FOR not FoV. It indicates FORVT improved attention, motor component of VF, although sensory component of VF was not obtained. Further study that includes the functional improvement after FORVT could reveal efficacy of FORVT.

table1. Results of Wilcoxon signed-ranks test relative to comparison between pre- and post-FORVT conditions.

	<i>Pre-training</i>	<i>Post-training</i>	<i>p-value</i>
FoV Detection time	1.72±0.86	1.61±0.73	>0.288
FoV Success rate	80%	86%	>0.185
FoR Detection time	3.78±1.70	2.91±1.58	<0.005
FoR Success rate	82%	94%	<0.005
Head movement	133367.01±7366.15	9438.68±5591.38	>0.240

Effects of Cerebrolysin® on Consciousness Level in Post-Stroke Minimally Conscious State(MCS)

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Introduction

The Porcine brain peptide(Cerebrolysin®) is composed of low molecular weight peptides and amino acids and has been shown to have potentially neuroprotective and neurotrophic properties. Cerebrolysin® has been reported to promote recovery of motor function in central nervous system disorders. However, the changes of cognitive function after Cerebrolysin® administration did not have been studied. Therefore, we aimed to examine the feasibility of Cerebrolysin® for the consciousness level in severe post-stroke patients with minimal conscious state through this retrospective study.

Method

75 patients with ischemic or hemorrhagic stroke who were admitted to Department of Rehabilitation Medicine from 2014 to 2017 were included in this retrospective study. They all met MCS criteria using JFK Coma recovery scale-Revised scores(CRS-R). The patients who missed CRS-R scores on admission and/or discharge or diagnosed as other brain disorders such as TBI(Traumatic Brain Injury) or HBI(Hypoxic Brain Injury) and etc. were excluded from this study (Fig. 1). All the medical records of a total 75 patients were reviewed. Among the 75 patients, 43 patients received Cerebrolysin® and the remaining 32 patients did not. In Cerebrolysin group, Cerebrolysin® was administered at a daily dosage of 10 ml for at least 20 days as an intravenous injection. Compared with Cerebrolysin group, control group received the same comprehensive rehabilitation treatment including physical therapy, occupational therapy except for only Cerebrolysin®. The CRS-R scores were assessed on admission and discharge. The difference of outcomes between two groups were compared by repeated measures ANOVA(Analysis of variance).

Result

The statistically significant differences were not found in baseline characteristics including age, sex, etiology of stroke, side of lesion, length of hospital stay, duration from onset and recurrence between two groups (Table 1). Compared with control group, Cerebrolysin group showed the significant improvements in CRS-R total scores ($p=0.011$), especially in oromotor ($p=0.005$) and arousal subscales (Fig. 2, Table 2), ($p=0.038$). However, the difference in CRS-R scores was not statistically significant depending on concomitant administration of other central nervous system(CNS) acting agents ($p>0.05$). Cerebrolysin® was safe and well tolerated.

Conclusion

This retrospective study suggested the possibility that intravenous administration of Cerebrolysin® in post-stroke patients with MCS may improve the consciousness levels of them. a well-designed double-blind placebo randomized controlled trial with Cerebrolysin® will be needed in future.

Table 1. Baseline characteristics of subjects.

	Cerebrolysin® (n=43, 58.1%)	Control (n=32, 41.9%)	p value
Age (years)	69.0±15.4	68.7±14.5	0.940
Sex (M/F)	23/20	22/10	0.236
Etiology (Hemorrhage/Infarction/Both)	18/22/3	8/23/1	0.205
Side of lesion (Rt./Lt./Bilateral)	2/24/17	3/10/19	0.090
Length of hospital stay (days)	50.1±13.7	64.0±45.0	0.776
Duration from onset (months)	2.9±2.7	4.8±5.7	0.160
Recurrence (1st /Recurrent onset)	34/9	25/7	1.000

Continuous variables are expressed as mean ± standard deviation.

Table 2. Comparison of JFK-CRS revised scores on admission and at discharge between Cerebrolysin® and control group.

JFK-CRS revised	Cerebrolysin® (n=43, 58.1%)		Control (n=32, 41.9%)		p value
	Admission	Discharge	Admission	Discharge	
Total	13.1±3.9	17.3±4.0	14.4±3.2	16.7±4.2	0.011*
Subscores					
Auditory	2.2±0.8	2.9±1.0	2.5±1.0	2.9±1.0	0.116
Visual	2.8±1.1	3.9±0.9	3.2±1.0	3.8±1.1	0.061
Motor	4.0±1.5	4.9±1.2	4.0±1.5	4.6±1.6	0.300
Oromotor	1.5±0.6	2.1±0.8	1.8±0.6	2.0±0.7	0.005*
Communication	0.5±0.5	1.0±0.7	0.7±0.5	1.0±0.6	0.351
Arousal	2.1±0.7	2.5±0.6	2.3±0.5	2.4±0.5	0.038*

The variables are expressed as mean ± standard deviation. * p<0.05

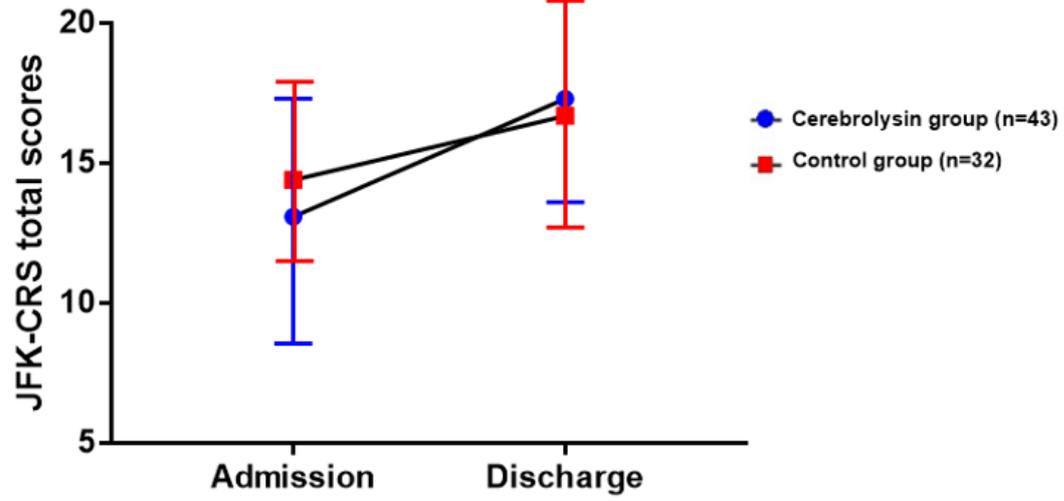


Figure 1. Changes of JFK-CRS scores in both groups from admission to discharge.

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Effect of Chin-down Maneuver in dysphagia patients by using High Resolution Manometry

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Introduction

While a number of studies have investigated the effect of swallowing compensatory maneuver on changes of pharyngeal pressure and timing among healthy subjects, only a few studies were conducted among dysphagia patients. We aimed to demonstrate the effect of the chin-down maneuver on pharyngeal pressure and timing with high resolution manometry (HRM).

Method

A total of 20 healthy subjects and 64 dysphagia patients were recruited between 2014 and 2017. Participants swallowed 5 cc of thin fluid in neutral and chin down position, respectively. Furthermore, 10 healthy subjects and 15 patients swallowed 5 cc of thick fluid (yogurt) in both positions. During swallowing, a 32 sensor HRM catheter was used to record the following parameters: maximum velopharyngeal (VP) pressure & area, maximum tongue base (TB) pressure & area, maximum low pharyngeal pressure, pre- & post-swallow UES peak pressure, minimal UES pressure, UES activity time, and nadir duration. Paired t-test and Student's t-test were used to evaluate the effect of chin down on swallowing of thin fluid, and Wilcoxon signed rank test and Mann-Whitney test on thick fluid.

Results

Compared to swallowing thin fluid in neutral position, chin-down swallowing was associated with a 7% reduction in VP pressure among dysphagia patients (p value 0.036). Chin-down swallowing was also associated with increased pressure and area of TB contraction by 14.6% (p value 0.001) and 22.9% (p value 0.009), respectively. Compared to healthy subjects, dysphagia patients had significantly lower post-swallow peak UES pressure (healthy: 32.4 mmHg, patients: 10.7 mmHg, p value 0.010) and UES activity time (healthy: 0.03 msec, patients: 0.00 msec, p value 0.032) upon swallowing thin fluid. Among dysphagia patients, chin-down swallowing of thick fluid was associated with decreased UES nadir duration (neutral: 0.30 msec, chin-down: 0.26 msec, p value 0.016) compared to neutral swallowing.

Conclusion

Our findings imply that chin-down maneuver with thin fluid may decrease VP pressure and improve tongue effort. Future studies with larger study populations are needed to further evaluate the effect of chin-down maneuver on swallowing of thick fluid.

Table 1. The changes of pharyngeal pressure parameters after the chin-down maneuver in dysphagic patients.

	Thin fluid (n=59)			Thick fluid (n=15)		
	Neutral	Chin down	p value	Neutral	Chin down	p value
Max. pressure of VP (mmHg)	166.3 (70.1)	154.0 (73.5)	0.036	150.0 (96.0)	149.5 (92.6)	0.733
Area of VP contraction.	39.7 (23.6)	38.9 (26.2)	0.708	43.6 (45.3)	47.0 (42.8)	0.363
Max. pressure of TB contraction (mmHg)	92.6 (44.0)	106.1 (49.7)	0.001	114.5 (41.9)	133.5 (62.5)	0.078
Area of TB contraction	38.0 (23.2)	46.7 (34.5)	0.009	43.9 (22.4)	51.4 (29.5)	0.088
Pre-swallow peak UES pressure (mmHg)	116.7 (68.1)	116.1 (67.2)	0.934	120.1 (55.7)	122.3 (74.0)	0.865
Max. low pharyngeal peak pressure (mmHg)	329.3 (131.6)	324.3 (141.7)	0.636	365.8 (103.7)	355.6 (109.6)	0.999
Post-swallow peak UES pressure (mmHg)	209.8 (110.6)	119.2 (105.3)	0.110	266.8 (99.6)	250.8 (90.7)	0.334
Min. UES pressure (mmHg)	-9.2 (6.7)	-8.0 (7.2)	0.117	-0.1 (20.8)	-4.6 (5.0)	0.842
UES activity time (msec)	0.72 (0.21)	0.72 (0.19)	0.915	0.82 (0.23)	0.74 (0.19)	0.070
UES nadir duration (msec)	0.26 (0.13)	0.26 (0.12)	0.669	0.30 (0.14)	0.26 (0.14)	0.016

Values are mean (SD).

p value on thin fluid was calculated by paired t-test, and p value on thick fluid was calculated by Wilcoxon signed rank test.

VP, velopharynx ; TB, tongue base ; UES, upper esophageal sphincter

Table 2. The comparisons of pharyngeal pressure parameters after the chin-down maneuver between healthy subjects and dysphagic patients. .

	Thin fluid			Thick fluid		
	Control (n=20)	Patient (n=59)	p value	Control (n=10)	Patient (n=15)	p value
Max. pressure of VP (mmHg)	-4.1 (34.1)	12.3 (44.0)	0.687	-8.6 (41.3)	0.4 (33.0)	0.567
Area of VP contraction.	-3.6 (19.2)	0.8 (16.3)	0.227	-1.1 (12.0)	-3.4 (14.6)	0.849
Max. pressure of TB contraction (mmHg)	-14.9 (26.9)	-13.5 (29.9)	0.840	-4.0 (10.8)	-19.0 (38.2)	0.567
Area of TB contraction	-8.6 (18.1)	-8.6 (24.3)	0.769	-7.1 (8.9)	-7.5 (15.1)	1.000
Pre-swallow peak UES pressure (mmHg)	13.8 (91.3)	0.6 (57.6)	0.094	6.5 (112.1)	-2.2 (42.3)	0.367
Max. low pharyngeal peak pressure (mmHg)	42.7 (71.5)	5.1 (81.8)	0.807	55.6 (90.3)	10.2 (83.7)	0.216
Post-swallow peak UES pressure (mmHg)	32.4 (92.5)	10.7 (50.4)	0.010	28.1 (59.0)	16.0 (63.1)	0.807
Min. UES pressure (mmHg)	-2.4 (6.3)	-1.2 (5.7)	0.429	-3.6 (4.1)	4.5 (19.9)	0.115
UES activity time (msec)	0.03 (0.08)	0.0 (0.18)	0.032	0.04 (0.12)	0.07 (0.14)	0.461
UES nadir duration (msec)	0.06 (0.09)	0.01 (0.10)	0.243	0.07 (0.08)	0.04 (0.05)	0.461

Mean was estimated by average of pre(neutral)-post(chin-down) difference value.

p value on thin fluid was calculated by Student's t-test, and p value on thick fluid was calculated by Mann-Whitney test.

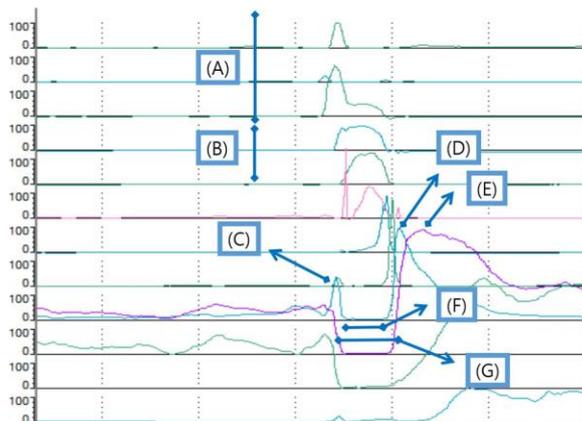


Fig.1 High resolution manometry parameters ; (A) velopharynx, (B) tongue base, (C) pre-swallow UES peak (D) low pharyngeal peak, (E) Post-swallow UES peak, (F) UES Nadir duration, (G) UES activity time (pre-UES peak to post-UES peak)

Fig.1 High resolution manometry parameters

Effect of home-based exercise program with augmented reality system on balance in stroke patients

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Objective

Recent advances in the augmented reality (AR) technology have significantly extended to the clinical rehabilitation in patients with stroke. The aim of this study is to investigate the effects of the home-based exercise program with the AR system to improve balance in stroke patients.

Materials and Methods

The home-based exercise program with AR system was designed as prospective, randomized controlled study with blind observer. Subacute hemispheric stroke patients who can walk independently on the surface without severe cognitive impairment were recruited in this study. We analyzed data of total 32 stroke patients who completed functional assessment immediately after the intervention for 4 weeks. In the experimental group (n=18), we provided the home-based exercise program with the AR system (Uincare[®]) which was composed with the task-specific game-based system. In the control group (n=14), the written home-based exercise program was provided. All participants were recommended the home-based exercise with 30 minutes a day for 4 weeks. Functional assessments with Timed Up and Go test (TUG), Tinetti Performance Oriented Mobility Assessment, and Berg Balance scale were performed before and after the intervention for 4 weeks.

Results

There was no significant difference in general and functional characteristics before the intervention (Table 1). In each group, there was a significant improvement on balance after the home-based exercise for 4 weeks ($p < 0.05$, table 2). In addition, the change of TUG for 4 weeks was significant higher in the experimental group than the control group ($p < 0.05$). There was no serious adverse effect in both groups.

Conclusions

This study was the first clinical trial to use the home-based exercise program with AR system in stroke patients. In addition, the Results of present study revealed that a therapeutic effects of the home-based exercise program with the AR system to improve

balance in stroke patients. Further study with larger number of patients will be needed to clarify the effects of the home-based exercise program with the AR system.

Table 1. Demographic and Functional Characteristics in Each Group

	Experimental group (n=18)	Control group (n=14)	P-value
Demographic characteristics			
Sex (M : F)	13 : 5	13 : 1	0.138
Age (yrs)	57.6±16.8	63.8±8.6	0.221
Height (cm)	166.2±9.7	167.9±5.2	0.543
Weight (kg)	69.5±11.6	69.1±8.4	0.911
Body mass index	25.1±2.8	24.4±2.7	0.522
Stroke type (ischemic : hemorrhage)	14 : 4	13 : 1	0.244
Affected side (right : left)	9 : 9	3 : 11	0.098
Stroke duration (months)	2.1±2.1	1.2±1.7	0.196
Functional characteristics			
K-MMSE	28.2±2.0	28.0±1.8	0.748
FAC (3 : 4 : 5)	4 : 8 : 6	3 : 4 : 7	0.586

Table 2. Change of Balance and Mood after Intervention in Each Group

	T0	T1	P-value
Timed Up and Go test(s)			
Experimental group	14.0±5.8	11.6±3.6*	<0.001
Control group	11.8±2.9	11.6±3.1*	<0.001
POMA			
Experimental group	25.7±3.6	26.6±2.7*	0.023
Control group	26.8±2.2	27.4±1.6*	<0.001
Berg Balance scale			
Experimental group	51.7±5.8	53.5±3.7*	0.006
Control group	53.3±2.6	54.3±2.5*	0.002
K-GDS-SF			
Experimental group	5.1±4.2	4.6±4.8*	<0.001
Control group	5.8±4.8	4.4±3.7	0.115
EQ-5D			
Experimental group	0.8261±0.1347	0.8750±0.7333	0.359
Control group	0.8391±0.1042	0.8751±0.0770	0.093
K-FES			
Experimental group	23.9±7.9	22.3±7.7*	0.008
Control group	19.9±6.0	19.6±5.4	0.260
K-PASE			
Experimental group	84.5±54.0	105.0±68.7	0.058
Control group	105.6±76.7	123.7±73.4	0.320

POMA, Tinetti Performance Oriented Mobility Assessment; BBB, Berg Balance scale; K-GDS-SF, Korean-Geriatric Depression Scale- Short Form; K-FES, Korean Falls Efficacy Scale; K-PASE, Korean version of Physical Activity Scale for the Elderly (K-PASE)

*p<0.05

The Difference between Maximal phonation test in stroke patients with supra & infratentorial lesion

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Objective

Dysphagia affects many stroke patients and may cause pneumonia and fatal outcome. There are many screening test to evaluate dysphagia in post-stroke patients, but there is no agreed gold standard test. Maximum Phonation Time (MPT) is a good screening test on bedside to identify pharyngeal function. The Purpose of this study is the relationship between MPT and aspiration and validity of using MPT as a bedside screening test for the risk of aspiration in acute and subacute stroke patients with supratentorial and infratentorial lesion.

Subjects and Methods

Total 106 patients who suffered from acute and subacute stroke with dysphagia were consecutively admitted to oo hospital. We checked the MPT, Parramatta Hospitals Assessment of Dysphagia (PADH) before the video fluoroscopic swallowing study (VFSS) and confirmed the factors associated with dysphagia. To find the difference between supratentorial lesion and infratentorial lesion, student's t-test was performed. To find the relationship between dysphagia evaluating value in each group, Spearman correlation analysis was performed with independent variable including the Penetration-Aspiration Scale (PAS), MPT, the American Speech-Language Hearing Association National Outcome Measurement System Swallowing Scale (ASHA-NORMS), and the Functional Dysphagia Scale (FDS), and the Age, and PAHD.

Results

Of the total 106 acute and subacute stroke patients with evaluating dysphagia, supratentorial lesion is 82 and infratentorial lesion is 24. Mean values for MPT were 9.47s in supratentorial group and 8.38s in infratentorial group. MPT and ASHA-NOMS were significant different between two groups (Table 1). In the analysis of the correlations, the MPT was correlated significantly with the PAS, ASHA-NOMS, FDS (Table 2, 3). PADH was correlated with MPT in supratentorial group but not in infratentorial group. According to ROC analysis, we suggest cut off value of MPT is 7.94s (sensitivity = 93.5%, specificity = 90.0%) in supratentorial group and 6.22s (sensitivity = 94.4%, specificity = 83.3%) in infratentorial group.

Conclusion

This research comes to the Conclusion that the MPT has a great matter of importance on dysphagia evaluation in both supratentorial and infratentorial lesion stroke patients. The Results suggest that the MPT may be a useful early screening test for detecting patients

who may be at risk for aspiration in both group and predict better Results in stroke with infratentorial lesion group.

Table 1. Demographic characteristics

Characteristics	Supratentorial	Infratentorial	t-test(<i>p</i>)
Patient (N)	82	24	
Male(N)	34 (41.5%)	10 (41.7%)	
Female(N)	48 (58.5%)	14 (58.3%)	
Onset-VFSS (days)	24.67 ± 18.60	12.08 ± 8.97	
MPT(s)	9.47 ±2.65	8.38 ±1.97	0.033*
PAS	3.07±2.78	3.54 ±2.65	0.456
ASHA-NOMS	5.21 ±1.34	4.38 ±1.58	0.025*
FDS	23.39±17.07	28.67 ±12.98	0.111
PAHD	80.52±11.22	80.17 ±7.75	0.859

Abbreviations: MPT; Maximum Phonation Time, PAS; Penetration-Aspiration Scale, ASHA-NOMS; American Speech-Language Hearing Association National Outcome Measurement System Swallowing Scale, FDS; Functional Dysphagia Scale, PAHD; Parramatta Hospitals Assessment of Dysphagia, SD; standard deviation. , * : *p*-value <0.05

Table 2. Correlation with dysphagia evaluating value in supratentorial lesion patient

	Age	PAS	MPT	ASHA-NOMS	FDS	PAHD
Age		<i>r</i> = 0.343** <i>p</i> = 0.002	<i>r</i> = -0.441** <i>p</i> = 0.000	<i>r</i> = -0.264* <i>p</i> = 0.017	<i>r</i> = 0.334** <i>p</i> = 0.002	<i>r</i> = -0.024 <i>p</i> = 0.828
PAS			<i>r</i> = -0.775** <i>p</i> = 0.000	<i>r</i> = -0.0779** <i>p</i> = 0.000	<i>r</i> = 0.612** <i>p</i> = 0.000	<i>r</i> = -0.436** <i>p</i> = 0.000
MPT				<i>r</i> = 0.694** <i>p</i> = 0.000	<i>r</i> = -0.622** <i>p</i> = 0.000	<i>r</i> = -0.292** <i>p</i> = 0.008
ASHA-NOMS					<i>r</i> = -0.745** <i>p</i> = 0.000	<i>r</i> = 0.665** <i>p</i> = 0.000
FDS						<i>r</i> = -0.476** <i>p</i> = 0.000
PAHD						

Abbreviations: MPT; Maximum Phonation Time, PAS; Penetration-Aspiration Scale, ASHA-NOMS; American Speech-Language Hearing Association National Outcome Measurement System Swallowing Scale, FDS; Functional Dysphagia Scale, PAHD; Parramatta Hospitals Assessment of Dysphagia. ** : *p*-value <0.01, * : *p*-value <0.05

Table 3. Correlation with dysphagia evaluating value in infratentorial lesion patient

	Age	PAS	MPT	ASHA-NOMS	FDS	PAHD
Age	$r = 0.060$	$r = -0.166$	$r = 0.009$	$r = -0.177$	$r = 0.063$	
	$p = 0.781$	$p = 0.438$	$p = 0.969$	$p = 0.409$	$p = 0.769$	
PAS		$r = -0.893^{**}$	$r = -0.794^{**}$	$r = 0.306$	$r = -0.167$	
		$p = 0.000$	$p = 0.000$	$p = 0.146$	$p = 0.435$	
MPT			$r = 0.684^{**}$	$r = -0.457^*$	$r = 0.212$	
			$p = 0.000$	$p = 0.025$	$p = 0.320$	
ASHA-NOMS				$r = -0.375^{**}$	$r = 0.215$	
				$p = 0.071$	$p = 0.313$	
FDS					$r = -0.287$	
					$p = 0.174$	
PAHD						

Injury of corticofugal tracts from the secondary motor area in patients with putaminal hemorrhage

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Objectives

We investigated injury of the corticofugal tracts (CFTs) from the secondary motor area in patients with putaminal hemorrhage by performing diffusion tensor tractography (DTT).

Methods

Forty-four patients with putaminal hemorrhage and 41 age- and sex-matched control subjects were recruited. A probabilistic tractography Method was used in fiber tracking for reconstruction of the corticospinal tract (CST) and the CFT. Fractional anisotropy (FA), mean diffusivity (MD), and tract volume of the CSTs and CFTs from the dorsal premotor cortex (dPMC) and supplementary motor area (SMA) were measured.

Results

Patients showed severe motor weakness (motricity index [MI] = 57.6/100). In the affected hemisphere of the patient group, the FA and tract volume of the CST and CFTs were significantly lower than those of the unaffected hemisphere and the control group ($p < 0.05$). MI was strongly positively correlated with the FA of the affected CST in the patient group ($p < 0.05$, $r = 0.783$). However, we did not detect any correlations between MI and DTT parameters (FA, MD, or tract volume) of the CFTs ($p > 0.05$).

Conclusions

The DTT Results demonstrated concurrent injuries of the CFTs from the dPMC and SMA with injury of the CST in patients with putaminal hemorrhage. Our Results suggest that limb-kinetic apraxia ascribed to injury of the CFTs from the secondary motor area could be accompanied by injury of the CST following putaminal hemorrhage.

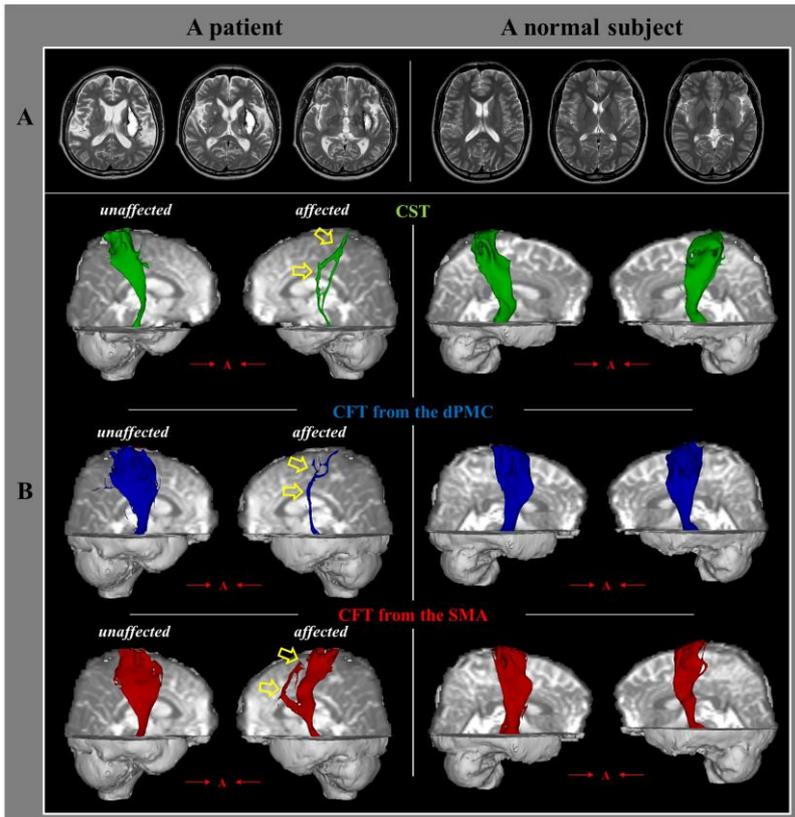


Fig. 1. (A) T2-weighted brain magnetic resonance images of a patient (55-year-old male) and a normal subject (56-year-old male). (B) Results of diffusion tensor tractography. The corticospinal tract (CST, green color) and the corticofugal tracts (CFTs) from the dorsal premotor cortex (dPMC, blue color) and supplementary motor area (SMA, red color) are reconstructed in both hemispheres. Injured neural tracts are indicated with yellow arrows.

Dual-task interference can be reduced by cognitive and physical training

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OBJECTIVE

Dual-task interference (DTI) is an impairment in performance when simultaneously performing two tasks such as cognitive and motor tasks. The aims of this study were (1) to identify the factors affecting DTI in healthy participants, and (2) to analyze the relative implications to decrease DTI.

METHODS

A total of 46 healthy farmers performed the following three computerized experiments: (1) cognitive (CT): release button 1 (BT1) as rapidly as possible when the font color of a word and its meaning were congruent (Go), (2) motor (MT): release BT1 and then tap button 2 (BT2) 10 times as rapidly as possible if the symbol “o” was presented (Go), and (3) dual tasks (DT): combination of CT and MT elements. The reaction time (RT) of correct releases (RTCR) of BT1 in all tasks was measured, and the RTCR ratios in CT and MT were divided by the RTCR of DT to obtain the DTI values. Additionally, general and agriculture working characteristics, psycho-cognitive status, and physical performance status were assessed. Data were analyzed by correlation analysis and multiple linear regression analysis (stepwise) to determine the explanatory factors of DTI.

RESULTS

The ratios of RTCR in CT (%CT/DT, 78.6±13.0%, $p<0.001$) and MT (%MT/DT, 74.2±10.1%, $p<0.001$) were significantly decreased compared to that of DT (100%). The Results revealed that in the female group, %MT/DT (up to 100% means lesser cognitive DTI) showed significant correlations with the Korean version of the Mini-Mental State Examination (MMSE-KC) from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) score ($r=0.392$, $p=0.027$) and exercise time (hrs) per year ($r=0.371$, $p=0.037$). Regression analysis showed that MMSE-KC score ($\beta=0.356$, $p<0.05$) and exercise time per year ($\beta=0.333$, $p<0.05$) remained as explanatory factors of %MT/DT.

CONCLUSIONS

We developed a computerized program that can measure the performances of single/dual-task, and quantify the DTI. The Results of this study showed that cognitive DTI is related to cognitive level and exercise duration. Based on these Results, the training programs to overcome DTI might include specific cognitive and physical training protocols.

Table 1. Pearson's correlation coefficients between ratio of computerized single/dual tests and demographic data

		Total (n=46)				Male (n=14)				Female (n=32)			
		%CT/DT		%MT/DT		%CT/DT		%MT/DT		%CT/DT		%MT/DT	
		Pearson Correlation	p-value										
General characteristics	Age	.061	.689	-.122	.420	.462	.096	.037	.901	-.044	.810	-.227	.212
	Education period (yr)	-.119	.432	.222	.138	.033	.910	.260	.370	-.122	.506	.212	.243
Agriculture Characteristics	Farming period (yr)	.010	.945	-.076	.614	-.164	.575	.065	.825	.069	.706	-.148	.419
	Farm working time per year (hr)	-.021	.891	-.003	.985	-.010	.973	.001	.996	-.012	.950	-.015	.935
	Housekeeping time per year (hr)	.214	.154	-.036	.814	-.103	.725	.193	.509	.248	.170	-.038	.838
	Exercise time per year (hr)	.029	.850	.211	.159	-.148	.613	.003	.992	.125	.494	.371*	.037*
	Total working time per year (hr)	.100	.510	.009	.954	-.089	.761	.043	.885	.152	.407	.013	.945
Psychocognitive status	MMSE-KC (0-30)	-.220	.142	.303*	.041*	.187	.521	.072	.806	-.323	.071	.392*	.027*
	GNG reaction time	.040	.790	-.289	.051	.018	.951	-.254	.382	.034	.851	-.305	.089
	K-BDI (0-63)	.150	.319	-.008	.956	-.220	.449	.199	.495	.203	.266	-.039	.833
	Stress (0-10)	-.148	.328	-.056	.710	-.180	.538	-.219	.452	-.139	.447	-.007	.970
	FSS(1-7)	-.047	.756	.036	.812	-.226	.436	.147	.615	.017	.926	-.017	.925
	PPT(N)	-.181	.230	-.019	.901	.247	.394	.333	.244	-.263	.146	-.170	.351
Physical performance status	Grip strength (kg)	-.134	.375	.007	.964	-.308	.284	-.099	.736	-.026	.889	-.031	.866
	Finger tapping reaction time	.108	.474	-.173	.251	-.211	.468	.198	.497	.167	.360	-.282	.117
	SPPB (0-12)	-.099	.511	.028	.856	-.417	.138	.322	.261	.066	.719	-.177	.334

CR, correct response; CT, cognitive task; DT, dual task; MT, motor task; MMSE-KC, Korean version of the mini-mental state examination; GNG, Go/no go task; K-BDI, Korean version of beck depression inventory; FSS, fatigue severity scale; PPT, pain pressure threshold; SPPB, Short Physical Performance Battery

Table 2. Stepwise multiple linear regression analysis with %MT/DT as a dependent variable performed in all (n = 46) and female(n=32) subjects.

		%MT/DT							
		R ²	F(p)	B	Std.Error	Beta	t-value	p-value	VIF
Total (n=46)	MMSE-KC (0-30)	.092	4.454 *	1.333	.632	.303	2.110	.041	1.000
	Exercise time per year (hr)								
Female (n=32)	MMSE-KC (0-30)	.263	5.176 *	1.352	.609	.356	2.221	.034	1.012
	Exercise time per year (hr)			.023	.011	.333	2.077	.047	1.012

Effect of reducing assistance during robot-assisted gait training on step length asymmetry

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Objective

An assist-as-needed robot-assisted gait training protocol was recently developed. It allows active movement during training, but its exact criteria remain unknown. Asymmetric step length is a common abnormal gait pattern in hemiplegic stroke patients. We compared the effects of assist-as-needed robot-assisted gait training on the unaffected and affected limbs of hemiplegic stroke patients.

Method

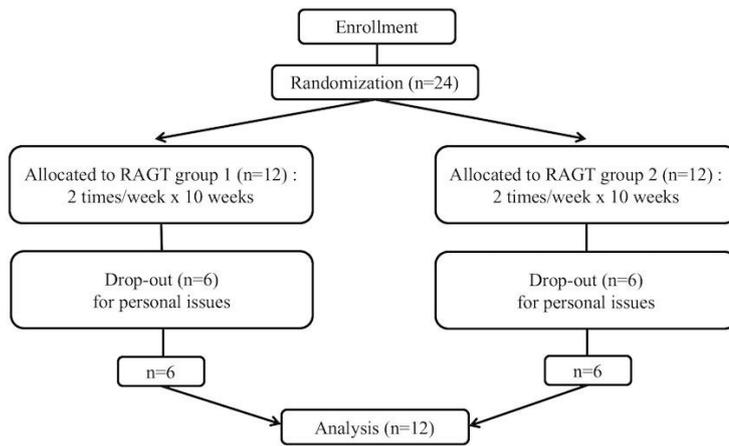
Twenty-four chronic stroke patients with asymmetric step lengths were randomly assigned to one of two groups. Twelve completed the study protocol. Group 1 underwent 20 sessions of assist-as-needed robot-assisted gait training for the unaffected limb and fully-assisted robot-assisted training for the affected limb. Group 2 underwent 20 sessions of robot-assisted gait training using the opposite protocol. Clinical measurements were obtained and three-dimensional gait analyses were performed at baseline and after 10 and 20 training sessions.

Results

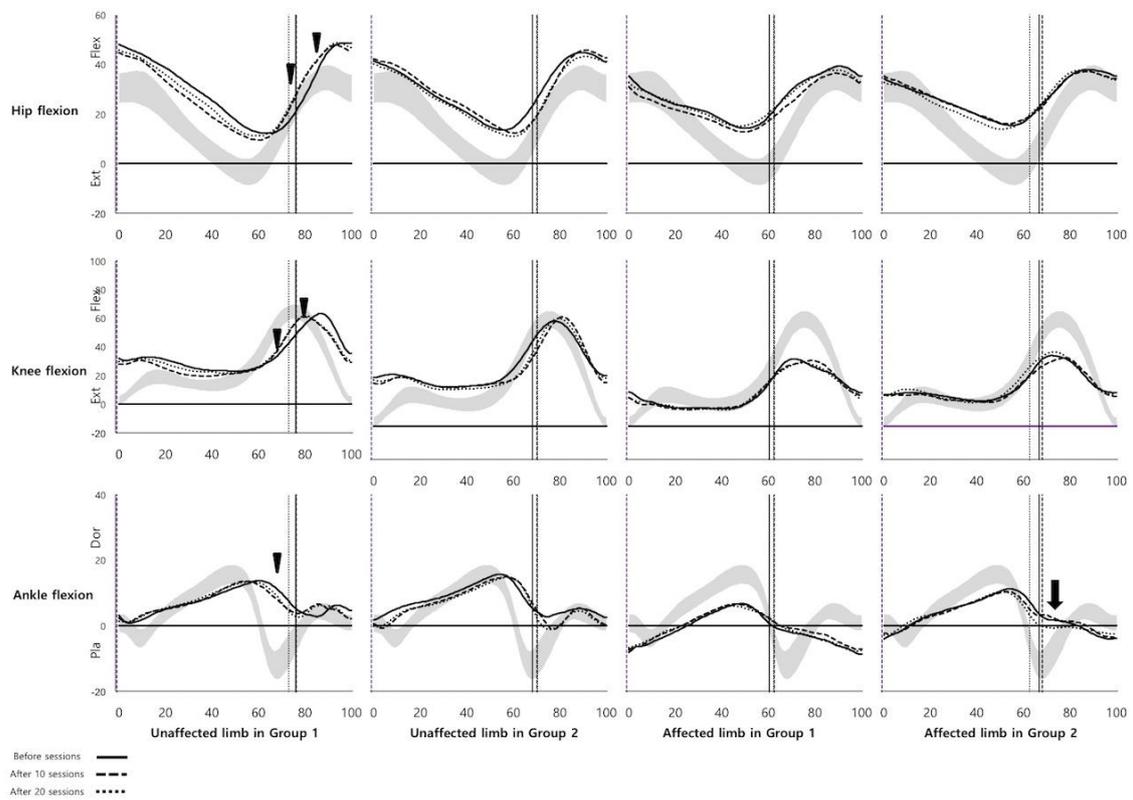
Clinical measurements improved in both groups after 20 training sessions. The unaffected limb's step length asymmetry ratio and hip maximal extension moment significantly improved in group 1. The affected limb's maximal dorsiflexion angle for the ankle in the swing phase significantly improved in group 2.

Conclusion

Application of the assist-as-needed training mode for the unaffected limb helped improve step length asymmetry in chronic stroke patients.



CONSORT flow diagram.



Changes in kinematic variables at baseline, after 10 sessions, and after 20 sessions of training.

Relationship between SLF injury and visual pursuit in patients with unconsciousness follow HI-BI

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Introduction

By using diffusion tensor tractography (DTT), we investigated the relationship between visual pursuit disturbance and injury of the superior longitudinal fasciculus (SLF) in patients with impaired consciousness following hypoxic-ischemic brain injury (HI-BI).

Methods

Twenty patients with impaired consciousness due to HI-BI and 11 control subjects were recruited to this study. We placed the patients into one of two groups according to whether they had visual pursuit ability, which was based on their visual function scale score on the Coma Recovery Scale-Revised (CRS-R): group A (visual fixation; CRS-R visual function scale score 0~2), 13 patients; group B (visual pursuit; CRS-R visual function scale score 3~5), 7 patients. The SLF of each participant was analyzed to obtain fractional anisotropy (FA), apparent diffusion coefficient (ADC), and fiber number (FN) values.

Results

Significant differences were observed in all three DTT parameters (FA, ADC, and FN) between patient groups A and B and the control group ($p < 0.05$). In the comparison of groups A and B, the FA, ADC, and FN values were different for the right, left, and both SLF except for the FN of the left SLF and the ADC of the right SLF ($p < 0.05$). A moderate positive correlation was observed between the CRS-R visual function scale and FA ($r = 0.619$, $p < 0.05$) and FN ($r = 0.522$, $p < 0.05$) values for both SLF. However, a moderate negative correlation was observed between the CRS-R visual function scale and ADC values for both SLF ($r = -0.451$, $p < 0.05$).

Conclusion

We observed a close relationship between visual pursuit disturbance and SLF injury in patients with impaired consciousness following HI-BI. We believe that SLF injury is a pathophysiological mechanism in visual pursuit disturbance of patients with impaired consciousness following HI-BI.

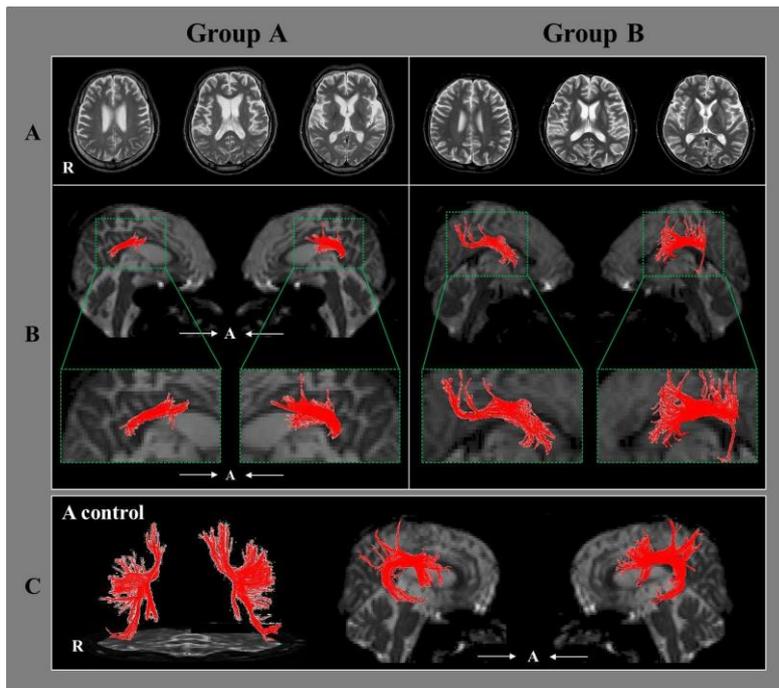


Fig. 1 (A) T2-weighted brain magnetic resonance images of representative patients in group A (46-year-old male) and group B (49-year-old male). (B, C) Results of diffusion tensor tractography for the superior longitudinal fasciculus (SLF) of (B) the same patients and (C) a control subject (50-year-old male). The SLF in both hemispheres of the patients show the presence of injuries when compared with those of the control subject. Moreover, the group A patient images indicate more severe injury than that in the group B patient.

Brain Connectivity of Lesions causing Post-stroke Depression

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Introduction

Depression is the most common neuropsychological sequela of stroke and an independent predictor of morbidity and mortality. Patients with focal brain lesions can yield insight into the causal neuroanatomical substrate underlying depression. However, localization of depression-causing brain region based on lesion location has led to inconsistent Results. Here, we test whether functional connectivity with each lesion location was related to depression along with a normative connectome, to identify underpinning brain regions or networks of post-stroke depression.

Method

Three independent post-stroke lesion data sets totaling 155 patients were included (Table 1). Lesions were manually segmented based on CT or structural MRI images, spatially normalized to MNI 152 space, and binarized. First, voxel lesion symptom mapping was performed to identify any lesioned brain voxels associated with depression (versus control lesions) using Bayesian Spatial Generalized Linear Mixed Model software. Second, functional connectivity between each lesion location and the rest of the brain was computed using resting state functional connectivity data from 1000 healthy subjects. Lesion network maps of depressed versus non-depressed subjects were statistically compared using a general linear model.

Result

Lesion location was not significantly associated with depression. In contrast to analyses focused on lesion location alone, lesion connectivity was significantly associated with depression. Specifically, a focal region in the left dorsolateral prefrontal cortex was significantly more connected to lesion locations associated with depression compared to control lesions. Negative functional connectivity (anti-correlation) to limbic regions was also predictive (Figure 1, Table 2)

Conclusion

Positive frontal connectivity and negative limbic connectivity were independent predictors of lesion-induced depression. These Results lend insight into the causal substrate of depression symptoms, identify patients at risk for post-stroke depression, and may help refine treatment targets for brain stimulation.

Table 1. Demographics and Clinical Characteristics

	Total Data	<u>Gozzi et al, 2014</u>	<u>Corbetta et al, 2015</u>	Kim et al, 2017
Total Subjects for Primary Analysis (Depressed/Control)	156 (29/127)	45 (7/38)	87 (14/73)	24 (8/16)
Mean age (<u>stdev</u>)	56.8 (15.6)	63.5 (13.5)	53.8 (11.0)	54.8 (17.7)
Sex (% M, % F)	89 M (57%), 67 F (43%)	29 M (64%), 16 F (36%)	45 M (52%), 42 F (48%)	15 M (63%), 9 F (37%)
Depression scale		Hospital Anxiety and Depression Scale	Geriatric Depression Score (Short Form)	Geriatric Depression Score (Long Form)
Depression threshold		HADS ≥ 11	GDSS ≥ 11	GDSS ≥ 17
Control threshold		HADS < 11	GDSS ≤ 5	GDSS ≤ 16

Table 2. Positive and negative peaks for lesion network mapping of depression

Cluster	Location	Voxels	Max T value	Max X	Max Y	Max Z
Positive correlations						
1	Left middle frontal gyrus (left DLPFC)	612	4.68	-32	14	36
2	Right middle frontal gyrus (right DLPFC)	59	3.48	30	14	36
3	Left cerebral white matter (corpus callosum)	14	3.19	-2	-6	24
Negative correlations						
1	Left cerebral white matter (medial forebrain bundle)	11	-3.39	-18	26	2
2	Right lateral ventricle (septal nuclei)	52	-3.33	2	18	4
3	Right cerebral white matter (right ventral striatum)	3	-3.05	20	14	-12

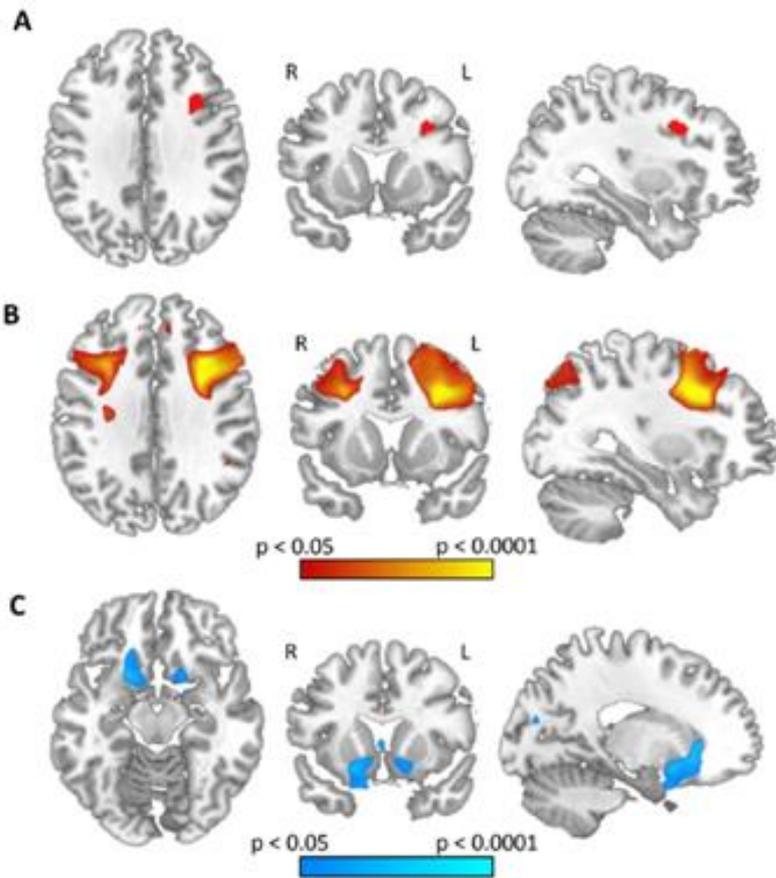


Figure 1. The connectivity profile of brain lesions causing depression. (A) A focal region in the left dorsolateral prefrontal cortex was significantly more connected to lesions causing depression than control lesions (whole brain voxel-level family-wise error corrected $p < 0.05$). Relaxing statistical threshold ($p < 0.05$, uncorrected) reveals a similar positive association in the right DLPFC (B) and identifies regions in limbic regions negatively associated with depression (C)

Brain Structural Connectome Accurately Classifies Alzheimer's Disease Related Dementia

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INTRODUCTION

There is an urgent, unmet need for clinically useful biomarkers of Alzheimer's disease related dementia (ADRD) based on non-invasive and affordable measures. This studies have focused on brain MRI-derived markers. We tested utility of brain's structural connectome in classification of Alzheimer's disease related dementia.

METHODS

Participants : We used data from 211 elderly people who visited the dementia clinic at Ilsan Hospital from 2009 to 2013. Diagnosis was made by physicians based on history taking, neuropsychological evaluations and MMSE. Participants included 110 with diagnosis of Alzheimer's disease, 64 with mild cognitive impairment and 37 subjective mild cognitive impairment. **MRI acquisition and analysis :** Firstly, we estimated morphometrics measures using Freesurfer image analysis pipeline from T1 and FLAIR images. Morphometric measures (N=948 per subject) include volumes of the hippocampal subdivisions, and thickness, surface area, and volume of cortical/subcortical regions. Secondly, we estimated structural connectome using the diffusion MRI analysis pipeline, Mrtrix 3. The connectome measures (N= 33,698 per subject) include counts of streamlines, a surrogate measure of structural connectivity, and mean length of streamlines given any two brain regions based on multiple atlases. **Classification :** We built several machine learning models using the large-scale brain MRI-derived phenotypes to predict diagnosis of AD and MCI, respectively. Logistic regression (L1 regularization) and support vector machine (SVM) was used.

RESULTS

In prediction of Alzheimer's disease(AD) vs. subjective mild cognitive impairment(SMI), models based on both morphometric and connectomic estimates showed good classification accuracy (SVM accuracy = 0.98 ± 0.011 ; LR accuracy= 0.97 ± 0.009 ; ten-fold cross validation). In prediction of MCI (mild cognitive impairment), models also showed good classification accuracy (SVM accuracy= 0.93 ± 0.05 ; LR accuracy= 0.86 ± 0.042 ; Figure 1). We also compared morphometry- and connectome-based models and testing model performance as a function of numbers of features. In prediction of AD, classification accuracy of the connectome-based model is similar to that of the combined model, significantly outperforming that of morphometry-based model (Figure 2). Likewise, in prediction of MCI, classification accuracy of the connectome-based model is similar to

that of the combined model, significantly outperforming that of morphometry-based model.

CONCLUSIONS

In this study, we showed that large-scale MRI-derived brain phenotypes, including the whole brain morphometric and connectomic estimates, can be used to reliably classify Alzheimer’s disease related dementia. This shows potential clinical utility of the machine learning models using large-scale MRI-derived brain phenotypes in prediction of risk for ADRD.

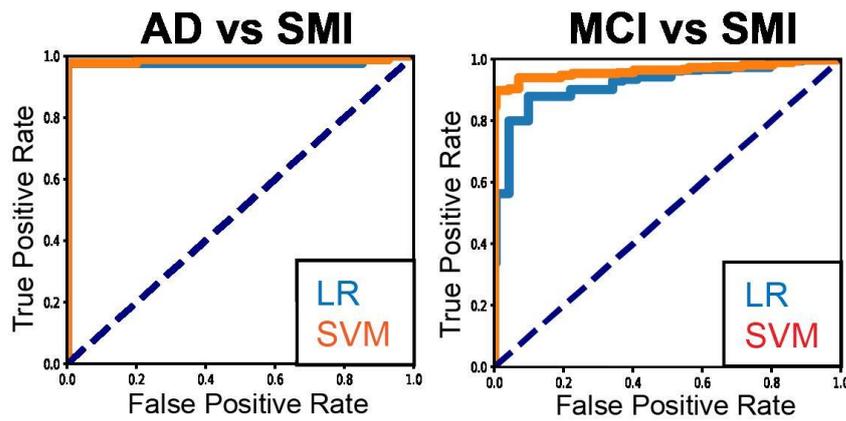


Figure 1. Classification accuracy of Logistic regression and support vector machine.

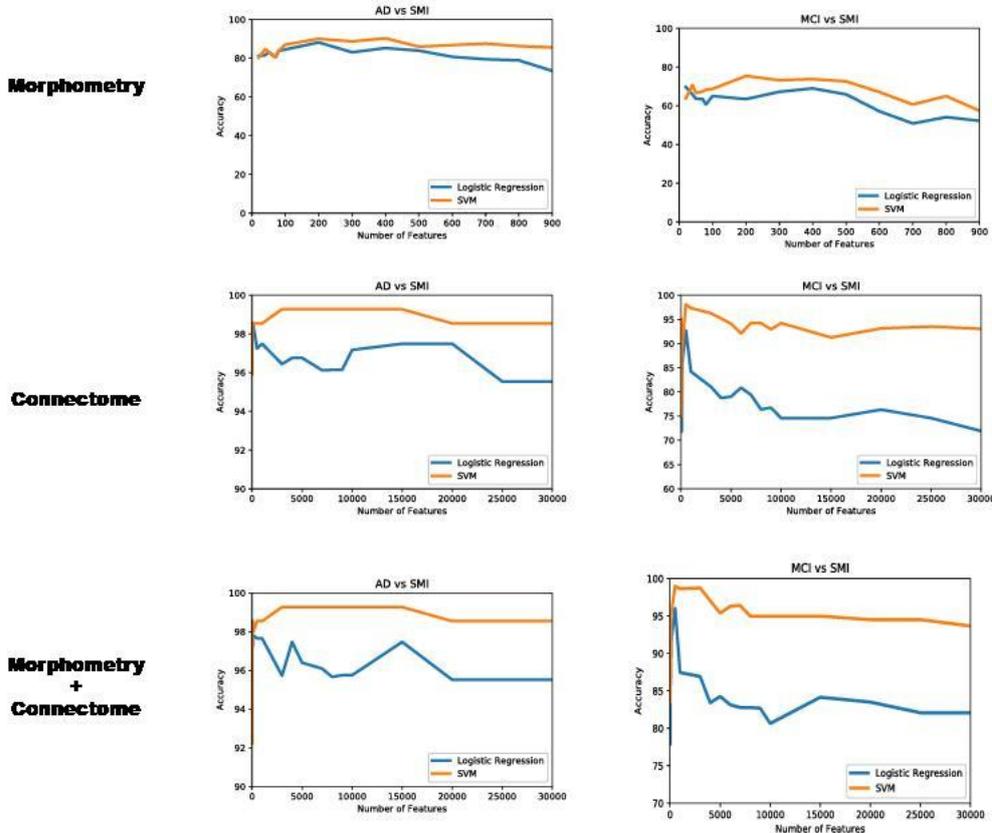


Figure 2. Classification accuracy of the morphometry-based model, connectome-based model and the combined model.

The effect of the hydrocephalus to the neural tracts : DTT study

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College of Medicine, Yeungnam University, Department of Rehabilitation Medicine¹

Introduction

We investigated the effect of hydrocephalus to the adjacent the neural tracts of the lateral ventricle in patients with hydrocephalus following spontaneous intracerebral hemorrhage (ICH), using diffusion tensor tractography (DTT).

Method

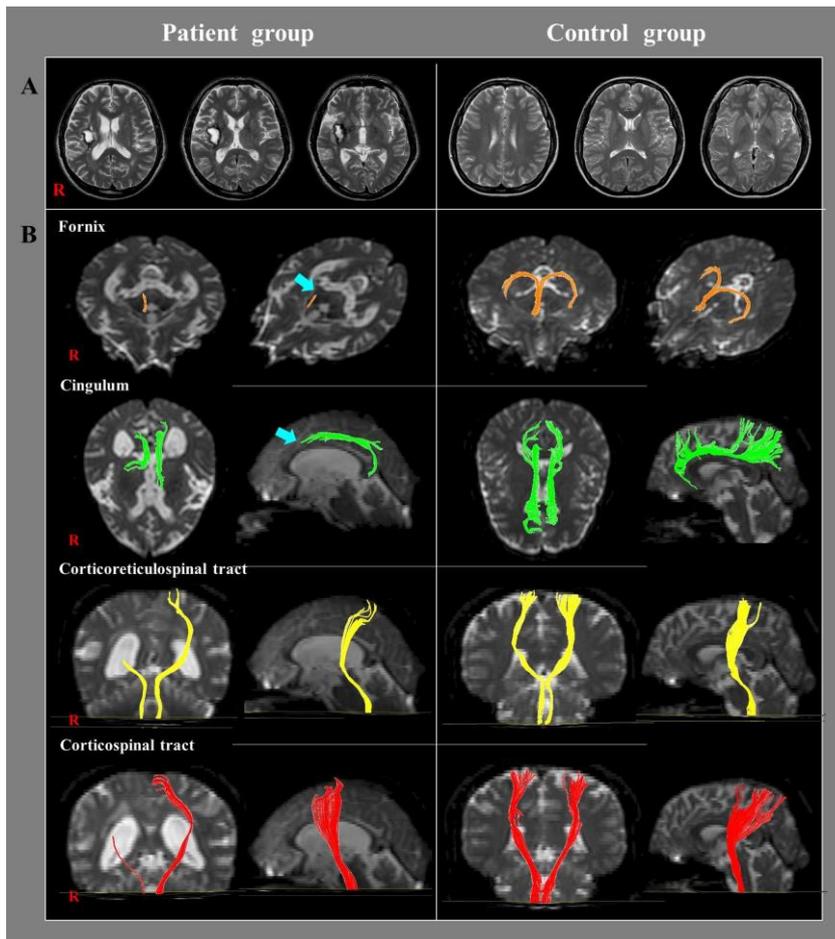
Fourteen consecutive patients with spontaneous ICH and hydrocephalus and 20 control subjects were recruited for this study. DTI studio software was used for evaluation of four neural tracts: corticospinal tract (CST), corticoreticulospinal tract (CRT), fornix, and cingulum. We measured the fiber number (FN) and fractional anisotropy (FA) of each neural tracts.

Results

The values of FN and FA of the fornix, and FN of the cingulum showed significant differences between the patient and control groups ($p < 0.05$). However, no significant difference was not observed in the other DTT parameters of the rest neural tracts ($p > 0.05$). In terms of the FN, the effect size of the fornix showed the largest effect size (-554.761), followed by cingulum (-460.261), CRT (-216.471), and CST (-21.096). In addition, regarding the FN value, CST had statistically significant effect sizes compared to CRT, fornix, cingulum ($p < 0.05$), except for the comparison between fornix and cingulum ($p > 0.05$). However, as for the FA value, any pairwise comparisons of two effect sizes did not show significant difference ($p > 0.05$).

Conclusion

We found that the hydrocephalus affected to the fornix and cingulum without significant affection to the CRT and CST. Our Results suggest that the neural tracts related to the cognition (fornix and cingulum) appeared to be more affected by hydrocephalus rather than motor function (the CRT and CST).



(A) T2-weighted MR images shows a patient with hydrocephalus (59-year-old male) and control subject (56-year-old male). (B) Results of diffusion tensor tractography images of the fornix, cingulum, corticoreticulospinal tract and corticospinal tract in a patient and control subject. Blue arrow: injury of the neural tracts in unaffected hemisphere.

Isolated oculomotor nerve palsy in mild traumatic brain injury: A literature review

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Background

Isolated oculomotor nerve palsy (ONP) is rarely encountered after mild traumatic brain injury (TBI). It is difficult to offer patients accurate management strategies or prognostic assessments because only a few reports have described the management of ONP.

Methods

We performed a search for all clinical studies of isolated ONP after mild TBI published up to December 14, 2017. We placed no restrictions on language or year of publication in our search, and we searched the following keywords: traumatic brain injury, isolated oculomotor nerve palsy, mild head trauma, management, and prognosis.

Results

We identified 13 cases of isolated ONP after TBI. Except for two cases of incomplete ONP with pupil sparing, the degree of ONP was complete. In three cases, steroids were used to manage the ONP. Five patients who had underlying brain lesions underwent surgery, and six patients were observed and followed up. The time to partial or complete resolution was 6.2 months \pm 5.8 months with a range of 0.5 to 18 months.

Conclusion

Observation is considered to be sufficient management for isolated ONP after TBI because there are no set guidelines. We can expect improvement in ONP without specific management within approximately 6 months after the accident.

Factors Affected to Unplanned Transfer in Inpatient Rehabilitation Hospital

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Objective

Effective inpatient rehabilitation after acute phase treatment can minimize functional disability, enhance recovery toward independence, and optimize community participation. But in-hospital unplanned transfer generates high health care costs and contributes to patient morbidity and mortality. In addition, they are associated with increased acute care length of stay (LOS) and therefore to reduced access to hospital beds for other patients. Our Objective is to improve the efficiency of rehabilitation by early detection and prevention of patient unplanned transfer during inpatient rehabilitation treatment by evaluating the reason for transfer to other departments.

Methods

Medical records of 693 inpatient rehabilitation facility patients who had admitted to the department of rehabilitation from October 2017 to May 2018 were reviewed retrospectively. All patients were classified into six groups of brain injury, spinal cord injury, musculoskeletal injury, neuromuscular disease, cancer and cardiopulmonology rehabilitation which were investigated about other department transfers during the hospital stay. The outcome is all-cause, unplanned transfer rate from an inpatient rehabilitation facility to the other departments. In addition, we confirmed the transfer department and the cause of transfer to the other department.

Results

A total of 693 patients (age, 65.72±13.51 years; 58.1% male, 41.9% female) who had admitted in a tertiary hospital rehabilitation center from October 2017 to May 2018 were reviewed in this study. The number of patients who were transferred to the other department ward in brain injury group was 36 (10.71%), in spinal cord injury group was 19 (16.96%), in musculoskeletal injury group was 8 (4.35%), in neuromuscular disease group was 4 (21.05%), in cancer group was 5 (33.33%) and cardiopulmonology rehabilitation group was 7 (25.93%). The major cause of the transfer to the other departments in brain injury group was septic shock and hydrocephalus. The major cause of it spinal cord injury group was operation and pneumonia. In musculoskeletal injury group, neuromuscular disease group, cancer group and cardiopulmonology rehabilitation group, the major cause of it was pneumonia or septic shock.

Conclusions

The highest transfer rate was observed in the cancer group. As reported in other studies, patients with high severity and comorbidity had a high unplanned transfer rate. In the brain injury and spinal cord injury group, unplanned transfer due to intervention and

operation is considered to be a major factor and attention should be needed to this as well as complications. The early detection and prevention of the causes of unplanned transfer in this study may reduce the transfer to the other departments and improve the efficiency of rehabilitation.

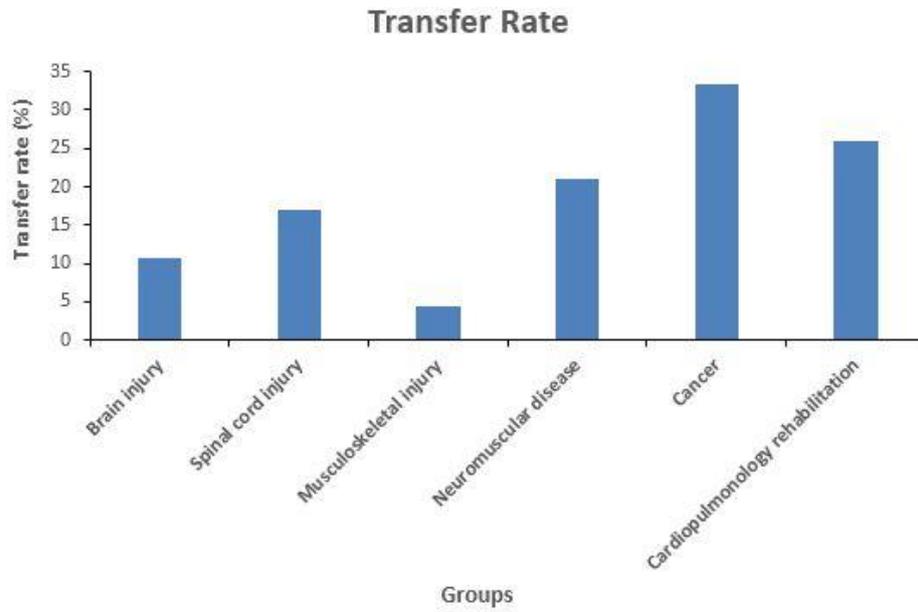


Fig 1. Unplanned transfer rate in each groups

Correlation between Arcuate Fasciculus and Aphasia Score with/without rTMS in Subacute Stroke

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Kyung Hee University Medical Center, Department of Rehabilitation Medicine²

Objective

After a stroke, up to 20% of patients has been reported aphasia. Arcuate fasciculus (AF) as the neural tract connecting Broca's and Wernicke's areas has been regarded as an important neural tract for language. Recently research showed correlation between language function and diffusion tensor tractography (DTT) findings in AF in stroke patients with aphasia. In the present study, repetitive transcranial magnetic stimulation (rTMS) might enhance recovery of aphasia. The main Purpose of this study is to analyze correlations between value of initial DTT of AF and aphasia quotient (AQ) in subacute stroke patients.

Method

A total of twenty patients with stroke and aphasia were recruited during December, 2016 - April, 2018. The changes of AQ value of initial treatment and posttreatment were measured using Korean version of western aphasia battery (K-WAB) when early stage of stroke and after about 1 month when discharge from our department. Conventional treatment for aphasia performed 3 times per week in both group. 10 patients of 10 Hz high-frequency rTMS intervention during 2-weeks treatment period whom of the patient received 10 sessions: 1 session consists of 10 seconds stimulus train and 50 seconds duration which applied to left Broca's areas. Using DTT, we measured initial values of volume (mm³) of AF tract, fractional anisotropy (FA), and apparent diffusion coefficient (ADC).

Results

According to our findings, between rTMS treatment group and only language treatment were no significant difference in changing value of AQ, spontaneous speech (SS), auditory verbal comprehension (AVC), repetition and naming. Comparing content of AQs with initial value of AF tract, moderate positive correlation was observed between remain left volume of AF tract and changing value of AVC ($r=0.353$, $p<0.05$). Also, moderate negative correlation were observed between left ADC value and changing value of repetition ($r=-0.478$, $p<0.05$).

Conclusion

Other previous researches referred both language treatment and rTMS effect to aphasia patient with stroke. In our study, each of treatment effected in AQ score. But no significant different in treatment effect between combined rTMS treatment and only

received language treatment group. Volume of AF, ADC value were important factors for language function which of AVC and naming progression. We recommend DTT in subacute stroke patient with aphasia for choosing specific treatment Method and predict to treatment effect.

Pre-stroke Core Muscle Stability as a Predictor of Trunk Balance in Subacute Stroke Patients

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Objective

Postural core instability is associated with poor dynamic balance, and trunk control ability is a crucial component to perform activity of daily living (ADL). Previous studies presented that trunk control ability or sitting balance at an early stage could predict ADL outcome at a late stage in patients after a stroke. There have been some reports about the correlation between trunk balance and change of muscle thickness during core exercise. But, there has been no trial about the correlation between trunk balance and resting muscle thickness including back muscles and the abdominal balance in subacute stroke patients. The Objective of this study was to determine the relationship between trunk muscles thickness measured by ultrasonography and trunk balance of stroke patients during the subacute phase.

Methods

We enrolled 21 patients with first-ever stroke during the period of March, 2018 through June, 2018. All patients were admitted or transferred to our rehabilitation department within 6 months of onset. Patients with recent abdominal or spine surgical procedure were excluded from the study. The thickness of the abdominal muscles and back muscles was measured by ultrasonography with the patient in the hook-lying position and prone position on an examination table, respectively. Abdominal muscles such as external and internal oblique muscles (EO and IO), transverse abdominis (TrA), rectus abdominis (RA) and back muscle such as lumbar multifidus (LM), lumbar erector spinae (ES), quadratus lumborum (QL) were measured. Functional ability was evaluated with the functional independence measure (FIM) instrument, and balance was measured using the 14-item of Berg Balance Scale (BBS) and trunk impairment scale (TIS). All measures were assessed at the same day of inpatient rehabilitation. Partial correlation coefficient was used to analyze the correlation between trunk muscles thickness and trunk balance and functional outcome. Data analyses involved use of SPSS v18.0 for Windows. $P < 0.05$ was considered statistically significant.

Results

Correlation analysis revealed that BBS showed significant positive correlation with the thickness of EO ($p=0.008$) and TrA. ($p=0.005$) in non-paretic side (Table 1). The functional outcome also revealed significant positive correlation with the non-paretic side EO thickness ($p=0.009$) and non-paretic side TrA thickness ($p=0.025$) (Table 2). There was no significant relationship between trunk balance and back muscles thickness.

Conclusion

This is the first study to investigate the correlation between resting trunk muscles thickness and trunk balance in stroke patients. Our Results reveal that abdominal muscle thickness of non-paretic side is significantly associated with trunk balance and functional outcome during subacute phase of rehabilitation. These findings suggest that prestroke core muscle stability including abdominal muscle thickness might influence the trunk balance in subacute stroke patients.

Table 1. Partial correlation coefficient (r) between the Trunk Muscles and Trunk Balance (BBS, TIS) adjusted for sex, age, height and weight (n=21)

Variables	BBS		TIS	
	Pearson coefficient : r	p-Value	Pearson coefficient : r	p-Value
p-EO	0.168	0.519	-0.134	0.608
p-TrA	0.305	0.235	0.074	0.777
p-LM	-0.194	0.455	-0.308	0.229
n-EO	0.616	0.008*	0.318	0.213
n-TrA	0.647	0.005*	0.356	0.161
n-LM	-0.083	0.753	-0.319	0.212

p-: paretic side, n-: non paretic side, EO: External oblique, TrA: Transverse abdominis, LM: Lumbar multifidus

*P <0.05

Table 2. Partial correlation coefficient (r) between the Trunk Muscles and Functional Outcome (FIM) adjusted for sex, age, height and weight (n=21)

Variables	FIM	
	Pearson coefficient : r	p-Value
pEO	0.265	0.305
pTrA	0.308	0.229
pLM	0.010	0.971
nEO	0.614	0.009*
nTrA	0.540	0.025*
nLM	-0.027	0.919

p-: paretic side, n-: non paretic side, EO: External oblique, TrA: Transverse abdominis, LM: Lumbar multifidus

*P <0.05

The effect of hemispatial neglect on balance and functional mobility of patients with stroke

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Introduction

Clinicians have suspected poststroke hemispatial neglect may affect balance function and functional mobility with stroke. The Purpose of this study was to investigate the effect of poststroke hemispatial neglect on the balance and functional mobility of patients with stroke.

Methods

Among the patients with first ever stroke who were admitted to the university hospital for poststroke rehabilitation, patients with Korean Mini-Mental State Examination (K-MMSE) ≥ 24 and Motility Index (MI) of upper extremity ≥ 61 and MI of lower extremity ≥ 58 were included. Kessler Foundation-Neglect Assessment Process (KF-NAP) was used to decide whether the enrolled patients have hemispatial neglect or not. Patients with KF-NAP ≥ 1 were considered to have hemispatial neglect and the others were considered to not have it. We excluded patients with peripheral neuropathy that may affect sensory abnormality, vestibular dysfunction, visual field defect, Ataxia, Spasticity, or Sarcopenia. We used Berg balance scale (BBS), Functional Ambulatory Categories (FAC), modified Barthel index (BI) as the primary outcome measurements.

Results

We enrolled 35 patients with first-ever stroke (24 men; 28 ischemic; 30 supratentorial stroke; 59.06 ± 14.54 years). Interval between onset of stroke and evaluation of hemispatial neglect was 27.54 ± 28.79 days. The patients with hemispatial neglect have lower score of BBS and mBI, albeit without significance ($p = 0.069$ and $p = 0.136$, respectively). We however found out that the patients with hemispatial neglect have lower score in BBS subdomains significantly; standing with feet together, turning to look behind, turning 360 degrees, and placing alternate foot on stool ($p = 0.015$, $p = 0.048$, $p = 0.035$ and $p = 0.040$, respectively). We also showed that the patients with hemispatial neglect have lower score in one subdomain of mBI which was 'chair to bed transfer' ($p = 0.030$).

Conclusion

In the present study, we found out that patients with poststroke hemispatial neglect have balance dysfunction in a few of specific postural control, which may Result in disability of daily living. Therefore, poststroke patients with hemispatial neglect need to be trained to take good balance with doing the specific tasks.

Rehabilitation therapy utilization in patients with Parkinson disease in Korea

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Background

Recent evidence and guidelines recommend appropriate rehabilitation from the beginning of diagnosis in patients with Parkinson disease (PD). Although rehabilitation for PD may not be adequately provided in Korea, there is no information about rehabilitation therapy utilization in these patients.

Objectives

The Purpose of this study is to investigate the utilization of rehabilitation therapy in patients with PD and to analyze the patients' characteristics associated with it.

Materials and Methods

We used the National Health Insurance Service-National Sample Cohort (NHIS-NSC) for 2002-2015, including total 1,000,000 sampled from a target population of 48,222,537 individuals in the 2006 NHI Database. We identified cases with Parkinson disease using the registration code for PD (V124), from the registration program for cancer and 62 rare intractable diseases initiated in 2004, in every 3 years. Therefore, these prevalent cases were divided into 4 groups according to the period: 2004-2006, 2007-2009, 2010-2012, and 2013-2015. Among them, we excluded individuals who had diagnostic claims for other parkinsonisms (G21, G22, and G23) and who had no prescription of antiparkinson medication. We assessed utilization of rehabilitation therapies by identifying claims having procedure codes for physical therapy (PT), occupational therapy (OT), and swallowing therapy (ST) in each 3-year study period. Demographic data, comorbidities which might require rehabilitation, and prescribed antiparkinson medications were also identified. The effect of patients' characteristics on rehabilitation therapy utilization was investigated multivariable logistic regression analysis in the period of 2013-2015.

Results

PD patients who met the inclusion and exclusion criteria were identified as 384 in 2004, 855 in 2007, 1,023 in 2010, and 1,222 in 2013 (Table 1). The numbers of physiatrist visits were 221 (0.58 per person) in 2004-2006, 824 (0.96 per person) in 2007-2009, 2013 (1.97 per person) in 2010-2012, and 3550 (2.91 per person) in 2013-2015. Among these patients, 35-40% had claims for PT, 16-19% had claims for OT, and 4-6% had claims for ST without remarkable differences between the study periods (Fig. 1). The number of claims for each rehabilitation therapies is presented in Table 2. Female sex, age older than 70,

high income, severe disability, and high levodopa equivalent dose were significantly associated with rehabilitation therapy utilization in patients with PD.

Conclusion

Although the number of physiatrist visits increased about 5 times over 10 years, the number of claims for PT, OT, and ST showed no change in patients with PD. According to recent evidence and guidelines, rehabilitation therapy utilization may be suboptimal in Korea. The associated patients' characteristics should be considered to provide adequate rehabilitation in these patients.

Table 1. Characteristics of patients with PD in each 3-year study period.

Characteristics	2004-2006		2007-2009		2010-2012		2013-2015	
	No	%	No	%	No	%	No	%
Total	384	100	855	100	1023	100	1221	100
Sex								
Male	141	37.68	321	37.54	401	39.20	483	39.56
Female	243	62.32	534	62.46	622	60.80	738	60.44
Age, y								
0-59	64	16.67	97	11.35	105	10.26	121	9.91
60-69	159	41.40	232	27.13	249	24.34	276	22.60
70-79	129	33.59	385	45.03	480	46.92	545	44.64
80+	32	8.33	141	16.49	189	18.48	279	22.85
Income								
N/A	0	0	95	11.11	77	7.53	74	6.06
Low	92	23.96	171	20.00	193	18.87	253	20.72
Middle	149	38.80	283	33.10	357	34.90	435	35.63
High	143	37.24	306	35.79	396	38.71	459	37.59
Region of residence								
Seoul/Incheon	96	25.00	211	24.68	252	24.63	293	24.00
Gyeonggi/Gangwon	84	21.88	187	21.87	240	23.46	314	25.72
Busan/Daegu/Ulsan/ Gyeongsang	91	23.70	215	25.15	262	25.61	328	26.86
Daejeon/Sejong/Chungcheong	45	11.72	96	11.23	116	11.34	105	8.60
Gwangju/Jeolla/Jeju	68	17.71	146	17.08	153	14.96	181	14.82
Number of visits								
Neurologists	6003		12546		16895		21652	
Physiatrists	221		824		2013		3550	

Table 2. Number of claims for each rehabilitation therapies. *Simple therapeutic exercise (MM101) was excluded in this study because this code serves only 10 minutes of exercise, which is too short for the rehabilitation Purpose, and widely used in primary health care service for musculoskeletal problems.

Types of rehabilitation therapies		2004- 2006	2007- 2009	2010- 2012	2013- 2015
PT	Complex therapeutic exercise (MM102)	442	747	1226	1380
	Isokinetic therapeutic exercise (MM103)	0	10	66	146
	Rehabilitative development therapy for disorder of central nervous system (MM105)	656	1068	2396	3021
	Mattress or mobilization training (MM301)	394	724	1298	1502
	Gait training (MM302)	705	1075	1795	2639
	Total	2197	3624	6781	8688
	Per person	14.36	11.69	18.08	20.06
OT	Simple occupational therapy (MM111)	18	60	142	51
	Complex occupational therapy (MM112)	1138	1299	2139	2582
	Special occupational therapy (MM113)	112	427	756	1462
	Activities of daily living training (MM114)	212	362	832	980
	Total	1480	2148	3869	5075
	Per person	20.85	15.34	20.15	24.28
ST	Rehabilitative dysphagia therapy (MX141)	374	450	766	792
	Per person	22	12.16	12.77	14.67

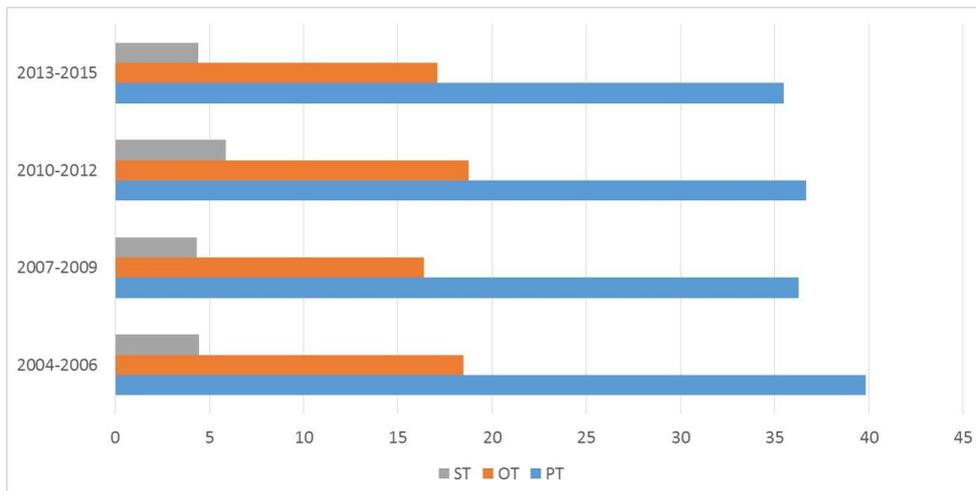


Fig. 1. The percentage of patients who had claims for PT, OT, and ST in each study period.

The Effectiveness of Early Functional Electrical Stimulation for Acute Stroke Patients in ICU

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Objective

To evaluate the safety and the effectiveness of early rehabilitation using functional electrical stimulation (FES) for acute stroke patients with hemiplegia in intensive care unit (ICU).

Methods

A retrospective review of medical records was performed for group of 48 patients with acute stroke who had been admitted in ICU for at least seven days, and had been consulted or transferred to the departments of rehabilitation medicine. The power in the paralyzed upper limb of all patients were less than 2/5 according to Medical Research Council grading. All patients underwent passive range of motion (PROM) exercise, immediately as possible after admission less than 5 days. Patients were into 2 groups, 23 patients underwent the early interventional program with FES apply to supraspinatus and posterior deltoid muscles in addition to PROM exercise in ICU within A. or B. who underwent only PROM exercise in ICU. (n=25). The duration of FES was 30 minutes, passive-exercise protocol consisted of 20 minutes of flexion-extension movements for upper limb simultaneously with physical therapist 5 times a week for 8 weeks. The shoulder pain of affected side during resting, shoulder abduction's passive range of motion (PROM), was measured with visual analog scale (VAS) score. Additionally we investigated other measurements of upper limbs which include spasticity (modified Ashworth scale, MAS) and the level of ADL dependency (Korean version of modified barthel index) at the start of the rehabilitation and after 8 weeks.

Results

The mean age of group A was 61.2 years old and group B was 63.7 years old. And the mean of days after onset of group A was 3.7 days and group B was 4.1 days. (table 1) After 8 weeks, all groups showed increase in the scores ADL dependency and in PROM of hemiplegic shoulder abduction. Statically the mean numbers of spasticity and PROM were not significantly different. ($P>0.05$) But pain measured by the VAS scores, and ADL in group A was significantly improved than group B statically. ($P<0.05$) (table 2)

Conclusions

The Results of our study suggest that apply immediate FES treatment in addition to conventional treatment with hemiplegic patient can be helpful.

Table 1. Patient characteristics ¹passive range of motion measured on shoulder abduction, ²Korean version of modified barthel index

Variable	Group starts FES and PROM exercise (N=23)	Group starts PROM exercise only (N=25)
Male	13	14
Female	10	11
Age (y)	61.2 ± 5.4	63.7 ± 6.1
Days after onset	3.7±1.1	4.1 ± 1.2
PROM ¹	130.2±10.7	124.6±9.2
K-MBI ²	31.6±2.6	29.7±3.1

Table 2. Differences between two groups, after 8 weeks of rehabilitation. Mean values and standard deviations(SD) were calculated. ¹passive range of motion measured on shoulder abduction, ²Korean version of modified barthel index, ³visual analog scale, hemiplegic shoulder pain during resting, 4 modified ashworth scale

	Difference (mean ± SD)		p value
	Group starts FES and PROM exercise (N=23)	Group starts PROM exercise only (N=25)	
PROM ¹	133.1 ± 8.3	127.9. ± 10.2	0.297
K-MBI ²	51.1 ± 4.5	41.3 ± 5.7	0.041*
VAS ³	3.2 ± 0.9	5.5 ± 1.3	0.027*
MAS ⁴	1.7 ± 0.9	2.2 ± 0.8	0.389

Factors Affecting Stress in Chronic Stroke Patients who Receive Rehabilitation

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Introduction

In spite of advances in acute treatment, many stroke patients had debilitating sequelae. Therefore, they might be stressed including impaired motor function. However, previous studies focused on depressive mood in chronic stroke patients. In this study, we aim to evaluate the level of stress in patients with chronic stroke and identify which factor influence on their stress.

Method

We conducted this prospective study with patients who are over 18 years of age and whose symptoms developed for more than 6 months. The patients who visited outpatient clinic of rehabilitation department from 2016 to 2018 were included. They confirmed diagnosis of stroke with radiological evidence by either CT scan or MRI. Adult Self Report (ASR) were used to check the stress in the patients. ASR is a reliable and valid self-report tool and was designed to assess the extent of a variety of emotional/behavioral problems in individuals. ASR consists of three broad-spectrum scales (Internalizing Problems, Externalizing Problems and Total Problem). Questionnaires were distributed to the patients, in which questions include education level, period after the disease outbreak, and annual income. Information about the neuropathic pain, spasticity, sleep disorder, bladder problems, and bowel problems was also collected.

Results

Thirty patients were included (Table 1). The mean age was 56.5 years and patients with college graduate were most common (13 patients, 43.3%). The annual income of most patients (17 patients, 56.7%) was less than 10 million won. There were 8 patients complaining of neuropathic pain, 9 patients complaining of spasticity, 7 patients complaining of sleep disorder. Also, 8 and 6 patients complained of bladder and bowel problems, respectively. When the relationship between the stress in patients and the factors were investigated (Table 2), total problems of patients were related with the annual income ($\rho=-0.391$, $p=0.033$), neuropathic pain ($\rho=-0.457$, $p=0.011$) and sleep disorder ($\rho=-0.188$, $p=0.041$). Internalizing problems of patients were also related with the annual income and neuropathic pain, but they were not related to other factors, such as spasticity, sleep disorder, period after the disease outbreak, bladder and bowel problems.

Conclusion

We identified that factors affecting stress in chronic stroke patients. Neuropathic pain, annual income, and sleep disorder affected the stress in chronic stroke patients.

However, considering the limitations of our study, such as small number of patients, future studies are needed.

Table1. Baseline Characteristics of Chronic Stroke Patients

Characteristics		
Total number (n)		30
Age (years)		56.5±18.0
Male : Female (n)		15:15
Education level (n)	Under high school graduate	4
	High school graduate	12
	Collage graduate	13
	Graduate school graduate	1
Diagnosis (n)	Cerebral infarction	17
	Cerebral hemorrhage	13
Period after the disease outbreak (years)		5.3±5.6
Annual income (n)	<10 million (won)	17
	10 million≤, <30 million (won)	2
	30 million≤ , <50 million (won)	5
	50 million≤ (won)	6
Neuropathic pain	Absent	8
	Present	22
Spasticity	Absent	9
	Present	21
Sleep disorder	Absent	7
	Present	23
Bladder problems	Absent	8
	Present	22
Bowel problems	Absent	6
	Present	24

Values are presented as number (%), years, or mean ± SD.

Table2. Relationship between the Stress in Patients and the Factors Associated with Them

		Spearman correlation coefficient (rho)	p-value
Total problems of patients	Annual income	-0.391	0.033*
	Education level	-0.257	0.170
	Spasticity	-0.261	0.163
	Neuropathic pain	-0.457	0.011*
	Sleep disorder	-0.188	0.041*
	Bladder disorder	-0.188	0.320
	Bowel disorder	-0.130	0.492
	Period after the disease outbreak	0.106	0.578
Internalizing problems of patients	Annual income	-0.434	0.017*
	Spasticity	-0.1841	0.338
	Neuropathic pain	-0.406	0.026*
	Sleep disorder	-0.342	0.064
	Bladder disorder	-0.157	0.407
	Bowel disorder	-0.063	0.742
	Period after the disease outbreak	0.271	0.147
Externalizing problems of caregivers	Annual income	-0.215	0.254
	Neuropathic pain	-0.329	0.076
	Sleep disorder	-0.288	0.123

*p<0.05 by Spearman correlation analysis.

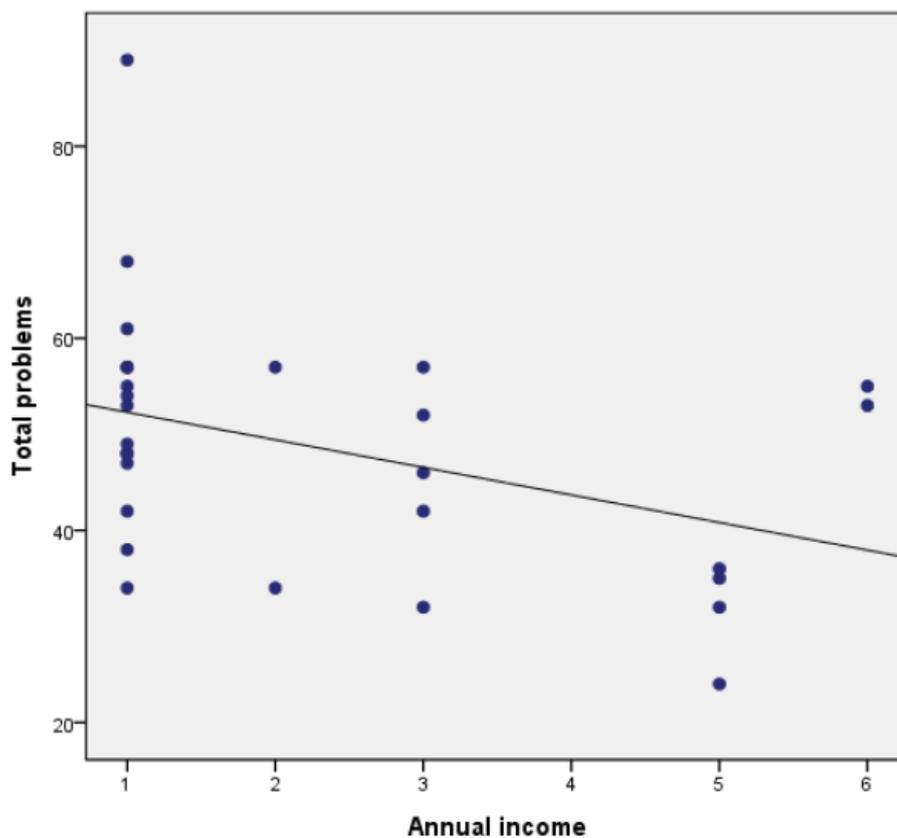


fig 1. Relationship between the stress in patients and annua income

Development of Magnet-Based Rehabilitation Device for Recovery of Hand Function after Stroke

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Purpose

We proposed a novel one-dimensional rehabilitation device using electromagnetic control system for the recovery of hand function after stroke.

Methods

When an electric current is applied to a coil in an electromagnetic control system, a magnetic field is generated in coil. Between this magnetic field and the magnet, the attractive force or repulsive force act by the electromagnetic phenomena. A Method of flexing or extending fingers by using the magnetic force between the magnetic field and the permanent magnet was devised. To attach the magnets to the fingers, a magnet structure was fabricated using a 3D printer and elastic band. When flexing the fingers, magnets were attached to the palm so that the magnets could be attracted to each other and the fingers could flex more effectively. Four patients with hand motor grade 0 after stroke within 1-month had hand rehabilitation therapies for 2 weeks. The finger training consisted of various motions such as finger flexion, extension, opposition, and lateral deviation, and conducted for 30 minutes per day.

Results

For finger extension, the magnets are placed below the fingers to extend as much as possible. To verify the above Method, we investigated the magnetic field distribution in the coil through simulation and observed how the fingers were flexed and extended through the experiment. First, to investigate the force during the rehabilitation, the magnitude of the magnetic force acting between the magnet on finger and the magnetic field generated by coil was measured along the movement trajectory of the finger. Second, the magnitude of the magnetic force acting between the finger magnet and the auxiliary magnets on the palm and below the finger without applying current to the coil was measured along the movement trajectory as well. Finally, the magnitude of the magnetic force was measured according to the movement trajectory when the current was applied to the coil and magnets were added on the palm and below the fingers. 10-session hand training by this device improved gross finger motion without any complications for all participating patients.

Conclusion

We have developed a novel hand rehabilitation device, and it can be safely applied to hemiplegic patients to improve hand function after stroke.

Difference in the ascending reticular activating system injury between mild traumatic brain injury

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Introduction

We investigated differences in the ascending reticular activating system (ARAS) injuries between patients with mild traumatic brain injury (mTBI) and cerebral concussion by using diffusion tensor tractography (DTT).

Methods

Thirty-one patients with mTBI, 29 patients with concussion, and 30 control subjects were recruited. We used DTT to reconstruct the lower ventral and dorsal ARAS, and the upper ARAS. The fractional anisotropy (FA) value and the fiber number (FN) of the lower ventral and dorsal ARAS, and the upper ARAS were determined.

Results

Significant differences were observed in the FA values of the lower ventral and dorsal ARAS on both sides between the mTBI and control groups and between the concussion and control groups ($p < 0.05$). The FN value was significantly different in the lower ventral ARAS on both sides between the concussion and control groups and between the mTBI and concussion groups ($p < 0.05$).

Conclusion

Both the mTBI and concussion patients suffered injuries in the lower ventral and dorsal ARAS, with the concussion patients exhibiting more severe injury in the ventral ARAS than that in the mTBI patients. These Results suggest that the terms mTBI and concussion should be used differentially, even though they have used interchangeably for a long time

Table 1. Demographic data of the mild traumatic brain injury and concussion groups[†]

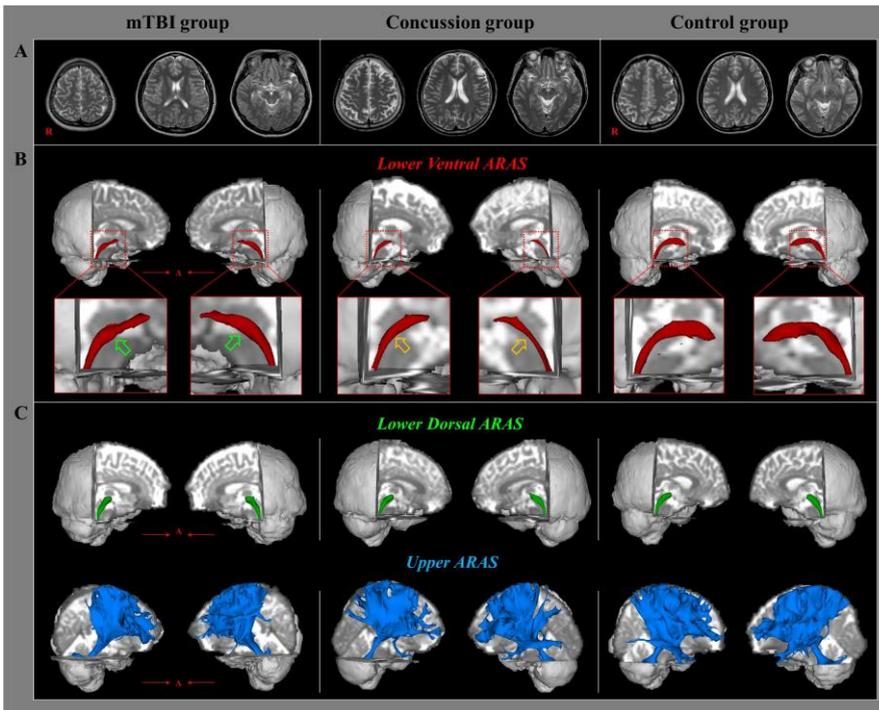
Variables [‡]	mTBI group [‡]	Concussion group [‡]
Patients, n (%) [‡]	31 (50.81%) [‡]	29 (49.18%) [‡]
Age (year) [‡]	45.85 (10.03) [‡]	47.57 (13.43) [‡]
Sex, male/female [‡]	15/16 [‡]	13/17 [‡]
Duration to DTI (months) [‡]	3.03 (6.02) [‡]	3.85 (6.32) [‡]
LOC (minutes / hours) [‡]	7.11 (6.47) [‡] (minutes) [‡]	3.13 (1.80) [‡] (hours) [‡]

Values represent mean (\pm standard deviation). mTBI: mild traumatic brain injury, DTI: diffusion tensor imaging, LOC: loss of consciousness[‡]

Table 2. Comparison of diffusion tensor tractography parameters for the ascending reticular activating system between the mild traumatic brain injury and concussion groups

ARAS: ascending reticular activating system, FA: fractional anisotropy, FN: fiber number, mTBI: mild traumatic brain injury, Rt: right, Lt: left, means \pm standard deviation, * $p < 0.05$.

	Right		Left				
	FA	FN	FA	FN			
Lower ventral ARAS							
mTBI group	0.37 \pm 0.04	293.68 \pm 117.06	0.37 \pm 0.03	301.72 \pm 114.30			
Concussion group	0.37 \pm 0.06	221.73 \pm 121.89	0.36 \pm 0.06	226.61 \pm 59.99			
Control group	0.41 \pm 0.03	343.71 \pm 67.62	0.41 \pm 0.05	346.13 \pm 107.25			
Lower dorsal ARAS							
mTBI group	0.39 \pm 0.04	356.06 \pm 163.36	0.39 \pm 0.02	375.66 \pm 182.10			
Concussion group	0.39 \pm 0.06	339.27 \pm 163.71	0.39 \pm 0.04	356.10 \pm 0.04			
Control group	0.42 \pm 0.03	382.03 \pm 141.58	0.42 \pm 0.03	412.03 \pm 145.11			
Upper ARAS							
mTBI group	0.36 \pm 0.02	10500.41 \pm 4617.71	0.37 \pm 0.02	11153.43 \pm 4241.51			
Concussion group	0.35 \pm 0.02	15111.86 \pm 4240.95	0.35 \pm 0.02	11378.35 \pm 5060.18			
Control group	0.36 \pm 0.01	10311.16 \pm 3240.42	0.36	10282.91 \pm 3663.50			
<i>P</i> – value							
Lower ventral ARAS							
		<i>Rt</i>	<i>Lt</i>		<i>Rt</i>	<i>Lt</i>	
<i>FA</i>	mTBI – Control	0.00*	0.01*	FN	mTBI – Control	0.09	0.08
	Concussion – Control	0.01*	0.00*		Concussion – Control	0.00*	0.00*
	mTBI - Concussion	0.61	0.58		mTBI - Concussion	0.01*	0.05*
Lower dorsal ARAS							
		<i>Rt</i>	<i>Lt</i>		<i>Rt</i>	<i>Lt</i>	
<i>FA</i>	mTBI – Control	0.05*	0.01*	FN	mTBI – Control	0.69	0.09
	Concussion – Control	0.04*	0.00*		Concussion – Control	0.35	0.09
	mTBI - Concussion	0.86	0.44		mTBI - Concussion	0.59	0.99
Upper ARAS							
		<i>Rt</i>	<i>Lt</i>		<i>Rt</i>	<i>Lt</i>	
<i>FA</i>	mTBI – Control	0.69	0.15	FN	mTBI – Control	0.30	0.44
	Concussion – Control	0.08	0.63		Concussion – Control	0.48	0.34
	mTBI - Concussion	0.13	0.36		mTBI - Concussion	0.31	0.84



(A) T2-weighted brain magnetic resonance images at the time of diffusion tensor imaging scanning in representative patients with mild traumatic brain injury (mTBI; 51-year-old female) and concussion (48-year-old female) and in a control subject (50-year-old female). (B) Results of diffusion tensor tractography (DTT) for the lower ventral ascending reticular activating system (ARAS): the lower ventral ARAS of the mTBI (green arrows) and concussion (orange arrows) groups are thinner compared with the control group and that of the concussion group is thinner than that in the mTBI group (orange arrows). (C) Results of DTT for lower dorsal and upper ARAS show similar findings among the three groups.

Characteristics and associated factors of esophageal dysphagia

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Objective

Videofluoroscopic swallowing study (VFSS) is widely used to evaluate oropharyngeal swallowing. Chest x-ray is traditionally studied in Purpose of assessing the endobronchial barium coating implicating endotracheal aspiration. The residual esophageal barium in chest x-ray may suggest any neuromuscular dysmotility or obstructive lesions of esophagus. This study Purposed to evaluate prevalence of esophageal dysphagia with residual esophageal barium after VFSS and to identify characteristic of esophageal abnormality.

Methods

Medical records of 535 adults aged 19 years or older who tested VFSS from March 2016 to May 2018 were reviewed retrospectively. Chest x-ray was taken in all patients after VFSS, and was checked whether there were any abnormal findings in esophagus like barium wall coating or esophageal dilatation or mechanical obstruction like bird beak sign. Abnormal esophageal findings were analyzed and classified by anatomic level (cervical [cricoid to suprasternal notch] / upper thoracic [suprasternal notch to tracheal bifurcation] / midthoracic [tracheal bifurcation to diaphragmatic hiatus] / lower thoracic and abdominal [diaphragm to junction with stomach]), and by esophageal dilatation severity (minimal [barium wall coating normal] / mild [$<1\text{cm}$] / moderate [$1\text{-}2\text{cm}$] / severe [$>2\text{cm}$]). The cause of esophageal dysphagia was also reviewed.

Results

In 11% of the subjects (64/535), esophageal dysphagia was identified in post-VFSS chest x-ray. Esophageal dysphagia was more frequent in aged 65-79 (OR=2.43, $P<.05$), and dementia (OR=2.15, $P<.05$). Midthoracic (n=24) and lower thoracic and abdominal esophageal barium (n=25) were more frequent than cervical (n=1) and upper thoracic (n=14). Esophageal dilatation was minimal in 24, mild in 13, moderate in 19, and severe in 8 patients. The cause of esophageal dysphagia was reviewed 19 patients who undergone diagnostic evaluation such as gastrofibroscopy or chest CT. Esophagitis (n=5), myopathy (n=1), achalasia (n=1), and caner (n=3) were identified causes and there were no abnormalities in 8 subjects. Cancer patients were significantly associated with cervical or upper thoracic esophageal moderate to severe dilatation ($P<.01$). Two were known esophageal cancer patients, and one was newly diagnosed with a lung cancer with metastasis mediastinal lymph node which was compressing the esophagus at subcarinal level.

Conclusion

Esophageal dysphagia was a frequent finding in videofluoroscopic swallowing study. Esophageal dysphagia in proximal dilatation can be an important sign in several malignancies, making the chest x-ray taken after VFSS an important step to evaluate.

Table 1. Associated factors with esophageal dysphagia from univariate logistic regression analyses

	OR (95% CI)	P value
Sex		
Male	1	
Female	1.65 (0.98-2.78)	.6
Age		
<65	1	
65-79	2.43 (1.1-5.41)	<.05
80 or more	1.39 (0.58-3.31)	.46
Referred cause of dysphagia		
Stroke	1	
Dementia	2.15 (1.01-4.59)	<.05
Cancer	2.24 (0.45-11.2)	.33
Parkinsonism	-	
Others	0.72 (0.27-1.94)	.52
Unknown	1.24 (0.61-2.5)	.56

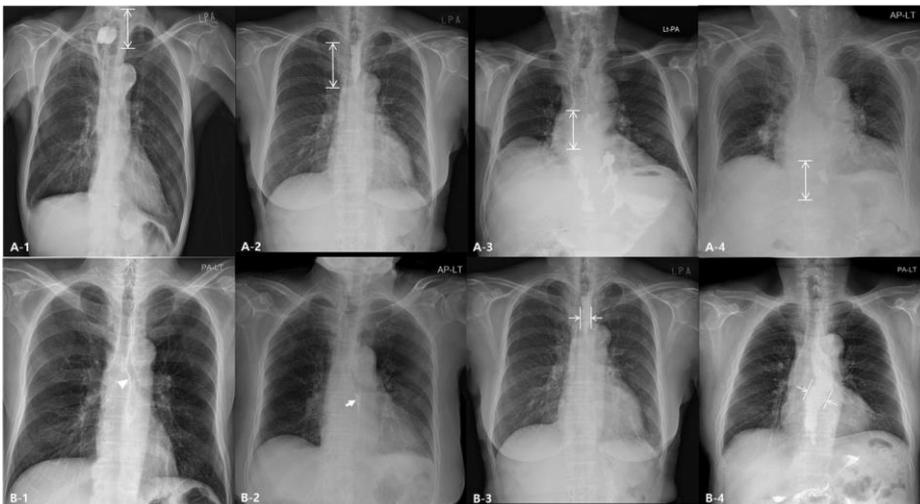


Figure 1. Classification of esophageal dysphagia by anatomic level (A) and by dilatation severity (B). A-1: Cervical (cricoid to suprasternal notch). A-2: Upper thoracic (suprasternal notch to tracheal bifurcation). A-3: Midthoracic (tracheal bifurcation to diaphragmatic hiatus). A-4: Lower thoracic and abdominal (diaphragm to junction with stomach). B-1: Minimal (barium wall coating). B-2: Mild (diameter less than 1cm). B-3: Moderate (diameter from 1cm to 2cm). B-4: Severe (diameter more than 2cm).

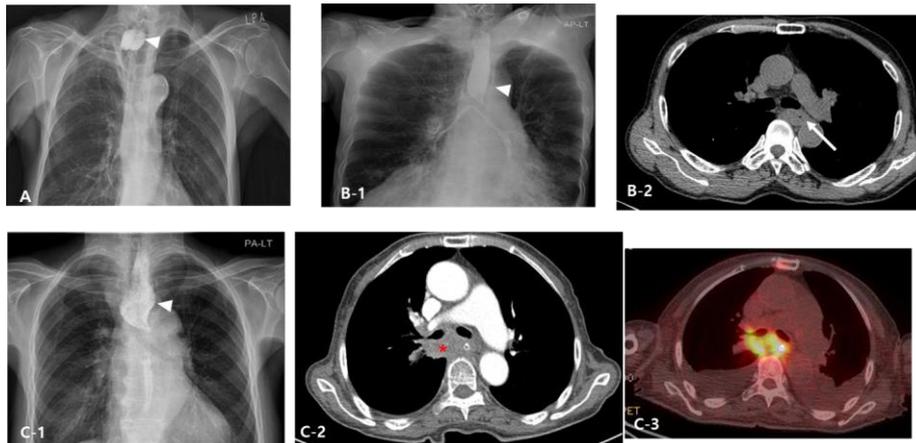


Figure 2. Chest roentgenogram which was taken after videofluoroscopic swallowing studies in 3 cases with obstructive esophageal dysphagia due to malignancy shows severe dilatation (arrow head) in cervical (A) and upper thoracic (B-1, C-1) esophagus. Two patients had been diagnosed as esophageal cancer and received bypass operation due to esophageal cancer in 5 years ago (A) or chemotherapy (B-1). Segmental circumferential wall thickening was noted in the mid esophagus (B-2). The third case who suffered from poor oral intake presented for unexplained swallowing difficulty. After videofluoroscopic swallowing study, severe esophageal dilatation is observed at upper thoracic level (C-1, arrowhead) in chest roentgenogram. The esophagus with nasogastric tube is compressed by metastatic lymph nodes (C-2, asterisk) with hypermetabolism in PET (C-3).

Robotic assist therapy for upper limb rehabilitation in infratentorial stroke patients

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Objective

Infratentorial stroke cause various symptoms depending on the position of the lesion, and upper limb motor function impairment is one of the major symptoms appealing to a large number of patients. The benefits of robotic therapy for the rehabilitation of upper extremity motor function after stroke are well known, but there are few studies on infratentorial stroke patients. The aim of this study is to determine the effects of newly developed upper limb rehabilitation training robot trainer (Camillo[®], Man&tel co., Korea) which can perform task specific training using game contents in infratentorial stroke patient.

Materials and Methods

Ten patient with hemiplegia admitted to rehabilitation center enrolled in this study. Patients were categorized as the combination treatment (conventional and robotic assist therapy) group, and the control group was matched one by one to the conventional treatment group according to the location of the lesion, function, and age. The treatment session was performed during 30 minute for 2 weeks (total 8 sessions) using a robotic device. Patients in the treatment group received conventional occupation therapy additionally, one session of robotic therapy, while the control groups received two sessions of conventional occupation therapy. Outcome were compared for Fugl-Meyer assessment (FMA), box & block test (BBT), nine hole pegboard test (NHPT), functional independence measure (FIM), and hand strength were evaluated at each time before and after treatment.

Results

Ten patients participated in this study, The two groups (combination treatment vs control group) seems to be no differences in improvement on FMA, BBT and FIM (Table 1). The combination treatment group showed improvement in NHPT and hand strength compared with the control group (Table 1). There was no significant differences in upper extremity function test score installed in robotic device.

Conclusion

Robotic assist therapy seems to be improves fine motion of upper limb, hand strength in infratentorial stroke patient. Additional patient enrollment is required to determine the effects of robotic assist therapy for upper limb rehabilitation in infratentorial stroke patients.

Table 1. Comparison of outcome measures between treatment and control group

		Δ FMA-UE	Δ BBT (E.a.)	Δ NHPT (Sec.)	Δ FIM	Δ hand strength (Kg)
Treatment group (n=3)	mean	1.33	10.67	43.85	12.33	4.67
	<i>p</i> value	.637	.507	.05	.184	.05
Control group (n=3)	mean	2.33	8	12.60	0	0.33
	<i>p</i> value	.637	.507	.05	.184	.05

FMA, Fugl-Meyer assessment; K-MBI, korean version modified Barthel index; MMT, manual muscle test; K-MMSE, korean version mini-mental state examination; BBT, box & block test; NHPT, nine hole pegboard test; FIM, functional independence measure



Figure 1. (A) Camillo® robotic device, an upper extremity rehabilitation robot, consisting of a video monitor, a robot arm and a computer: (B) The patient performing robot-assisted game training with the upper extremity rehabilitation robot.



Figure 2. The upper extremity function (accuracy) evaluation tools installed in Camillo® robotic device.

The therapeutic effect and complications of OE tube feeding in stroke patients

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Background and Objective

Swallowing disorders commonly occur in stroke patients and may cause aspiration pneumonia or malnutrition. Acute stroke patients with severe dysphagia are usually fed by nasogastric tube. However, that Method is inconvenience and sometimes causes complications such as aspiration pneumonia or diarrhea. The oro-esophageal tube (OE tube) was used as an alternative parenteral feeding Method in patients whom safe oral feeding was impossible. The aim of this study was to evaluate the therapeutic effect and complications of OE tube in stroke patients with dysphagia.

Methods

This study was designed as a retrograde medical chart review. The authors reviewed the medical records of dysphagic stroke patients who were recommended to use OE tube feeding from May 2013 through June 2017. OE tube feeding was indicated for patients who had severe dysphagia with decreased gag reflex, but had possible cognitive and hand function to achieve OE tube insertion according to the physiatrist's instruction. Thirty-eight stroke patients were recommended to use OE tube feeding based on their videofluoroscopic swallowing study (VFSS) findings. Of these, 17 patients were received OE tube feeding training and conventional dysphagia therapy. Follow-up VFSS were performed seriously, based on the patients' condition. If a patient could swallow therapeutic food with certain viscosities without serious aspiration or choking, and showed low amount of pharyngeal residue after swallowing during the VFSS, oral feeding was considered to start. Patients' clinical information including stroke characters, duration of intervention, and complications of OE tube feeding were evaluated. Patients were divided into the two groups according to final feeding Methods.

Results

Seventeen patients attempted OE tube feeding. Among them, 11 (64.7%) patients could change full oral feeding on their follow-up VFSS evaluation. Table 1 showed demographic factors of patients according to the feeding Methods. Full oral feeding was achieved in younger patients. Among 9 patients with lateral medullary infarction, 5 (55.6%) patients were able to eat orally. However, 75.5% patients showed gastroesophageal reflux disease regardless of changing to the oral feeding. Patients who could change to oral feeding were significantly improved swallowing function while patients who could not change to oral feeding showed significant improvement only in pharyngeal phase of functional dysphagia scale, especially amount of pharyngeal residue (Table2).

Conclusion

OE tube feeding itself could facilitated swallowing and assisted stroke patients to transition to oral feeding. The OE tube stimulates the pharynx during insertion and enhances the swallowing reflex and relaxation of upper esophageal sphincter. This study suggests that OE tube training could be a therapeutic Method for patients with severe dysphagia after stroke.

Table 1. Demographic factors of Patients according to the feeding methods (N=17)

	Patients who could change to oral feeding (n=11)	Patients who could not change to oral feeding, OE tube only (n=6)
Age (year)*	56.3 ± 21.7	72.2 ± 15.4
Gender (M/F)	7/4	4/2
Stroke type (ischemic/hemorrhagic)	8/3	2/4
Stroke lesion	Lateral medullar (n=5) Bilateral pons (n=2) Bilateral MCA infarction (n=2) Basal ganglia (n=2) Thalamus (n=1)	Lateral medullar (n=4) Bilateral pons (n=1) Pons, cerebellum (n=1)
Initial FDS	47.7 ± 18.6	49.1 ± 15.9
Initial PAS	8.0	8.0
OE tube duration	14.1 ± 7.6	54.8 ± 38.5
Complications	GERD (n=7) Aspiration pneumonia (n=1)	GERD (n=6) Aspiration pneumonia (n=3) GI bleeding (n=1)

Values are mean ± SD. FDS: functional dysphagia scale, PAS: penetration aspiration scale, MCA: middle cerebral artery, GERD: gastroesophageal reflux disease, GI: gastrointestinal. *: p<0.05

Table 2. Changes of Swallowing function

	Patients who could change to oral feeding (n=11)			Patients who could not change to oral feeding, OE tube only (n=6)		
	Initial VFSS	Final VFSS	p-value	Initial VFSS	Final VFSS	p-value
FDS (total)	47.7 ± 18.6	28.5 ± 19.4	< 0.01	49.1 ± 15.9	44.8 ± 25.3	0.753
FDS (oral)	6.1 ± 3.3	3.4 ± 3.6	0.02	8.7 ± 5.6	8.1 ± 4.9	0.521
FDS (pharyngeal)	38.9 ± 12.8	25.7 ± 16.2	< 0.01	40.2 ± 18.4	35.8 ± 20.3	0.03
PAS	8.0	4.7±1.3	< 0.01	8.0	7.7 ± 0.5	0.936

Values are mean ± SD. FDS: functional dysphagia scale, PAS: penetration aspiration scale *: p<0.05

Upper limb reachable workspace using Kinect in hemiplegic patients after structural brain lesions

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Purpose

A novel upper extremity 3-dimensional reachable workspace using Kinect sensor was introduced as a upper extremity outcome measure that demonstrates clinically meaningfulness in neuromuscular diseases and musculoskeletal conditions. The patients with hemiplegia Resulting from stroke or other structural brain lesion had shown unilateral upper extremity impairment. In this study, we examined the Kinect-based reachable workspace analysis in hemiplegic patients and investigated its usefulness.

Methods

Fifteen patients (age 58.9±16.9 years, 7 men, 8 women) with hemiplegia after structural brain lesions (8 hemorrhagic stroke, 5 ischemic stroke, 1 brain tumor, 1 neuromyelitis optica) were included. Upper extremity active range of motion was captured by the Kinect sensor, and relative surface area (RSA) was obtained. Upper extremity impairment was measured by the upper extremity motor subscale of the Fugl-Meyer Assessment and the Motricity Index arm subscale in affected side. Disability was assessed by the shortened Disabilities of the Arm, Shoulder and Hand questionnaire (QuickDASH) and the Korean version of Modified Barthel Index (K-MBI). Correlations between RSAs, impairment and disability scores were analyzed.

Results

The Mean total RSA of the affected side was significantly reduced compared to the unaffected side (0.615±0.230 vs. 0.746±0.091, p=0.001). With quadrant RSA, quadrant 1 (upper medial) and quadrant 3 (upper lateral) RSAs were apparently reduced (0.138±0.075 vs. 0.186±0.053, p=0.004; 0.170±0.081 vs. 0.232±0.017, p=0.011). The total RSA of the affected side was significantly correlated with the upper extremity motor subscale of the Fugl-Meyer Assessment (r=0.795, p=0.001) and the Motricity Index arm subscale (r=0.665, p=0.013). Also, the total RSA was correlated with QuickDASH score (r=0.758, p=0.001) and K-MBI (r=0.665, p=0.013). Further, quadrant 1, quadrant 3, quadrant 4 (lower lateral) RSAs were correlated with the upper extremity motor subscale of the Fugl-Meyer Assessment, the Motricity Index arm subscale, K-MBI and QuickDASH score.

Conclusion

This study demonstrates that a Kinect-based reachable workspace could be a potential outcome measure for evaluating upper extremity impairment and disability in hemiplegic patients.

Keywords

Kinect; reachable workspace; upper extremity; disability; stroke; brain

Relationship between Serum BDNF Levels and Depressive Mood in Subacute Stroke Patients

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Objective

Brain-derived neurotrophic factor (BDNF) is involved in neuronal survival, synaptic plasticity, learning and memory, and neuroplasticity in both the intact and the damaged brain. Although serum BDNF could be used as a biomarker in major depressive disorder and bipolar disorder, there was a lack of reports with serum BDNF in stroke rehabilitation. In this study, we aimed to investigate the potential of BDNF as biomarker in stroke rehabilitation by analyzing the relationship between serum BDNF and depressive mood in subacute stroke patients.

Materials and Methods

Forty-five subacute stroke patients (mean age 62.8 yrs) were recruited in this study. All participants took the standard rehabilitation program included daily 2-hours of physical therapy and 1-hour of occupational therapy, 5 days a week, for 2 weeks during subacute stroke phase. We measured the serum BDNF, proBDNF and MMP-9 at T0 (before the standard rehabilitation program), T1 (1 week after the standard rehabilitation program) and T2 (2 weeks after the standard rehabilitation program). In addition, all participants were assessed with geriatric depression scale-short form (GDS-SF) for depressive mood and K-MMSE for cognitive function at three time points. Pearson correlation analysis was performed to determine the relationship between serum BDNF and each variable.

Results

Each depressive mood and cognitive function showed significantly improvement during the standard rehabilitation program for 2 weeks ($p < 0.05$). GDS-SF at T1 was significantly correlated with serum BDNF at T1 ($p < 0.05$). In addition, improvement of GDS-SF from T0 to T2 tended to be correlation with serum BDNF at T0 without statistical significance. There was no significant relationship between serum BDNF and K-MMSE at any time point. However, K-MMSE at T0 was significantly correlated with serum proBDNF level at T0 ($p < 0.05$).

Conclusion

These Results might suggest serum BDNF could be used as biomarker for depressive mood in subacute stroke patients. In addition, serum proBDNF might be regarded as the precursor of cognitive function in subacute stroke patients. However, further study with larger participants should be needed to clarify these Results

Is intensive rehabilitation meaningful to brain tumor patients with neurological impairment?

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Introduction

Brain tumor is one of the major causes of disability. Although advances of therapies led improvement of survival rate of victims, neuro-surgeon, neuro-oncologist and even physiatrist are not so interested in rehabilitation due to still poor survival and high recurrence rate. To evaluate substantial meaning of rehabilitation, we assessed two aspects. One is efficacy of intensive rehabilitation for neurological impairment in patients by comparing with stroke patients, for whom rehabilitation is world widely accepted as basic therapy. Other is perceived worth about rehabilitation by patients and caregivers long-term after period of intensive rehabilitation.

Methods

Patients with neurological impairments after tumor surgery who received intensive rehabilitation under hospitalization during December, 2013-May, 2017 were included. Stroke patients, who also received intensive rehabilitation at same duration by same rehabilitation team under same strategy, were included as control group to evaluate therapeutic efficacy. Retrospectively, scores of functional evaluations which conducted before and after intensive rehabilitation, were analyzed: Fugl-Meyer assessment, Berg balance scale, modified Barthel index, and psychological assessments including mini-mental state examination and Wechsler's intelligence quotient. As for worth-perceiving evaluation for therapy, subjective satisfaction was assessed by telephone-survey on 6 items about functional improvements, intensity of therapy, overall satisfaction, and whether recommend rehabilitation to other patients. Information on long term function and survival status were collected.

Results

Rehabilitation outcomes were collected from 21 benign and 14 malignant brain tumor; and 108 stroke patients. Telephone survey was available in 17 benign and 9 malignant patients. Rehabilitation Resulted in significantly equal improvement in brain tumor patients on every outcome measures compared to stroke regardless of malignancy status (Table 1, Figure 1.). Two patients with benign tumor and nine with malignant had expired. In survivors, over 80% caregivers answered that motor, ADL, and cognition has improved or maintained compared with discharge (Figure 2A). Over 60% caregivers answered that rehabilitation was effective in improving motor, ADL, and cognition. Around 70% answered positively about overall satisfaction, intensity, and recommend rehabilitation

to other patients. (Figure 2B). Impressively, the pattern was similar in malignant (Figure 2C) and in deceased cases (Figure 2D).

Conclusion

In Conclusion, the intensive rehabilitation brought functional improvement in brain tumor patients regardless of malignancy status, and caregivers expressed high satisfaction about rehabilitation. Therefore, intensive rehabilitation in brain tumor patients is worthwhile and medical staffs should draw more attention to provide appropriate rehabilitation therapy for brain tumor patients with neurological impairment.

Table 1. Rehabilitation Outcomes for Patients with Stroke vs. Brain Tumor and Benign vs. Malignant Brain Tumor

	Brain Tumor (n=35)			Stroke (n=108)			<i>p</i> [†] (between groups)
	Baseline	Discharge	<i>p</i> (within groups)	Baseline	Discharge	<i>p</i> (within groups)	
FMA score	34.5 (± 22.2)	49.1 (±17.5)	0.001*	30.1 (±21.6)	41.8 (±21.0)	0.001*	0.737
BBS score	17.0 (±15.9)	35.6 (±17.7)	0.001*	20.7 (±18.0)	35.2 (±17.7)	0.001*	0.929
K-MBI score	36.9 (±18.5)	58.3 (±20.1)	0.001*	38.6 (±21.0)	56.7 (±23.2)	0.001*	0.447
K-MMSE score	17.3 (±10.1)	23.1 (±7.6)	0.001*	16.7 (±8.2)	21.1 (±7.1)	0.001*	0.569
IQ score	67.1 (±18.1)	78.9 (±14.8)	0.001*	69.6 (±18.4)	78.5 (±18.4)	0.001*	0.180

	Benign Brain Tumor (n=21)			Malignant Brain Tumor (n=14)			<i>p</i> [†] (between groups)
	Baseline	Discharge	<i>p</i> (within groups)	Baseline	Discharge	<i>p</i> (within groups)	
FMA score	36.7 ± 22.3	51.1 ± 15.4	0.001*	31.1 ± 20.8	45.9 ± 20.7	0.002*	0.434
BBS score	19.1 ± 17.1	38.0 ± 15.7	0.001*	13.9 ± 13.0	32.1 ± 20.1	0.002*	0.210
K-MBI score	37.7 ± 20.2	61.4 ± 21.6	0.001*	35.9 ± 15.6	53.8 ± 18.4	0.016*	0.702
K-MMSE score	15.5 ± 7.3	23.5 ± 5.1	0.001*	19.3 ± 9.8	22.6 ± 7.1	0.001*	0.220
IQ score	63.9 ± 16.1	79.1 ± 12.8	0.001*	71.5 ± 20.7	78.5 ± 17.7	0.002*	0.156

All values are presented a mean±standard deviation.

Abbreviations: FMA, Fugl-Meyer Assessment; BBS, Berg Balance Scale; K-MBI, Korean Version of Modified Barthel Index; K-MMSE, Korean Version of Mini-Mental State Examination; IQ, Intelligence Quotient

**p*<0.05, when comparing each scores of baseline and discharge within same group by Wilcoxon signed rank test.

† compared the difference of each scores (score at discharge – score at admission) between two groups (brain tumor vs. stroke) by Mann-Whitney U test.

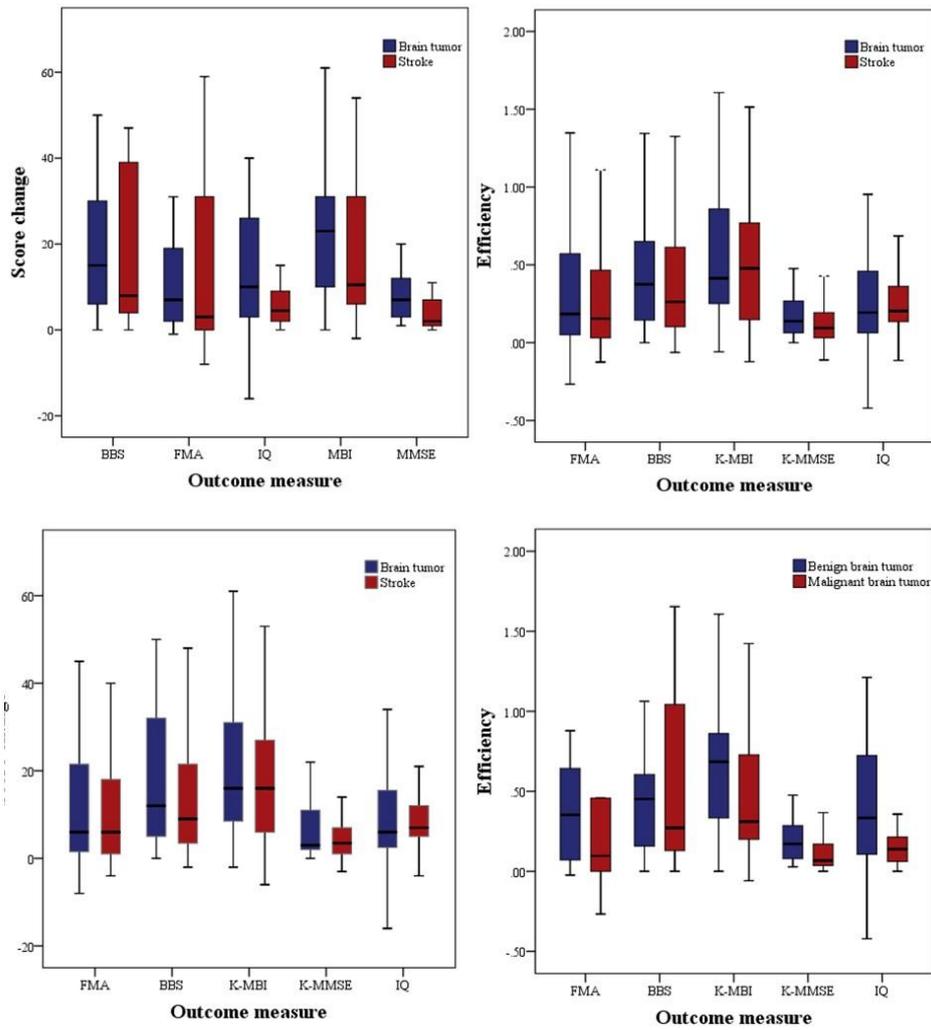
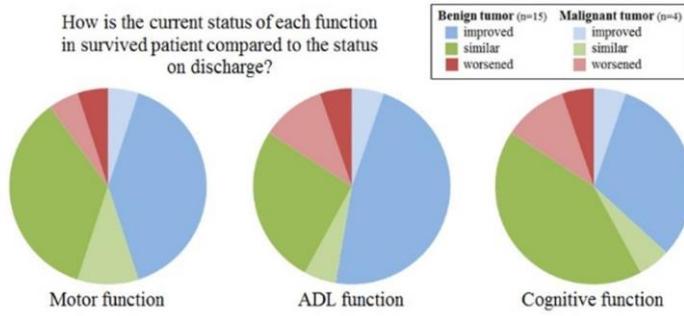
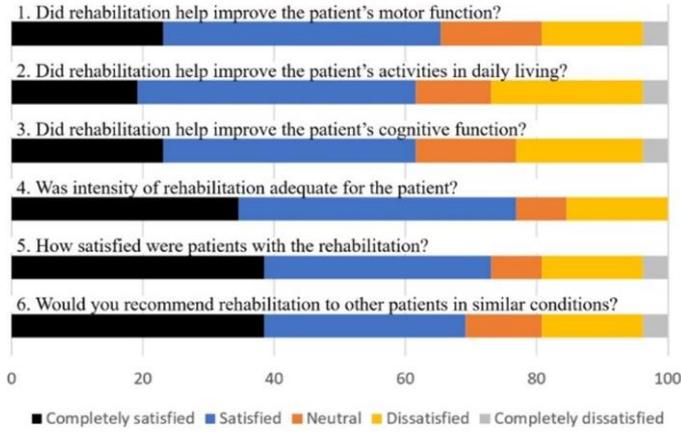


Figure 1. Comparison of Rehabilitation Outcome

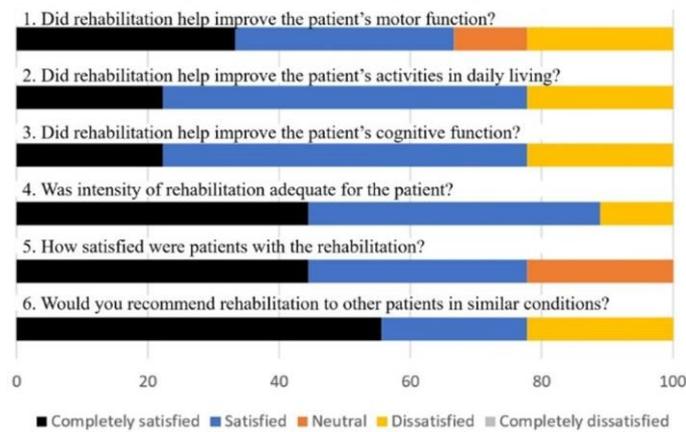
(A) Current status among the survived patients (n=19)



(B) Satisfaction survey on rehabilitation therapy in brain tumor (n=26)



(C) Satisfaction survey on rehabilitation therapy in malignant brain tumor (n=9)



(D) Satisfaction survey on rehabilitation therapy in deceased patients (n=9)

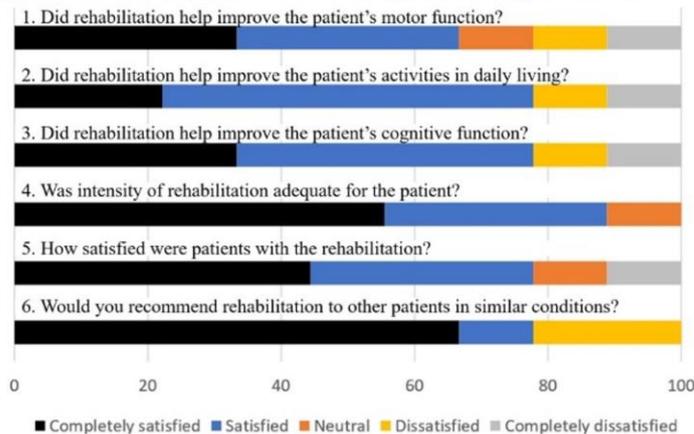


Figure 2. Results of Telephone Survey in Patients with Brain Tumor

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A Clinically Relevant Exoskeleton Robot for Elbow Spasticity in Hemiparetic Stroke Patients

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Objective

In this paper, we propose a new elbow exoskeleton robot and investigate the effect of the robot on spasticity for patients with hemiparesis after stroke.

Methods

The robotic device was designed to have clinically relevant features for spasticity management; accuracy, sufficiency, and compliancy. An assessment using the robot was processed for patients with each Modified Ashworth Scale (MAS) scores to verify the gaugeability. Twenty two participants with hemiparesis following stroke who had severe spasticity of the affected elbow were recruited and randomly assigned to a intervention group or a control group. The stretched state was maintained for 20 minutes/session, and the program on intervention group was performed for 5 days/week for 2 weeks.

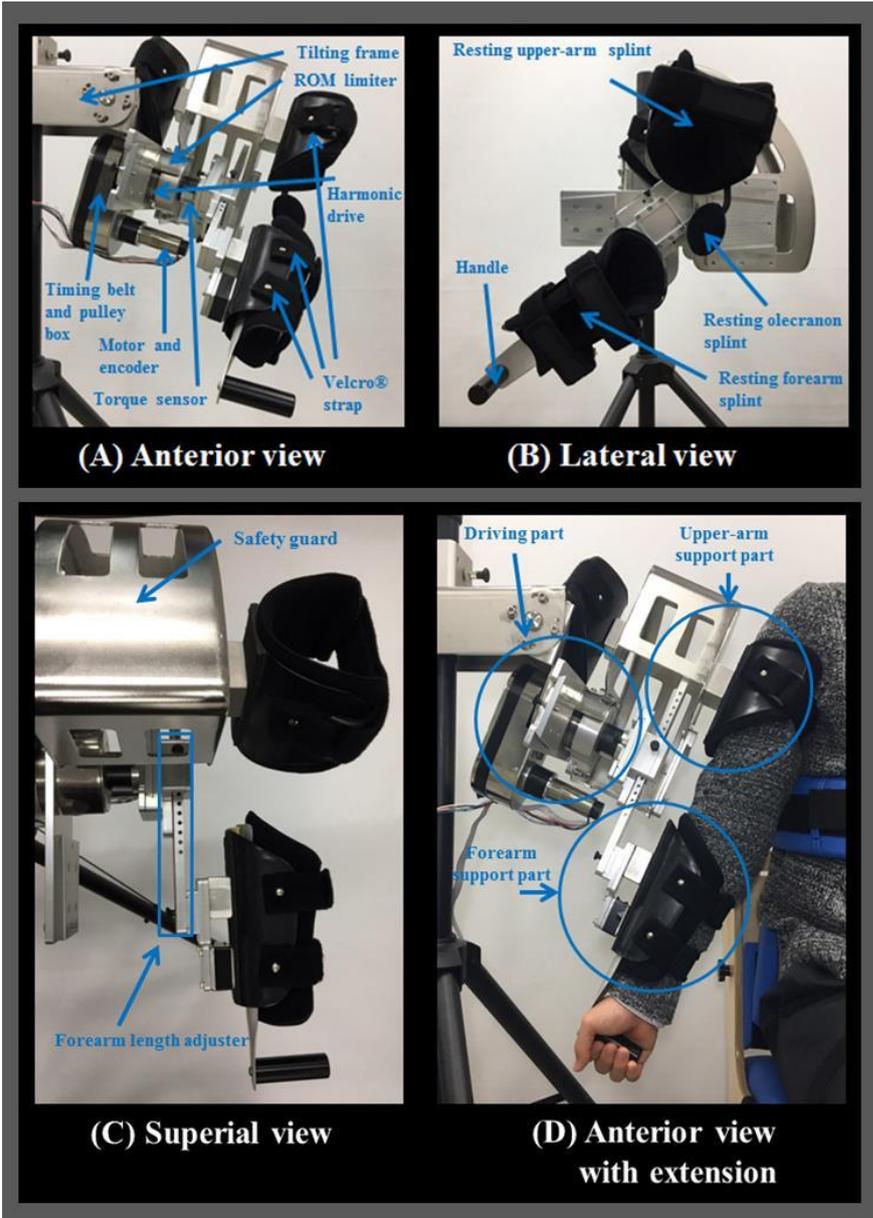
Spasticity of the affected elbow was assessed three times with intervals of a week (once [Pre] before and twice [post-1, post-2] after starting the static stretching program) using the MAS.

Results

The strong positive correlation was observed between the MAS measured by therapists and the maximum torque value measured by robot ($r=0.75$, $p<0.05$), and the correlation between MAS and gradient A ($r=0.71$, $p<0.05$). Significant differences were observed in mean MAS (Pre [3.29 ± 0.55] and Post-2 [2.25 ± 0.89], $p<0.05$) and in maximum torque (Pre [11.22 ± 3.62] and Post-2 [9.27 ± 3.92], $p<0.05$).

Conclusion

We found that the stretching program using robot could effectively relieve spasticity for patients with severe spasticity. Moreover, this robot system could be used as a measurement tool to identify the spasticity accurately based on the high correlation.



Exoskeleton robot, indicating (A) anterior view of exoskeleton robot that illustrates driving part mainly, (C) lateral view of exoskeleton robot that contains splints, (B) superial view, (D) anterior view with extension of upper limb.

Correlation between Diffusion Tensor Fractional Anisotropy and Functional Outcomes in stroke

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Objective

Fractional anisotropy (FA) measured by diffusion tensor imaging (DTI) represents neural fiber integrity and directionality of white matter tract. This study aimed to determine whether fractional anisotropy of the corticospinal tract is useful to predict functional outcome at a month after stroke onset.

Subject & Method

Medical records of 75 subacute stroke patients who admitted to rehabilitation center from August 2017 to February 2018 were reviewed retrospectively. Patients were classified into 2 groups by whether the FA value of affected side is measured or not : incompletely disrupted group and completely disrupted group. The FA ratio (the FA of affected side divided by that of unaffected side) and fiber number (FN) ratio of corticospinal tract were calculated to determine the correlation with functional outcome in incompletely disrupted group. Functional outcomes from a month after stroke onset were measured by functional independence measure (FIM), Fugl Meyer assessment (FMA) of upper extremity and lower extremity, trunk impairment scale (TIS), berg balance scale (BBS), and length of stay (LOS). In addition, incompletely disrupted group was compared with the group with completely disrupted group for functional outcome differences.

Result

The motor component of FIM, FMA of upper extremity, and BBS were positively correlated and LOS was negatively correlated with FA ratio (Table 2). Table 3 showed that incompletely disrupted group was significantly higher in FMA of upper extremity, TIS and BBS at one month after stroke onset and lower in LOS than in completely disrupted group.

Conclusion

This study found that the FA value of corticospinal tract can be a good predictor of functional outcomes and LOS for subacute stroke patients. Further prospective study should be needed for determining the predictability of diffusion tensor imaging for functional recovery in stroke patients.

Table 1. Demographic and clinical characteristics

	incompletely disrupted group (n=69)	completely disrupted group (n=6)
Age (years)	66.51±11.46	71.83±12.32
Sex (male/women)	38/31 (55.1/44.9%)	4/2 (66.7/33.3%)
Interval time to DTI (days)	15.49±8.74	24.33±10.42
Etiology (cerebral infarction/ cerebral hemorrhage)	56/13 (81.2/18.8%)	4/2 (66.7/33.3%)
Lesion side (right/left)	25/44 (36.2/63.8%)	4/2 (66.7/33.3%)
Lesion location (supratentorial/infratentorial/cerebellum)	56/12/1 (81.2/17.4/1.4%)	4/2/0 (66.7/33.3/0%)

Table 2. Correlation between functional outcome and functional anisotropy ratio (rFA) and fiber number ratio (rFN) of corticospinal tract

		rFA	rFN
LOS_total	pearson correlation coefficient	-.355**	-.035
	p value	.003	.778
FIM_motor	pearson correlation coefficient	.249*	.151
	p value	.039	.217
FIM_cognitive	pearson correlation coefficient	-.025	.047
	p value	.839	.700
FIM_total	pearson correlation coefficient	.176	.127
	p value	.147	.300
FMA_U/E	pearson correlation coefficient	.415**	.190
	p value	.000	.119
FMA_L/E	pearson correlation coefficient	.234	.212
	p value	.053	.080
TIS	pearson correlation coefficient	.000	.139
	p value	.276	.254
BBS	pearson correlation coefficient	.261*	.171
	p value	.030	.160

Table 3. Comparison of functional outcome at one month after stroke onset between incompletely disrupted group and completely disrupted group

	incompletely disrupted group (n=69)	completely disrupted group (n=6)	p value
LOS_total	52.54±13.30	78.83±20.41	.024
FIM_motor	50.71±21.58	29.67±24.87	.094
FIM_cognitive	23.25±9.17	19.00±11.70	.422
FIM_total	73.96±29.13	48.67±34.78	.138
FMA_U/E	48.16±22.13	18.33±23.54	.025
FMA_L/E	25.41±9.08	12.33±11.70	.136
TIS	17.16±6.90	10.17±9.58	.065
BBS	35.71±18.97	15.17±21.32	.040

Pre-stroke Cardiopulmonary Fitness Level as a Predictor of Functional Outcome

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Objective

For individuals with stroke, physical activity gets significantly reduced and it might affect cardiopulmonary fitness level or peak oxygen consumption (peak VO₂). Peak VO₂ value is a gold standard for predicting metabolic cart through gas analysis, and this value can be used as an indicator to represent individual physical activity. For disabled patients after stroke, it is difficult to conduct an exercise test to assess peak VO₂. Previously, Jurca et al. proposed a relatively simple and easy Method to obtain pre-stroke peak VO₂ during subacute stroke hospital stay using non-exercise prediction equations. We hypothesized that pre-stroke peak VO₂ is related with post-stroke respiratory function that could affect functional outcome. In this study, we investigated the effect of pre-stroke cardiopulmonary fitness level measured by non-exercise estimation equation (Jurca equation) on post-stroke respiratory function and functional outcome of the subacute stroke phase.

Methods

We enrolled 44 patients with first-ever stroke during the period of December, 2017 through May, 2018. All patients were admitted or transferred to our rehabilitation department within 6 months of onset. Patient with recent surgical procedure, disease of respiratory condition and tracheostomy status were excluded from the study. We assess pre-stroke peak VO₂ using a non-exercise estimation equation including sex, age, body mass index (BMI), resting heart rate (rHR) and self-reported measure of physical activity. Respiratory function including post-stroke peak cough flow (PCF), maximal inspired pressure (MIP), maximal expired pressure (MEP), forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV₁) and FEV₁/FVC were measured on admission. Outcome measures were assessed before discharge using by berg balance scale (BBS) and functional independence measure (FIM) score. Partial correlation analysis was used to analyze the relationship between pre-stroke peak VO₂ and respiratory function. Multiple regression analyses were performed to find out the effect of pre-stroke VO₂ on discharge functional outcome. Data analyses involved use of SPSS v18.0 for Windows. P < 0.05 was considered statistically significant.

Results

Table 1 showed demographic characteristics of patients. Table 2 revealed post-stroke PCF and MEP were significantly correlated with pre-stroke peak VO₂. The pre-stroke peak VO₂ was a significant predictive value for BBS and FIM score at discharge in univariate linear regression (Table 3).

Conclusion

This Results show that pre-stroke cardiopulmonary fitness level (peak VO₂) has a significant relationships with post-stroke respiratory function. Furthermore, estimated pre-stroke peak VO₂ could affect sitting balance and functional level at discharge in stroke patients during subacute phase.

Table 1. Demographic Characteristics and Anthropometric Data of the Subjects

	Number of patient (n=44)	Men (n=26)	Women (n=18)
Age(years)	57.66±15.13	53.08±13.16	64.28±15.69
BMI(kg/m ²)	23.35±3.85	23.86±4.25	22.62±3.18
Subtype (Ischemic:Hemorrhagic)	16:28	7:19	1:1
MMSE-K	23.59±5.16	24.54±5.27	22.22±4.80
Albumin(g/dl)	3.88±0.26	3.90±0.31	3.86±0.15

Values are mean ± standard deviation

BMI, Body mean index; MMSE-K, Korean version of the mini-mental mtate examination

Table 2. Partial Correlation Coefficient (r) between Pre-stroke Peak VO₂ and Pulmonary Function adjusted for Age, Sex and BMI (n=44)

Variables	Partial Correlation(pre-stroke peak VO ₂)	
	r	P-value
PCF	0.364	0.010**
MIP	0.094	0.522
MEP	0.312	0.029*
FVC	0.275	0.056
FEV1	0.177	0.224
FEV1/FVC	0.101	0.491

*P<0.05, ** P<0.01

PCF, Peak cough flow; MIP, Maximal inspired pressure; MEP, Maximal expired pressure; FVC, Forced vital capacity; FEV1, Forced expiratory volume in 1 second

Table 3. Univariate Linear Regression Analyses for Functional Outcome (dBBS, dFIM)

Variable	dBBS		dFIM	
	β	P-value	β	P-value
Pre-stroke Peak VO ₂	0.386	0.005**	0.511	<0.0001**

*P<0.05, ** P<0.01

dBBS, Berg Balance Scale at discharge; dFIM, Functional Independence Measure at discharge

Therapeutic effects of rehabilitation therapy on controlling of *Clostridium difficile* infection

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Objective

To assess the prevalence of *Clostridium difficile* (CD) infection and therapeutic effects of rehabilitation therapy on treatment duration of CD infection in patients with stroke at tertiary university hospital

Materials and Methods

This is retrospective study. One thousand five patients who transferred to rehabilitation department were recruited. One hundred twenty four out of 1005 stroke patients who were concordant for *Clostridium difficile* (*C. difficile*) positively on culture and presence of toxigenic strain. The patients (n=124) diagnosed with CD infection were divided into two groups (Figure 1). Group 1 (n=67) consisted of patients who were hospitalized in rehabilitation department with greater mobilization through rehabilitation therapy, and group 2 (n=57) was patients with lesser mobilization who were hospitalized in neurology and neurosurgery department. We compared the differences of several risk factors, the treatment Method, and treatment duration between the two groups.

Results

There were no significant differences in demographics between two groups (Table 1). Among the risk factors related to CD infection, the period of use of antibiotics, H2 blocker, and enteral feeding was significantly higher in group 1 than that in group 2 (p<0.05, Table 2). The treatment duration of metronidazole PO medication was significantly shorter in group 1 than that in group 2 (p=0.011, Table 2)

Conclusions

This study showed that the group with rehabilitation therapy had shorter treatment duration of CD infection than that in the group without rehabilitation therapy. Rehabilitation therapy may be early and effectively controlling of CD infection in patients with stroke.

Table 1. Patients demographics and initial clinical data of CD infection risk factors (N = 124)

	Group 1 (n=67)	Group 2 (n=57)	P value
Age (years)	71.73±10.99	68.84±12.82	0.179
Sex, n (%)			0.065
Male/female	37(55.2) 30(44.8)	/ 22(38.6) / 35(61.4)	
Risk factor			
Pre-CD infection Antibiotics use	63(94.0)	50(87.7)	0.218
H2 blocker use	58(86.6)	39(40.2)	0.015*
PPI use	28(41.8)	16(28.1)	0.112
Enteral feeding	47(70.1)	38(66.7)	0.677

NOTE. Age value is mean ± SD

* P<0.05 by Mann-Whitney U test

Abbreviations: PMC, Pseudomembrane colitis; PPI, Proton pump inhibitor

Group 1: Patients with greater mobilization through rehabilitation therapy; Group 2: Patients with lesser mobilization

Table 2. Comparison of the risk factors and the treatment duration of CD infection between two groups

	Group 1 (n=67)	Group 2 (n=57)	P value
Antibiotics use (days)	17.21±18.51	11.71±9.46	0.039*
Gastric suppression			
H2 blocker (days)	33.20±23.65	19.75±19.92	0.003*
PPI (days)	22.71±19.51	16.25±15.32	0.480
Enteral feeding (days)	35.57±30.22	19.35±16.86	0.013*
Metronidazole PO medication (days)	12.69±6.49	16.05±6.53	0.011*

NOTE. Values are mean ± SD

* P<0.05 by Mann-Whitney U test

Abbreviations: PMC, Pseudomembrane colitis; PPI, Proton pump inhibitor

Group 1: Patients with rehabilitation therapy; Group 2: Patients without rehabilitation therapy

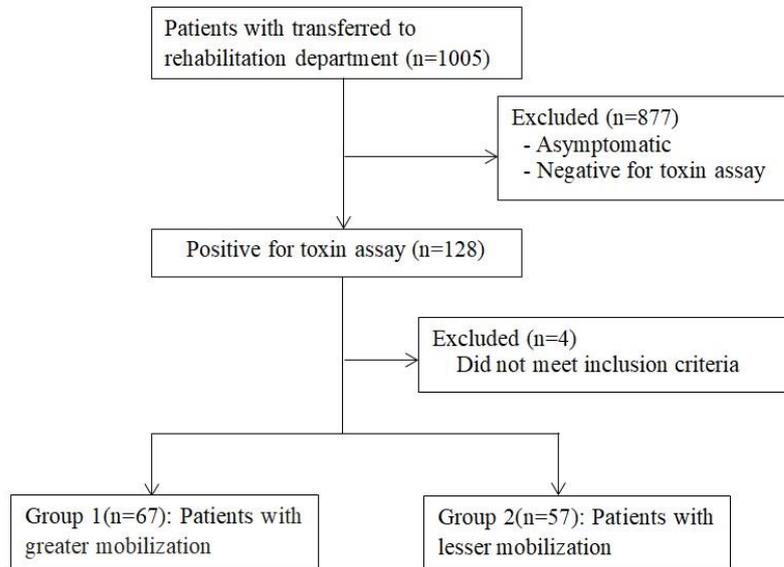


Figure 1. Flowchart of the study protocol

Effect of Cognitive Reserve on Cognitive Impairment and Recovery after Stroke: The KOSCO Study

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Purpose

The theory of cognitive reserve (CR) was introduced to account for individual differences in clinical manifestation of neuropathology. This study was conducted to investigate whether CR had moderating effect on cognitive impairment and recovery after stroke.

Methods

This study was an interim analysis of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) designed as 10 years long-term follow-up study of stroke patients. All patients who admitted to the representative hospitals in 9 distinct areas of Korea with their acute first-ever stroke (from August 2012 to May 2015) were recruited. In this study, a total of 7,166 patients with cognitive test score at least at one time point until 30 months after onset were included. Educational level and premorbid occupation were used as proxies of CR. performance on Korean Version of Mini-Mental State Examination (K-MMSE) was analyzed with ANCOVA, logistic regression and multi-level model.

Results

The rate of cognitive impairment (<16%ile), classified according to an age and education adjusted norm, was higher in patients with low levels of education (except patients with no education) or occupation than patients with high levels of education or occupation at every time points (7 days after stroke, transfer to rehabilitation, discharge, and 3 months, 6 months, 12 months, 18 months, 24 months, and 30 months after stroke). As a Result of ANCOVA, cognitive impairment was more severe in patients with low levels of education (except patients with no education) or occupation than in patients with high education or occupation at every time points when adjusted for demographic and stroke-related risk factors ($p<0.05$). Predictive effect of CR composite score was significant in logistic regression ($p<0.05$): low CR increased risk of cognitive impairment at every time points. In multi-level model analysis, K-MMSE total score was improved within the first 6 months and reached plateau, but the slope of the increase over the first 6 months was steeper in patients with high CR than low CR ($p<0.05$).

Conclusion

These Results supported the moderating role of CR on cognitive impairment and recovery after stroke. High CR reduced the risk of cognitive impairment after stroke and increased the speed of cognitive recovery during 6 months after stroke.

Change of corticoreticulospinal tract with aging on diffusion tensor tractography in the human brain

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Objective

The corticoreticulospinal tract (CRT) is mainly involved in gait function in human brain. We investigated the change of the CRT with aging, using diffusion tensor tractography (DTT).

Methods

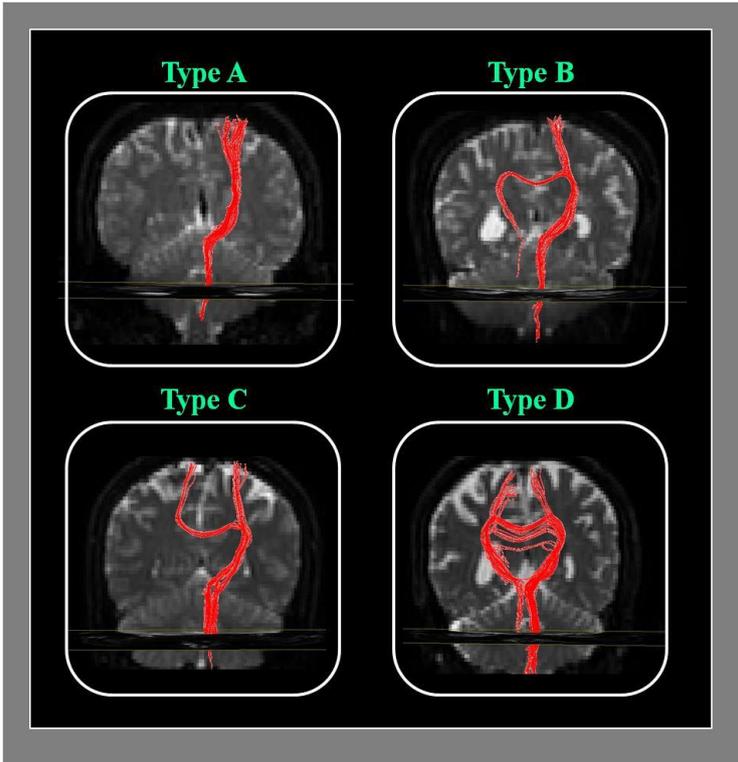
Sixty one healthy subjects aged from the 20s to the 70s were recruited. The CRT was reconstructed, and values of fractional anisotropy (FA), mean diffusivity (MD), and fiber number (FN) of CRT were measured. We classified the DTT findings as follows: no transcallosal fiber (TCF) from the CRT (type A), TCF ended within the corpus callosum or descended below the corpus callosum in the opposite hemisphere (type B), TCF ascended to the cerebral cortex in the opposite hemisphere (type C), and type D indicates mixed TCF of type B and C.

Results

Significant differences in the value of MD were observed between 50s and 70s ($p < 0.05$). Regarding the value of FN, the significant differences were observed between 20s and 50s, 50s and 70s ($p < 0.05$). However, no significant difference in the value of FA was observed between age groups ($p > 0.05$). A weak correlation was observed between age group and MD ($r = 0.208$, $p < 0.05$). We found that the type A was most commonly observed until 50s whereas type D was most commonly observed from 60s.

Conclusion

We demonstrated the aging process of the CRT in normal subjects using DTT and found the general critical age of the CRT was 60s in terms of DTT parameters and configuration. Our Results would be helpful in understanding and prevention of aging process of gait in normal subjects.



Classification of transcallosal fibers. Type A: no transcallosal fibers from the corticoreticulospinal tract; Type B: transcallosal fibers end in the corpus callosum or descend below the corpus callosum in the opposite hemisphere; Type C: transcallosal fibers ascend to the cerebral cortex in the opposite hemisphere; Type D: mixed type of Type B, and C.

Relationship of respiratory infection with aspiration and other characteristics in Parkinsonism

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Introduction

Parkinson's disease and Parkinson plus syndrome are progressive neurodegenerative disorders. Most patients with Parkinsonism eventually develop dysphagia, and aspiration pneumonia is an important cause of morbidity and mortality in these patients. Although videofluoroscopic swallowing study (VFSS) is considered as 'gold standard' technique to assess dysphagia, the association between videofluoroscopic findings and respiratory infection in patients with Parkinsonism is not well studied. This study aimed to investigate the relationship of respiratory infection with aspiration and other findings in VFSS as well as clinical characteristics in patients with Parkinsonism.

Methods

Total 113 VFSS cases in 208 patients of Parkinsonism who were referred due to dysphagia symptoms were reviewed retrospectively from Dec. 2015 to Jan. 2018. Demographic characteristics and VFSS findings were collected by reviewing the electronic medical record for each patient. The videofluoroscopic dysphagia scale (VDS), which consisted of 14 items, were used to evaluate the functional components of swallowing. The swallowing disturbance questionnaire (SDQ), which consisted of 15 items, were used to evaluate history of the respiratory infection over last one year and dysphagia symptoms. The relationship of clinical characteristics and VFSS findings, including aspiration, with respiratory infection were analyzed by Mann–Whitney U Tests for continuous and ordinal variables, and Fisher exact tests for categorical variables.

Results

The patients with history of the respiratory infection were more older ($P = 0.019$) and had a higher score on the Hoehn and Yahr stage (Table 1). Videofluoroscopic evidence of aspiration and lip closure, bolus formation, apraxia, premature bolus loss, oral transit time, vallecular residue, pyriform sinus residue, coating of pharyngeal wall and penetration/aspiration of VDS were significantly associated with history of the respiratory infection (Table 2). However, type of aspirated diet and presence of reflex cough were not significantly related with history of respiratory infection in patients who showed aspiration in VFSS (Table 3).

Conclusion

This study suggested that age, Hoehn and Yahr stage, videofluoroscopic evidence of aspiration were associated with history of the respiratory infection in patients with

Parkinsonism. In addition, oral phase dysfunction, vallecular residue and pyriform sinus residues were more frequent and severe in patients with history of the respiratory infection. These characteristics and findings may be considered to prevent respiratory infection in dysphagic patients with Parkinsonism.

Table 1. Demographic and clinical characteristics of patients

Variable	All patients (N=123)	No history of respiratory infection (N=103)	History of respiratory infection (N=20)	P
Age, y (SD)	72.29 (9.31)	70.35 (8.77)	76.15 (10.69)	<i>0.019</i>
Sex, n (%)				0.079
Male	73 (59.3)	58 (56.3)	16 (80.0)	
Female	50 (40.7)	45 (43.7)	4 (20.0)	
Diagnosis, n (%)				0.220
IPD	56 (45.5)	44 (42.7)	12 (60.0)	
Parkinson plus syndrome				
MSA	28 (22.8)	26 (25.2)	2 (10.0)	
PSP	22 (17.9)	11 (10.7)	3 (15.0)	
CBD	2 (1.6)	2 (1.9)	0 (0.0)	
DLB	1 (0.8)	1 (1.0)	0 (0.0)	
Not diagnosed	14 (11.4)	11 (10.7)	3 (15.0)	
Duration, disease, y (SD)	6.44 (4.50)	6.46 (4.60)	6.35 (4.02)	0.989
Duration, dysphagia, y (SD)	1.85 (2.04)	1.85 (2.102)	1.85 (1.69)	0.673
Hoehn and Yahr stage, n. (%)				<i>0.011</i>
Hoehn and Yahr stage I-III	53 (43.1)	50 (48.5)	3 (15.0)	
Hoehn and Yahr stage IV-V	68 (55.3)	52 (50.5)	16 (80.0)	
Can not evaluate	2 (1.6)	1 (1.0)	1 (5.0)	
LED, n. (SD)	764.48 (544.59)	783.05 (561.92)	662.36 (436.36)	0.550

IPD : idiopathic parkinson's disease; MSA : multiple system atrophy; PSP : progressive supranuclear palsy; CBD : corticobasal degeneration; DLB : Dementia with Lewy bodies; LED : Levodopa equivalent dose.
p values <0.05 appear in italics.

Table 2. Relationship of aspiration and other findings in VFSS with history of respiratory infection

	No history of respiratory infection (N=103)	History of respiratory infection (N=20)	P
Aspiration on VFSS, n. (%)	43 (41.7)	15 (75.0)	<i>0.007</i>
No evidence of aspiration on VFSS, n. (%)	60 (58.3)	5 (25.0)	
VDS subdomains, n. (%)			
Lip closure (intact/inadequate + none)	93/10 (9.7)	14/6 (30.0)	<i>0.024</i>
Bolus formation (intact/inadequate + none)	39/64 (62.1)	2/18 (90.0)	<i>0.018</i>
Mastication (intact/inadequate + none)	40/63 (61.2)	5/15 (75.0)	0.314
Apraxia (none/mild + moderate + severe)	93/10 (9.7)	14/6 (30.0)	<i>0.024</i>
Tongue to palate contact (intact/inadequate + none)	70/33 (32.0)	11/9 (45.0)	0.306
Premature bolus loss (none/<10%/10–50%/>50%)	40/33/24/5 (61.2)	6/2/9/3 (70.0)	<i>0.046</i>
Oral transit time (≤1.5 s/>1.5 s)	91/12 (11.7)	13/7 (35.0)	<i>0.015</i>
Triggering of pharyngeal swallow (normal/delayed)	55/48 (46.6)	6/14 (70.0)	0.086
Vallecular residue (none/<10%/10–50%/>50%)	45/21/28/9 (56.3)	6/2/6/6 (70.0)	<i>0.037</i>
Laryngeal elevation (normal/impaired)	14/89 (86.4)	1/19 (95.0)	0.461
Pyriform sinus residue (none/<10%/10–50%/>50%)	62/26/12/3 (39.8)	7/6/2/5 (65.0)	<i>0.011</i>
Coating of pharyngeal wall (no/yes)	52/51 (49.5)	5/15 (75.0)	<i>0.049</i>
Pharyngeal transit time (≤1.0 s/>1.0 s)	89/14 (13.6)	15/5 (25.0)	0.193
Aspiration (none/supraglottic penetration/subglottic aspiration)	12/48/43 (88.3)	0/5/15 (100)	<i>0.005</i>

VFSS, videofluoroscopic swallowing study; VDS, videofluoroscopic dysphagia scale
p values <0.05 appear in italics.

Table 3. Relationship of type of aspirated diet and presence of reflex cough with history of respiratory infection in patients who showed aspiration in VFSS

	Aspiration without history of respiratory infection (N=43)	Aspiration with history of respiratory infection (N=15)	P
Diet type, n. (%)			0.484
Aspiration of thickened liquids or solid food	9 (20.9)	5 (33.3)	
Aspiration of thin liquids only	34 (79.1)	10 (66.7)	
Presence of reflex cough, n. (%)			1.000
Silent aspiration	35 (81.4)	12 (80.0)	
Aspiration with reflex cough	8 (18.6)	3 (20.0)	

Clinical Validity of Changes of the Pharyngeal Width at Rest in Dysphagic Patients with Stroke

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Introduction

Dysphagia in ischemic or hemorrhagic stroke patients is a critical condition which can be caused by weakness of pharyngeal constrictor muscles that increases the risk of aspiration, leading to serious pneumonia. The pharyngeal width at rest affected by tensivity of pharyngeal constrictor muscles could be a significant index for difficulty swallowing by our previous studies. The present study aimed to create a new tool for evaluating if there is alleviation or deterioration in dysphagia, using lateral neck x-ray, video fluoroscopic swallowing study (VFSS) and well known dysphagia scales (Penetration Aspiration scale, PAS; Dysphagia Outcome and Severity Scale, DOSS) in order to analyze the changes of the pharyngeal width at rest in chronologic sequence in dysphagic patients with stroke.

Methods

We conducted lateral cervical spine x-rays from 22 patients with ischemic or hemorrhagic stroke. A video fluoroscopic swallowing study was performed and the PAS and the DOSS were determined as the estimation of the current state of dysphagia. The patients had the first VFSS in the acute stage within 30 days after the stroke and had the follow-up studies without time limits when each patient visited the outpatient clinics. Before the studies, one physician verified age, gender, height, weight and neck circumference at each study. Pharyngeal diameter at rest was defined as an average value of the 2 lengths measured at the middle of the second and third cervical vertebral bodies using a lateral neck radiograph and was named "JOSCYL Width" which was a combination of the first letters of the developer's surnames. We made comparisons between the Results from the first VFSS and the follow-up VFSSs and then analyzed the correlation between the changes of the JOSCYL Width and the changes of the PAS and the DOSS over time, using Pearson correlation coefficient as a statistic tool.

Results

The ages of the patients in every case ranged between 40 and 81 years old (mean age of 63.9 ± 13.9 years). The uphill linear correlation between the changes of the JOSCYL Width and the PAS values existed significantly for the stroke group ($r = 0.511$, $p < 0.05$). The changes of the DOSS scores had significant downhill linear correlation with the ones of the JOSCYL Width ($r = -0.435$, $p < 0.05$).

Conclusion

As the JOSCYL Width changed in a positive or negative direction, the PAS scores changed in the same direction and the DOSS scores changed in the opposite way accordingly in this study. The JOSCYL Width well reflected the current condition at each dysphagic patient with stroke and could be a useful tool to evaluate whether alleviation or aggravation of dysphagia occurred following stroke. We need to examine more patients with dysphagia to see if strong correlations exist between this index and the PAS & DOSS values.

Relationship Between Vitamin D Deficiency And Depression in Acute Stroke Patients

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Objective

Recent studies show low serum vitamin D levels are associated with depression in the general population. However, the study about relationship between vitamin D levels and depression in acute stroke patients is rare. The aim of this study is to evaluate whether the serum level of 25(OH)D was associated with depression in people with acute stroke patients.

Subjects and Method

We analyzed 36 patients who were diagnosed with acute stroke (within 3 months) retrospectively from July 2017 to May 2018. Patient underwent functional and biochemical evaluation, including assessment of 25(OH)D levels (within 24hrs of onsets) and depressive symptom was used the self-report questionnaire, Beck Depression Inventory-II (BDI-II). Depression was defined as BDI-II score ≥ 14 , and patients were divided into depressive and non-depressive groups.

Results

Depression was observed in 18 of 36 of the study population. Basic characteristic including sex, age, education level, BMI, K-MMSE, K-MBI, mRS and seasonal variation showed no statistical differences between groups. BDI-II scores were 34.8 ± 12.6 in depressive group and 6.45 ± 4.3 in non-depressive group. The mean level of 25(OH)D was lower in the depressive group than in the non-depressive group. (10.1 ± 2.6 vs 20.7 ± 8.9 ng/mL ; $p < 0.05$)

Conclusion

The levels of 25(OH)D were significantly lower in depressive group with respect to non-depressive group in acute stroke patients. This study suggests that serum vitamin D is significantly associated with the depression in acute stroke patients.

The effect of sensory deficit on the gait and balance of patients with supratentorial ischemic stro

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Objective

Sensory deficit is common in patients with stroke and seems to be related to balance and ambulation. The aim of present study is to investigate whether the deficit of sensory confirmed by somatosensory evoked potential (SSEP) of lower extremities affects poststroke gait and balance.

Method

We reviewed medical records for stroke patients who were admitted to the department of rehabilitation medicine from January 1, 2014 to April 30, 2018 and had SSEP done after stroke. We included the patients who received hospitalization within 3 months of stroke and measured by MRC grade 3 or higher of hemiplegic lower limb. Patients with history of previous stroke, visual field defect, hemineglect, spasticity, or peripheral polyneuropathy of lower extremities confirmed by electrophysiologic study were excluded. We divided the enrolled patients into the group with normal SSEP values (latency, and amplitude) and abnormal SSEP values. We evaluated balance function and ability of ambulation of the patients by means of the Berg Balance Scale (BBS) and Functional Ambulation Category (FAC).

Results

A sample of 14 patients was recruited. The mean age of patients was 64.64 years, with 9 men and 9 right hemiplegia, and the mean duration between onset of stroke and evaluation of SSEP was 16.64 days. The scores of BBS and FAC was 41.67 ± 9.69 and 3.67 ± 1.21 in patients with abnormal SSEP latency group and 42.0 ± 14.46 and 3.62 ± 1.85 in the normal SSEP latency subjects. In the abnormal SSEP amplitude group, the scores of BBS and FAC was 41.67 ± 9.64 and 3.78 ± 1.30 , and in normal SSEP amplitude group was 42.20 ± 17.24 and 3.40 ± 2.07 . The difference failed to reach a statistically significant level ($P > 0.05$).

Conclusion

The balance and gait ability in patient with supratentorial ischemic stroke have not relation to latency and amplitude of SSEP. The Results were probably due to small sample size of enrolled patients and insensitivity of reference value of SSEP.

Key words

stroke · evoked potential, somatosensory · gait · balance

Table 1. General Characteristics of the Patients

Characteristics	Values
Age (years)	64.64 ± 11.89
Gender (M / F) (n)	9 / 5
Hemiplegic side (right / left) (n)	9 / 5
Interval between onset of stroke and evaluation of SSEP (days)	16.64 ± 7.90
BBS	41.86 ± 12.20
FAC	3.64 ± 1.55

Table 2. Comparison of BBS and FAC values between the NSLG and ASLG of supratentorial ischemic stroke patients

Characteristics	NSLG (n=8)	ASLG (n=6)	p-value
Age (years)	63.38 ± 11.36	66.33 ± 13.44	0.673
Gender (M / F) (n)	5 / 3	4 / 2	1.000
Hemiplegic side (right / left) (n)	5 / 3	4 / 2	1.000
Interval between onset of stroke and evaluation of SSEP (days)	18.75 ± 9.87	13.83 ± 3.06	0.559
BBS	42 ± 14.46	41.67 ± 9.69	0.746
FAC	3.62 ± 1.85	3.67 ± 1.21	0.839

Table 3. Comparison of BBS and FAC values between the NSAG and ASAG of supratentorial ischemic stroke patients

Characteristics	NSAG (n=5)	ASAG (n=9)	p-value
Age (years)	69.20 ± 12.83	62.11 ± 11.27	0.334
Gender (M / F) (n)	4 / 1	5 / 4	0.739
Hemiplegic side (right / left) (n)	3 / 2	6 / 3	1.000
Interval between onset of stroke and evaluation of SSEP (days)	16.40 ± 12.70	16.78 ± 4.55	0.081
BBS	42.20 ± 17.24	41.67 ± 9.64	0.423
FAC	3.40 ± 2.07	3.78 ± 1.30	0.944

P 3-56

Determining the peak cough flow values to predict Dysphagia in stroke patients

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Objective

To determine the diagnostic parameters and appropriate cut-off values of the voluntary cough flow, maximal inspiratory and expiratory pressures and determine which parameter could aid in the diagnosis of dysphagia in stroke patients.

Method

Retrospective analysis of a prospectively maintained database was done in a single university affiliated hospital. Patients with first-ever diagnosed dysphagia attributable to cerebrovascular disease, prospectively performed spirometry measurements for the voluntary peak cough flow and respiratory pressure meters were recruited. These values were compared to patients with no evidence of dysphagia after stroke. Primary outcome measures were peak cough flow (L/min) during voluntary coughing and maximal pressure meter (cmH₂O).

Results

A total of 237 stroke patients with 163 patients were diagnosed with dysphagia through instrumental assessments. Receiver operating curve analysis showed that peak cough flow cut-off values set at 151 L/min were significantly associated with presence of dysphagia with sensitivity levels of 0.72 (0.66-0.79) and specificity levels of 0.78 (0.69-0.88) [area under the curve (AUC) 95% confidence interval (CI) = 0.81 (0.76-0.87)]. In contrast, the cut-off values set at 20 and 38 for the MIP and MEP showed lower sensitivity levels (0.49, 0.58) with lower AUC values of 0.65 (0.58-0.72) and 0.70 (0.64-0.77). A multivariate regression logistic regression analysis with other clinical variables revealed that only the inclusion of the peak cough flow could significantly predict the presence of dysphagia with an adjusted odds ratio of 4.12 (2.20-8.69, $p < 0.001$).

Conclusions

Among the various respiratory parameters, the peak cough flow cut-off values of the voluntary cough flow set at 151 L/min can significantly indicate presence of dysphagia. Results advocate the objective measurement of cough peak flow from voluntary coughing to be used as part of the formal assessment of those with post-stroke dysphagia.

	non-Dysphagia	Dysphagia	se(95% CI)	sp(95% CI)	PPV(95%)	NPV(95%)	AUC(95% CI)
MBI							
>40	54	56	0.66(0.58-0.73)	0.73(0.63-0.83)	34(0.78-0.91)	0.49(0.40-0.58)	0.74(0.67-0.81)
≤40	20	107					
<i>Respiratory parameters</i>							
Peak cough flow/ 사발적 기침 세기							
>151	58	45	0.72(0.66-0.79)	0.78(0.69-0.88)	38(0.83-0.94)	0.56(0.47-0.66)	0.81(0.76-0.87)
≤151	16	118					
Pimax/ or MIP							
>20	62	83	0.49(0.41-0.57)	0.84(0.75-0.92)	37(0.80-0.94)	0.43(0.35-0.51)	0.65(0.58-0.72)
≤20	12	80					
Pemax/ MEP							
>38	57	68	0.58(0.51-0.66)	0.77(0.67-0.87)	35(0.78-0.91)	0.46(0.37-0.54)	0.70(0.64-0.77)
≤38	17	95					
cut-off value can be determined using ROC curve analysis (with youden index)							

Optimal Cutoff points on the ROC curve for Dysphagia

Effect of cognitive improvement by high or low frequency rTMS treatment in Alzheimer-induced mouse

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Introduction

Previous studies of repetitive transcranial magnetic stimulation (rTMS) has been shown possibility of efficacy to relieve cognitive dysfunction from Alzheimer dementia. However, because the rTMS protocols used in each study are different, there are no Objective data that reveal most effective protocol. And frequency of the stimulation is still on debate in protocols of rTMS. Therefore, we conducted an experiment to determine more effective stimulation between high and low frequencies in cognitive function improvement when rTMS was applied in Alzheimer-induced mouse model.

Methods

Thirty-six mouse were included in this research and those were divided into three groups: control group with no experiment, control group with saline injection in cerebral ventricle and Alzheimer-induced mouse group with amyloid beta injection in the ventricle. Each group was divided into high frequency rTMS, low frequency rTMS, and no treatment subgroups. The rTMS treated groups were stimulated for 2 weeks, 5 days a week (Figure 1). High frequency rTMS group received rTMS with 20 Hz, 2s, 40 trains, 28s interstimulus interval, with total 1,600 pulses; and low frequency rTMS group received rTMS of continuous 1 Hz and 1,600 pulses in total. Both rTMS applied to the whole brain of the mouse and the intensity was 1.26 tesla. Y Maze test and novel object recognition task (NORT) were used for assessment of cognitive function and measured before rTMS and 1st and 2nd week after the rTMS.

Results

Before rTMS, the Alzheimer-induced mouse group showed lower Y maze and NORT scores than the other control groups, and there was no difference among the subgroups in each group. After initiation of rTMS, Alzheimer-induced mouse group showed increments of spontaneous alteration in Y Maze and recognition of novel objects in NORT in both high and low frequencies of rTMS compared to non-stimulated subgroup at 1st and 2nd week (Figure 2, 3). There was no statistical differences in scores of Y Maze and NORT between high and low frequency at 1st and 2nd week after the rTMS.

Conclusions

Both high and low frequency rTMS in Alzheimer-induced mouse brought improvement of cognitive function, which may be used as a therapeutic Method to treat Alzheimer's

disease. Studies on the pathophysiology of rTMS effect and long term follow up are needed.

	MON	TUE	WED	THU	FRI	SAT
			Experimental mouse modeling		Adaptive training: Y maze, NORT	
1 st week	rTMS	rTMS	rTMS	rTMS	rTMS, Y maze test, NORT training	NORT test
2 nd week	rTMS	rTMS	rTMS	rTMS	rTMS, Y maze test, NORT training	NORT test

fig1. Flow chart of experiment

Y maze

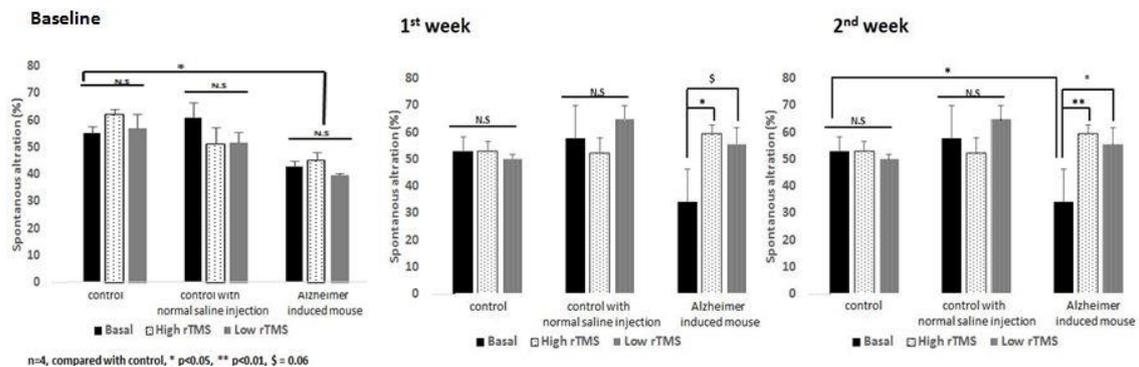


fig2. Changes of Y maze test score

Novel object recognition task

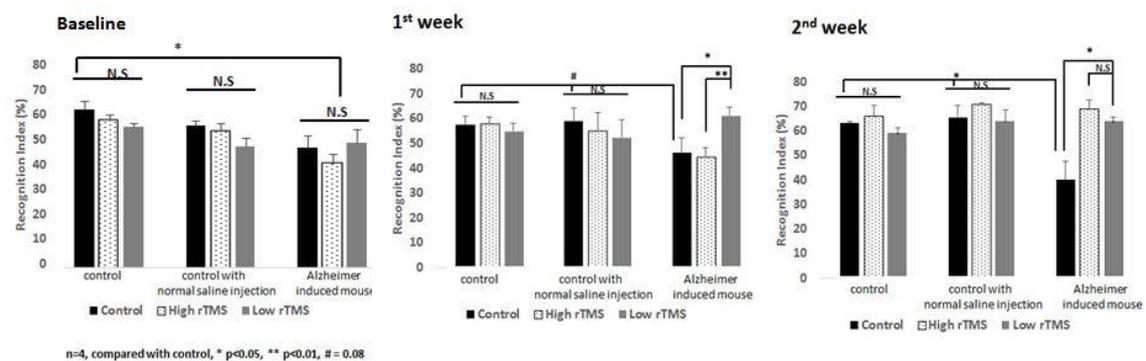


fig3. Changes of novel object recognition task test score

Changes of Psychosocial and Functional Assessment After Rehabilitation in Patients with Brain lesion

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Objective

Cognitive dysfunction and psychological changes in patients with brain lesion may be a major factor in disturbing successful rehabilitation of the patient. The Purpose of our study was to identify improvement of activities of daily living(ADL), psychosocial status after rehabilitation and to find out correlation between ADL and psychosocial tests in patients with brain lesion.

Materials and Methods

A retrospective analysis was conducted using the medical records of 432 patients with brain lesions. The inclusion criteria for the study were adult patients (≥ 18 years old) with psychological status(BDI, BAI, Hamilton depression inventory), social maturity(SMS), cognitive function test(MMSE, Digit span test, K-BNT, NPI, GDS) and ADL assessments(MBI) performed before and after rehabilitation. We excluded patients who had more than 2 weeks interval between each assessment. Thirty-seven patients who satisfied our criteria were included in this study. All statistical analyses were performed using the SPSS ver. 12.0. Wilcoxon signed-rank test was done to compare the scores of MMSE, DST, K-BNT, SMS, NPI, BDI, BAI, HDI, GDS and MBI. Linear regression analysis was performed to confirm the correlation between cognitive, psychological tests and functional outcomes. For predicting improvement of functional status, logistic regression analysis was performed with independent variables such as initial cognitive function, psychological status and social maturity.

Results

Among 37 patients, 20 were men and 17 women and the mean age was 61.92 ± 16.78 years. 11(29.7%), 18(48.6%) and 8(21.6%) patients had right-sided, left-sided, and bilateral brain lesions, 29(78.4%) and 8(21.6%) patients had each hemispheric and brainstem lesion, respectively. The initial mean MMSE of all patients was 17.38 ± 8.78 and the mean MBI score was 26.86 ± 19.87 . The mean MMSE and MBI after rehabilitation were improved to 18.81 ± 7.67 and 45.08 ± 26.98 . When comparing the initial and follow-up evaluations, MMSE, Digit span test, KBNT, SMS, MBI score were significantly improved($p < 0.05$). Their showed no significant correlation between cognitive, psychological tests and functional outcomes. According to the degree of MBI score improvement, 25 patients were categorized into the high improvement group and 12 patients low group. When comparing the assessments scores of the two groups, initial MMSE, DST, KBNT, SMS were significantly higher in high improvement group. According

to multivariate logistic analysis, initial MMSE score showed significant positive correlation with degree of MBI score improvement ($b=0.270$, $p=0.014$).

Conclusion

In our study, significant improvements was shown in most of functional and cognitive tests after rehabilitation, but not in emotional tests. And initial MMSE score showed significant positive correlation with degree of MBI score improvement, that suggest the initial MMSE score is related to functional recovery.

Pulmonary Function Test as a Functional Outcome Predictor of Stroke Patients

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Objective

Stroke patients may experience pulmonary dysfunction that reduce respiratory muscle movement such as diaphragm, intercostal and abdominal muscles. These phenomena lead to the weakness of intercostal and abdominal muscle, the reduction of pulmonary function, which makes it difficult to control posture and which can Result in functional movement disorders. The quality of life after stroke depends on their ability to ambulate and perform activities of daily living(ADL), predicting functional outcomes during the initial stage is important. We think that post-stroke pulmonary function indirectly reflects the trunk control ability of patients who are not able to maintain sitting balance. We tried to check the core muscle strength by using pulmonary function test because it was difficult to check directly. Therefore, we investigated the relationship between short-term clinical outcomes and pulmonary function test in subacute stroke patients.

Methods

We prospectively recruited 52 patients with first-ever stroke during the period of August, 2017 through April, 2018. All patients were enrolled inpatient referred to our rehabilitation department within 6 months of onset and cognitive capability of complying with pulmonary function test. Patient with recent surgical procedure, disease of respiratory condition and tracheostomy status were excluded from the study. To evaluate respiratory function including peak cough flow(PCF), maximal inspired pressure(MIP), maximal expired pressure(MEP), forced vital capacity(FVC) and forced expiratory volume in 1 second(FEV1) and FEV1/FVC were performed at baseline and 4 weeks after conventional rehabilitation. Trunk balance was checked by using trunk impairment scale(TIS). To evaluate correlation of respiratory function, trunk balance and functional outcomes (Berg Balance Scale (BBS) and functional independence measure(FIM)) were also checked. Spearman's correlation analysis was used to analyze the correlation between respiratory function, trunk balance and functional outcome. Multiple regression analyses were performed. Data analyses involved use of SPSS v18.0 for Windows. $P < 0.05$ was considered statistically significant.

Results

Table 1 showed demographic characteristics of patients. Table 2 revealed initial PCF, FVC and FEV1 were correlated with those of TIS at admission. The initial PCF and FVC is a significant predictive value for TIS score only in multivariable linear regression. Table 3 reveals that initial PCF is a significant predictive value for follow up BBS and FIM score at discharge in multivariable linear regression.

Conclusion

This study demonstrated that initial respiratory function has a significant correlation with trunk balance and functional outcome. Therefore, the availability of pulmonary function test data for stroke patients could be useful for evaluating the response after the initial stage of rehabilitation. This can be used as a predictor for functional outcome.

Table 1. Demographic Characteristics and Anthropometric Data of the Subjects

	Number of patient (n=52)
Age(years)	57.46±14.72
Gender(Male:Female)	34:18
Height(cm)	165.55±8.99
Weight(kg)	65.21±13.13
BMI(kg/m²)	23.52±3.75
Subtype (ischemic:hemorrhagic)	21:31
MMSE-K	23.46±5.33
Albumin(g/dl)	3.88±0.29
Days since stroke onset	68.83±44.32
TIS	13.38±5.45
BBS	23.25±19.54
FIM	61.42±23.65

Values are mean ± standard deviation

BMI, Body mean index; MMSE-K, Korean version of the mini-mental estimate examination; TIS, Trunk impairment scale; BBS, Berg balance scale; FIM, Functional independence measure

Table 2. Partial correlation coefficient(r) adjusted for Age, Height and Weight and Multiple Linear Regression adjusted for sex, age, body mean index, mini-mental state examination(MMSE) and albumin between the Pulmonary Function and iTIS (n=52)

Variables	Partial Correlation(iTIS)		Regression(iTIS)	
	r	p-value	β	p-value
PCF	0.646	<0.0001**	0.733	<0.0001**
MIP	0.007	0.959	0.040	0.445
MEP	0.171	0.239	0.056	0.704
FVC	0.446	<0.001**	0.341	0.019*
FEV1	0.317	0.026*	0.235	0.110
FEV1/FVC	0.064	0.662	0.021	0.884

* $P < 0.05$, ** $P < 0.01$

PCF, Peak cough flow; MIP, Maximal inspired pressure; MEP, Maximal expired pressure; FVC, Forced vital capacity; FEV1, Forced expiratory volume in 1 second; iTIS, Trunk impairment scale at baseline

Table 3. Multiple Linear Regression Analyses for Functional Outcome(dBBT, dFIM) adjusted for Sex, Age, Body Mean Index, Mini-Mental State Examination(MMSE) and Albumin

Variable	dBBT		dFIM	
	β	<i>p</i> -value	β	<i>p</i> -value
PCF	0.513	0.001**	0.283	0.025*
MIP	0.225	0.113	0.153	0.177
MEP	0.217	0.145	0.051	0.672
FVC	0.387	0.008**	0.054	0.658
FEV1	0.280	0.062	0.024	0.845
FEV1/FVC	0.028	0.851	0.017	0.889

* $P < 0.05$, ** $P < 0.01$

PCF, Peak cough flow; MIP, Maximal inspired pressure; MEP, Maximal expired pressure; FVC, Forced vital capacity; FEV1, Forced expiratory volume in 1 second; dBBT, Berg balance scale at discharge; dFIM, Functional independence measure at discharge

Gait performance and cardiopulmonary energy consumption with wearable robot : A pilot study

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Objective

Robotic technology has developed rapidly in recent years, and several robot-assisted gait devices were developed to enhance gait function and quality of life in elderly adults and patient with lower limb weakness. In this study, we investigated the effect of a newly developed exoskeletal wearable robot developed by SG mecahtronics Co, Ltd., Korea, on gait performance and activities of daily living.

Methods

The Angelegs[®] is an exoskeletal wearable robot suit that assists in voluntary control of knee and hip joint motion. (Fig1) Five patients participated in this study. All patients were received adaptive training with the Angelegs[®] 6 sessions (20–30 min/day within 2 days/week). 6 Minutes walking test(6MWT), berg balance scale (BBS), cardiopulmonary exercise test (CPET) and Nottingham extended activities of daily living scale (NEADLS) were evaluated after 6 sessions training under two conditions; free gait without robot assistance (FG) and robot assisted gait (RAG).

Results

Five patients participated in this study. However, two participants completed the study. The patient 2 and 3 could not continue this study because of failure to adapt Angelegs[®] and complained that it was heavy and difficult to wear. The patient 1 could not continue this study because of pneumonia. Outcomes of study are shown in table 1. The score of 6MWT, BBS decreased under robot assisted gait. And it found that the NEADLS was lower with wearing the robot than without the robot. The analysis of oxygen uptake change during CPET under two conditions is shown in the figure2.

Conclusion

Overall, short duration exoskeleton walking does not seem less energy-consuming and measurable gait effect. It is necessary to improve the problems such as provision of perfect fit, control of assistive power, more lightweight to help individuals with impaired mobility as a Result of strength deficits.

Table 1. Comparison of outcomes under two conditions; free gait without robot assistance

(FG) and robot assisted gait (RAG).

Patient 4.		BBS.	6MWT(m).	NEADLS.
	Free gait without robot assistance (FG).	50/56.	380.	50/66.
	Robot assisted gait (RAG).	44/52.	193.	37/66.
Patient 5.				
	Free gait without robot assistance (FG).	42/56.	293.	48/66.
	Robot assisted gait (RAG).	36/52.	180.	35/66.

BBS, Berg balance scale; 6MWT, 6 minutes walking test; NEADLS, Nottingham extended activities of daily living scale; m, meter.



Fig 1. Exoskeletal wearable robot – Angelegs®

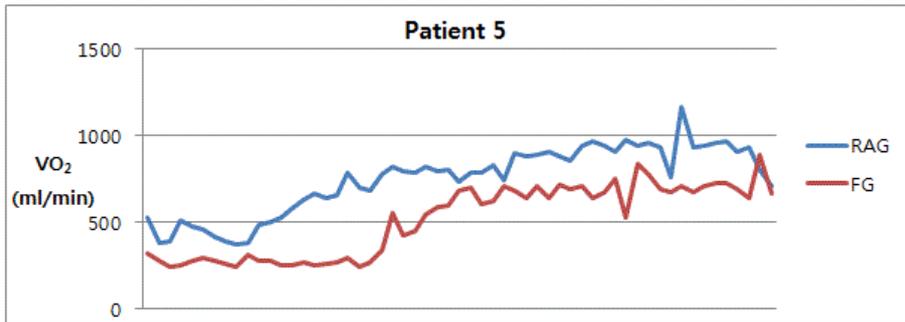
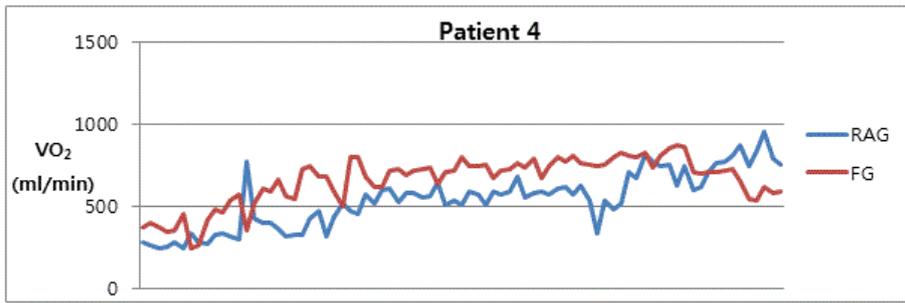


Fig 2. Oxygen uptake change during cardiopulmonary function test.

Effects of rTMS on Cognition and Functional Connectivity in Subacute Stroke Patients

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Objective

To determine the mechanisms on cognitive improvement with repetitive transcranial magnetic stimulation (rTMS) over the left dorsolateral prefrontal cortex(L-DLPFC) in subacute stroke patients.

Methods

Twenty-eight first-ever stroke patients with cognitive impairment were recruited. All subjects were randomly assigned to real or sham stimulation group and completed 10 sessions of rTMS for 2 weeks. 10Hz of navigation rTMS were applied (5sec stimulation and 25sec resting, total 1500 pulses) on the L-DLPFC at 80% of resting motor threshold (rMT). At the time of baseline, 1 month and 3 months after stroke onset, all subjects received the Korean-mini mental state examination(K-MMSE), Korean-Montreal Cognitive Assessment(K-MOCA), Upper Fugl-Meyer Assessment(U-FMA), Korean-Modified Bathel Index(K-MBI), European Quality of life 5 Dimension(EQ-5D), Korean-Geriatric Depression Scale(K-GDS). In addition, the Continuous performance test(CPT), Vascular cognitive impairment harmonization standards (VCIHS), motor evoked potentials (MEP), event-related potentials (ERPs), resting state functional magnetic resonance imaging (RS fMRI) and diffusion tensor imaging (DTI) were completed at baseline and 3 months after stroke onset.

Results

After the intervention period, the real stimulation group improved significantly in the K-MMSE, K-MOCA, K-MBI and K-GDS compared with sham stimulation group. And these effects lasted after three months in MOCA. There was no significant time x group effect among the U-FMA, EQ-5D, and CPT. Among the VCIHS parameters, Z-scores of executive and memory function showed higher delta value between baseline and 3 months timepoints in rTMS group. The MEP showed higher TIME x GROUP interaction in the intracortical inhibition value on right hand. It suggests that there is beneficial effect on premotor cortical excitability of rTMS. The change of P300 amplitude on F3 and C3 was more increased in real stimulation group significantly only in the auditory Oddball paradigm. The RS fMRI analysis Results showed more increased functional connectivity of Cingulate Gyrus, Supramarginal Gyrus, Cerebellum Crus2, Precentral gyrus, Middle temporal gyrus and Inferior temporal gyrus after stimulation compare with the sham group. Brain activation in the cingulum showed a tendency that after 3 months, fractional anisotropy (FA) and fiber number (FN) in real group were larger than sham group, however there was no significant effect. The relationship between the change of K-MOCA and fractional anisotropy of the cingulum was found positive correlation in all subjects.

Conclusion

These Results suggest that high frequency rTMS on the L-DLPFC improves cognitive function and functional network activity in subacute stroke. The rTMS seems to be a recommendable treatment in stroke patients with cognitive impairment.

Clinical Features of Dysphagia in Oldest Old Population

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Objective

Dysphagia is an important issue in an aging society. Stroke is the most common cause, but dysphagia can occur without a stroke or underlying disease. Aging itself can cause or aggravate dysphagia and there have been many studies that describe the effect of aging on swallowing physiology. Among the elderly population, there is a need to examine how the dysphagia in oldest old people differ from others.

Methods

From January 1, 2017 to December 31, 2017, patients with aged 60 years or older who underwent VFSS due to dysphagia were included. The WHO and the UN defined the older/elderly criteria as 60 to 79 years old and the oldest old as 80 or older patients. Based on this, a total of 206 patients were divided into two groups. : group I(60~79 years old, n=135), group II(80~96 years old, n=71). General characteristics such as gender, cognition, and duration of symptom were compared between the groups. Through a VFSS, widely used penetration aspiration scale(PAS) and videofluoroscopic dysphagia scale(VDS) scores were evaluated and compared between the groups. The etiologies of dysphagia were classified into two categories: neurologic disorders(ND) and non-neurologic disorders(nND). ND included CNS disorders(stroke, brain tumor, neurodegenerative disease, traumatic brain injury, other brain disorders, spinal cord injury) and PNS disorders(NMJ disorders, myopathy, peripheral neuropathy). nND included local structural lesions involving the head and neck, poor general medical condition, and unknown etiology.

Result

The male ratio was significantly higher in both groups, the ratio was statistically significantly lower in Group II(n = 56, 78.9%) than Group I(n = 124, 91.9%). K-MMSE was significantly lower in group II(12.61 ± 9.08) than group I(17.85 ± 9.89). The duration of dysphagia was 17.78 ± 20.04 months in group I and 11.96 ± 17.73 months in group II, which was shorter in group II.(Table 1) PAS was statistically significantly higher, meaning more severe dysphagia, in group II(5.60 ± 2.71) than in group I(4.26 ± 2.88)(p value = 0.004). Oral VDS score, pharyngeal VDS score, and total VDS score also showed higher value, meaning more severe dysphagia, in group II : oral VDS score, 6.37±6.56 in group I, 8.77±7.22 in group II(p-value=0.009); pharyngeal VDS score, 23.23±14.19 in group I, 30.59±14.54 in group II(p-value=0.001); total VDS score, 29.60±18.12 in group I, 39.36±18.62 in group II(p-value 0.001).(Table 2) In an etiology, the ratio of nND was higher in group II than group I(n=34, 25.2% in group I, n=24, 33.8%), but there was no statistical significance(p value=0.192).(Fig 1)

Conclusion

Among the elderly population, dysphagia in the oldest old population has a tendency to be more severe with shorter duration of onset compared to the elderly population. If oldest old patients present with swallowing difficulty, immediate evaluation and therapeutic intervention should be carried out regardless of the etiology.

Table 1. General characteristics

Characteristics	Group I (n=135)	Group II (n=71)	<i>p</i> -value
Sex	male 124 (91.9%)	male 56 (78.9%)	0.008*
Age (years)	71.53±3.76	86.13±3.50	0.000*
K-MMSE	17.85±9.89	12.61±9.08	0.000*
Duration of dysphagia(months)	17.78±20.04	11.96±17.73	0.047*

Values are presented as mean±standard deviation(%)

K-MMSE, Korean version of the Mini-Mental State Examination

**p*<0.05

Table 2. VFSS findings

Scale	Group I (n=135)	Group II (n=71)	<i>p</i> -value
PAS	4.26±2.88	5.60±2.71	0.004*
Oral VDS score	6.37±6.56	8.77±7.22	0.009*
Pharyngeal VDS score	23.23±14.19	30.59±14.54	0.001*
Total VDS score	29.60±18.12	39.36±18.62	0.001*

Values are presented as mean±standard deviation

PAS, penetration aspiration scale; VDS, videofluoroscopic dysphagia scale

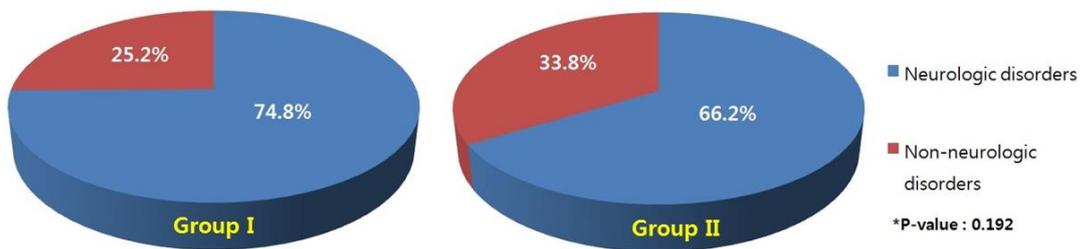


fig 1. Etiology of Dysphagia

Effects of Upper Extremity Rehabilitation Using Smart Glove in Subacute Stroke Patients

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Background/Objective

About half of stroke survivors have upper extremity dysfunction. Although many trials and various interventions aiming to regain arm and hand function have been conducted, restoring upper limb function still remains a challenge. The aim of this study is to investigate the effect of smart glove for upper extremity rehabilitation in subacute stroke patients.

Methods

A single-blinded, randomized, controlled study was conducted on the patients who 1) were 19 years old or older, 2) had a first stroke within three months confirmed by CT or MRI, 3) had upper extremity hemiplegia with Brunnstrom stage 2 to 5, and 4) could tolerate sitting at least one hour of intervention. Exclusion criteria were patients with 1) severe hemineglect or hemianopia, 2) upper extremity contracture, 3) Fugl-Meyer Assessment-Wrist & Hand score ≥ 21 , 4) upper extremity spasticity in the wrist and fingers with modified Ashworth scale ≥ 3 , and 5) moderate to severe cognitive dysfunction (MMSE < 18). Eligible participants were randomly allocated to the smart glove training (SGT) group or the conventional occupational therapy (COT) group. Participants in the SGT group received 30 minutes of standard occupational therapy followed by 30 minutes of upper extremity training with smart glove, the RAPAEL Smart GloveTM (Neofect, Yong-in, Korea), while the COT group received standard occupational therapy for 30 minutes followed by upper extremity rehabilitation homework, self-training at bedside, for 30 minutes. All participants received each intervention five days a week for two consecutive weeks. The primary outcome was the Fugl-Meyer Assessment-upper extremity (FMA-UE). Secondary outcomes included the Jebsen Hand Function Test (JHFT), Box and Block Test (BBT), grip power, Modified Barthel Index-Upper Extremity (MBI-UE), and Caregiver Burden Scale (CBS). Participants were evaluated before (T1), immediately after (T2) and six weeks after the intervention (T3). This study protocol was registered at ClinicalTrials.gov (NCT02592759).

Results

A total of 23 patients were enrolled in this study. Table 1 shows the baseline characteristics of the participants. Table 2 shows the changes in the outcomes between before and immediately after intervention. There was no statistical difference of short-term efficacy. Table 3 shows the changes in the outcomes between before and six weeks

after intervention. After six weeks, the FMA-UE score was significantly greater in the SGT group compared with the COT group ($p=0.023$). There were no significant changes in other outcome measures.

Conclusion

Upper extremity rehabilitation using smart glove may reduce upper extremity impairment in subacute stroke patients.

Table 1. Clinical characteristics of the participants (n=23)

Characteristics	SGT group (n=12)	COT group (n=11)
Age (in years)	50.92 ± 16.68	64.64 ± 13.83
Sex		
Male	7 (58.3%)	5 (45.5%)
Female	5 (41.7%)	6 (54.5%)
Hemiplegic side		
Right	5 (41.7%)	3 (27.3%)
Left	7 (58.3%)	8 (72.7%)
Stroke type		
Hemorrhagic	6 (50.0%)	5 (45.5%)
Infarct	6 (50.0%)	6 (54.5%)
Time to onset (in days)	30.75 ± 20.01	17.91 ± 11.05
MMSE	24.83 ± 3.33	26.27 ± 3.17
FMA-UE	33.83 ± 13.99	35.55 ± 15.06
JHFT	7.00 ± 11.70	9.09 ± 17.48
BBT	10.75 ± 12.93	9.91 ± 15.20
Grip power	12.33 ± 10.49	14.71 ± 18.04
MBI-UE	16.83 ± 6.24	11.55 ± 5.66
CBS	10.50 ± 3.87	12.82 ± 4.33

Variables are presented as a number (%) or a mean ± standard deviation.

SGT, Smart Glove Training; COT, Conventional Occupational Therapy; MMSE, Mini-Mental State Examination; FMA-UE, Fugl-Meyer Assessment-upper extremity; JHFT, Jebsen Hand Function Test; BBT, Box and Block Test; MBI-UE, Modified Barthel Index-Upper Extremity; CBS, Caregiver Burden Scale.

Table 2. The changes in the outcomes between before and immediately after intervention

	SGT (T2-T1)	COT (T2-T1)	<i>p</i> -value
FMA-UE	14.00 ± 8.91	9.55 ± 11.60	0.316
JHFT	18.92 ± 21.78	17.82 ± 20.54	0.928
BBT	8.33 ± 9.41	13.00 ± 9.86	0.235
Grip Power	7.42 ± 6.76	9.09 ± 14.51	0.695
MBI-UE	3.92 ± 3.75	8.45 ± 5.73	0.051
CBS	-3.25 ± 2.18	-2.91 ± 2.39	0.695

Variables are presented as mean ± standard deviation.

SGT, Smart Glove Training; COT, Conventional Occupational Therapy; T1, before intervention; T2, immediately after intervention; T3, six weeks after intervention; FMA-UE, Fugl-Meyer Assessment-upper extremity; JHFT, Jebsen Hand Function Test; BBT, Box and Block Test; MBI-UE, Modified Barthel Index-Upper Extremity; CBS, Caregiver Burden Scale.

Table 3. The changes in the outcomes between before and six weeks after intervention

	SGT (T3-T1)	COT (T3-T1)	<i>p</i> -value
FMA	21.58 ± 9.55	11.36 ± 8.02	0.023*
JHFT	33.08 ± 21.18	20.55 ± 23.59	0.288
BBT	20.58 ± 15.18	13.91 ± 9.19	0.260
Grip Power	12.33 ± 11.91	9.32 ± 8.49	0.608
MBI-UE	8.33 ± 6.15	10.09 ± 7.08	0.786
CBS	-4.33 ± 2.31	-3.45 ± 2.30	0.566

Variables are presented as mean ± standard deviation.

SGT, Smart Glove Training; COT, Conventional Occupational Therapy; T1, before intervention; T2, immediately after intervention; T3, six weeks after intervention; FMA-UE, Fugl-Meyer Assessment-upper extremity; JHFT, Jebsen Hand Function Test; BBT, Box and Block Test; MBI-UE, Modified Barthel Index-Upper Extremity; CBS, Caregiver Burden Scale.

**p*<0.05

Relationship between balance function and trunk contraction measured by USG in mild stroke patients

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Objective

Some stroke patients may experience a reduction in mobility even though they have little motor or sensory deficit in the affected limb. Decreased control of trunk muscles is recognized to be the main reason in these cases and the importance of facilitating trunk stability is widely known in the course of rehabilitation. However relations between individual trunk muscle and the balance function are not sufficiently revealed. In this study, we measured thicknesses of trunk muscles in resting and contracted state by ultrasonography and identify the relationship between each muscle and balance function of mild stroke patients.

Methods

45 patients (27 males, 18 females; mean age 65.4 ± 13.2 years) with hemiparesis were enrolled and their scores of manual muscle test(MMT) in the affected legs were 4 or more. To measure the contractile ability of trunk muscles, we used ultrasonography by measuring the thickness of trunk muscles in both affected and unaffected side at rest and consecutively at contraction during proper motion. Measured muscles are rectus abdominis(RA), external oblique(EO), internal oblique(IO), transversus abdominis(TA), paravertebral muscle(PV) and iliopsoas(IP). Contractile ability was calculated by dividing the active thickness by the resting thickness. Ratio of contractile ability was calculated by dividing the unaffected side contractile ability by affected side contractile ability. For the functional evaluation of trunk balance, Scales for the assessment and rating of ataxia(SARA), Berg balance scale(BBS) and Timed up and go test(TUG) were conducted. We used student T-test to compare the Result of contractile ability of affected versus unaffected muscles, and Pearson's Correlation to get relationship between contractile ability or contractile ability ratio of each muscle and Results of balance assessments.

Results

General characteristics of the participants are described in Table 1. The average of age was 65.4 ± 13.24 years, and the average of NIHSS score was 3.40 ± 3.63 . As the Result of hemiparesis, contractile ability of the affected side was confirmed to be decreased significantly in all measured muscles except TA. [Table 2] By the Pearson's correlation, the muscles which have significant correlation with balance scales were RA, and IO of the unaffected side and PV of the affected side. The ratios of contractile ability of RA, EO, IO, PV and IP had statistically significant correlation with Results of all balance scales of SARA, BBS and TUG.

Conclusion

In mild hemiparetic stroke patients, the contractile abilities of trunk muscles have correlation with balance function. Ultrasonographic measurement of trunk muscles can provide additional information about proper evaluation of functional deficit and to make selective rehabilitation training promoting balance function in mild stroke patients.

Table 1. Demographics and characteristics of patients (n=45)

Characteristics	Value
Sex Male : Female	27 (60) : 18 (40)
Age (yr)	65.4±13.24
BMI	23.76±3.20
SARA score	4.28±4.10
BBS score	47.46±7.75
TUG	16.07±8.25
Smoking Yes : No	9 (20) : 36 (80)
Cardiovascular disease Yes : No	5 (11.1) : 40 (89.9)
Hypertension Yes : No	25 (71.1) : 20 (28.9)
Diabetes mellitus Yes : No	8 (31.1) : 37 (68.9)
Atrial fibrillation Yes : No	4 (8.9) : 41 (91.1)
NIHSS	3.40±3.63
mRS	1.90±1.47

BMI, Body Mass Index; SARA, Scale for the assessment and rating of ataxia;

BBS, Berg balance scale; TUG, Timed Up and Go Test;

NIHSS, The National Institutes of Health Stroke Scale; mRS, Modified Rankin Scale

Table 2. Contractile ability of Trunk muscle

Muscle	Affected Side	Unaffected Side	P-value
RA	1.0882	1.1778	0.000*
EO	1.1542	1.2793	0.001*
IO	1.2927	1.1862	0.001*
TA	1.4418	1.6476	0.054
PVM	1.1300	1.1896	0.007*
IP	1.1720	1.2524	0.004*

*means statistically significant at 0.05 level.

RA, rectus abdominis muscle; EO, external oblique muscle; IO,

internal oblique muscle; TA, transversus abdominis;

PVM, paravertebral muscle; IP, iliopsoas muscle

Table 3 The relationship between Trunk balance and Trunk muscle contraction

Muscle		SARA	BBS	TUG
RA	Unaffected side Contractile ability	0.333*	-0.374*	0.212
	Affected side Contractile ability	-0.107	0.068	-0.137
	Ratio of Contractile ability	0.574*	-0.581*	0.440*
EO	Unaffected side Contractile ability	0.279	-0.272	0.116
	Affected side Contractile ability	-0.196	0.192	-0.263
	Ratio of Contractile ability	0.587*	-0.574*	0.433*
IO	Unaffected side Contractile ability	0.477*	-0.492*	0.416*
	Affected side Contractile ability	-0.130	0.123	-0.123
	Ratio of Contractile ability	0.681*	-0.690*	0.600*
TA	Unaffected side Contractile ability	-0.006	0.014	-0.013
	Affected side Contractile ability	-0.222	0.201	-0.198
	Ratio of Contractile ability	0.395*	-0.354*	0.3188
PVM	Unaffected side Contractile ability	0.039	0.073	-0.147
	Affected side Contractile ability	-0.301*	0.377*	-0.424*
	Ratio of Contractile ability	0.524*	-0.447*	0.386*
IP	Unaffected side Contractile ability	0.211	-0.257	0.193
	Affected side Contractile ability	-0.670	0.929	-0.002
	Ratio of Contractile ability	0.563*	-0.563*	0.418*

RA, rectus abdominis muscle; EO, external oblique muscle;

IO, internal oblique muscle; TA, transversus abdominis;

PVM, paravertebral muscle; IP iliopsoas muscle

Values are shown with correlation coefficient.

*means statistically significant at 0.05 level.

P 3-65

The Effect of assistive force of rehabilitation robot on upper extremity function in stroke patients

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Objective

Recently, robot-assisted therapy has been reported to have beneficial effects on upper extremity function among stroke survivors. However, it lacks of studies about the differential effects according to the characteristics. We tried to explore whether assistive force of rehabilitation robot is beneficial or not, as assistive force has been regarded as important characteristics.

Method

This study was a single blinded randomized controlled trial among chronic stroke survivors who showed upper extremity muscle strength above or Medical research council grade 3. Participants were randomly allocated to the robot supported by assistive force(SA) (Armeo® Power; Hocoma Inc, Zurich, Switzerland) or robot without assistive force(WOA) (Armeo® Spring; Hocoma Inc, Zurich, Switzerland). Each participant completed 20 sessions of 30-minute training with conventional therapy over 4 weeks. The primary outcomes were changes in Fugl-Meyer assessment of the upper extremity function (FMA-total and FMA-proximal) and Wolf Motor Function Test (WMFT-score, WMFT-time and WMFT-weight). Assessments were performed at baseline (T0), 2 weeks (T2), 4 weeks (T4) and 8 weeks (T8) after the baseline. Comparisons between two groups were performed using RM-ANOVA and $p < .05$ was used to indicate a significant difference.

Results

Among 20 randomized patients, 19 participants (10 in the the SA group, 9 in the WOA group) completed 4 weeks of intervention. There were no significant differences in baseline characteristics between the SA and the WOA group. Both groups showed improvements in most of outcomes over time ($P < .05$) except WMFT-weight. Both groups showed no significant differences in WMFT-weight over time. ($P = .06$ and $P = .21$) There were no statistically significant time x group interactions for all outcomes including FMA-total, FMA-Proximal, WMFT-score, WMFT-time and WMFT-weight. ($p = .43$, $p = .68$, $p = .50$, $p = .46$ and $P = .69$ respectively)

Conclusion

In our study, both groups showed statistically significant improvement on upper extremity function after intervention. However, there were no statistically significant differences between presence or absence of assistive force. In the future, detailed kinematics study could reveal minor difference between two types of robot.

Temporal Changes of Recovery-related Transcriptome in Stroke

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Objective

The endogenous remodeling post stroke, such as angiogenesis, neurogenesis and axonal sprouting is restrictive to induce complete restoration of neurological function. To identify the therapeutic targets to evoke endogenous restorative mechanism for stroke recovery, we investigated temporal alteration of endogenous recovery-related genes at different time points post stroke.

Methods

Photothrombotic stroke was induced in wistar rats. Peri-infarct tissues were collected at different time points (1w, 4w and 8w) and RNA sequencing was conducted. Kyoto Encyclopedia of Genes and Genomes (KEGG) pathway analysis and Gene Ontology (GO) analysis were conducted to analyze the profiles of the genes involved in axonal sprouting, growth factor and angiogenesis categories (FDR<0.05 and |fc|>2)

Results

KEGG pathway analysis revealed that inflammatory response was dominant at 1 week and downregulated afterwards. ECM-receptor interaction was facilitated to support recovery until late stages. GO analysis discovered that endogenous recovery process was active until 4 weeks and the change was not completed even at 8 weeks, Nefh, Syt2 and Robo3 were downregulated and conversely, C3, Gfap, Igf2, Aqp1, Spp1, Anxa1, Cd44, Bmp6, Dcn, Crabp2, Dab2, Vim, Lgals1, Lgals3, Aprnr, Col1a1, Col3a1, Foxd1, Foxc2, Efemp1, sfrp1, Aldh1a2, Cdkn1c were upregulated.

Conclusion

These gene profile alterations may identify new therapeutic target to prompt recovery post stroke at various time points.

Effect of Horticultural Therapy on Functional Improvement of the Upper Limb in Poststroke Patients

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Objective

To delineate the effect of horticultural therapy (HT) on the recovery of upper extremity function in poststroke hemiplegic patients.

Methods

A total of 16 poststroke hemiplegic patients who had unilateral upper extremity dysfunction were randomly allocated into two groups; 5 patients who received conventional occupational therapy without HT were the control group, and 11 patients who received additional HT as well as conventional occupational therapy were the treatment group. HT program consisted of 10 sessions for 2 weeks, and the session was 1 hour. To assess the upper extremity function, Jebson hand function test (JHFT) and Fugl-Meyer assessment (FMA) were performed 3 times at admission just before HT, just after HT, and one month after HT. In addition, Korean version of Modified Barthel Index (K-MBI), Functional Independence Measure (FIM), and Korean-National Institute of Health Stroke Scale (K-NIHSS), Korean version of Mini-Mental State Examination (K-MMSE) were also performed 3 times to detect functional and cognitive improvements.

Results

The age, gender, hemiplegic side, type of stroke, and initial JHFT and FMA scores were not different between the control and treatment groups. JHFT, FMA scores at initial and follow-up periods, and their total gain scores were not also different between two groups. However the initial and gain scores of bathing subscore of K-MBI were significantly different from the control and treatment groups (3.0 ± 1.22 vs. 1.54 ± 0.93 and 0.6 ± 0.55 vs. 2.36 ± 1.36 respectively). The other subscores and total score of K-MBI, FIM, K-NIHSS, K-MMSE, and FIM were not different between two groups.

Conclusion

Although one subscore of K-MBI showed improvement, overall hand, cognitive, and functional status were not changed after additional HT to poststroke hemiplegic patients. Further studies with more patients and the long-term follow-up are necessary to confirm the effect of HT to poststroke hemiplegic patients.

Brain mapping of motor and functional recovery after supratentorial stroke

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Objectives

The present study aimed to identify the brain regions involved in upper and lower limb motor and functional recovery after stroke.

Methods

Twenty-five patients (mean age, 73.4 years; average duration from stroke onset, 50.1 months) were examined. Fractional anisotropy (FA) mapping using diffusion tensor imaging, and clinical measures, including the Fugl-Meyer motor assessment of upper and lower limbs, the Modified Barthel Index, and Functional Ambulation Category were used for examinations. Linear regression analyses were conducted with the FA map as a dependent variable, each clinical measure as an independent variable, and patient age as a covariate.

Results

FA in the internal capsule of the posterior limb of the lesioned hemisphere was significantly associated with Fugl-Meyer motor assessment scores for the upper limbs, whereas that in the internal capsule of the posterior limb of the lesioned hemisphere, posterior corpus callosum of the lesioned hemisphere, and middle cerebellar peduncle of the contralateral hemisphere was associated with Fugl-Meyer motor assessment scores for the lower limb. FA in brain regions with bilateral connection fibers was commonly associated with the score on the Korean version of the Modified Barthel Index and participants' functional ambulation. Furthermore, the FA in the corticospinal tract in the contralesional hemisphere was also associated with the score on the Korean version of the Modified Barthel Index (corrected $p < .05$).

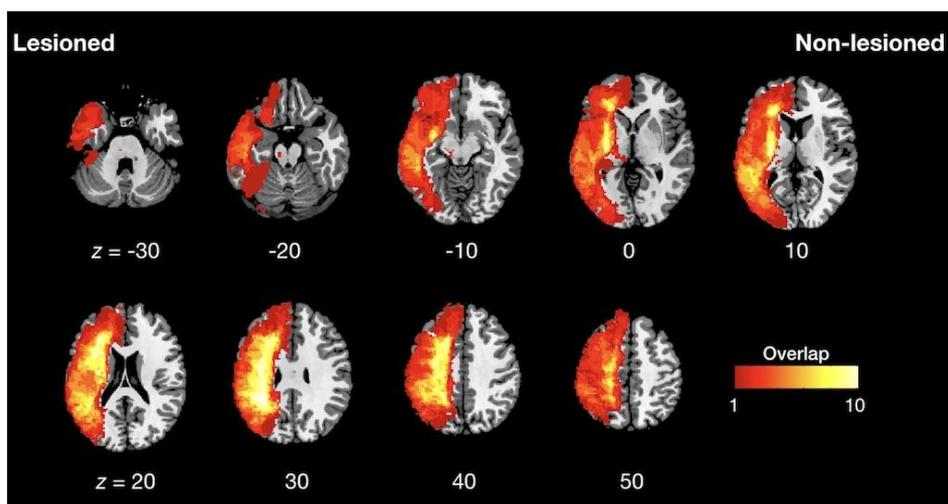
Conclusions

Motor and functional recovery of upper and lower limbs involves different brain regions. This finding is of particular relevance for treatment and recovery in stroke

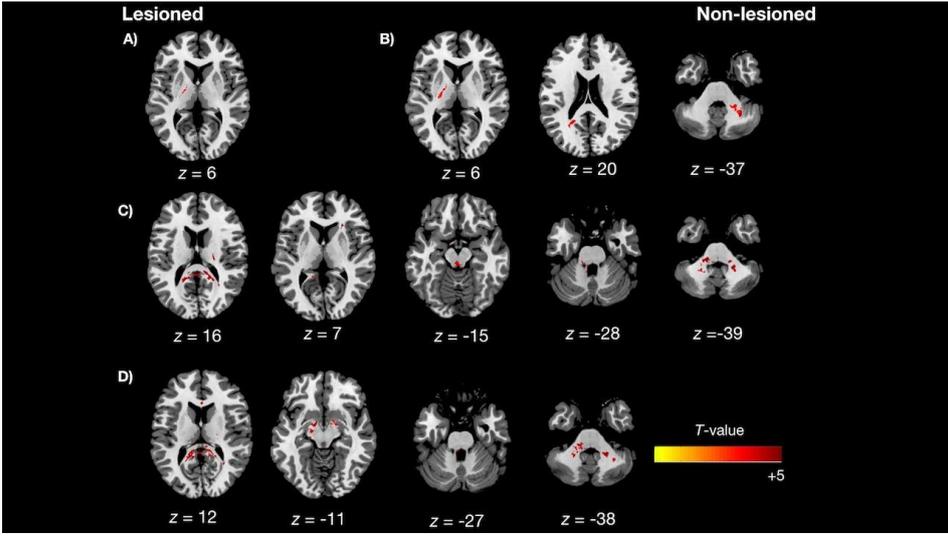
Patient ^a	Sex ^a	Age ^a	Duration (months) ^a	Lesional hemisphere ^a	Lesion volume (cm ³) ^a	FMUL ^a	FMLL ^a	MBI ^a	FAC ^a
1 ^a	male ^a	68 ^a	13.7 ^a	Left ^a	4.1 ^a	34 ^a	22 ^a	56 ^a	2 ^a
2 ^a	male ^a	66 ^a	18.6 ^a	Left ^a	3.8 ^a	65 ^a	33 ^a	97 ^a	4 ^a
3 ^a	male ^a	71 ^a	317.4 ^a	Left ^a	150.7 ^a	40 ^a	25 ^a	8 ^a	1 ^a
4 ^a	male ^a	70 ^a	42.9 ^a	Left ^a	17.6 ^a	50 ^a	26 ^a	83 ^a	4 ^a
5 ^a	male ^a	65 ^a	11.9 ^a	Left ^a	57.9 ^a	52 ^a	30 ^a	91 ^a	4 ^a
6 ^a	male ^a	84 ^a	6 ^a	Right ^a	11.7 ^a	34 ^a	19 ^a	62 ^a	2 ^a
7 ^a	male ^a	87 ^a	3 ^a	Right ^a	15.0 ^a	32 ^a	19 ^a	0 ^a	0 ^a
8 ^a	male ^a	71 ^a	31.2 ^a	Left ^a	2.2 ^a	56 ^a	31 ^a	89 ^a	4 ^a
9 ^a	male ^a	70 ^a	71.5 ^a	Left ^a	143.1 ^a	43 ^a	27 ^a	88 ^a	5 ^a
10 ^a	male ^a	74 ^a	5.6 ^a	Right ^a	5.3 ^a	64 ^a	34 ^a	100 ^a	3 ^a
11 ^a	male ^a	89 ^a	21.4 ^a	Left ^a	21.1 ^a	52 ^a	30 ^a	84 ^a	3 ^a
12 ^a	male ^a	73 ^a	9.3 ^a	Right ^a	4.4 ^a	63 ^a	26 ^a	97 ^a	5 ^a
13 ^a	male ^a	73 ^a	9.3 ^a	Right ^a	2.3 ^a	11 ^a	9 ^a	55 ^a	2 ^a
14 ^a	male ^a	71 ^a	117.4 ^a	Right ^a	26.4 ^a	32 ^a	14 ^a	69 ^a	3 ^a
15 ^a	male ^a	68 ^a	297.8 ^a	Right ^a	93.7 ^a	30 ^a	14 ^a	57 ^a	2 ^a
16 ^a	male ^a	74 ^a	8 ^a	Right ^a	48.1 ^a	4 ^a	4 ^a	7 ^a	0 ^a
17 ^a	male ^a	73 ^a	6.5 ^a	Left ^a	2.9 ^a	30 ^a	11 ^a	79 ^a	3 ^a
18 ^a	male ^a	95 ^a	34.3 ^a	Right ^a	82.0 ^a	18 ^a	11 ^a	9 ^a	0 ^a
19 ^a	male ^a	73 ^a	21.4 ^a	Right ^a	2.9 ^a	20 ^a	27 ^a	78 ^a	4 ^a
20 ^a	male ^a	72 ^a	24.3 ^a	Right ^a	10.7 ^a	5 ^a	17 ^a	77 ^a	4 ^a
21 ^a	male ^a	72 ^a	24.2 ^a	Left ^a	173.9 ^a	4 ^a	4 ^a	63 ^a	3 ^a
22 ^a	male ^a	70 ^a	12.3 ^a	Right ^a	262.8 ^a	4 ^a	4 ^a	1 ^a	0 ^a
23 ^a	male ^a	67 ^a	27.3 ^a	Right ^a	2.0 ^a	4 ^a	10 ^a	72 ^a	4 ^a
24 ^a	male ^a	69 ^a	16.6 ^a	Right ^a	186.1 ^a	4 ^a	9 ^a	54 ^a	4 ^a
25 ^a	male ^a	71 ^a	98.3 ^a	Right ^a	1.2 ^a	5 ^a	7 ^a	49 ^a	2 ^a

Table 1. Patient characteristics^d

Duration, duration after stroke; FMUL, Fugl -Meyer motor assessment for upper limb; FMLL, Fugl -Meyer motor assessment for lower limb; MBI, modified Barthel index; FAC, functional ambulation category^d



The color scale indicates the number of overlapping lesions in each patient.



A, FMUL; B, FMLL; C, MBI; D, FAC

Sagittal alignment as a prognostic factor of standing balance in stroke patients: A pilot study

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INTRODUCTION

Sagittal plane alignment is an essential factor for maintaining standing balance. Although the stroke patients have more forward-tilted posture than healthy people, the correlation between sagittal plane alignment and standing balance of stroke patients has not been studied yet. This study was made to investigate the correlation between sagittal plane alignment and standing balance of stroke patients.

METHOD

This study included 19 patients who had been hospitalized in the department of rehabilitation medicine from February 2018 to June 2018. Patients were excluded if they had orthopedic surgery of spine or lower extremities or they could not maintain a standing position for plain radiograph study. Plain whole spine radiograph and clinical outcomes including Berg balance scale (BBS), Modified Barthel index (MBI) were evaluated on admission and discharge. Sagittal plane alignment was assessed using whole spine radiograph. Patients were divided into two groups with sagittal vertebral axis score. The kyphotic group had longer than 30 mm of sagittal vertebral axis score and the non-kyphotic group had shorter than 30 mm of the sagittal vertebral axis. We aimed to compare the effect of standard rehabilitation in kyphotic and non-kyphotic groups, differences between admission and discharge clinical outcomes were analyzed by Mann-Whitney U test.

RESULTS

The kyphotic patients can improve standing balance more than non-kyphotic patients, after standard rehabilitation. There was no definite characteristic difference between the two groups (Table 1.). There were no significant differences between kyphotic and non-kyphotic groups except for SVA at admission and discharge (Table 2.). The values of the non-kyphotic group at admission were, SVA (16.1 ± 8.6), BBS (12.5 ± 5.7), MBI (57.5 ± 20.6). The kyphotic group showed SVA (49.6 ± 26.8), BBS (16.2 ± 7.1), MBI (57.1 ± 18.9). At discharge the measured scores of the non-kyphotic group were SVA (19.2 ± 22.3), BBS (46.2 ± 8.9), MBI (69.9 ± 12.5) and in the Kyphotic group, there were SVA (39.1 ± 14.9), BBS (49.6 ± 2.9), MBI (75.3 ± 11.8). Difference values between admission and discharge of BBS, MBI, and sagittal vertebral axis showed the increasing tendency in the kyphotic group, however, there were no significant differences between the two groups (Table 2.). In the non-kyphotic group, the difference values between admission and discharge were BBS (7.1 ± 7.6), MBI (12.4 ± 10.4), SVA (3.1 ± 16.8). In the kyphotic group, the same values were BBS (12.0 ± 9.9), MBI (18.1 ± 18.1), SVA (12.8 ± 26.4).

CONCLUSION

Kyphotic patient with stroke would be a more effective standing balance after standard rehabilitation. Further study with a larger number of patients will be needed to find the effect of the sagittal plane alignment in stroke patients for standing balance.

Table 1. Clinical characteristics of the subjects

Characteristics	Non-Kyphotic	Kyphotic
Age (year)	54.8	62.5
Gender		
Male (n)	10	6
Female (n)	2	1
Cause of stroke		
Hemorrhage (n)	4	2
Ischemia (n)	8	5
Type of impairment		
Lt. hemiplegia (n)	3	3
Rt. Hemiplegia (n)	7	3
Quadriplegia (n)	2	1

Table 2. Sagittal plane alignment and clinical outcomes of non-kyphotic and kyphotic patients.

	Non-Kyphotic	Kyphotic	<i>P</i> -value
Admission			
SVA	16.1 ± 8.65	49.6 ± 26.8	0.000
BBS	12.5 ± 5.7	16.2 ± 7.1	0.592
MBI	57.5 ± 20.6	57.1 ± 18.9	0.837
Discharge			
SVA	19.2 ± 22.3	39.1 ± 14.9	0.022
BBS	46.2±8.9	49.6 ± 2.9	0.902
MBI	69.9 ± 12.5	75.3 ± 11.8	0.536
Difference			
BBS	7.1 ± 7.6	12.0 ± 9.9	0.261
MBI	12.4 ± 10.4	18.1 ± 18.1	0.536
SVA	3.1 ± 16.8	12.8 ± 26.4	0.227

Abbreviations: SVA: sagittal vertebral axis, BBS:, Berg balance scale, MBI: Modified Barthel index

Effect of Low-level Light Therapy in the Elderly and Patients with Mild Cognitive Impairment

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Objective

Low-level light therapy (LLLT) is used to stimulate cell function or to reduce pain by applying light emitting diodes (LED) to the skin. LLLT is also known to contribute to enhance neuronal reconstruction of brain tissue for the treatment of degenerative disorders in the animal studies. This study aimed to investigate the effects of LLLT in patients with mild cognitive impairment (MCI) and the elderly.

Materials and Methods

Twenty-one patients with MCI (17 females; mean age 67.19±6.02 years) and 24 elderly persons (13 females; mean age 63.50±5.96 years) participated from two medical centers. Participants were randomly divided into four conditions; carotid artery stimulation (CA), vertebral artery stimulation (VA), simultaneous carotid and vertebral artery stimulation (CA-VA), or sham stimulation (sham) groups. Participants received LLLT using Color DNA[®] (Color Seven Co.) for 30 minutes per day during 20 weekdays of consecutive 4 weeks. To confirm the effect of cognitive function, the Seoul Neuropsychological Screening Battery-II (SNSB-II) was conducted before and after the LLLT intervention for 4 weeks. The Mann-Whitney U test was used for comparisons between two groups. The hemodynamic responses were recorded by an fNIRS system (NIRScout[®], NIRx Medical Technologies, Germany). Nine patients with MCI and eleven elderly participants were recorded hemodynamic responses during LLLT from one medical center. Seventy-four channels were placed in the whole brain area. fNIRS measurement was applied for 5 min before LLLT, 30 min during LLLT, and 10 min after LLLT. To increase signal-to-noise ratio, data were averaged into 4 regions. Raw data from each channel was converted into the z-score and applied moving average filter.

Results

All participants completed the LLLT intervention without any significant side effect. In MCI patients, each CA and CA-VA condition demonstrated significant improvements in memory scores of SNSB-II measured by Seoul verbal learning test and Rey complex figure test compared to the sham condition after LLLT ($p < 0.05$). There were also a significant improvement of Geriatric Depression Scale in each three stimulation condition after the LLLT ($p < 0.05$), but not in the sham condition. In the elderly group, the VA condition demonstrated a significant improvement in SVLT recognition scores compared to the sham condition ($p < 0.05$). In both MCI patients and the elderly, the changes of oxy-

hemoglobin concentration increased in the 4 cerebral regions during LLLT compared to the resting state, and these changes are more contrasting in the CA-VA condition.

Conclusion

The Results of this study suggested that the LLLT applied to a carotid artery and both carotid and vertebral arteries might have positive impacts on memory and mood of the patients with MCI and the elderly. Also, the Results of this study revealed that LLLT could change the oxy-hemoglobin concentration in the cerebral hemodynamics

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Effects of Wearing Robot on Stroke Patients with Hemiplegic Elbow Movement

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Objective

This experiment was performed to evaluate the efficacy of the robot therapy with minimizing the reflex contribution by providing game training of the wearable robot to stroke patients with hemiplegic elbow.

Methods

Twenty patients with subacute stroke within 6 month of onset randomly assigned to two group. The Medical Research Council (MRC) Scale is from 1 to 4. The experimental group(EG) applied intelligent stretcher robot therapy with game. The sham group(SG) used the robotic device with pseudo-exercise. Training performed 16 sessions 5 times a week for four weeks. The Outcomes were measured three times (before and after, and 4 weeks follow up) by Fugl Meyer score of Upper extremity, PROM, MMT, Motricity index, MAS, K-MBI, Block and box test, Jebson hand function test, Brunnstrom stage, FAC, and dynamometer.

Results

Both groups showed improvement after management, except PROM. The improvement of MMT is better in EG compare to SG after management after management ($p < 0.05$). The Jebson hand function and K-MBI are greater in the EG than SG after 4 weeks follow up. ($p < 0.05$).

Conclusion

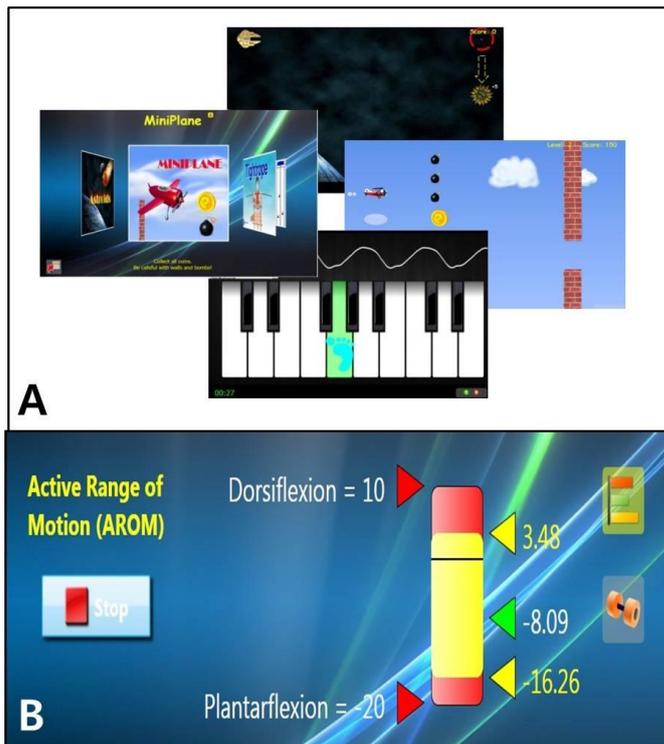
The wearable robot for elbow control to subacute hemiplegic patients seems to have a beneficial effect on motor and ADL.



The robot-guided training is including demonstration, initiation, proprioceptive training with visual feedback, and guided motion. The patient on the bed has active assistive strengthening and range of motion trainings using the game interface on the monitor. The affected limb is at full extension and the elbow center of rotation is lined up with the rotation axis of the motor.



The layout of robotic device. Experimental setup using the portable rehabilitation robot with wearable robotic arm.



Screenshot of biofeedback active training games (A) and testing of active ROM with visual feedback (B) with the yellow bar representing the ankle active ROM.

Effect of Dysarthria Rehabilitation Training on Dysphagia

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Objective

Dysphagia and dysarthria are common complications after stroke. In many stroke patients, dysphagia and dysarthria co-occur frequently. Because many oral, pharyngeal and laryngeal structures are used in the process of both speech and swallowing, there could be a certain association between the management of dysphagia and dysarthria. Several studies have established relationship between dysphagia and dysarthria, however, there are no study investigating whether rehabilitation of dysphagia or dysarthria can improve each other. The aim of this study was to investigate the effect of dysarthria rehabilitation training on dysphagia in post-stroke patients.

Methods

A quasi-experimental study was performed on participants who were admitted to department of physical medicine and rehabilitation. Inclusion criteria were as follow: 1) first stroke attack (diagnosed within 6 months); 2) proper cognitive function (Mini Mental State Examination ≥ 18); 3) dysphagia was confirmed by videofluoroscopic swallowing study (VFSS); 4) dysarthria was diagnosed using alternating motion rate (AMR), sequential motion rate (SMR). AMR and SMR, screening test of dysarthria, evaluate articulatory diadochokinesis and have age specific cut-off value. All participants were divided into two groups; dysarthria-dysphagia rehabilitation group and only dysphagia rehabilitation group. Two groups underwent 30 minutes dysphagia training, 5 times a week for 3 weeks. In addition to dysphagia training, dysarthria-dysphagia rehabilitation group underwent 40 minutes dysarthria rehabilitation training, twice a week for 3 weeks. VFSS was performed before and after the intervention and degree of dysphagia was assessed by American Speech-Language-Hearing Association National Outcome Measurement System (ASHA-NOMS), Clinical Dysphagia Scale (CDS), New VFSS Scale.

Results

Total 10 post-stroke patients with dysphagia and dysarthria were enrolled. 5 patients were allocated to dysarthria-dysphagia rehabilitation group (DD) and 5 patients were allocated to only dysphagia rehabilitation group (OD). There was no significant difference in demographic characteristics between two groups. Changes between before and after intervention were 1.5 ± 0.5 (ASHA-NOMS), 21.6 ± 14.0 (CDS), 18.1 ± 8.2 (New VFSS scale) in DD group and 3.0 ± 1.0 (ASHA-NOMS), 9.6 ± 10.5 (CDS), 5.8 ± 3.2 (New VFSS scale) in OD group, respectively (Table 1,2,3). CDS and New VFSS scale showed significant improvement between before and after intervention in DD group ($p=0.043$, respectively),

however, not in OD group. Also, there was significant difference between two groups in New VFSS scale ($p=0.009$).

Conclusion

Dysarthria rehabilitation training may be helpful to enhance swallowing function in stroke patients. However, larger sample size will be needed to clarify these Results.

Table 1. American Speech-Language-Hearing Association National Outcome Measurement System(ASHA-NOMS) before and after intervention

Variable	Group	Pre	Post	P-value*	Δ (Post - Pre)	P-value†
Score	DD	5.5±0.5	7.0±0.0	0.063	1.5±0.5	0.267
	OD	3.0±2.0	6.0±0.0	0.180	3.0±1.0	

DD, dysarthria-dysphagia rehabilitation group; OD, only dysphagia rehabilitation group

Data were reported as mean±standard deviation.

* P-values were calculated by Wilcoxon's signed-rank test.

† P-values were calculated by Mann-Whitney test.

Table 2. Clinical Dysphagia Scale (CDS) before and after intervention

Variable	Group	Pre	Post	P-value*	Δ (Post - Pre)	P-value†
Score	DD	24.6±13.2	3.0±2.4	0.043	-21.6±14.0	0.073
	OD	21.6±11.8	12.0±2.4	0.066	-9.6±10.5	

DD, dysarthria-dysphagia rehabilitation group; OD, only dysphagia rehabilitation group

Data were reported as mean±standard deviation.

* P-values were calculated by Wilcoxon's signed-rank test.

† P-values were calculated by Mann-Whitney test.

Table 3. New Videofluoroscopic Swallowing (VFSS) Scale before and after intervention

Variable	Group	Pre	Post	P-value*	Δ (Post - Pre)	P-value†
Score in oral phase	DD	8.4±4.0	5.8±2.5	0.042	-5.6±2.1	0.014
	OD	7.4±3.0	5.8±2.4	0.102	-1.6±1.4	
Score in pharyngeal phase	DD	28.4±16.3	12.0±7.0	0.043	-12.5±6.6	0.028
	OD	35.2±12.7	31.0±13.9	0.066	-4.2±2.9	
Total score	DD	36.8±20.0	14.8±8.8	0.043	-18.1±8.2	0.009
	OD	42.6±12.9	36.8±13.6	0.066	-5.8±3.2	

DD, dysarthria-dysphagia rehabilitation group; OD, only dysphagia rehabilitation group

Data were reported as mean±standard deviation.

* P-values were calculated by Wilcoxon's signed-rank test.

† P-values were calculated by Mann-Whitney test.

The Relationship between Depression Level and Patient-set Goal Achievement

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Patient participation in rehabilitation goal setting is known to have a positive impact on recovery. The participation process can provide patients with goals that are personally relevant, and therefore should theoretically increase patient satisfaction and ensure better recovery. However, many patients set independent gait as their primary goal, which may not be realistic in some cases. We conducted a retrospective chart review to assess patient depression level of meeting self-selected goals during in-patient rehabilitation following stroke. A total of 57 post-stroke patients who went through in-patient rehabilitation at our medical center from January through December of 2017 were selected for chart review. Patient goals regarding mobility were asked at the beginning of rehabilitation, and the patient or care giver selected personalized goals. Rehabilitation programs were approximately 3 weeks, and Burg Balance Score (BBS) was evaluated both at the beginning and end of the rehabilitation program. Beck Depression Index (BDI) was checked at discharge. Out of 57 patients, 33 patients set independent gait as their primary goal. The patients with such rehabilitation goal had a wide range of initial BBS score, ranging from 0 to 52. Many validation studies such as those conducted by Hayes et al and Robbins et al support a cut-off BBS score of 45 out of 56 for independent self-ambulation. The 33 patients thus had to receive a BBS score of 45 or higher in order to achieve their goals at discharge. The difference between primary goal (BBS=45) and BBS score at discharge was calculated for each patient to evaluate goal achievement. We compared the depression levels and the discrepancy between goal and actual achievement. Patients with a follow up BBS of 36 or higher, which is 80% achievement of their initial goal, showed significantly lower level of depression at the end of the rehabilitation program and also exhibited greater change in BBS during rehabilitation (Table 1). A Spearman analysis revealed that goal achievement extent was negatively correlated to BDI with significance (Figure 1, $r = -0.495$, $p = 0.003$). BBS improvement extent, defined as the difference in initial BBS and BBS at discharge, also showed negative correlation to BDI (Figure 2, $r = -0.245$, $p = 0.048$). Patient satisfaction upon achieving the goals was thought to better motivate the patients and therefore improve the recovery process. However, our study suggests that unrealistic goal setting which can lead to greater discrepancy between goal and actual achievement may ultimately be associated with higher depression level. Among those who set independent gait as their primary goal, patients who achieved less than 80% of that goal showed higher levels of depression. We therefore emphasize the importance of setting realistic goals that patients have a better chance of achieving. It may be the role of clinicians to guide patients in the process of individualizing rehabilitation goals.

Table 1. Patients who achieve less than 80% of their initial primary goal showed higher degree of depression and less change in BBS during rehabilitation (p-value<0.05).

	BBS _{discharge} ≥36	BBS _{discharge} <36	p-value
BDI score	11.12±9.78	17.5±10.17	0.039
ΔBBS (BBS _{discharge} -BBS _{initial})	19.18±11.28	8.88±12.6	0.024

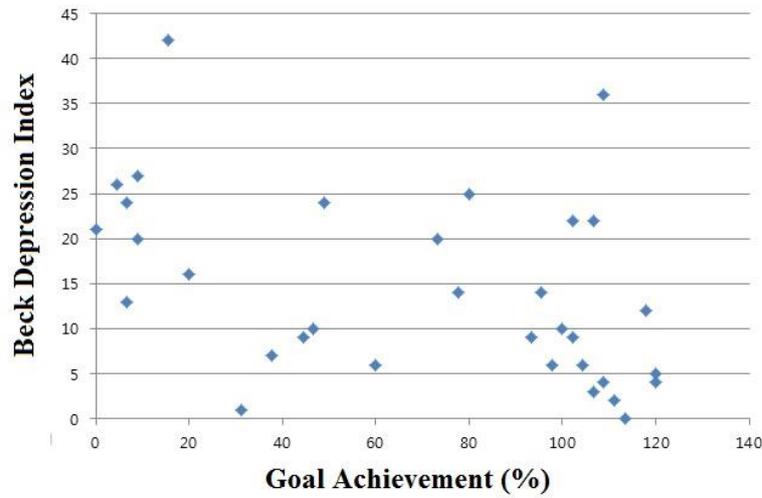


Fig 1. Higher percentage of goal achievement was negatively associated with BDI ($r = -0.495$, $p = 0.003$).

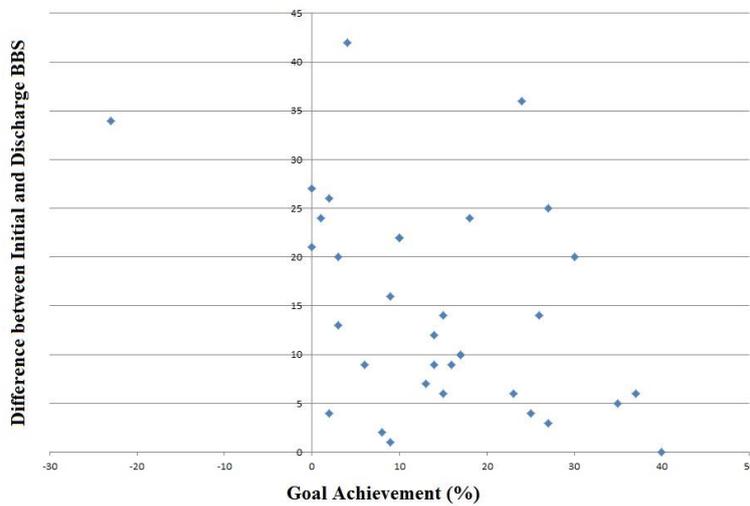


Fig 2. Greater difference between initial and discharge BBS score was negatively associated with BDI ($r = -0.245$, $p = 0.048$).

Injury of the spinothalamic tract following whiplash injury: A diffusion tensor tractography study

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Objectives

Using diffusion tensor tractography (DTT), we investigated the injury of the spinothalamic tract (STT) in patients with who have central pain following whiplash injury.

Methods

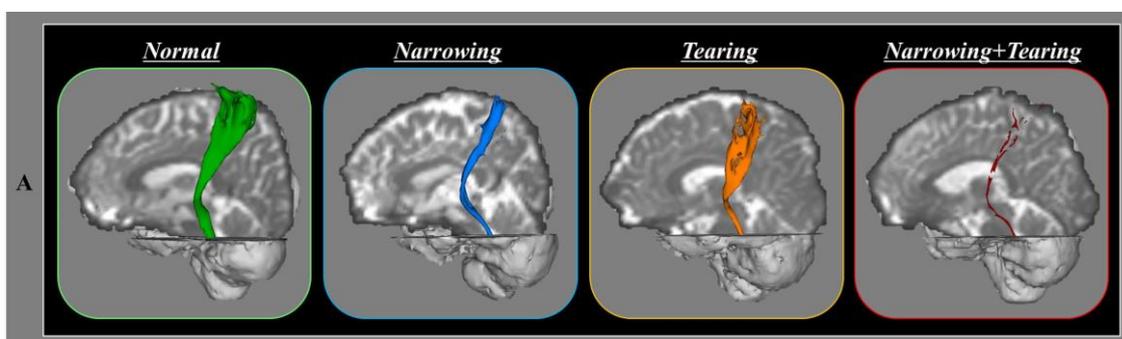
Nine-teen patients with central pain following whiplash injury and 19 healthy control subjects were recruited for this study. After reconstruction of the STT, fractional anisotropy and tract volume of the STT were measured. In addition, different characteristics of the STT injury according to the collision direction were investigated.

Results

FA value did not show significant difference between the patient and control groups ($p > .05$). However, TV value in the patient group was significantly lower than the control group ($p < .05$). On the Results regarding the collision direction, the patients with frontal collision (13.5 days) showed significantly delayed onset duration of the central pain than the patients with real-end collision (0.6 days) ($p < .05$). By contrast, Visual Analogue Scale was higher in the patients with real-end collision than the patients with frontal collision ($p < 0.05$).

Conclusions

We found injury of the STT in patients with mild TBI who suffered central pain after whiplash injury, using DTT. In addition, we demonstrated the different characteristics of the STT injury according to the collision direction. We believe that DTT would be an useful technique for detection of injury of the STT following whiplash injury.



Examples of injury of the spinothalamic tract on diffusion tensor tractography

EFFECTS OF PAIN SCRAMBLER THERAPY FOR THE ALTERATIONS OF CEREBRAL BLOOD VOLUME IN PAIN NETWORK

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Introduction

Prevalence of chronic pain has been shown to be high after thermal injury. Post-burn neuropathic pain causes chronic disabilities that is often difficult to treat effectively. Pain Scrambler therapy is a patient-specific electrocutaneous nerve stimulation device. To study changes in the pain network associated with neuropathic pain, magnetic resonance imaging(MRI) was used to evaluate cerebral blood volume(CBV) in patients who had been injured by burn.

Method

Participants (N=10) comprised patients with neuropathic pain after thermal injury. The subjects complained of severe neuropathic pain that was rated at least 5 on the visual analogue scale (VAS), despite treatments with gabapentin medication and other physical modalities. Each Scrambler therapy with the MC5-A Calmare[®] therapy device (Competitive Technologies, Inc. Fairfield, USA) was performed for 40 min daily (Monday through Friday) for 10 consecutive days. The stimulus was increased to the maximum intensity bearable by the individual patient without causing any additional pain or discomfort. The intensity of neuropathic pain was measured using the visual analogue scale(VAS). Depressive mood was assessed using the Beck Depression Scale(BDS). Voxel-wise comparisons of relative CBV maps were made between before scrambler therapy and after 10 scrambler therapy sessions over the entire brain volume. The relationship between individual participant CBV(measured in voxels), BDS and VAS score was also examined.

Results

Compared with before scrambler therapy, the measures of CBV exhibited significantly lower CBV in the mid cingulate cortex, posterior cingulated cortex and primary somatosensory cortex.

Conclusion

We observed decreased in the cerebral pain network of patients with burn injury. Scrambler therapy is a non-invasive, non-medicinal modality that significantly reduced burn-associated neuropathic pain. Scrambler therapy should be considered as a treatment option for burn survivors with severe neuropathic pain.

The Effect of Robot-Assisted Gait Training in Patients With Parkinson's Disease : Study Protocol

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Background/Objective

Loss of dopamine in the sensorimotor territories of basal ganglia disturb habitual control in Parkinson's disease (PD). Consequently, patients have to make a cognitive effort to perform habitual action such as gait. In other words, gait automaticity is reduced. Robot-assisted gait training (RAGT) had been developed to restore gait function by promoting neuroplasticity through repetitive locomotor training and utilized in gait training for stroke patients. However, contradictory Results have been reported for PD patients. In addition, mechanism of RAGT's treatment effect is still unknown. The aim of this study is to investigate the effect of RAGT and to unveil the mechanism of treatment effect by comparing the change in gait automaticity and functional connectivity in patients with PD.

Methods

This is a prospective, single-blind, single-center, randomized controlled trial. Eligible participants will be randomly allocated to: 1) the robot-assisted gait training with Walkbot-S™ (P&S Mechanics, Seoul, Korea) group, or 2) the treadmill training group. Participants will receive 45-minutes of each intervention for 3 times per week for 4 weeks. The gait speed during RAGT will be targeted to the maximum speed depending on the participant's height and the same principle will be applied to the treadmill training group to match the training intensity. The primary outcome measure is the gait speed measured by 10-Meter Walk Test at a comfortable pace under single-task. Secondary outcomes include dual-task interference, Berg Balance Scale, Timed Up and Go test, Korean version of the Falls Efficacy Scale-International, New Freezing of Gait Questionnaire, MDS-UPDRS, and functional connectivity measured by resting-state functional MRI. Dual-task interference, an indicator of gait automaticity, is defined by the difference between dual-task and single-task performance. Baseline assessments (T0) will be conducted to acquire clinical characteristics and values of primary and secondary outcome measures before the intervention. Post-intervention assessments (T1) to compare the short-term efficacy of each intervention will be performed within three days after the intervention. Follow up assessments (T2) to detect potential long-term effects will be conducted one month after the intervention.

Discussions

This study will reveal the effect of RAGT using exoskeletal robot, not only on gait speed, but also on gait automaticity, balance function, fall risk, quality of life, and disease

disability. Besides, the study’s findings will shed new light on the mechanism of RAGT effect such as the change in gait automaticity and brain functional networks, following the RAGT. We hope that the information acquired from this trial will influence the clinical decision when physiatrists plan gait training for PD patients.

Trial status:

The study has been initiated in May 2018 and will be completed in Dec 2019. (ClinicalTrials.gov: NCT0349057)

Table 1. Schedule for outcome measures per visit

	Baseline assessment (T0)	Post-intervention (T1)	1-month follow up (T2)
Demographics	√		
10MWT (single-task)	√	√	√
10MWT (dual-task)	√	√	√
BBS	√	√	√
TUG	√	√	√
KFES-I	√	√	√
NFOG-Q	√	√	√
MDS-UPDRS	√	√	√
rs-fMRI	√	√	

10MWT, 10-Meter Walk Test; BBS, Berg Balance Scale; TUG, Timed Up and Go Test; KFES-I, Korean version of the Falls Efficacy Scale-International; FOG-Q, New Freezing of Gait Questionnaire; MDS-UPDRS, Movement Disorder Society-sponsored revision of the Unified Parkinson’s Disease Rating Scale; rs-fMRI, resting-state functional MRI.

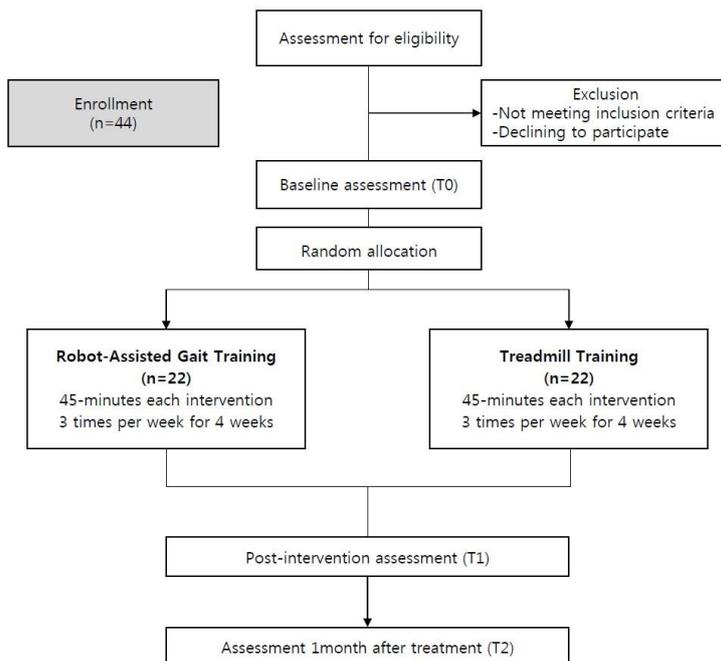


Figure 1. Consolidated Standards of Reporting Trials (CONSORT) flow diagram

sEMG Studies of the Supra- and Infra-Hyoid Muscle Activity During Swallowing in Healthy Volunteers

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Objective

Surface electromyographic (sEMG) studies were performed on 10 healthy adults to establish normative database of suprahyoid and infrahyoid EMG activity during swallowing.

Methods

As a preliminary study, ten healthy subjects were prospectively enrolled. Parameters evaluated during swallowing include onset latency, offset latency, peak latency, amplitude and duration of the suprahyoid and infrahyoid muscle groups. And the variability of electromyographic activity was also examined. Four tests were examined: voluntary single swallows of saliva ("dry" swallow), voluntary single water swallows as normal (2ml and 5ml), and voluntary single swallows of excessive amount of water (up to 20ml).

Results

Normative data for EMG activity during swallowing were established for healthy adults. The activation of the suprahyoid muscles developed earlier than that of the infrahyoid muscles ($p=0.05$). The mean onset latency of suprahyoid muscle activity was $0.417\pm 0.273s$, and that of infrahyoid muscle was $0.491\pm 0.235s$. The mean duration of suprahyoid and infrahyoid muscle activity were $0.993\pm 0.251s$ and $1.071\pm 0.235s$. The maximal amplitude of muscle activity during swallowing showed increase with the volume ($p<0.05$) and amplitude was higher with suprahyoid muscles than infrahyoid muscles ($p<0.001$). The area under curve of the rectified EMG signal also showed increase with the volume ($p<0.001$), and infrahyoid muscle showed a tendency of larger integrated rectified EMG signal than suprahyoid muscle ($p=0.094$). The intra-individual variability of the duration was lower (less than 30%) when compared to other parameters, and showed decrease with the volume in all muscle groups.

Conclusion

Surface EMG is a simple, reliable and noninvasive tool for screening evaluation of swallowing with low level of discomfort of the examination. The normative data of surface EMG can be used for evaluation of complaints and symptoms, as well as for comparison of swallowing performance, both within and between patients.

Effectiveness of bimanual activity exercise in upper motor function outcome in unilateral stroke

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Objective

In hemiparetic stroke patients, the focus of conventional rehabilitation therapy has been strictly steered towards contralesional side weakness. However, with ipsilesional hand function deficit known to be common in patients with unilateral stroke, a need for strategic modification of occupational therapy should be validated. Previous studies have documented motor impairments of ipsilateral side in the form of subtle impairments in dexterity, which might be attributed to changes in the corpus callosum with microstructural deficits. Therefore, the aim of this study is to investigate the effectiveness of bimanual activity training in upper motor function outcome in terms of Jebsen Hand Function Test (JHFT) in patients with unilateral stroke.

Methods

The outcomes of the first 14 unilateral stroke patients who received the bimanual activity training in combination with the conventional occupational therapy from September 2017 to June 2018 at a tertiary hospital were examined. Patients were selected according to inclusion criteria of unilateral stroke with onset of less than 3 months and absence of previous history of stroke or other neurodegenerative disease. This study group was compared to 14 propensity-matched control patients identified from a database between August 2012 and August 2017, which constitutes the time frame prior to the implementation of the bimanual activity regimen.

Results

Upper motor function measured in terms of JHFT score was significantly improved in both sides. In hemiparetic stroke patients, who received the bimanual activity training combined with the conventional occupational therapy compared to those receiving only the conventional regimen, JHFT scores increased by 2.6 ± 8.4 and 1.1 ± 0.3 on contralesional and ipsilesional sides, respectively ($p < 0.05$).

Conclusion

Our data suggest that the implementation of bimanual activity training in addition to the conventional occupational therapy has improved not only the ipsilesional upper motor function but also the contralesional side, validating the effectiveness of bimanual activity training in upper motor function outcome of patients with unilateral stroke.

Key words

Ipsilateral hand function deficit, unilateral stroke, bimanual activity

Chronic severe quadriplegia due to combined apraxias in a patient with traumatic brain injury

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Objectives

We report on a traumatic brain injury (TBI) patient with chronic severe quadriplegia caused by combined limb-kinetic and callosal apraxias due to corticofugal tract (CFT) and corpus callosum (CC) fiber injuries, which were demonstrated by applying diffusion tensor tractography (DTT).

Case description

A 35-year-old right-handed male patient had suffered from head trauma resulting from an accidental collision with a car while riding a motorcycle. He underwent CT-guided stereotactic extraventricular drainage for traumatic intraventricular hemorrhage and conservative management for traumatic subarachnoid hemorrhage and traumatic multifocal microhemorrhage in both prefrontal and parietal cortices. The patient exhibited complete weakness of both upper and lower extremities at the onset of TBI (Manual Muscle Test: right 0, left 0). At 16 months after onset, he showed severe quadriplegia of both upper and lower extremities (Manual Muscle Test: both shoulder abductors, 2- [20°]; both elbow extensors, 2- [30°]; both finger flexors and extensors, 0; both hip flexors, 2- [20°]; knee extensor, 2- [20°]; and ankle dorsiflexor, 0). On 16-month DTT, the right corticospinal tract showed partial tearing at the subcortical white matter. In addition, injuries to both CFTs from the secondary motor area, and the CC fibers from the primary motor cortex and secondary motor area were observed in both hemispheres.

Conclusions

By using DTT, combined limb-kinetic and callosal apraxias due to injuries to the CFT from the secondary motor area and CC fibers were demonstrated in a patient with chronic severe quadriplegia following TBI.

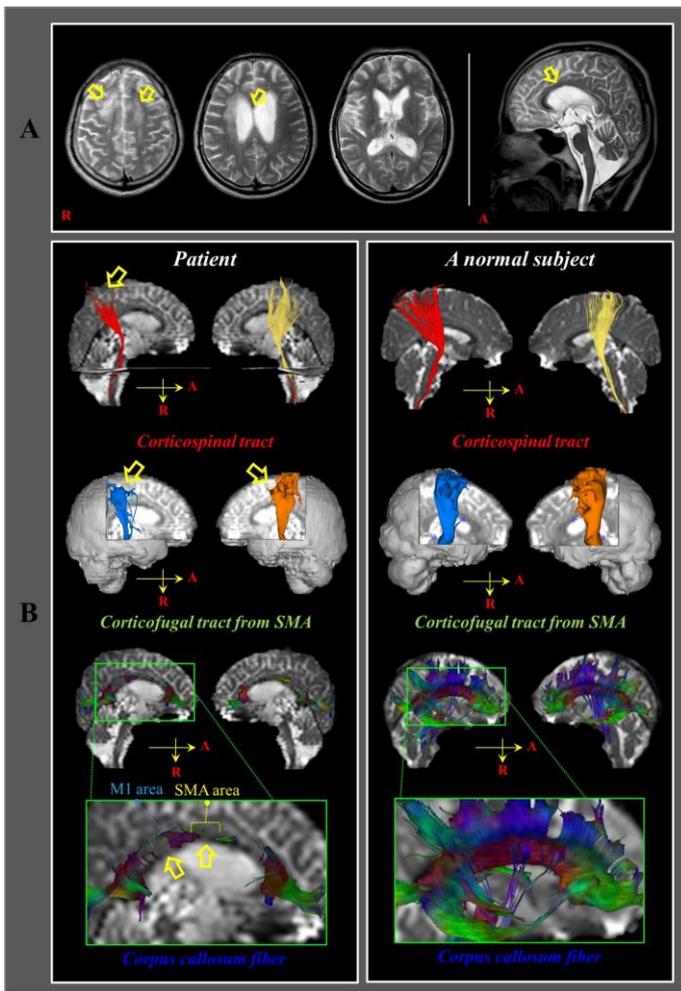


Fig. 1. (A) T2-weighted magnetic resonance images at 16 months after onset show leukomalactic lesions in both prefrontal lobes and the subcortical white matter (arrows) and in the thinned body of corpus callosum (arrow). (B) On 16-month diffusion tensor tractography, a partial tearing at the subcortical white matter (arrow) is observed in the right corticospinal tract. The corticofugal tracts from the secondary motor area (SMA) show narrowing (right) and partial tearing (both, arrows) compared to that in a normal subject (35-year-old male). Injuries of the corpus callosum fibers from the primary motor cortex (M1) and the SMA in both hemispheres are also present (arrow).

Sex Differences in Depression and Cognitive Impairment after Stroke: The KOSCO Study

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Purpose

The primary Purpose of this study was to investigate whether there were differences in prevalence and severity of depression or cognitive impairment between male and female patients with stroke. In addition to that, early features of depression or cognitive impairment associated with long term depression or cognitive impairment were studied for male and female stroke patients respectively.

Methods

This study was an interim analysis of the Korean Stroke Cohort for Functioning and Rehabilitation (KOSCO) designed as 10 years long-term follow-up study of stroke patients. All patients who admitted to the representative hospitals in 9 distinct areas of Korea with their acute first-ever stroke (from August 2012 to May 2015) were recruited. In this study, a total of 7,166 patients with depression scale or cognitive test score at least at one time point until 30 months after onset were included. Score of Korean Version of Geriatric Depression Scale Short Form (K-GDS-SF) and Performance on Korean Version of Mini-Mental State Examination (K-MMSE) was analyzed with ANCOVA and logistic regression.

Results

The prevalence of depression (K-GDS-SF \geq 8) and cognitive impairment (K-MMSE $<$ 16%ile) was higher in female stroke patients (61.4% to 25.5% for depression and 53.7% to 31.5% for cognitive impairment) than male stroke patients (53% to 19.6% for depression and 39.6% to 17.2% for cognitive impairment) at every time points. As a Result of ANCOVA, depression and cognitive impairment were more severe in female stroke patients than in male stroke patients at every time points ($p<0.05$). In logistic regression analysis, female stroke patients were at increased risk for depression at discharge, 6 months and 18 months after stroke and for cognitive impairment at every time points except at transfer to rehabilitation ($p<0.05$). In sub scores analysis, high score of the 'lowered affect' factor in the K-GDS-SF at acute phase increased the risk of depression at 30 months and low score of the 'orientation' domain in K-MMSE at acute phase increased the risk of cognitive impairment at 30 months only in female stroke patients. In male stroke patients, high score of the 'cognitive inefficiency and a lack of motivation' factor in K-GDS-SF increased the risk of depression at 30 months and low score of 'memory' domain in K-MMSE increased the risk of cognitive impairment at 30 months. High score of the 'Negative judgment' factor in the K-GDS-SF, and low score of the 'attention' or 'construction' domain of the K-MMSE were common risk factors in both male and female stroke patients.

Conclusion

There was sex difference in the prevalence and severity of depression or cognitive impairment after stroke, and in the effect of sub scores on the prediction of long term depression or cognitive impairment. These Results are consistent with the traditional view that female patients have more severe emotional or cognitive outcomes after stroke than male patients.

Which factors affect the severity of dysphagia in lateral medullary syndrome?

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Background & Purpose

The Purpose of this study is to identify the factors that relate with the prognosis of dysphagia after lateral medullary syndrome (LMS).

Methods

LMS patients with dysphagia who admitted from Jan 2013 to Dec 2017 were included and divided into two groups (mild vs. severe). Severe dysphagia was defined as the condition that showed decreased bilateral pharyngeal constriction without esophageal passage in a videofluoroscopic swallowing study (VFSS) and initially required enteral tube feeding. Their clinical data (age, sex, lesion side, onset duration, Modified barthel index (MBI), National Institutes of Health Stroke Scale (NIHSS) and anatomical lesion on diffusion-weighted MRI) were statistically compared to find the differences between the two groups.

Results

Twelve patients were shown the absence of esophageal passage among a total of 30 LMS dysphagia. Only the anatomical lesion location and extent was significantly different and the severe group showed more vertical extension and far lateral involvement of medulla. In other factors, there is no differences between the two groups.

Conclusion

The location and the extent of involvement in medulla is considered to be the most important factor in the prognosis of dysphagia after LMS.

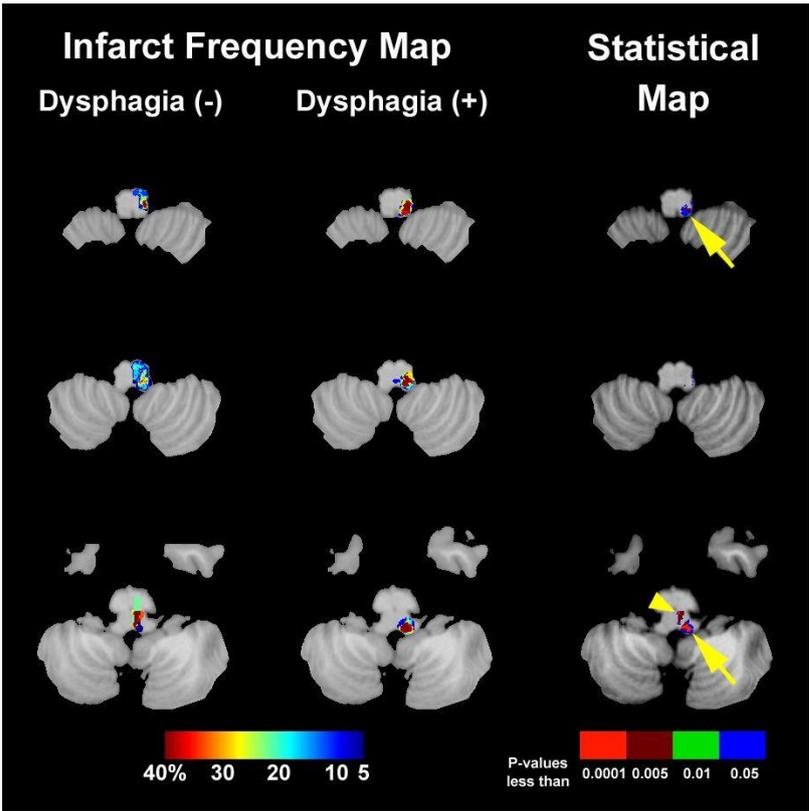


Fig 1. The location and the extent of involvement in 30 lateral medullary infarction patient

Dysphagia Screening Using MASA and mMASA in Brain Injured Patients with Cognitive Impairment

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Introduction

Dysphagia is one of the common and important complications of brain injured patients. Since early diagnosis of dysphagia and proper dietary control are emphasized for improving rehabilitation outcome, screening tools are routinely used to assess the risk of dysphagia and aspiration. However, cognitive impairment which is frequently accompanied with brain injured patients makes it difficult to evaluate the patient's performance in accordance with the instruction during dysphagia screening. In other words, we do not know if these tests are reliable when it is applied to a patient with a cognitive impairment. Therefore, this study was designed to reveal the impact of cognitive status on the Result of dysphagia screening tools, MASA and mMASA.

Methods

The medical records of 146 patients with brain injury from various causes were evaluated (Table 1). Dysphagia was assessed with VFSS, MASA, and mMASA. According to the VFSS Results, patients were divided into two groups, one with aspiration (aspirator) and the other without aspiration (nonaspirator). Cognitive function was assessed by K-MMSE Result, of which scores less than 24 are considered abnormal; classifies 20-24 as mild, 10-20 as moderate and <10 as severe cognitive impairment. The correlation between the MASA and mMASA according to cognitive status, and the difference of MASA and mMASA between aspirators and nonaspirators were analyzed. The sensitivity, specificity, positive predictive value and negative predictive value of MASA and mMASA for prediction of aspiration were also calculated.

Results

MASA and mMASA score showed significant correlation ($r=0.911$, $P<0.01$). When patients are grouped according to cognitive status, MASA and mMASA also showed significant correlation in all groups. There were significant differences between aspirators and nonaspirators in MASA and m MASA scores (Table 2). However, normal cognition group did not show statistical difference of MASA and mMASA between aspirators and nonaspirators. The mMASA of moderate cognitive impairment group showed no statistical difference between aspirators and nonaspirators, either. The sensitivity and specificity of MASA for the prediction of aspiration was 82.5 % and 58.4% respectively.

On the other hand, mMASA showed higher sensitivity, 93.0% and lower specificity, 34.8 than MASA. In the analysis of subgroups according to cognitive status, the patients with more severely impaired cognitive function showed the trend of high sensitivity and positive predictive values, and low specificity and negative predictive value (Table 3).

Conclusions

The sensitivity and specificity of MASA and mMASA may vary depending on the cognitive status of brain injured patients. Therefore, the test Results should be interpreted carefully while perceiving the impact of cognitive status on the Results of MASA and mMASA.

table1. Demographics and clinical characteristics of patients

Parameters	
Age (years)	63.4±15.9
Etiology (n, M/F)	146, 90/56
Cerebral infarction	51, 24/27
Cerebral hemorrhage	28, 41/17
Traumatic brain injury	21, 17/4
Brain tumor	16, 8/8
Onset to evaluation (day)	67.0±89.3
K-MMSE (n, scores)	13.5±9.5
Normal	24, 27.2±1.6
Mild impairment	22, 21.5±1.2
Moderate impairment	46, 15.1±3.1
Severe impairment	54, 2.8±3.0

Values are presented as mean ± standard deviation (SD).

table2. Comparison of MASA and mMASA according to aspiration

N (total, aspiration/non aspiration)	MASA			mMASA		
	Aspiration	Non Aspiration	<i>p</i>	Aspiration	Non Aspiration	<i>p</i>
Total (146, 57/89)	114.5±40.3	182.7±13.8	0.000**	60.2±20.3	86.6±11.4	0.000**
Normal (24, 4/20)	167.5±48.0	185.2±13.7	0.816	84.8±17.2	89.2±11.8	0.697
Mild impairment (22, 3/19)	162.0±20.1	185.1±13.6	0.044*	74.0±14.9	91.6±9.0	0.044*
Moderate impairment (46, 18/28)	150.7±33.2	178.7±19.3	0.001**	77.8±14.6	82.9±11.8	0.201
Severe impairment (54, 32/22)	106.2±47.9	149.7±35.4	0.012*	54.9±22.7	71.7±16.3	0.031*

Values are presented as mean± standard deviation (SD).

p* < 0.05, *p* < 0.01

table3. Accuracy of MASA and mMASA for prediction of aspiration according to cognitive status

	MASA					mMASA				
	Total	Normal	Mild	Moderate	Severe	Total	Normal	Mild	Moderate	Severe
Sensitivity	82.5	25.0	66.7	77.8	93.7	93.0	50.0	100	94.4	96.9
Specificity	58.4	75.0	78.9	57.1	27.3	34.8	50.0	57.9	32.1	4.5
Positive predictive value	65.2	16.7	33.3	53.8	65.2	59.6	16.7	27.3	47.2	59.6
Negative predictive value	75.0	83.3	93.8	80.0	75.0	50.0	83.3	100	90.0	50.0

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FRONTAL LOBE OXYHEMOGLOBIN LEVELS IN PATIENTS WITH BURN DURING WALKING ASSESSED USING fNIRS

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Introduction

An understanding of the mechanisms associated with locomotor networks has the potential to benefit the burn rehabilitation of patients with neurological locomotor deficits. However, the effects of peripheral neurological injury on locomotor network remain unknown. This study is Purposed to examine patterns of cortical activation using the NIRST functional nearinfrared spectroscopy(fNIRS) device in patients with neurological injury caused by lower extremities burn.

Method

15 patients with lower extremities burn, 10 patients with upper extremities burn and 11 healthy controls were assessed in this study. We evaluated gait related cortical activity using an fNIRS system at baseline and usual walking. Cortical activity was determined through the relative changes in the hemoglobin concentrations.

Results

fNIRS showed increased cortical activation in the prefrontal cortex in patients with lower extremities burn compared with cortical activation in the patients with upper extremities burn and healthy controls

Conclusion

This study is the first to evaluate the changes in cortical activity measured with an fNIRS system on patient with burn injury. Prefrontal activation during walking is dependent on lower extremities burn and that the patients with neurological injury apparently rely more on cognitive resources even during usual walking task.

Predictive Factors for Aspiration Pneumonia in Videofluoroscopic Swallowing Studies

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Introduction

Aspiration pneumonia is a major cause of morbidity and mortality in acutely hospitalized patients. Aspiration pneumonia is considered a multifactorial problem, and risk is higher in patients with dysphagia. Although a videofluoroscopic swallowing study (VFSS) is considered the gold standard for evaluation of swallowing function, studies on the correlation between aspiration pneumonia and VFSS parameters are not well established. We aimed to identify significant risk factors associated with aspiration pneumonia in patients with suspected dysphagia who were evaluated with VFSS.

Methods

A total of 747 patients who underwent VFSS between September 2014 and September 2017 were enrolled. Patients were divided into groups with and without aspiration pneumonia. Clinical information and VFSS findings were reviewed.

Results

The mean age of the enrolled patients was 70.98±13.57 years, with 394 men and 353 women. Of these, 84 were diagnosed with aspiration pneumonia. There were no group differences according to underlying neurological conditions. Patients with pneumonia were significantly older than those without pneumonia ($p=0.03$). There are significantly larger proportion of male subjects in aspiration pneumonia group ($p = 0.04$). Within the parameters of initial VFSS, positive aspiration findings with a 1-cc or 2-cc trial irrespective of consistency showed significant differences between the two groups ($p<0.001$, $p=0.013$ respectively), while the findings of aspiration with 5 cc, penetration, or remnant of bolus showed no significant differences. Multiple logistic regression analysis showed that the finding of aspiration with a 1-cc trial in VFSS was the best predictor of aspiration pneumonia (odds ratio=4.96; 95% confidence interval, 1.98–12.43; $p=0.001$).

Conclusion

The finding of aspiration with a small bolus in VFSS is the best predictor of aspiration pneumonia, while other parameters failed to reveal a significant effect. The Results highlight the importance of detecting small amounts of aspiration on routine VFSS.

Measurement and correction of stooped posture using wearable sensors in patients with Parkinsonism

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Background

The stooped or bent posture is one of the typical postural deformities in patients with Parkinsonism. This deformity usually aggravated during walking. Sometimes, verbal or sensory cues are helpful to correct their posture during walking. However, the severity of the stooped posture is difficult to measure quantitatively during walking, and continuous feedback on their posture is also difficult to be provided during their activities.

Objectives

The study Objectives were to measure the degree of stooped posture using wearable sensors during walking in patients with Parkinsonism and to investigate whether sensory feedback using vibration of the sensors improve their posture.

Materials and Methods

Patients with Parkinsonism and stooped posture due to forward flexion of the thoracolumbar region were recruited in this study. Patients who showed fixed kyphosis or severe dyskinesia/tremor were excluded. Two wearable sensors containing 3-axis accelerometers were attached at the upper neck (neck sensor), and just below the C7 spinous process (back sensor), respectively (Fig. 1). After calibration of the sensors in most upright posture (defined as 0 degree), the sensors continuously recording the sagittal angles at 1 kHz and averaged the data at every seconds during 6-min walking test. This measurement was validated in healthy subjects by comparing with 3D camera system with markers (Optitrack) with mean absolute errors of 0.9 to 1.5 degree. In the control session, the patients walked with the sensors as usual. In the vibration session, sensory feedback was provided by vibration of the neck sensor when the sagittal angle was lower than the threshold angle (10 or 20 degree). The sequence of the sessions was quasi-randomized according to the order of participation. The absolute sagittal angles in most upright posture before walking and mean changes of the sagittal angles during walking were measured in each patient.

Results

Ten patients with Parkinsonism participated in the study. Because 2 patients were excluded due to measurement errors, data of 8 patients (7 females and 70.25 ± 6.11 years old) were analyzed (Table 1). The neck and back flexion somewhat aggravated

during gait, but the changes were less than average 10 degree in most patients in both measurement sessions. Therefore, it was difficult to evaluate the effect of sensory feedback by vibration. However, some patients showed immediate response to the feedback and corrected their posture during gait (Fig. 2).

Conclusion

This pilot study suggests that stooped posture could be measured quantitatively during gait using the wearable sensors in patients with Parkinsonism. Sensory feedback by vibration of the sensors may be helpful to correct the posture during gait in selected patients. A further study is warranted to validate the effect of sensory feedback using the wearable sensors in patients with Parkinsonism.

Table 1. Characteristics and individual data of the study participants

Subject	Sex	Age	H&Y	Threshold	Control		Vibration						
					Base_N	Base_B	Mean_N	Mean_B	Base_N	Base_B	Mean_N	Mean_B	Vib #
R001	F	74	2.5	20	87	72	8.85	8.74	101	75	8.56	8.05	11
R004	F	72	3	20	100	63	3.2	2.52	105	62	13.15	5.57	17
R005	F	74	2.5	20	102	52	-0.33	5.87	104	55	6.75	5.66	0
R006	F	79	3	20	92	55	9.57	6.53	88	53	3.53	8.69	0
R007	F	65	2	10	97	60	2.85	2.55	97	62	-2.6	-1.68	0
R008	F	72	3	10	99	52	0.78	5.29	99	55	-1.18	3.54	11
R009	M	66	3	10	91	89	20.21	16.46	88	83	12.99	23.11	240
R010	F	60	2.5	10	96	91	9.72	-2.75	77	89	5.39	1.03	27
Average					95.5	66.75	6.86	5.65	94.88	66.75	5.82	6.75	38.25



Fig. 1. Two wearable sensors to measure neck and back flexion angles.

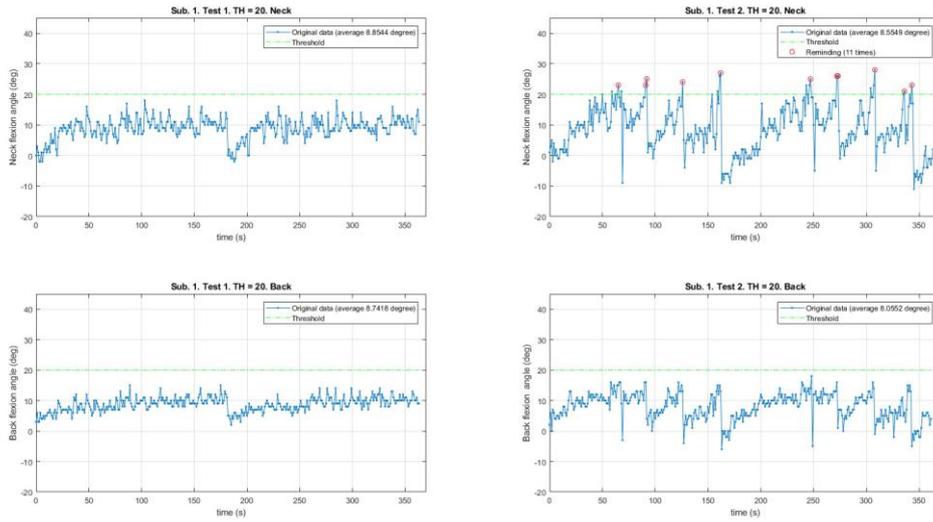


Fig. 2. The changes of neck and back flexion angles continuously measured during 6-min walking test in an example case (R001). In the vibration session (Test 2) with 20 degree of the threshold angle, the patients responded immediately to the neck sensor vibration (red circles), and corrected both neck and back flexion postures.

Increased Brain White Matter Diffusivity Associated with Phantom Limb Pain

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Introduction

We used diffusion tensor imaging (DTI) to evaluate the phantom limb pain-related changes of cerebral white matter in unilateral arm amputation patients whose cerebral blood volume (CBV) changes was proved to be associated with emotion in the cerebral pain network in our previous paper (DOI: <https://doi.org/10.1016/j.apmr.2017.03.010>).

Methods

Ten patients with phantom limb pain (43.8±3.4 years, 1 woman) and 16 age- and sex-matched healthy controls (41.7±2.2 years, 7 women) participated in the study. The patients (i) were aged less than 50 years, (ii) underwent the amputation of the unilateral upper limb after electrical injury, (iii) suffered from the phantom limb pain longer than 12 months, and (iv) had uncontrolled pain despite medication and physical therapy. DTI data were obtained using a MAGNETOM Sonata 1.5 T system (Siemens AG, Erlangen, Germany). Preprocessing and diffusion tensor modeling were performed using FDT v3.0 included in FSL (<http://fsl.fmrib.ox.ac.uk/fsl/>). At each voxel within the whole-brain mask created by excluding non-brain tissue, a diffusion tensor was modelled and diffusion tensor-derived parameters, including fractional anisotropy (FA), mean diffusivity (MD), axial diffusivity (AD), and radial diffusivity (RD), were computed. We flipped the images of the diffusion tensor-derived parameters around the midsagittal axis for the patients who underwent the amputation of the left upper limb, such that the amputated upper limb could be uniformly connected to the left hemisphere in all patients. Then, for voxel-wise statistical analyses of the diffusion tensor-derived measures, we utilized a tract-based spatial statistics approach implemented in FSL. For each diffusion tensor-derived measure, the images projected onto the mean FA skeleton were fed into voxel-wise analyses to examine differences in values between the patients and healthy controls. In addition, associations between the values of each diffusion tensor-derived measure and VAS scores across the patients were assessed. Because HDRS scores were much higher in the patients than in the healthy controls and individual differences in the severity of depression may affect white matter microstructure as well as pain, HDRS scores were included as a nuisance covariate in the statistical models.

Results

The patients showed higher AD values compared to the healthy controls. White matter structures of the altered AD values in the patients comprised the internal capsule, posterior thalamic radiation, sagittal striatum, corona radiata, external capsule, superior longitudinal fasciculus, superior fronto-occipital fasciculus, and fornix in both

hemispheres (Fig 1). The RD values of patients were positively correlated with VAS scores, specifically across white matter structures in the hemisphere associated with missing hand (Fig 2).

Conclusion

The increase of diffusivity in phantom limb pain patients reflects white matter alteration associated with pain intensity.

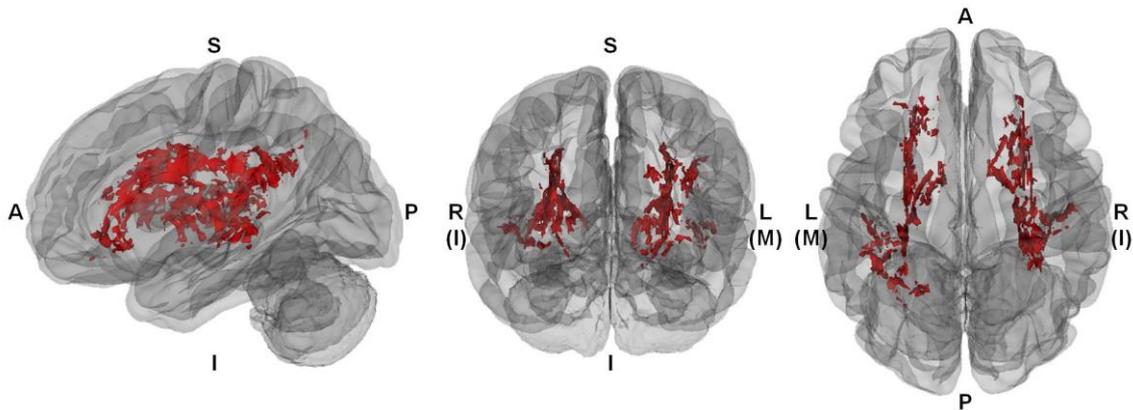


fig1. Mapping of patient versus control AD as adjusted for depressive symptoms. The distribution of white matter structures in which the values of AD were higher in patients with phantom limb pain than in healthy controls. Abbreviations: M, hemisphere associated with missing hand; I, hemisphere associated with intact hand; A, anterior; P, posterior.

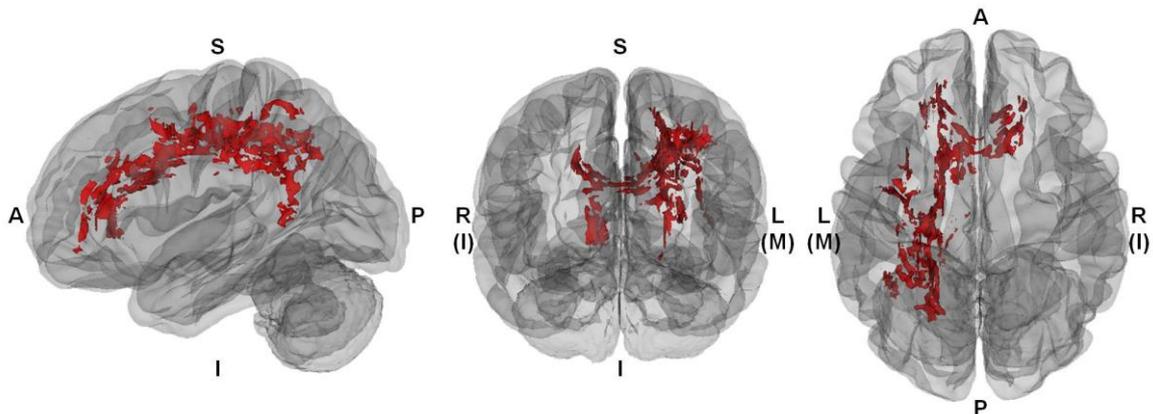


fig2. Mapping of RD correlations with severity of phantom limb pain in the patient group. When the HDRS scores were included as a nuisance covariate, the distribution of white matter structures in which the values of RD were positively correlated with VAS scores in patients with phantom limb pain. Abbreviations: M, hemisphere associated with missing hand; I, hemisphere associated with intact hand; A, anterior; P, posterior.

Correlation with Cerebral White Matter Hyperintensity and Rehabilitation Outcome in brain stem stroke

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Objective

Cerebral white matter hyperintensities (WMHs) are a common finding on magnetic resonance imaging (MRI) in elderly persons and patients with cerebrovascular diseases. The pathogenesis of WMHs has known to be closely related with ischemic pathogenesis. Previous studies have shown that WMHs are also related to cognitive impairment, gait disturbance, motor compromise and global functional decline. Brain stem stroke minimally affect the cognitive function than other parts of the stroke, so we can hypothesize that cognitive impairment was related with WMHs. The Purpose of this study was to determine whether a functional improvement is associated with severity of WMH.

Method

Eighty brain stem stroke patients were enrolled. WMHs was evaluated by the Fazekas scale and the Scheltens scale. All participants were divided into two groups based on the severity of WMH according to Fazekas scale. Mild WMH group was defined as patients with Fazekas scale 0,1 and severe WMH group was defined as Fazekas scale 2,3. Functional status was assessed by the modified Barthel Index (MBI) Score and functional gains were determined by using absolute and relative Methods calculated from the MBI score. The absolute functional gain (AFG) is the MBI score difference between first assessment and assessment when they were discharged, and the absolute functional efficiency reflects the functional gain per day. General characteristics and functional improvement were compared between the groups. Student T-test and Mann-Whitney test were performed to analysis relation between Fazekas scale and absolute functional gain, absolute functional efficiency.

Result

Mean age of patients was 64.72 ± 13.27 years. AFG was 23.73 ± 10.20 in mild group, 19.29 ± 15.14 in severe group and there were no significant differences. Age, length of stay, the initial NIHSS score, MFT also showed no significant differences. Initial MBI score, MMSE and absolute functional efficiency in the mild WMH group (51.03 ± 18.52 , 26 ± 4.15 , 1.00 ± 0.59) were significantly higher compared to the severe WMH group (38.06 ± 21.81 , 23 ± 6.73 , 0.65 ± 0.27 , $p < 0.05$). There was a significant correlation between Fazekas scale and absolute functional efficiency ($p < 0.05$).

Conclusion

In our study, the severity and extent of WMHs are significantly correlated with the cognitive impairment and poor efficiency of functional improvement in patients with ischemic stroke at brain stem. The WMHs could be considered as one of factors that can influence functional recovery during rehabilitation of stroke patients with WMH.

The Correlation between Abdominal Muscle Thickness and Postural Balance in Chronic Stroke Patients

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Objective

To evaluate the correlation between postural balance and asymmetry of abdominal muscle thickness in both resting and activation state in chronic stroke patients.

Method

The 24 chronic hemiplegic stroke patients were included in this study, who were diagnosed with brain hemorrhage or infarction by radiologic evaluation. We included (1)patients whose post-onset duration is more than 6 months, (2)patients who have ability to follow instruction for abdominal muscle activation(K-MMSE \geq 15), (3)patients who have ability to follow instruction for evaluation of balance tests. And we excluded (1)patients who have quadriplegic or double hemiplegic impairment, (2)patients who have history of spine or disc related operation and scoliosis, (3)patients who have more than 27 of body mass index(BMI), (4)patients who have ataxic movement. We evaluated the parameters of postural balance by measuring the trunk impairment scale(TIS) and berg balance scale(BBS). And we measured the total abdominal muscle thickness(summation of external oblique, internal oblique and transverse abdominis muscles) by ultrasound in both resting and activation state. Partial correlation coefficient was used to analyze the correlation between abdominal muscle thickness and postural balance. And Mann-whitney U test was used to analyze the differences of subgroups in patients. Data analyses involved use of SPSS v18.0 for Windows. P value < 0.05 was considered statistically significant.

Results

Demographic information of the enrolled chronic stroke patients is presented in Table 1. The abdominal muscle thickness of paretic side in both resting and activation state was correlated with BBS($r=0.57$, $r=0.67$, $p<0.05$). Also, the contraction ratio of the paretic side abdominal muscle was significantly correlated with the TIS($r=0.61$, $p<0.05$)(Table2). We found that the two types of the asymmetry of the abdominal muscle thickness. The abdominal muscle of non-paretic side was thicker ($159.6\text{mm} \pm 36.1$ vs $133.7\text{mm} \pm 30.0$) than paretic side in 12 patients(NTG). However, in the other 12 hemiplegic patients(PTG), abdominal muscle of paretic side was thicker($140.0\text{mm} \pm 20.0$ vs $125.2\text{mm} \pm 18.1$)(Table 1). The spasticity of the PTG was significantly higher than the NTG($p<0.05$). In the NTG, bilateral abdominal muscle thickness became less asymmetric during activation and TIS score was significantly higher than the PTG(Table 3).

Conclusion

This study demonstrated that the abdominal muscle thickness and contraction ratio of paretic side were correlated with trunk balance in the chronic stroke survivors. In

addition, the NTG had a better dynamic sitting balance than the PTG. Although spasticity had affected the abdominal muscle thickness of paretic side, it didn't mean good contractility or strength. Therefore, the ability of fascilitation of paretic side abdominal muscle might be important to dynamic sitting balance in the chronic stroke survivors.

Table1. Patients' demographics and clinical characteristics

Characterists	Subjects(n=24)	NTG(n=12)	PTG(n=12)
Sex			
Male : Female	19 : 5	8 : 4	11 : 1
Age(years)	61.0±12.5	59.3±15.9	62.8±8.1
Post-onset duration(months)	53.8±42.5	52.75±42.0	54.8±44.9
Lesion Type			
Hemorhage : Infarction	17 : 7	10 : 2	7 : 5
Lesion Side			
Right : Left	12 : 12	4 : 8	8 : 4
K-MMSE	26.6±3	26.7±3.1	26.4±3.1
BMI	23.0±2.4	23.0±2.9	22.9±2.0
BSA(m ²)	1.7±0.2	1.7±0.2	1.7±0.1
Absolute thickness of abdominal muscle (mm)			
Resting			
Paretic side	136.8±25.0	133.7±30.0	140.0±20.0
Non-paretic side	142.4±33.0	159.6±36.1	125.2±18.1
Activation			
Paretic side	227.3±43.6	232.8±54.3	222.0±31.1
Non-paretic side	233.5±57.6	257.5±53.5	209.4±53.0

Values are presented as n:n or mean±standard deviation

NTG: non-paretic side thicker group in resting abdominal muscle thickness, PTG: paretic side thicker group in resting abdominal muscle thickness, K-MMSE: Korean Mini-Mental State Examination, BMI: body mass index, BSA: body surface area

Table 2. Partial correlation between abdominal muscle and postural balance adjusted by sex, age, height, weight, BMI and BSA

Variables	TIS	BBS
	Correlation Coefficient(r)*	
Absolute thickness in resting (mm)		
Paretic side	0.24	0.57**
Non-paretic side	0.31	0.39
Absolute thickness in activation (mm)		
Paretic side	0.39	0.67**
Non-paretic side	0.49	0.43
Contraction ratio		
Paretic side	0.61**	0.15
Non-paretic side	0.23	0.06
Asymmetry		
Resting	0.13	-0.09
Activation	-0.37	-0.10

*Spearman correlation coefficient **Significant correlation ($P < 0.05$)

Contraction ratio : (abdominal thickness in activation state / abdominal thickness in resting state) * 100

Asymmetry : (| 1- abdominal thickness of paretic side / abdominal thickness of non-paretic side) * 100

TIS: trunk impairment scale, BBS: berg balance scale

Table 3. Mann-whitney U test for comparison between the NTG and the PTG

Variables	Subjects(n=24)	NTG(n=12)	PTG(n=12)
Spasticity(MAS)	1.7±1.3	0.9±1.3*	2.3±1.1*
Contraction ratio			
Paretic side	167.9±28.5	176.9±37.5	158.9±11.0
Non-paretic side	165.6±30.4	164.2±28.0	167.0±33.8
Asymmetry			
Resting	13.9±9.5	15.6±9.6	12.2±9.5
Activation	15.1±10.8	9.8±9.8*	20.3±9.3*
TIS	12.9±4.8	15.1±4.9 *	10.7±3.6*
BBS	42.0±13.0	43.1±12.4	41.0±13.9

Values are presented as mean±standard deviation

*Significant difference ($P < 0.05$) within two groups by Mann-whitney U test.

MAS: modified Ashworth scale, it is calculated Gr1 as 1, Gr1+ as 2, Gr2 as 3, Gr3 as 4 and Gr4 as 5

Contraction ratio : (abdominal thickness in activation state / abdominal thickness in resting state) * 100

Asymmetry : (| 1- abdominal thickness of paretic side / abdominal thickness of non-paretic side) * 100

The effect of a driving simulator based rehabilitation on cognitive functions in subacute survivors

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Objective

Driving is complex activity that requires intact perceptual, cognitive, behavioral and motor functions. To drive safely, drivers should recognize and respond to lots of visuoperceptive informations. Because stroke can cause not only deteriorations in motor control but also those in cognitive function, communication and emotional areas, patients who were able to drive before stroke also need to be evaluated and trained their driving ability to drive safely. Since rehabilitation using driving simulator requires various cognitive functions, it is also expected that cognitive function will be improved after simulator training. Devos et al. reported that using a driving simulator in patients with Parkinson's disease helped to improve their on-road driving and driving related cognitive skills. However, to our knowledge, there is no research to find out how the driving rehabilitation affects the cognitive function of stroke patient. The Purpose of study is to investigate the effects of driving simulator training on cognitive functions in subacute stroke survivors.

Methods

Inclusion criteria were: (1) history of first stroke within 6 months, documented by CT or MRI; (2) Korean version of Mini-mental status exam(K-MMSE) ≥ 24 ; and 3) A person who can maintain balance in sitting position. Exclusion criteria were: (1) severe neurologic deficits by stroke that make simulator training difficult; (2) Other neurologic deficits that can affect cognitive and motor functions except stroke. Participants were randomly assigned in two groups. Driving simulator group (D) conducted both driving simulator training and computer based cognitive rehabilitation (30 minutes/day and five times/week for 3 weeks, respectively). Control group (cognitive rehabilitation group; C) conducted only computer based cognitive rehabilitation (one hour/day and five times/week for 3 weeks). Driving Health Inventory (divided visual search; DVS, Useful Field of View; UFOV,), computerized neurocognitive test (Trail Making Test A, Digit Span Test, Card Sorting Test, Word Color Test), modified Barthel Index (MBI) and Beck Depression Inventory (BDI) were evaluated pre and post treatment.

Results

Eight patients were recruited for this study. The demographics and baseline characteristics in the two groups did not differ significantly (Table 1). All Result

parameters showed no significant difference between pre and post interventions in both groups. However, in both groups, DVS, UFOV and BDI tended to decrease and the other parameters to increase after training. There was no significant group difference in pre/post changes in all parameters (Table 2).

Conclusion

In stroke patients, driving simulator based rehabilitation may have possibility to improve cognitive function as much as computer based cognitive rehabilitation. To clarify these Results, larger sample sizes will be needed.

Table 1. Demographics and clinical characteristics of study subjects

Variable	Total	Driving	Comcog	p-value
	(N=8)	(N=4)	(N=4)	
Age (year)	44.75 ± 5.1	41.75 ± 7.8	47.75 ± 7.5	0.686
Sex				0.317
Male	7(87.5%)	4(100.0%)	3(75.0%)	
Female	1(12.5%)	0(0.0%)	1(25.0%)	
Affected side				0.317
Right	1(12.5%)	0(0.0%)	1(25.0%)	
Left	7(87.5%)	4(100.0%)	3(75.0%)	
Etiology				0.495
Infarction	3(37.5%)	1(25.0%)	2(50.0%)	
Hemorrhage	5(62.5%)	3(75.0%)	2(50.0%)	
K-MMSE	26.75 ± 0.8	27.75 ± 1.2	25.75 ± 1.1	0.268

K-MMSE, Korean version of Mini-mental status exam

Data were reported as mean ± standard deviation for continuous variables and n (%) for categorical variables.

Table 2. Comparison between 2 groups; pre and post treatment

Variable	Group	Pre	Post	P-value*	Δ (Post - Pre)	P-value†
DVS	D	114,2 ± 52,3	90,0 ± 38,5	0.068	-24.2 ± 14.1	0.083
	C	187,5 ± 86,5	127,5 ± 61,8	0.068	-60.0 ± 29.4	
UFOV	D	225,7 ± 163,0	160,0 ± 101,6	0.066	-65.7 ± 61.4	0.486
	C	311,2 ± 185,3	214,2 ± 122,6	0.066	-97.0 ± 59.7	
TMT(A)	D	45,7 ± 9,0	55,0 ± 5,7	0.066	9.2 ± 4.9	0.686
	C	33,5 ± 7,5	43,7 ± 10,3	0.066	10.2 ± 3.3	
DST(F)	D	36,0 ± 7,5	44,2 ± 7,4	0.068	8.2 ± 3.3	0.486
	C	50,3 ± 33,2	59,3 ± 28,3	0.109	9.0 ± 11.1	
DST(B)	D	47,0 ± 3,5	54,5 ± 4,2	0.068	7.5 ± 2.0	0.200
	C	52,2 ± 27,6	64,2 ± 27,1	0.068	12.0 ± 4.6	
CST	D	46,0 ± 11,1	52,2 ± 11,8	0.066	6.2 ± 0.9	0.200
	C	31,7 ± 3,5	41,7 ± 6,2	0.068	10.0 ± 3.5	
WCT	D	38,5 ± 10,0	44,0 ± 8,9	0.066	5.5 ± 1.9	0.114
	C	40,2 ± 24,5	52,7 ± 22,6	0.068	12.5 ± 7.0	
MBI	D	62,0 ± 29,1	70,25 ± 34,2	0.109	8.2 ± 7.4	0.057
	C	31,7 ± 3,5	72,5 ± 19,7	0.068	25.0 ± 9.1	
BDI	D	21,0 ± 4,3	11,0 ± 2,5	0.068	-10.0 ± 2.5	0.343
	C	17,7 ± 7,7	10,2 ± 5,5	0.066	-7.5 ± 3.0	

DVS, divided visual search(s); UFOV, Useful Field of View(ms); TMT(A), Trail Making Test A (t-score); DST(F), Digit Span Test forward(t-score); DST(B), Digit Span Test backward(t-score); CST, Card Sort Test(t-score); WCT, Word Color Test(t-score); MBI, modified Barthel Index; BDI, Beck Depression Inventory; D, driving simulator group; C, computer based rehabilitation group.

Data were reported as mean ± standard deviation.

* P-values were calculated by Wilcoxon's signed-rank test.

† P-values were calculated by Mann-Whitney test.

Effects of Cognitive Training in Healthy Elderly and Patients with Mild Cognitive Impairment

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Purpose

The Purpose of this study was to investigate the effect of cognitive training using newly developed serious games on the improvement of cognitive functions in the healthy elderly and patients with mild cognitive impairment (MCI).

Methods

Cognitive training programs operable on tablet PC were developed to improve cognitive functions of the elderly or patients with MCI which consisted of four serious games targeting major symptoms of cognitive disorders; attention, working memory, long-term memory, and visuospatial perception. Thirty-two healthy elderly persons and thirty-five patients with MCI between 55 and 85 years of age participated in this study. Each participant was randomly assigned to one of two groups, intervention or control groups. The intervention group received four weeks of cognitive training, 30 minutes per day, three times per week for consecutive 4 weeks. The control group didn't receive any intervention. To assess the effectiveness of the cognitive training using tablet PC, comprehensive neuropsychological tests were administered three times; at pre- and post-intervention, and at four weeks after completing the intervention in both healthy and MCI groups.

Results

In the healthy elderly, the intervention group demonstrated significant improvement on global cognitive function, working memory, and verbal learning after training compared to the control group ($p < 0.05$). Significant improvement of attention and verbal learning was also demonstrated after training in the intervention group compared to the control group in MCI patients ($p < 0.05$). Interference in the verbal learning, which is regarded as an early sign of cognitive aging and dementia, was reduced after cognitive training in both healthy and MCI participants.

Conclusion

Cognitive training using serious games on tablet PC can be used for improving cognitive functions in both normal and pathological aging.

The Effects of End-Effector Type Robot-Assisted Gait Training in Ataxia Patient with Brain Lesion

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OBJECTIVE

Robot-assisted gait training has been in the spotlight and its effectiveness of regaining ability to walk has been proven in patients with traumatic brain injury, stroke and spinal cord injury. Ataxia, caused by stroke or meningoencephalitis, lowers the balance of body and induces gait disturbance. The aim of study is to investigate the improvements of gait and balance in patients with ataxia caused by brain lesion after the end-effector type (Morning Walk[®]) robot-assisted gait training.

METHODS

Among the patients who admitted in rehabilitation department, patients with ataxia caused by brain lesion, such as infarction, hemorrhagic stroke, or meningoencephalitis, within the preceding year were included. Subjects were randomly assigned to two groups: 30 min of Morning Walk[®] training with 1 hr of conventional physiotherapy; or 1.5 hr of conventional physiotherapy for 3 weeks. Primary outcomes of walking ability and balance were assessed using Functional Ambulatory Category (FAC) and Berg balance scale (BBS). 10m Walk Test (10mWT), Rivermead Mobility Index (RMI), Motricity Index (MI) and Modified Barthel Index (MBI) were used for measurements of secondary outcomes.

RESULTS

At baseline, there was no statistically significant difference between two groups except for MBI (Table 1, 2). After 3 weeks of treatment, Morning Walk[®] group showed statistically significant improvements of FAC, 10mWT, MBI, RMI and BBS. Control group showed statistically significant improvements of MBI, MI, BBS. Inter-group comparison of changes of outcome measures demonstrated that Δ FAC and Δ RMI of Morning Walk[®] group were higher than control group with statistical significance (Δ FAC_{case}=1.88±0.35, Δ FAC_{control}=0.57±0.30, p-value=0.029, Δ RMI_{case}=3.50±0.50, Δ RMI_{control}=2.00±0.38, p-value=0.040). Notably however, a higher degree improvement of Δ BBS was observed in Morning Walk[®] group without statistical significance (Table 2).

CONCLUSIONS

In the aspects of gait function of ataxia patients, End-effector type (Morning Walk[®]) robot-assisted gait training group demonstrated more significant improvements than conventional physiotherapy alone group.

Table 1 Baseline characteristics of case and control group

	Morning Walk [®] group (N=8)	Control group (N=7)	<i>p</i> -value
Age (years)	62.1±5.5	66.3±3.1	0.613 ^b
Sex (female : male)	4 : 4	3 : 4	1.000 ^a
Weight (kg)	62.8±3.5	60.0±5.2	0.613 ^b
Height (cm)	162.3±2.1	163.2±4.5	0.867 ^b
Time from onset to enrollment (months)	3.4±2.6	2.6±1.8	0.955 ^b
Etiology			
Hemorrhage	1	1	1.000 ^a
Infarction	6	6	
Infection	1		

^a Analysis was done by Fisher's exact test.

^b Analysis was done by Mann-Whitney test.

Table 2 Outcome measurements of case and control groups, at baseline, post- treatment and changes (Δ Post-Pre) after treatment

	Morning Walk [®] group (N=8)			Control group(N=7)			<i>p</i> -value ^a
	Pre-treatment	Post-treatment	Δ Post-Pre	Pre-treatment	Post-treatment	Δ Post-Pre	
FAC	2.88±0.30	4.75±0.53*	1.88±0.35	2.29±0.29	2.86±0.55	0.57±0.30	0.029
BBS	30.38±6.19	43.5±6.31*	13.13±3.70	20.29±5.00	26.1±6.41*	5.85±1.77	0.152
10mWT	17.57±4.34	9.71±3.80*	7.87±2.03	25.00±4.91	18.44±4.74	6.56±1.25	0.927
RMI	6.75±1.00	10.25±1.10*	3.50±0.50	4.43±0.92	6.43±1.19	2.00±0.38	0.040
MI	79.00±3.00	87.00±4.25	8.00±4.00	78.57±3.67	88.57±4.57*	10.00±4.72	0.867
MBI ^b	67.75±8.67	88.13±6.56*	20.38±6.92	43.14±8.01	59.14±8.75*	16.00±5.06	0.779

Values are expressed as Mean \pm SD.

FAC, Functional Ambulatory Category, *BBS*, Berg Balance Scale, *10mWT*, 10m Walk Test, *RMI*, Rivermead Mobility Index, *MI*, Motricity Index (Lower extremity, severe side), *MBI*, Modified Barthel Index,

^a Δ Post-Pre values between two groups were analyzed by Mann-Whitney test. *p* –value < 0.05 was considered as statistically significant.

^b At baseline (pre-treatment), there were no variables showing statistically significant differences other than MBI. Baseline comparison of inter-group was done by Mann-Whitney test.

* Treatment effects of each group were evaluated by Wilcoxon signed rank test. Statistically significant changes between pre- and post- treatment were indicated in post-treatment column; * *p* –value < 0.05

Predictors of Functional and Motor Outcomes following Upper Limb Robot-assisted Therapy after Stroke

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Objective

Upper limb recovery is one of the main goals of post-stroke rehabilitation due to its importance in activities of daily living (ADL). Robot-assisted therapy (RT) provide high-intensive, repetitive, task-specific and interactive treatment of the impaired upper limb. Although the efficacy of RT is well established in literature, the impact of the initial status of the patient on the effects of RT is still understudied. In this study, we aim to identify whether demographic and clinical characteristics of stroke patients may influence the functional and motor outcomes after RT. The identification of predictors will help to identify patients who can benefit more from RT, and to optimise the treatment planning.

Methods

A retrospective study was carried out on a database of 189 patients who conducted upper limb goal-directed tasks with the Rapael Smart Glove(Neofect[®], Gyeonggi-do, Republic of Korea) at our institution between January 2015 and March 2018. The exclusion criteria were as follows: Less than 20 sessions of RT; non-stroke lesion; Bilateral lesion; age <18 or >85 years; MMSE<15; and incomplete data. From the 189 patients, 48 satisfied the inclusion criteria. The RT was administered 5 days/week over 4 weeks and each session lasted 30 minutes. All patients had conventional occupational complex therapy for 30 minutes/day during hospital stay. The primary outcome measures were the Functional Independence Measure (FIM) and Manual Function Test (MFT). The potential predictors were the demographic records and clinical assessment scores: initial Mini-Mental State Examination (MMSE); initial MFT scores of affected upper extremity(MFT-A); initial FIM; Modified Ashworth Scale for the Upper Extremity (MAS-UE). We assessed twice for each, at baseline and after the intervention. Statistical analysis were done using correlation analysis and regression analysis prepared by Web-R.org., and the chosen level of statistical significance was <0.05.

Results

Demographic data and clinical characteristics of the enrolled patients are displayed in Table 1. Correlation analysis showed that age and initial MMSE were correlated with final FIM, and the MAS-UE and initial MFT-A were correlated with the final MFT (Table 2). Regression analysis showed that the initial MMSE score was significant predictor of final FIM, and MAS-UE, initial MFT-A and OTR were significant predictors of final MFT (Table 3).

Conclusion

Stroke patients with preserved cognitive function appear to have a higher probability of achieving clinically significant functional outcomes after upper limb RT. In addition, stroke patients with less spasticity and more strength of affected upper extremity and earlier intervention during the acute stage appear to be achievable a clinically significant motor function after upper limb RT. Further studies on a larger number of patients with a long-term follow up are recommended in order to evaluate other potential predictors and to validate the Results.

Table 1. Demographic and Clinical Characteristics of Subjects (n=48)

Variables	Values
Age (years)	58.48±14.20
Gender (male/female)	30/18
Subtype (ischemic/haemorrhagic)	18/30
Lesion side (right/left)	25/23
MAS-UE (scale)	0.65±0.76
Initial MMSE	22.83±6.43
Initial MFT of affected upper extremity	12.81±8.99
Initial FIM	75.44±21.43
OTR (days)	167.13±183.60
DRM (days)	66.08±14.83
Session count (times)	33.58±7.80

Values are mean ± standard deviation.

MAS-UE, Modified Ashworth Scale for the Upper extremity ; MMSE, Mini-Mental State Examination; MRC, Medical Research Council scale for muscle strength; FIM, Functional Independence measure; OTR, onset-to-robot-assisted therapy time ; DRM, duration of hospital stay in department of rehabilitation medicine

Table 2. Correlation between Clinical Characteristics and Outcome Measure

Variable	Final FIM	Final MFT of affected upper extremity
	(Pearson's Coefficient, r)	(Pearson's Coefficient, r)
Age	-0.54***	0.07
Gender	-0.18	0.07
Subtype	-0.06	-0.24
Lesion side	-0.23	0.19
MAS-UE	-0.18	-0.54***
Initial MMSE	0.54***	-0.05
Initial MFT of affected upper extremity	0.10	0.80***
OTR	-0.06	-0.23
DRM	0.03	-0.29
Session count	-0.24	-0.18

*** P<0.005

FIM, Functional Independence measure; MFT, Manual Function Test; MAS-UE, Modified Ashworth Scale for the upper extremity ; MMSE, Medical Research Council scale for muscle strength; OTR, onset-to-robot-assisted therapy time ; DRM, duration of hospital stay in department of rehabilitation medicine

Table 3. Predictors of Final FIM & MFT after Robot-assisted Therapy Using Multivariate Regression Analysis

Variable	Final FIM	Final MFT of affected upper extremity
Initial MMSE (score)	1.66 (<0.001)	-
MAS-UE (scale)	-	-2.44 (0.022)
Initial MFT of affected upper extremity (score)	-	0.69 (<0.001)
OTR (days)		-0.01 (0.034)

Values are β (P<0.05)

FIM, Functional Independence measure; MFT, Manual Function Test; MMSE, Mini-Mental State Examination; MAS-UE, Modified Ashworth Scale for the Upper extremity; OTR, onset-to-robot-assisted therapy time

Feasibility of Sliding Rehabilitation Machine on Stroke Patients with Severe Cognitive Dysfunction

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Objective

Sliding Rehabilitation Machine (SRM) allows closed kinetic chain exercises of hip, knee, and ankle, and offers repeated weight bearing exercise with flexion and extension of the lower extremities. The aim of the present study was to explore feasibility of the SRM when used for intensive rehabilitation program for stroke patients with severe cognitive dysfunction.

Subjects & Methods

The retrospective study conducted at Department of Rehabilitation Medicine at University hospital. Included patients were admitted to the department of rehabilitation medicine for intensive inpatient rehabilitation after stroke with severe cognitive dysfunction (MMSE < 10). Patients with visual impairment or other neurologic and musculoskeletal problem were excluded. Training with SRM was performed twice per day from Monday to Friday during 3-4 weeks of admission. The number of sessions and the occurrence of side effects were documented daily. The SRM's angle of inclination, Berg balance scale (BBS), Korean-modified Barthel index (K-MBI) were documented at admission and discharge.

Results

In 30 patients, 1754 sessions were actually performed from a total of 1736 scheduled sessions of SRM training. The performance rate was 98.9%, and there were no serious side effects. Transient side effects such as dizziness, nausea, knee pain were observed in a few cases. The cause of the absence in SRM training was due to knee pain (5 times), sleep disturbance or depressive mood (7 times), dizziness (3 times) or schedule error (3 times). At discharge, patients showed improvement in inclination angle of the SRM, BBS and K-MBI.

Conclusions

This study shows the use of SRM for intensive muscle strengthening early in the ischemic stroke patient with severe cognitive dysfunction is readily applicable and demonstrates that the physical therapy with SRM is safe when used as part of an inpatient rehabilitation program.

Table 1. General characteristics of subjects.

Variables	
Patients (number)	30
Age (years)	74.3±8.5
Sex (Male/Female)	12:18
Location(Rt./Lt.)	10:20
Training day	29.2±7.9
Time from stroke to inclusion (days)	15.8±6.0
MMSE-K	1.6±2.6
NIHSS	16.9±6.0

Values are mean ± standard deviation.

MMSE-K, Mini-Mental State Examination-Korean

Table 2. The measurement values of clinical parameters.

Clinical parameters	Baseline	After training	p
Angle of inclination	6.7 ± 4.6	12.6 ± 7.3	0.000
BBS	5.1 ± 9.1	15.4 ± 17.4	0.006
K-MBI	8.0 ± 9.2	28.2 ± 22.8	0.000

Values are mean ± standard deviation.

BBS, Berg Balance Scale; K-MBI, Korean Modified Barthel Index;



Fig 1. Patient performing lower extremity extensor strengthening using Sliding Rehabilitation Machine; (a) patient was knee flexion, (b) patient was knee extension

Effects of Diabetes on Motor Recovery after Cerebral Infarct: A Diffusion Tensor Imaging Study.

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Objective

Little is known about the effects of diabetes on motor recovery after cerebral infarct. In order to obtain an accurate evaluation, we adjusted for critical factors determining motor outcomes, including lesion location and the integrity of motor-related neural tracts. We only included patients with a corona radiata infarct, and evaluated motor outcome by classifying the included patients according to the integrity of the corticospinal tract (CST) on diffusion tensor tractography (DTT).

Research Design and Methods

One hundred patients were recruited, and the DTT was obtained within 7-30 days of infarct onset. Based on the DTT findings (DTT+: CST was preserved around the infarct, DTT-: CST was interrupted by the infarct) and the presence or absence of diabetes (DM+: presence of diabetes, DM-: absence of diabetes), patients were divided into DTT+/DM+ (19 patients), DTT+/DM- (36 patients), DTT-/DM+ (13 patients), and DTT-/DM- (32 patients) groups. Six months after cerebral infarct, motor function on the affected side was evaluated for each patient using the upper Motricity Index (MI), lower MI, modified Brunnstrom classification (MBC), and the functional ambulation category (FAC).

Results

In the patients with a DTT+ finding, comparing the DTT+/DM+ and DTT+/DM- groups, at the six-month evaluation, no motor function scores were significantly different between the two groups. However, with respect to the patients with a DTT- finding, all motor function scores at the six-month evaluation were significantly higher in the DTT-/DM- group, compared with those in the DTT-/DM+ group.

Conclusion

When the CST was interrupted by a corona radiata infarct, the presence of diabetes is a decisive factor in the patient's recovery of motor function

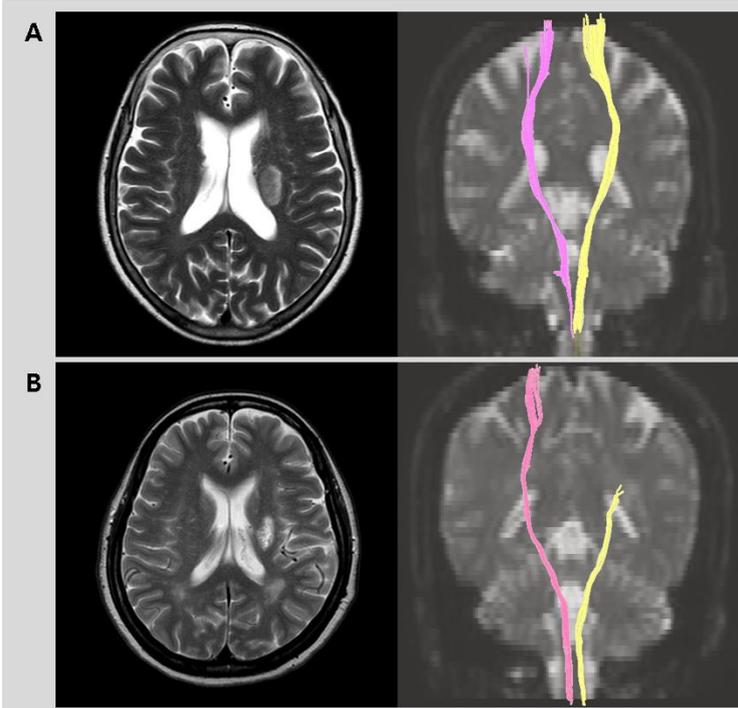


Figure 1. Classification according to the Results of diffusion tensor tractography (DTT) of the corticospinal tract. Axial T2-weighted magnetic resonance images (left) and coronal diffusion tensor tractography images (right). (A) DTT+: the corticospinal tract was preserved around the infarct. (B) DTT-: the corticospinal tract was interrupted by the infarct.

Effect of rTMS on the ascending reticular activating system in a patient with disorder of conscious

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Objectives

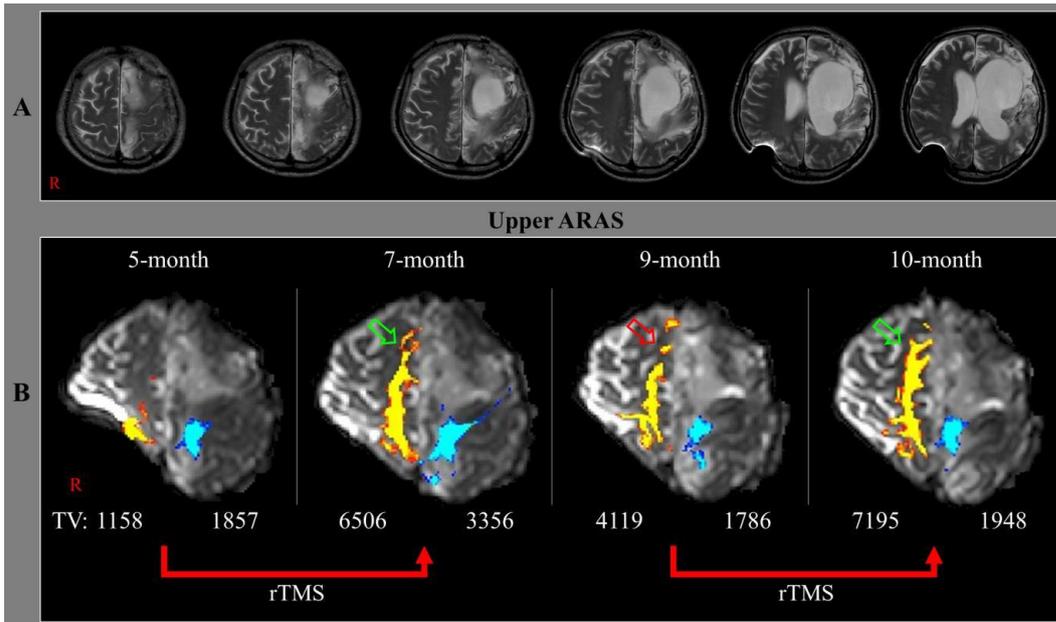
We report on a stroke patient with disorder of consciousness (DOC) who underwent repetitive transcranial magnetic stimulation (rTMS) and showed recovery of an injured upper ascending reticular activating system (ARAS), which was demonstrated by using serial diffusion tensor tractography (DTT).

Case description

A 45-year-old male patient was diagnosed as subarachnoid and intracerebral hemorrhages in the left fronto-parieto-temporal lobes. At five months from onset, the patient exhibited a persistent vegetative state, with a Coma Recovery Scale-Revised(CRS-R) score of 4. He underwent comprehensive rehabilitative therapy that included drugs for recovery of impaired consciousness and rTMS of the right dorsolateral prefrontal lobe. He recovered to a minimally conscious state(CRS-R: 13) at seven months after onset and was transferred to a local rehabilitation hospital where he underwent similar rehabilitation but without rTMS. At nine months after onset, his CRS-R score remained at 13. He was then readmitted to our hospital and underwent rehabilitation with rTMS until 10 months after onset. His CRS-R remained at 13, but his higher cognition improved. On 7-month DTT, the tract volume (TV) of the neural tract in the right prefrontal lobe in the upper ARAS was higher than that on 5-month DTT. However, compared to the 7-month DTT, the right prefrontal lobe TV was lower on 9-month DTT. On 10-month DTT, the TV of the same neural tract again increased.

Conclusions

Increases in neural-tract volume in the right prefrontal lobe of the upper ARAS that were related to the periods of application of rTMS were demonstrated in a stroke patient with DOC.



(A) Brain magnetic resonance images at five months after onset show leukomalactic lesions in the left fronto-parieto-temporal lobes.

Advantage of Helicopter Emergency Medical Services (HEMS) for patients with traumatic brain injury

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Objective

To assess the advantages of Helicopter Emergency Medical Services (HEMS) for neurological and functional recovery in patients with traumatic brain injury (TBI).

Method

We retrospectively assessed eighty-five TBI patients who finally admitted to a rehabilitation unit during recent 2 years. TBI patients were divided into two groups by transport Methods; HEMS or not. All subjects' initial trauma severity, mental status, cognition, and functional status were assessed. In emergency room, injury severity score (ISS), Glasgow coma scale (GCS) and revised trauma score (RTS) were evaluated initially, and Korean version of Modified Barthel Index (K-MBI), Functional Independence Measure (FIM), Korean version of Mini-Mental State Examination (K-MMSE), and Glasgow outcome scale (GOS) were evaluated in the rehabilitation unit at admission and just before discharge.

Results

Among 85 patients, 10 patients were transported by HEMS, and 75 patients came to emergency room with other transportation. The initial subscore indicating systolic blood pressure from RTS was significantly lower in patients without HEMS than those transported HEMS (3.79 ± 0.70 vs. 4.00 ± 0.00 , $p = 0.03$). Except for this Result, the other Results of initial ISS, GCS, and RTS, and K-MBI, FIM, K-MMSE, and GOS at admission and discharge, and their gain scores showed no difference between the two groups.

Conclusion

The Results demonstrate that patients transported by HEMS showed little difference of the improvement patterns in mental, cognitive and functional status with patients by other transportations. However, further studies with more patients are necessary to confirm the advantages of HEMS to patients with traumatic brain injury.

Virtual reality as therapy for stroke patient with apraxia : a case report

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Introduction:

Apraxia can occur in patients with stroke, and patients with apraxia have difficulty in using a limb when performing Purposeful movement in a specific situation; this is called "automatic-voluntary dissociation". Rehabilitation for apraxia has been directed towards inducing gestures to be performed in a variety of situations. However, consensus of the strategies of therapy for apraxia is lacking. Virtual reality (VR) has recently been studied as a Method of rehabilitation. VR is a tool that has therapeutic potential in stroke rehabilitation not only for motor function but also for cognition. Since we observed apraxia ameliorating effect of a VR intervention, we report the observed sequential findings in a patient with subacute stroke who presented ideomotor and limb-kinetic apraxia.

Case presentation

A 51 year-old man visited study hospital due to sudden development of weakness in the left side extremities and he was diagnosed as cerebral infarction in right frontal, parietal white matter and corpus callosum. After 10 days from the onset, he was transferred to department of rehabilitation medicine for intensive rehabilitation. At the start time of rehabilitation, weakness was not prominent, as fair plus grade by manual muscle test. The patient showed mild cognitive impairment, however he did not have difficulty in verbal understand and use of his right hand. He was able to perform simple activities such as grasp using his left hand (Table 1). When he was given verbal directions or commanded to follow some gestures, he could understand and expressed verbally about the motor sequences. However, performance using his left hand was seriously impaired and the tendency was more remarkable when executing Purposeful reaching, grasping, and releasing. The patient received conventional rehabilitation for facilitation of hand use and virtual reality trial was added for 30 minutes, 5 times per week for 4 weeks. The virtual environment was displayed using a head-mounted display, Oculus rift (Oculus Inc.). Virtual reality software, Blue Ocean (Hancom Inc.) was provided that included tasks of reaching and grasping the fish swimming in the sea around the user (Figure). On monitoring of his left hand performance according to the variable situations; block manipulation activity in conventional occupational therapy, commercialized augmented reality hand skill facilitation program, and the VR, we could observe best performance of left hand during his play in the VR (which will be displayed in the presentation).

Conclusions

The patient with apraxia seemed to be helped in overcoming “automatic-voluntary dissociation” with the VR rehabilitation program. VR could be used to treat apraxia by inducing more normal movement as response to motivating environment.

Table 1. Evaluation of patient’s function at baseline, 4 weeks and 12 weeks after rehabilitation (Baseline; 10 days after onset of stroke)

		Baseline	4 weeks	12 weeks
Manual muscle test	Right upper extremity	Good	Good	Good
	Left upper extremity	Fair plus	Good	Good
	Mini mental status examination	26	30	30
Grip strength (kg)	Right	28	30	26
	Left	18	24	28
Hand function test	Lateral pinch (kg)	Right 7	8	6.5
		Left 6	7	6.5
Tripod pinch (kg)	Right	5	6	6
	Left	4	5	5
Manual function test	Right	93.75	96.88	96.88
	Left	62.50	87.50	87.50
Fugl-Myer assessment	Right	65	65	66
	Left	39	58	62
	Korean modified Barthel index	55	84	87

Baseline; 10 days after onset of stroke

Table 2. Changes in Test of Upper Limb Apraxia (TULIA) scores after rehabilitation using virtual reality (Baseline; 10 days after onset of stroke)

	TULIA score			
	Baseline	2 weeks	4 weeks	12 weeks
Imitation, non-symbolic	27	34	35	35
Imitation, intransitive	22	27	27	33
Imitation, transitive	19	21	23	28
Total (Imitation) (120)	68	82	85	96
Pantomime, non-symbolic	22	27	31	31
Pantomime, intransitive	17	20	23	27
Pantomime, transitive	14	18	22	22
Total (pantomime) (120)	53	65	76	80
Total (240)	121	147	161	176



Figure. Rehabilitation using virtual reality with head mounted display

The Correlations between Blood Viscosity and Other Results of Blood Test in Stroke : A Pilot Study

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Objective

Blood viscosity has been reported to be one of the risk factors or predictors for cardio-cerebrovascular diseases. Previous studies have shown that patients with ischemic heart or cerebrovascular disease have higher blood viscosity than normal group. Blood viscosity has been known to be related to hematocrit, red blood cell (RBC) deformability, RBC and platelet aggregation, plasma proteins, lipid, etc. The Purpose of this study is to analyze correlations between whole blood viscosity (WBV) and other Results of blood tests in patients with acute and subacute stroke to see what values could be helpful in predicting blood viscosity in stroke.

Method

We retrospectively recruited patients with cerebral infarction or hemorrhage who had been admitted within 3 months of the onset. Forty patients were enrolled. In these patients, we collected the Results of blood test including WBV. WBV was evaluated as systolic blood viscosity (SBV) measured at high shear rate of 300s⁻¹ and diastolic blood viscosity (DBV) measured at low shear rate of 5s⁻¹. The Results of blood test other than WBV included complete blood count with differential count (CBC/DC), hemoglobin A1c (HbA1c), erythrocyte sedimentation rate (ESR), protein, albumin, blood urea nitrogen (BUN), creatinine, total lipid, total cholesterol, triglyceride (TG), low density lipoprotein (LDL), high density lipoprotein (HDL) and tissue oxygen delivery index (TODI). The Results of total lipid, total cholesterol, TG, LDL and HDL performed within one week before and after the viscosity test were included, and the Results of HbA1c performed within one month before and after the viscosity test were included. The other Results of blood test including WBV were obtained from the same blood sampling.

Results

The study population consisted of 29 infarction and 11 hemorrhage patients. The mean age of patients was 61.02 ± 13.10 years. SBV was significantly positive correlated with RBC (p<0.01, ρ=.726), hemoglobin (p<0.01, ρ=.773), hematocrit (p<0.01, ρ=.755) and LDL (p<0.01, ρ=.611), and significantly negative correlated with HDL (p<0.01, ρ=-.592) and TODI (p<0.01, ρ=-.828). DBV was significantly positive correlated with RBC (p<0.01, ρ=.790), hemoglobin (p<0.01, ρ=.814), hematocrit (p<0.01, ρ=.795), albumin (p<0.05, ρ=.506) and LDL (p<0.01, ρ=.600), and significantly negative correlated with HDL (p<0.01, ρ=-.527) and TODI (p<0.01, ρ=-.808).

Conclusion

This study showed that WBV was positive correlated with RBC, hemoglobin, hematocrit, albumin and LDL, and negative correlated with HDL and TODI in acute and subacute stroke. These findings suggested that the above blood test values may be helpful in predicting blood viscosity in stroke.

The Recovery of Aphasia in Chronic Stroke Patients

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Objective

The Purpose of this study was to investigate the characteristics of recovery pattern of aphasia in chronic stage of stroke with dominant hemisphere lesion.

Method

Among the patients who were admitted to our hospital from January 2011 to December 2017 and treated for acute cerebrovascular accidents, a total of 95 patients completed language evaluation using Korean version of the Western Aphasia Battery (K-WAB) at least twice. Only those with their initial evaluation done within three months after the onset and another one at least one year after the onset were left. After exclusion of the patients with non-dominant hemisphere lesion, recurrent attack, or any other functional or structural brain disorders, only twenty three patients were included in the study. Their brain imaging studies and Results of neurological tests were also used to evaluate their correlation with recovery pattern of aphasia and linguistic change.

Results

A total of 23 patients were included in the analysis. Among the twenty three were nine males (39.1%) and fourteen females (60.9%), with the mean age of 56.5±13.0 years old at the time of their first language evaluation. Eleven (47.8%) of them suffered from ischemic stroke, another eleven (47.8%) from hemorrhagic stroke, and one (4.4%) from both. The incidence of strokes involving cortical lesions was 82.6% (nineteen patients) including ten of those whose main lesions were limited to cortex and nine with both cortical and subcortical lesions. The mean values of post-onset duration before initial and follow-up language evaluation were 34.1±19.5 days and 715±251 days, respectively. (Table 1) The follow-up language evaluation showed statistically significant improvement of the Aphasia Quotient (AQ) and the scores in four subtests of K-WAB, including fluency, comprehension, repetition, and naming. (Table 2, Figure 1) Among the 23 patients, six were classified into fluent aphasia (fluency score of at least 10; 20 in maximum) on their initial evaluation, and seventeen into non-fluent aphasia. The AQ improved from 62.38±29.30 to 71.56±23.73 (P=0.118) in patients with fluent aphasia, and from 14.09±23.66 to 41.20±27.81 (P<0.001) in those with non-fluent aphasia.

Conclusion

Aphasia in patients with dominant hemisphere stroke lesion showed significant recovery in all four areas of K-WAB, including fluency, comprehension, repetition and naming, by the time of one year after the onset. By the mean time of 715 days after the stroke onset, the AQ improved from 23.33±30.05 to 47.5±29.54 (P<0.001). There was no significant

improvement in AQ in the fluent aphasia group ($P=0.118$), but in the non-fluent aphasia group ($P<0.001$).

Table 1. General characteristics of the patients (N=23)

	Total N=23	(Percent)
Mean age (years)	56.5±13.0 years	
Sex ratio (M:F)	9:14 (1:1.56)	(39.1%:60.9%)
Post-onset duration before initial evaluation	34.1±19.5 days	
Post-onset duration before follow-up evaluation	715±251 days	
Infarct or Hemorrhagic		
Infarct	11	(47.8%)
Hemorrhagic	11	(47.8%)
Both (including hemorrhagic transformation)	1	(4.4%)
Lesion: Cortical or Subcortical		
Subcortical	4	(17.4%)
Cortical	10	(43.5%)
Both	9	(39.1%)

Table 2. Results of language evaluations (K-WAB)

	Initial	Follow-up	P-value
Aphasia quotient	23.33±30.05	47.5±29.54	<0.001
Fluency	4.54±6.08	10.04±6.12	<0.001
Comprehension	59.91±62.81	106.13 ±64.09	<0.001
Repetition	18.87±32.72	46.52±37.79	<0.001
Naming	15.26±28.48	45.00 ± 35.4	<0.001

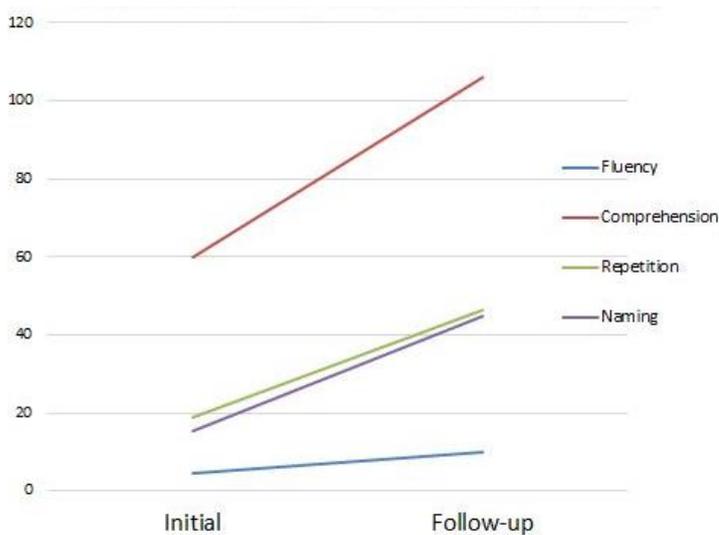


fig 1. Results of language evaluations(K-WAB)

Effects of NMES in combination with saliva or dry swallowing in stroke patients with dysphagia

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Abstract Objective

Dysphagia after stroke can cause various complications, especially aspiration pneumonia, which can be life-threatening. Therefore, rehabilitation Methods to reduce aspiration in patients with dysphagia are important. To investigate the effects of the NMES combined with saliva or dry swallowing on swallowing function in stroke patients with dysphagia.

Methods

Participants were assigned to the experimental group (n=9) or control group (n=8). The experimental group received the NMES combined with saliva or dry swallowing, whereas the control group received only the voluntary swallowing. NMES was applied using the VitalStim, a transcutaneous-type electrical stimulator. Two pairs of electrodes were placed on the anterior neck region. Two pairs of electrodes were also horizontally placed in the submental region and thyroid cartilage to target suprahyoid muscles and the thyrohyoid muscle, based on a previous study's Methods.(Figure 1) Both groups received training 5 days per week for 4 weeks. Oropharyngeal swallowing function was assessed using the videofluoroscopic dysphagia scale (VDS) and penetration-aspiration scale (PAS) based on a videofluoroscopic swallowing study.

Results

General characteristics of the participants are described in Table 1. There were no significant differences between groups based on general characteristics and the VDS and PAS scores. Three participants (experimental group, n = 1; control group, n = 2) dropped out before the post-test because of transfer to another hospital. Therefore, 17 participants were analyzed. 1.VDS assessment The experimental group showed more improvement in the pharyngeal phase of VDS than the control group. After the intervention, statistical analysis showed a significant difference in the pharyngeal phase of VDS between the groups (p=0.038)(Table 2).Effect sizes were observed for the oral phase (0.28), and pharyngeal phase of VDS (1.45). 2.PAS assessment The experimental group showed more improvement in the PAS score than the control group. After the intervention, statistical analysis showed a significant different in the PAS score between the groups (p=0.027)(Table 2).Effect sizes were observed for the PAS (0.83)

Conclusion

We confirmed that VSE during NMES had a positive effect on swallowing function in patients with stroke with dysphagia. In addition, saliva or dry swallowing conducted in

this study could be easily performed with only a small cue in stroke patients with lower cognitive function compared to other remedial or compensation approaches. It also has the advantage of high compliance. In addition, implementing NMES with VSE at the same time could reduce treatment time.

Table 1. Characteristics of participants.

Characteristics	Experimental group (n=9)	Control group (n=8)
Age (year), mean \pm SD	60.67 \pm 6.85	60.00 \pm 10.92
Gender(n)		
Men	5	3
Women	4	5
Type of stroke (n)		
Hemorrhage	4	4
Infarction	5	4
Site of stroke lesion (n)		
Middle cerebral artery	6	5
Pontine	2	1
Basal ganglia	1	2
Paretic side (n)		
Right	4	2
Left	5	6
Time after stroke (months)	3.22 \pm 1.20	3.25 \pm 1.16
Feeding type (n)		
Oral feeding	3	3
Tube feeding		
NG tube	6	5
PEG tube	1	0
OE tube	0	0

SD: standard deviation. NG tube: nasogastric tube, PEG: percutaneous gastrostomy tube
OE tube: Oro-esophageal tube

Table 2. Comparison of Results between experimental group and control group

parameters	Experimental group			Control Group			Between groups P-values
	Pre-test	Post-test	p-value	Pre-test	Post-test	p-value	
VDS							
Oral phase	18.00 \pm 7.37	8.33 \pm 6.15	.008*	18.62 \pm 6.47	12.00 \pm 5.19	.018*	.321
Pharyngeal phase	36.33 \pm 13.87	20.50 \pm 8.65	.012*	35.31 \pm 6.25	29.06 \pm 5.38	.018*	.038 [†]
PAS	4.44 \pm 1.87	2.44 \pm 1.50	.026*	5.25 \pm 1.98	4.50 \pm 1.77	.109	.027 [†]

Values are expressed as Mean \pm SD

VDS: Videofluoroscopy Dysphagia Scale, PAS: Penetration-Aspiration Scale.

*p<0.05, [†]p<0.05, *Wilcoxon signed-rank test, [†]Mann-Whitney U-test

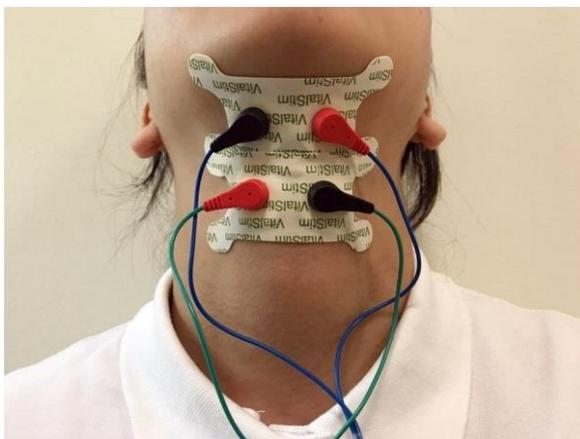


Figure 1. Electrode placement

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A new approach of spasticity measurement using mechanomyography in patients with brain lesions

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Introduction

Electromyography(EMG) and Modified Ashworth Scale(MAS) are among the most effective Methods to evaluate spasticity. However, they are often inappropriate for clinical use due to the complicated procedure and subjective evaluation outcomes. Mechanomyography (MMG) is a better quantitative and convenient measurement compared to MAS and EMG. In this study, we hypothesized the presence of force-dependent MMG signal measured from muscle activation is dependent on spasticity during passive isotonic flexion and extension. Based on this, the goal of this paper is to verify the correlation between MMG and MAS for subject with low spasticity and to provide a more accurate clinical indicator to evaluate spasticity.

Methods

A randomized pilot study for a parallel randomized controlled trial for comparison study was conducted. A passive stretch reflex test was performed for 10 subjects suffering from brain lesions. Mechanomyography, Electromyography, and Pendulum test were performed on vastus lateralis muscle (agonist) and semitendinosus muscle (antagonist) for subjects with brain lesion. The final output was measured a biomechanical signal that passive isotonic muscle flexion and extension.

Results

Mechanomyographic data of vastus lateralis muscle (agonist) and semitendinosus muscle (antagonist) were analyzed proportionally reflecting analyzed electromyographic firing point for semitendinosus muscle to develop a new clinical indicator that statistically distinguishes spastic muscles and normal muscles ($p=0.001$).

Conclusions

The Purpose of this study is a new approach that patients having even low degree of spasticity can be quantitatively evaluated by using the ratio of normalized hull area obtained by proportionally analyzing signals from spastic muscles using MMG combined with EMG. Our new approach is not only simple but also can overcome unnecessary human bias and can be used as a clinical indication.

Keyword Spasticity

Mechanomyography; Electromyography; Brain lesion; Quantitative assessment

P 3-102

Kinematic measures of upper-limb functional impairments in stroke patients using a robotic device

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Objective

To evaluate kinematic measures of upper-limb functional impairments in stroke patients using a robotic device, and construct database.

Methods

Subacute and chronic stroke patients with hemiparetic arm in Brunnstrom 3, 4, or 5 stage were enrolled. Hemiparetic arm function was evaluated and trained with 3 kinds of tasks (free exploration, point-to-point reaching, and round shape drawing) using RAPAE Smart Board™ (Neofect). The device has 2-axis planar board and position sensors. The 11 kinematic measures were included as follows: range of motion, normalized jerk, zero crossings in acceleration, mean arrest period rate, mean and maximum velocity, time to velocity peak, reaction time, hand path ratio, bias, and variability.

Results

The database was constructed for robotic measures, demographic data, and clinical scales such as Fugl-Meyer assessment score, box and block test, and Pegboard test. Processing metrics for 11 kinematic measures were developed, and raw kinematic data could be automatically drawn by Python program. The maximum speed in free exploration and bias in the round shape drawing task have negative correlation with Fugl-Meyer assessment score.

Conclusion

Various kinematic measures may be correlated with clinical parameters. The study Results can be further applied to patients classification, and robotic biomarkers investigation for prognostication of functional arm recovery. An accurate machine learning algorithm needs to be drawn with larger sample size.



Free exploration

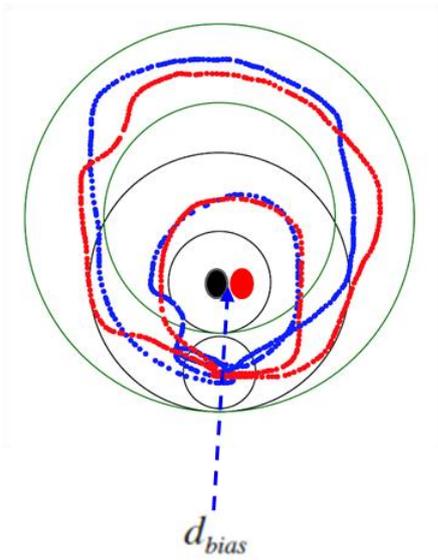


Point-to-point reaching

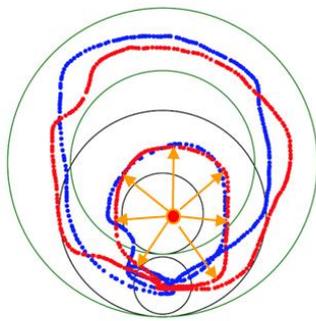
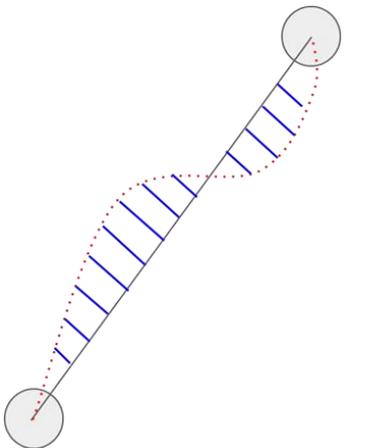


Round-shape drawing

The three tasks in a robotic device



Bias for accuracy evaluation



Variability in reaching and shape drawing tasks

The change of thyrohyoid muscle thickness in patients with dysphagia

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Puropose

A swallowing difficulty can caused by many neuromuscular diseases. The oropharyngeal muscle dysfunction from stroke is one of the most common reasons. In pharyngeal phase, once the suprahyoid muscle group contracts, the thyrohyoid muscle gets the power and raises up the cricothyroid complex followed by esophageal opening. The aim of this study is to find out the difference of thyrohyoid muscle thickness between normal people and patients with dysphagia from stroke.

Materials and Method

We conducted a pilot study of 20 patients with dysphagia from stroke so that we can compare the mean value of the thyrohyoid muscle thickness with normal people. The group was divided into A and B according to the duration of dysphagia, as more than 6months and less than 6months. We checked the age, sex, height, BMI and VFSS score. While performing ultrasonography, the patient was in supine position and the vertical line from mandibular body tip to hyoid bone was maintained to be perpendicular to the horizontal line from the upper margin of the thyroid cartilage to the hyoid bone. Table-1.

Results

The difference between mean value of muscle thickness was observed in two groups($p < 0.05$). Furthermore the mean values of muscle thickness of group A were slightly lower to normal values(2.83 ± 0.61 in left side and 2.93 ± 0.67 in right side, age of 40~59, $n=62$, p -value < 0.001) which we had studied before.

Conclusion

The thyrohyoid muscle atrophy was found in patient with dysphagia from stroke and it became worse more than 6 months after onset.

Table-1. Thickness of the left and right thyrohyoid muscles in Group A and Group B.

Muscle thickness	Group A	Group B	p-value
Left	2.74 ± 0.41	2.31 ± 0.36	0.026
Right	2.82 ± 0.36	2.39 ± 0.51	0.043

Traumatic axonal injury of the STT without clinical manifestation of mild TBI at the onset of trauma

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Objectives

We report on a patient with mild traumatic brain injury (TBI) who did not exhibit any clinical manifestations of mild TBI at the onset of head trauma but developed central pain due to traumatic axonal injury (TAI) of the spinothalamic tract (STT), as demonstrated by using diffusion tensor tractography (DTT).

Case descriptions

A 36-year-old female experienced head trauma Resulting from an in-car traffic accident: a slowly approaching car collided with the right side of her car while she was sitting in the backseat. During the collision, she was looking toward the front of the car and her head appeared to be shaken mildly but without direct head trauma. Her Glasgow Coma Scale score was 15 upon arrival at the hospital. She mentioned that she did not experience loss of consciousness or post-traumatic amnesia at the time of the head trauma. In addition, she did not experience any alteration in mental state (e.g., no dazed, disoriented, or confused feelings) or focal neurological deficit at the time of the accident. However, she began to feel left shoulder pain at approximately eight hours after the accident. The next day, she began to feel pain in the left hand and right leg, which spread with the passage of time. As a Result, she felt pain in both arms and legs beginning four days after the accident. At seven days after onset, she visited our clinic and described her pain as having tingling and electrical shock-like characteristics, but she reported no allodynia or hyperalgesia (Visual Analog Scale pain score: 6). On 7-day DTT, the patient's right STT showed severe narrowing and partial tearing in the subcortical white matter compared with that in the left STT.

Conclusion

TAI of the STT was demonstrated in a patient who developed central pain without any clinical manifestation of mild TBI after a mild whiplash injury. Our Results suggest that TAI can occur without any clinical manifestation of mild TBI in mild whiplash injury cases.

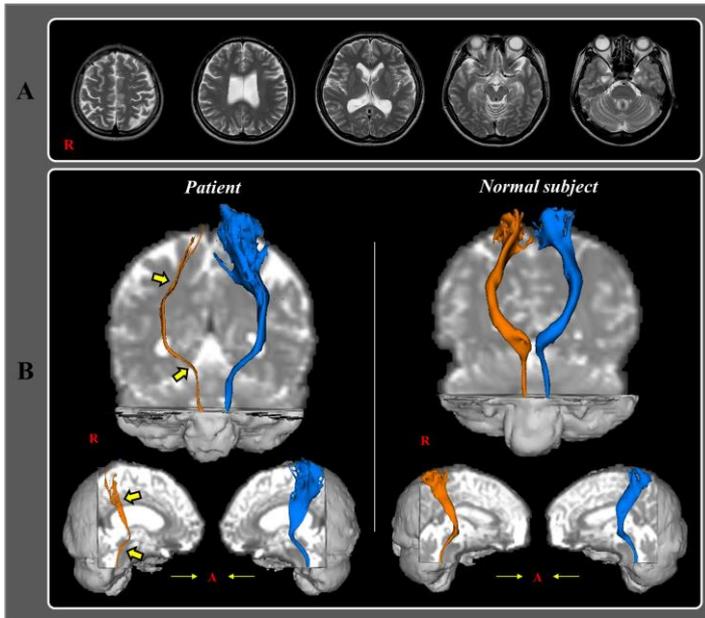


Fig. 1. (A) Brain magnetic resonance images obtained seven days after head trauma onset show no definite lesions. (B) Results of diffusion tensor tractography performed 7 days after onset. The right spinothalamic tract shows severe narrowing and partial tearing in the subcortical white matter (yellow arrow) compared with those of the patient's left side and those of a normal subject (38-year-old female).

Delayed diagnosed of brain tumor which is combined with large amount of intracerebral hemorrhage

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Introduction

Intracerebral hemorrhage (ICH) prevalence is 24.6 per 100,000 person-years in worldwide and 54 per 100,000 person-years in Korea. Brain tumor incidence rate is 10.82 per 100,000 person-years in worldwide, and 2,500~4,500 people are diagnosed as brain tumor every year in Korea. In retrospective reviewed study, the proportion of the hemorrhage caused by brain tumor to spontaneous intracerebral hemorrhage is 5.1%. We report a case of patient who was diagnosed spontaneous ICH and received stroke rehabilitation, and lately discover a brain tumor on the lesion of ICH

Case Report

A 58-year-old man, without a remarkable medical history, experienced confusion, headache and left side motor weakness. Brain computed tomography (CT) scans with contrast and CT angiograms on admission disclosed a lobulated 3.7x5.3 cm sized acute ICH in the right basal ganglia with right ventricle compressing mass effect (Fig. 1A). Stereotactic aspiration and instillation of external ventricle drainage was done (Fig. 1B). The biopsy was not performed. The serial follow-up cranial CT reported resolution of ICH amount and density with decreasing compression effects. The initial value when the patient was transfer in our department, The Mini-Mental State Examination score : 9, he fed using NG-tube, left side muscle strength was grade 2 by MMT. The patient has improved in function after 2 months stroke rehabilitation. The Mini-Mental State Examination score : 18, removal of NG tube, left hip and knee muscle strength grade 4 by MMT, so he could gait with supervision assist but only he had complained headache (VAS 3~4) at times. 3 months later from onset, left upper extremity weakness was occurred, the Brain magnetic resonance image (MRI) was done. That MRI finding was 6.7x5.6cm sized lobulated solid and multi-cystic mass, probably GBM at the hemorrhage site, with tumor spreading onto 3rd ventricle and optic chiasm (Fig. 1C). The patient was transferred to received tumor management, immediately.

Conclusion

We report diagnostic pitfall for spontaneous ICH instead of brain tumor (suspiciously GBM) with intratumoral hemorrhage. According several reports, tumors were found in 2% of the 461 autopsied cases of "spontaneous" intracerebral hemorrhage or 1% of the 225 reported, but it is not easy to detect brain tumor when it is with large amount of hemorrhage by CT scan, so the MRI can be a indispensable diagnostic image for early detection of brain tumor. We suggest early MRI scan in patient with large amount of ICH for excluding brain tumor which is combined with hemorrhage.

Key Words

Intracerebral hemorrhage • Tumor bleeding • Brain tumor • Glioblastoma multiforme • MRI

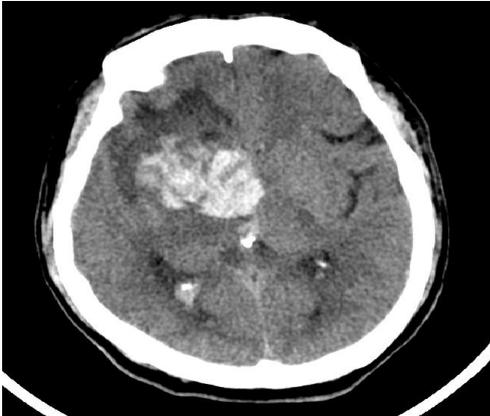


fig1A. acute ICH in the right basal ganglia with right ventricle compressing mass effect



fig1B. aspiration and instillation of external ventricle drainage was done

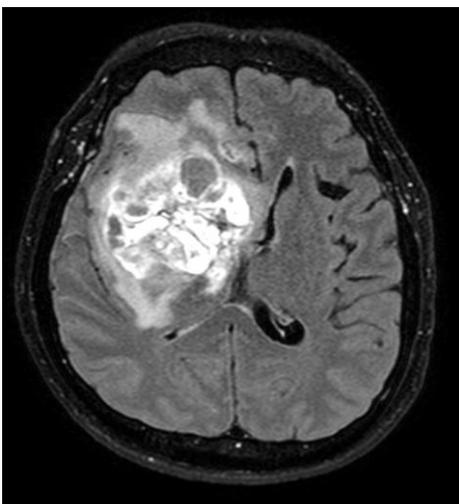


fig1C. 6.7x5.6cm sized lobulated solid and multi-cystic mass, probably GBM at the hemorrhage site, with tumor spreading onto 3rd ventricle and optic chiasm

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Difference in the ARAS between vegetative and minimally conscious states following TBI

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Introduction

We investigated differences in the ascending reticular activating system (ARAS) between vegetative state (VS) and minimally conscious state (MCS) in patients with traumatic brain injury (TBI) by using diffusion tensor tractography (DTT).

Methods

We recruited 23 patients with TBI who showed disorders of consciousness (DOC) and 12 normal subjects. Ten patients were enrolled in the VS group, 13 patients in the MCS group, and 12 normal subjects in the control group. We reconstructed the lower ARAS and five parts of upper ARAS (prefrontal cortex [PFC], premotor cortex, primary motor cortex, primary somatosensory cortex, and posterior parietal cortex). Fractional anisotropy (FA) and fiber number (FN) values of the lower ARAS and each of the five parts of upper ARAS were estimated.

Results

Significant differences were observed in the FA and FN values of the five parts of upper ARAS between the VS and control groups, and between the MCS and control groups ($p < 0.05$), but no differences were detected in the lower ARAS ($p > 0.05$). The FA and FN values of the PFC in the upper ARAS were significantly different between the VS and MCS groups ($p < 0.05$). No other significant differences in FA and FN values were detected among the other segments of the upper ARAS or in the lower ARAS ($p > 0.05$).

Conclusion

The Results indicate that that prefrontal portion of the upper ARAS is the critical area for distinguishing between VS and MCS in patients with TBI.

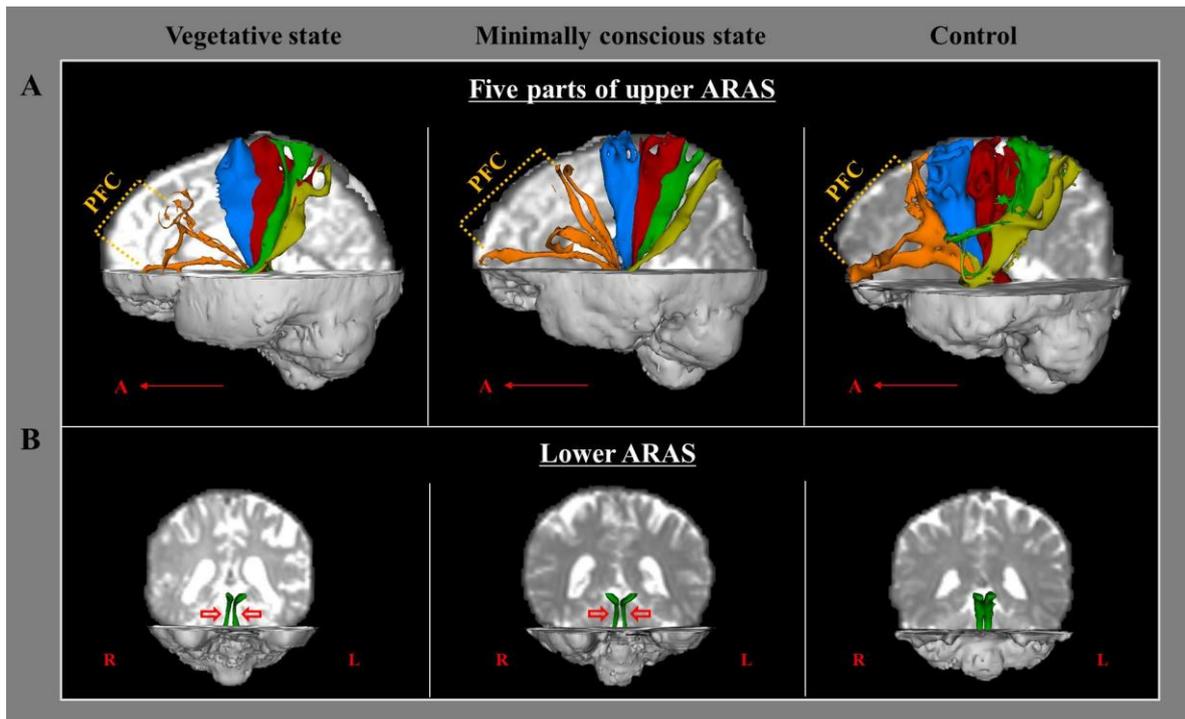


Fig.1. Results of diffusion tensor tractography (DTT) for the prefrontal cortex (PFC)-upper ascending reticular activating system (ARAS) (orange color), premotor cortex-upper ARAS (blue color), primary motor cortex-upper ARAS (red color), primary somatosensory cortex-upper ARAS (green color), and posterior parietal cortex-upper ARAS (yellow color) in representative subjects from each group (vegetative state: 41-year old female, minimally conscious state: 48-year old female, and control: 46-year old female). Narrowing of the PFC-upper ARAS is observed in the vegetative state (orange dotted line) compared with that in the minimally conscious state (orange dotted line). (B) Results of DTT for the lower ARAS show narrowing in the vegetative and minimally conscious states (red arrows) compared with control.

Functional Impairments and Cognitive Deficits in Recurrent Neuro-Behcet's Disease

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Introduction

Neurobehcet disease (NBD) is a rare complication of Behcet disease (BD) and has been reported to occur in 5 to 15% of cases. We performed rehabilitation therapy for chronic recurrent NBD patients with cognitive deficit and gait disturbance. We report a case of experience for them by 4 years follow-up.

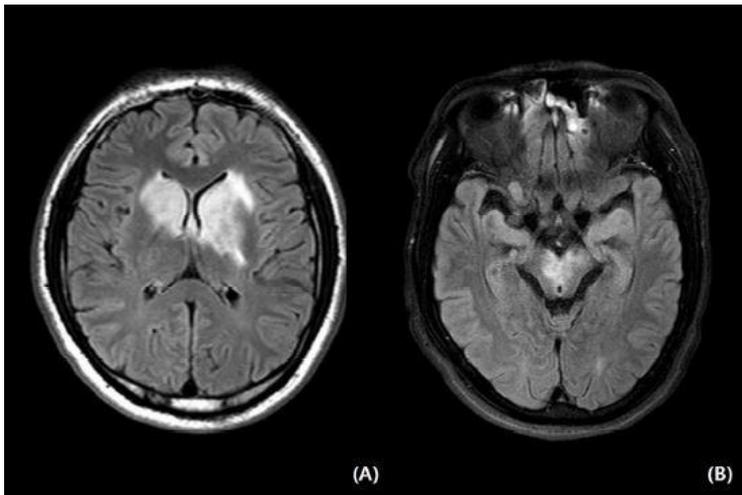
Case

A 34-year-old male presented with abrupt onset memory disturbance, aggressive behavior, and gait disturbance in January 2014. Oral ulcer, eye pain, diplopia, and ptosis were observed in a comprehensive physical examination and a neurologic examination. Brain-related lesions such as encephalitis and stroke were suspected and brain magnetic resonance imaging was performed. In the FLAIR images, high signal intensity was detected in bilateral basal ganglia and left thalamomesencephalic territory. Lab tests showed negative Results in HLA-B51 and other tests. NBD was diagnosed by combining the Results of the tests, and symptoms improved after steroid therapy. Steroid therapy started with IV methylprednisolone infusion and slowly tapered to oral steroid. Thereafter, the patient recurred 5 times (#2mo, #18mo, #20mo, #23mo, #27mo) in 2 years. At that time, steroid therapy was performed, but cognitive function and gait disturbance due to ataxia and motor weakness became more severe. Especially at the last recurrence, severe dysphagia and language impairment were associated, and the patient was referred to rehabilitation therapy because he was in a completely dependent condition where daily life was completely impossible. In the last recurrence, the patient was unable to ambulation and was evaluated as K-MMSE 23, GDS 5, CDR 2, K-MBI 27. In addition, the SNSB test showed general cognitive impairment, frontal / executive function impairment, memory impairment, visuospatial dysfunction, language dysfunction, and daily living ability impairment. We performed range of motion, strengthening, stretching, balance exercise, and gait training in physical therapy. In occupational therapy, cognitive function training, ADL training, and comcog were performed. Oromotor and vital stim were also performed for dysphagia. The patient was discharged after rehabilitation admission, and on the outpatient basis, consistently received rehabilitation therapy (mainly occupational therapy) as in the case of admission. The patient recovered gradually during the following 23 months and improved to K-MMSE 26, GDS 4, CDR 2, K-

MBI 47, and independent ambulation state. During the 23 months of enforcing the outpatient rehabilitation therapy, there is currently no recurrence in the treatment.

Conclusion

In addition to the medical therapy in terms of the cognitive and ambulatory function of recurrent NBD, rehabilitation therapy can help restore the patient's symptoms and function.



The axial sections of fluid attenuated inversion recovery (FLAIR) imaging of the patient. Multifocal high signal intensity lesions are observed in (A) bilateral basal ganglia and left thalamo-mesencephalic area, and (B) bilateral midbrain.

The effects of rTMS on eating disorder in a patient with stroke: A case report

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Introduction

The repetitive transcranial magnetic stimulation(rTMS) is known to be a non-invasive and safe treatment in post-stroke rehabilitation. The rTMS can modify excitability at the cerebral cortex site stimulated as well as in remote structures along functional anatomical connections. Recent RCT showed one evidence which the rTMS would modify eating behaviors and weight. We present a case who has had chronic stroke, morbid obesity, and binge eating disorder history, was treated by rTMS.

Case report

A 63 year-old male visited our rehabilitation clinic due to binge eating disorder, progressive weight gain and mild dysphagia. He had stroke histories; first attack was intracranial hemorrhage at left striatum 12 years ago, second attack was intracranial hemorrhage at right striatum 10 years ago. Since then, he has suffered by gait disturbance, cognitive decline, regularly visited in rehabilitation outpatient clinic. Several months ago, his caregiver has complaint of obsession for eating, mild dysphagia, and frequent binge eating. He experienced asphyxia due to binge eating in mealtime, recently. The patient received 10 Hz stimulation over the left dorsolateral prefrontal cortex(DLPFC) for 10 days with a daily dose of 1000 pulses. After then, total energy and macronutrient intakes were reduced, the weight of patient also reduced(Table 1). The functional status of dysphagia, assessed by the Dysphagia Outcome and Severity Scale, Functional Oral Intake Scale, modified Mann Assessment of Swallowing Ability were not changed

Conclusion

Several stroke survivors were changed the eating behaviors due to neuroanatomical changes, cognition and emotional status. These patients usually got the lower physical activities than premorbid state, and have gotten obese. These multi-dimensional reasons with eating behaviors would be a barrier for conventional treatment with medication or exercise. In our case, the high frequency rTMS for left DLPFC modified eating behavior, and induced reduction of weight and food intake. The rTMS would be a useful addition of patients with stroke, for modification of eating behaviors or weight.

Table 1. Changes in food intake and body weight.

	Baseline	Post
Total energy intake(kcal/day)	1875	1130
Carbohydrate(g/day)	303	168.3
Protein(g/day)	79.39	54.51
Fat (g/day)	39.31	25.56
Weight(kg)	92.6	87.3

Values are mean.

Subtle dysphagia as initial presentation, caused by hidden malignancy, A case report

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Introduction

The presence of post-swallowing remnants can be caused by reduced tongue driving force, impaired pharyngeal shortening, and/or pharyngeal constriction[1]. Such impairments may have various causes. The risk of pharyngeal residue increases in the elderly[2,3], as the triggering of swallowing is delayed in aging individuals[4,5]. Thus, subtle changes in swallowing, such as delayed triggering or small increases in pharyngeal residue, are frequently overlooked by physicians. However, subtle changes evident in a videofluoroscopic swallowing study (VFSS) may suggest a hidden disease. Therefore, subtle changes in swallowing without predisposing factors should arouse suspicion.

Case report

A 65-year-old male visited our dysphagia clinic complaining of residual sensation during swallowing that had started 1 month ago. He denied any relevant medical or social history (smoking). On physical examination, the right tongue was deviated and atrophied (Fig. 1A). A VFSS revealed moderate amounts of post-swallowing remnants in the vallecular fossa and pyriformis sinus (Supplementary video 1). Brain magnetic resonance imaging (MRI) revealed no remarkable abnormal finding. However, a bone scan revealed multiple bone metastases in the skull, right humerus, both scapulae, both ribs, the C-T-L vertebrae, the sacrum, both pelvic bones, and both femora (Fig. 1B, 1C). Further examination revealed adenocarcinoma of the prostate with multiple metastases.

Discussion

Post-swallowing residue represents a subtle swallowing change, increasing the risk of aspiration and subsequent pneumonia. Various diseases can create post-swallowing remnants, which also increase with aging as degenerative causes[6]. Thus, such remnants may be neglected or overlooked by clinicians who regard them as features of aging. However, such remnants may indicate a brain metastasis or a hidden malignancy; a thorough check of the oropharynx and brain is required. Our present case highlights the fact that mild dysphagia with increased post-swallowing remnants can be the initial presentation of a hidden malignancy with metastases. Physicians must be alert to unexplained dysphagia, including even mild dysphagia associated with increased levels of post-swallowing remnants.

Conclusion

Post-swallowing residue represents a subtle swallowing change, increasing the risk of aspiration and subsequent pneumonia. Our case highlights the fact that mild dysphagia with increased post-swallowing remnants can be the initial presentation of a hidden malignancy with metastases. Physicians should keep in mind for unexplained dysphagia or atrophied tongue might be initial presentations of hidden malignancy.

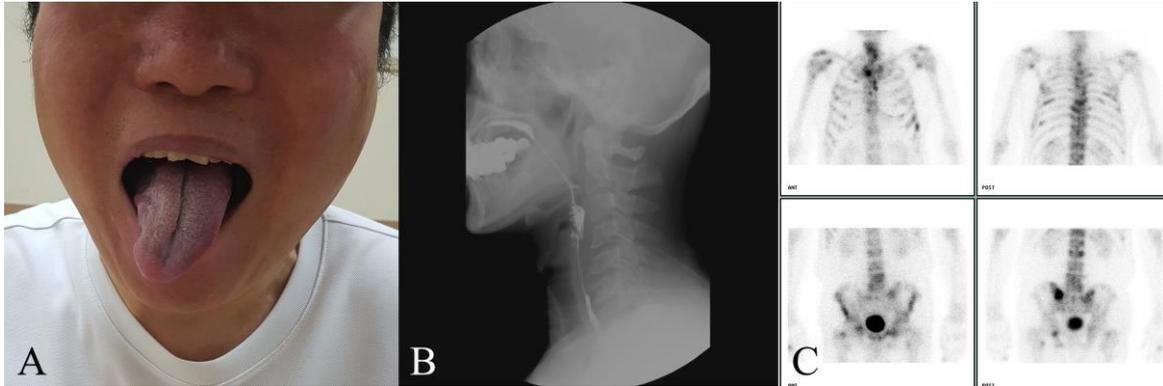


Fig1A. Tongue was mildly deviated to right side.

Fig1B. VFSS showed moderate post-swallow remnant.

Fig1C. Bone scan showed multiple metastasis.

P 3-110

Ascending reticular activating system injury recovery during early post-stroke period: A case report

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Objectives

We report on a patient who showed early recovery from impaired consciousness and ascending reticular activating system (ARAS) following intracerebral hemorrhage (ICH) and intraventricular hemorrhage (IVH).

Methods

A 62-year-old male was diagnosed with spontaneous IVH and ICH in the right temporal lobe due to moyamoya disease. At six weeks after stroke onset, he was transferred to the rehabilitation department of the same hospital to undergo rehabilitation. The patient exhibited impaired consciousness, with a Coma Recovery Scale-Revised (GRS-R) score of 16. He underwent comprehensive rehabilitative therapy, including drug treatment for recovery of consciousness, as well as physical and occupational therapies. He recovered well and rapidly, and his consciousness score recovered to full (GRS-R = 23) at nine weeks after onset. The right lower dorsal ARAS was not reconstructed on 6-week post-onset diffusion tensor tractography (DTT), but it was reconstructed on 9-week post-onset DTT. In the upper ARAS, neural connectivity to the prefrontal cortex, which was reduced on 6-week DTT, had enlarged in both hemispheres on 9-week DTT.

Conclusions

Recovery of ARAS injury was demonstrated by DTT in a patient who showed rapid and full recovery of consciousness during the early period following ICH and IVH. Our Results suggest the importance of intensive rehabilitation during the early post-onset period of stroke in patients with impaired consciousness following a stroke.

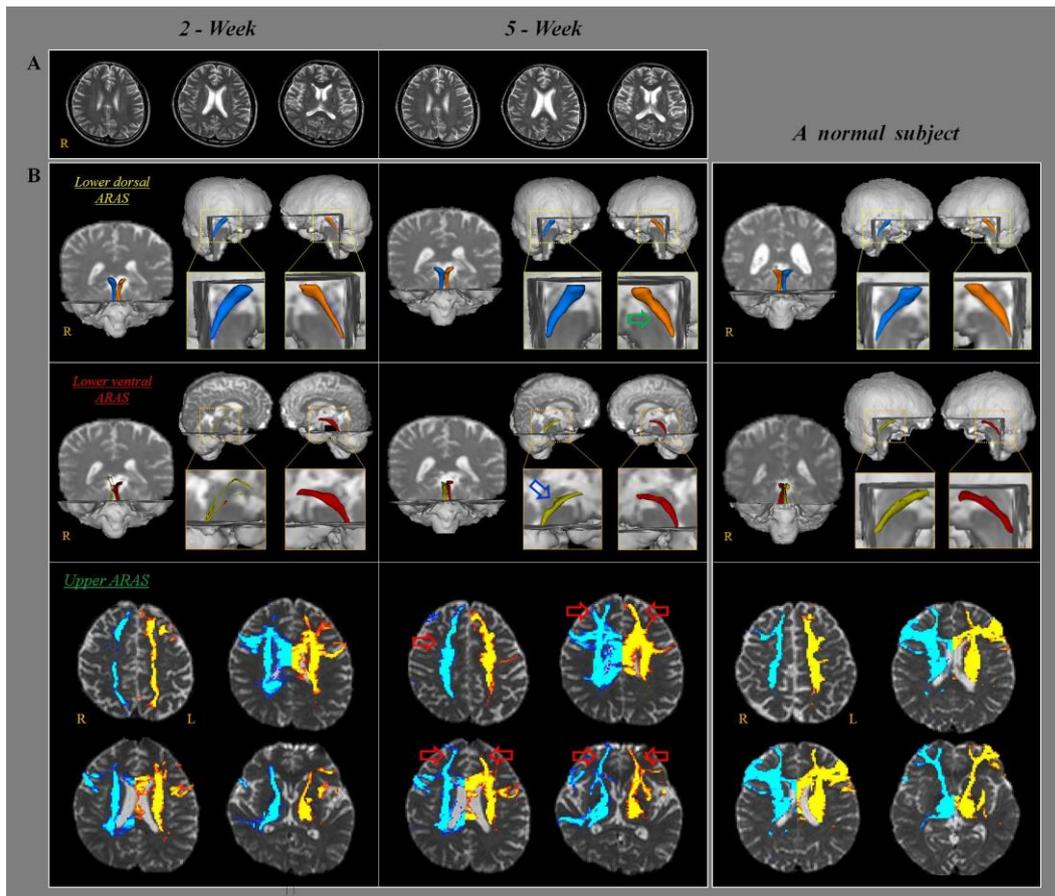


Fig. 1. (A) Brain computed tomography at stroke onset shows evidence of intraventricular hemorrhage and intracerebral hemorrhage in the right temporal lobe. (B) T2-weighted brain magnetic resonance images obtained at six weeks after stroke onset reveal leukomalactic lesions in the right temporal lobe and the subcortical white matter. (C) Results of diffusion tensor tractography (DTT) of the patient. The right lower dorsal ARAS is not reconstructed on 6-week DTT; however, it is reconstructed on 9-week DTT (green arrows). In the upper ARAS, reduced neural connectivity to the prefrontal cortex is observed on 6-week post-onset DTT (red arrows), but connectivity is increased in both hemispheres on 9-week DTT. The normal subject is a 62-year old male.

P 3-111

Hemorrhagic transformation of infarction caused after transcranial magnetic stimulation (TMS)

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Introduction

Transcranial magnetic stimulation (TMS) is a noninvasive procedure that uses magnetic fields to stimulate nerve cells in the brain. Numerous clinical studies have investigated the safety and efficacy of rTMS treatment for a wide variety of conditions including depression, anxiety disorders including obsessive compulsive disorder, Parkinson's disease, stroke, tinnitus, affective disorders, schizophrenia and chronic pain. In this case, we are going to address hemorrhagic transformation caused after contralesional hemispheric repetitive transcranial magnetic stimulation (rTMS)

Case

The 60 years old male patient was injured on april 3, 2018, who was diagnosed left hemiplegia due to cerebral infarction right internal capsule and corona radiata areas. A post stroke rehabilitation was implemented for around 2 month after injury. The MMT of left upper muscle was 3 to 4 grade and he was suffering from post-stroke depression. Contra-lesional hemispheric rTMS was performed with low frequency type and no specific complication was not reported. rTMS session was consist of 2nd step. In 1st step, stimulation consisted of 40 trains of 10-Hz stimulation, each lasting for 5 seconds and then repeated every 30 second given through a figure-of-eight coil positioned over left dorsolateral prefrontal cortex (DLPFC). A total 2000 stimuli of 10 Hz were applied. In 2nd step, stimulation consisted of 20 trains of 1-Hz stimulation, each lasting for 100 seconds and then repeated every 10 second over left frontoparietal area. A total 2000 stimuli of 1 Hz were applied. After 2 days, Second trial was conducted and the patient complains for sudden headache, so we perform brain CT. Hemorrhagic transformation was identified in a right paraventricle in this test, so we implemented conservative management and discontinue anticoagulant. [Fig.1]

Conclusion

The most common adverse event related to rTMS was scalp pain or discomfort at the treatment area during active TMS treatments, which as transient and mild to moderate in severity. Other safety concerns (effects on hearing; headache, pain, induced currents in electrical circuits, histotoxicity, electromagnetic field exposure, psychiatric complications, safety in pregnancy) are debatable. When given within recommended guidelines, however, the overall safety profile of rTMS is good and it is clinically valuable treatment option for stroke patients. But the additional studies regarding the relationship between HTF and rTMS are needed, in this case, it seems clear that magnetic stimuli could be contributing factor for neuron cells and surrounding tissues with physical properties.



fig1. Hemorrhagic transformation of infarction at right internal capsule and corona radiata areas.

Dysphagia in Wilson's Disease: a case report of one year follow-up

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Introduction

Wilson's disease (WD) is an autosomal recessive disease caused by mutations in the ATP7B gene. Impaired copper metabolism due to this mutation leads to metal accumulation in various tissues and organs, including the central nervous system. Although dysphagia is the earliest manifestation of the neurologic dysfunction in this disease, the swallowing dynamics remains unclear. In this report, we present a case of WD with associated dysphagia and its one year follow-up after treatment.

Case report

A 17-year-old man visited our hospital with a complaint of difficulty in swallowing and general weakness. A general weakness developed about 1 month before, and aphasia and dysphagia occurred in the last 5 days. After the admission to the Department of Pediatrics, he was diagnosed with Wilson's disease by mutation of the ATP7B gene. The physical examination showed that the cognitive function was normal while dysarthria and dysphagia was evident. Cerebellar function tests showed severe tremor in both upper extremities and dysdiadochokinesia in both finger to nose test. The initial manual muscle test showed good grade in all extremities without muscle atrophy. Low serum copper and ceruloplasmin level (28.4 ug/dL and < 4 mg/dL) were consistent with WD. The brain magnetic resonance imaging (MRI) on T2WI showed high signal intensity in both the pons and the midbrain (Figure 1A). Videofluoroscopic swallowing study (VFSS) findings were evaluated using videofluoroscopic dysphagia scale (VDS). The initial VDS score was 48. Incomplete lip closure was seen in the oral preparatory phase. Decreased tongue movement and posterior propelling were seen in the oral phase with delayed swallowing reflex. After the VFSS, the patient was treated with 15 sessions of neuromuscular electrical stimulation therapy (NMES) with the electrical pads attached horizontally just above the hyoid bone and thyroid notch. The stimulating intensity was increased from 5 mA to 6.5 mA. Double swallowing and chin tuck posture was educated. The patient continued to take the D-penicillamine(PO, 250mg QID) for the treatment of WD. One year after the symptom onset, brain MRI showed decreased signal intensity in the pons and the midbrain on T2WI (Figure 1B) in compared with initial brain MRI. By follow-up VFSS, the VDS score was improved to 23 (Table 1). Mastication, tongue thrust, and piecemeal deglutition were improved compared to the initial swallowing function. In the pharyngeal phase, the amount of vallecular residue was reduced (Figure 2).

Discussion

Our report shows that WD patients present prolonged oral transit duration and greater percentage of oral residue when compared to age-matched healthy individuals. In this case, the patient underwent NMES with medical treatment of D-penicillamine, showed improved swallowing function both oral and pharyngeal phases. Further studies are necessary to investigate the characteristics of dysphagia and the clinical efficacy of NMES in WD.

Table 1. One year follow up of videofluoroscopic swallowing study (videofluoroscopic dysphagia scale) *, improved item in follow-up VFSS.

	February 12, 2016	January 13, 2017
Lip closure	2	2
Bolus formation	3	3
Mastication*	4	0
Apraxia*	3	0
Tongue to palate contact	5	5
Premature bolus loss*	4.5	3
Oral transit time*	3	0
Triggering of pharyngeal swallow*	4.5	0
Valleular residue	4	4
Laryngeal elevation*	9	0
Pyramidal sinus residue	0	0
Coating on the pharyngeal wall	0	0
Pharyngeal transit time	0	0
Aspiration	6	6
Total VDS score	48	23

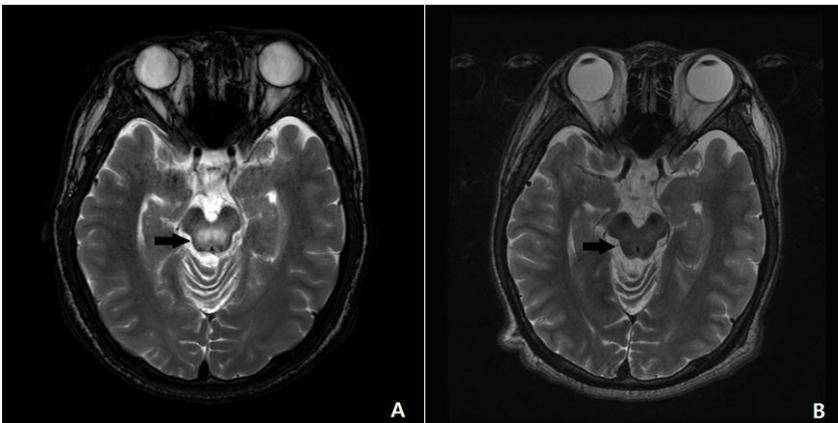


Figure 1. One year follow-up of brain MRI. Initial brain MRI shows high signal intensity (black arrow) in pons and midbrain (A, February 2, 2016). With the treatment of D-penicillamine, 1-year follow-up brain MRI shows decreased signal intensity (black arrow) in the pons and the midbrain (B, January 10, 2017).

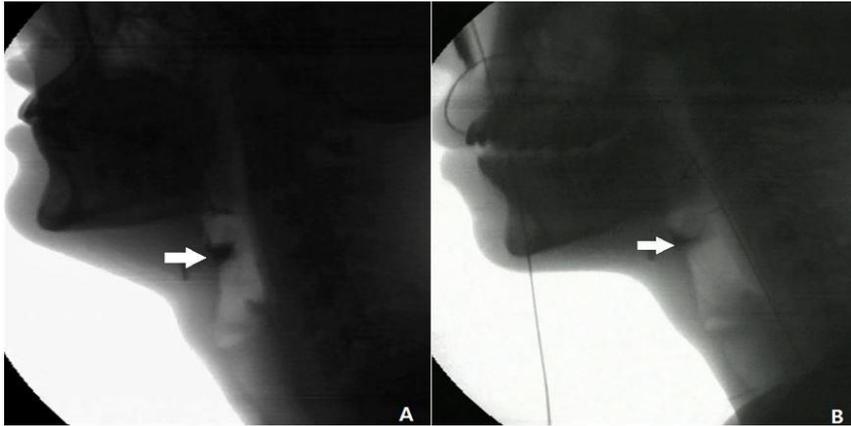


Figure 2. One year follow-up of videofluoroscopic swallowing study (VFSS). The amount of semisolid vallecular residue (B, January 13, 2017) was reduced compared to initial VFSS (A, February 12, 2016). White arrow is the vallecular residue.

Homolateral Synkinesis, an accompanied symptom with motor recovery? : A Case Study

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Introduction

Homolateral synkinesis (HS) is defined as nonpurposive associated movements on affected side of hemiparetic subjects, triggered during voluntary movement. We report a case showing HS after stroke.

Case report

The subject was a 59-year-old, right-handed woman, who had cerebral infarction on territory of right middle cerebral artery which occurred on 2018. Diffusion-weighted image at the day of stroke onset showed high signal intensity in frontoparietal deep white matter, parietal lobe, temporal lobe and right basal ganglia (Fig 1.). The patient had no other past history except for hypertension diagnosed on 2016. The subject had alert mentality, good communication with mini-mental state score (MMSE) 29, left side weakness of both upper and lower extremities and increased biceps jerk. Perception of sensory input such as light touch, proprioception, and pain from affected limb was intact. Brunnstrom stage was used as a parameter for poststroke motor recovery which was 5 on arm, 3 on hand, and 6 on leg. HS appeared on the 39th day from the onset. When she forced to clench her hand of the affected side, her foot was closed simultaneously (Fig 2.). The symptom lasted until the 56th day after the onset and disappeared gradually. DTI was conducted to investigate the relationship between homolateral synkinesis and corticospinal tract. We found the defect of corticospinal tract on parietal cortex. The corticospinal tract of deep white matter drawn based on Diffusion Tensor Tractography(DTT) started from the corona radiata passing through portion of internal capsule posterior limb corresponding to leg homunculus (Fig 3.).

Discussion

In this case report, we showed HS in a subject's affected hand and feet. Furthermore, we discovered that HS decreased as the days passed. Disappearance of HS was accompanied with recovery of affected upper extremity, which showed improvement from 5/3/6 to 6/5/6 presented as Brunnstrom stage.

Conclusion

HS could imply transient connection between domains located in cortex or deep white matter during the process of poststroke motor recovery.

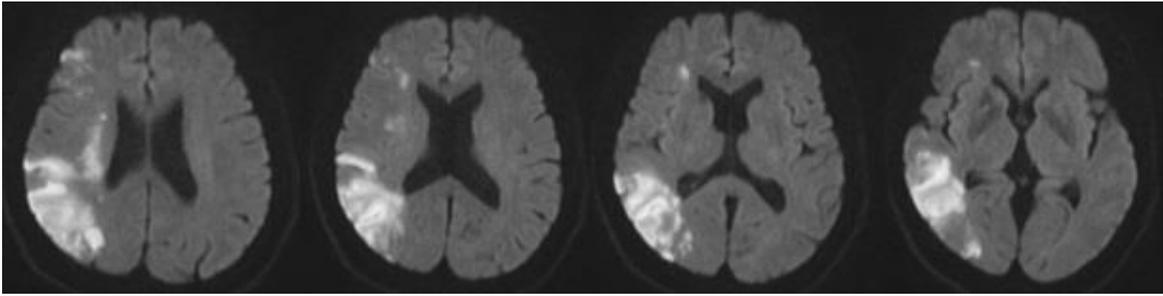


fig1. Diffusion-weighted image at the day of stroke onset



fig2. Homolateral synkinesis; when the patient forced to clench her hand of the affected side, her foot was closed simultaneously.

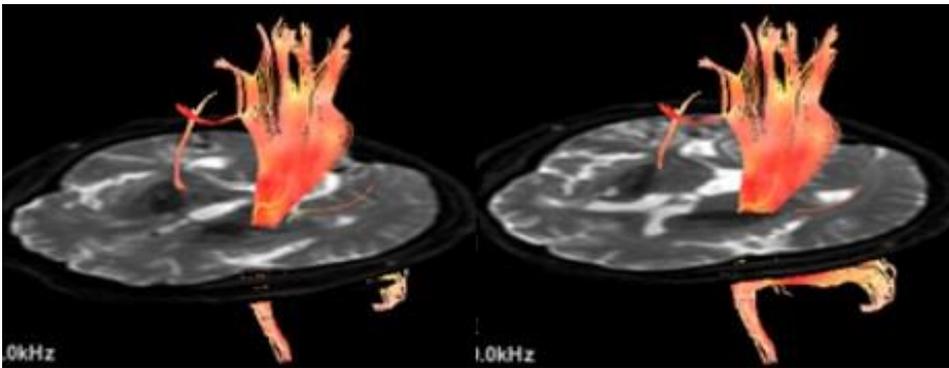


fig3. The corticospinal tract of deep white matter drawn based on Diffusion Tensor Tractography(DTT)

Can High Resolution Manometry Substitute for Videofluorography in Evaluation of Dysphagia?

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Abstract Background

Dysphagia has previously been reported in the inflammatory myopathies (IMs): inclusion body myositis (IBM), dermatomyositis (DM), and polymyositis (PM). Patients report coughing, choking, and bolus sticking in the pharynx. The utility of high-resolution impedance manometry (HRIM) for evaluating dysphagia has been investigated. Although HRIM provides precise pharyngeal pressure information, it has yet to be used as part of routine clinical practice for the assessment of dysphagia. The Purpose of this study was to determine whether the information obtained through HRIM in the evaluation of swallowing disorders in patients with IMs could reflect an abnormality not confirmed by VFSS.

Methods

A VFSS and HRIM were performed by nine patients: seven with DM and two with PM (median age, 52.0 years). Four patients manifested globus symptom and five patients had no symptom of dysphagia (Table 1). We evaluated the pharyngeal contraction and UES function fluorographically and compared the manometric parameters. Upper esophageal sphincter (UES) relaxation parameters were measured using a standard HRIM protocol. Peristalsis and bolus transit of the pharyngoesophageal segment were assessed using an HRIM-modified protocol in which the catheter was pulled back 10 cm. Penetration, aspiration and pharyngeal residue on VFSS were also recorded.

Results

Cricopharyngeal muscle dysfunction was noted in all four patients with globus symptom who had barium swallow studies. Three out of four patients manifested aspiration events. Five patients without dysphagia symptom didn't show any abnormality on VFSS (Table 2). A difference was observed between the manometric measures of patients with and without pharyngeal residue; UES residual pressures (UES-RP) were more than 8mmHg in patients with pharyngeal residue.

Conclusions

Dysphagia in IM patients appears to be more due to impaired muscle contraction and reduced hyolaryngeal excursion than the failed UES relaxation. Certain VFSS measures are correlated with measures of pressure assessed using HRIM. UES-RP could differentiate presence of pharyngeal residue and globus symptom with higher values (≥ 8 mmHg) in patients with IMs. Furthermore, HRIM facilitated a comprehensive assessment of dysphagia mechanisms and recognition of subtle abnormalities not yet visible to the

naked eye on VFSS. HRIM can supplement the information obtained regarding the pharyngeal contraction and UES function, and overcomes the drawbacks of a VFSS by providing Objective measurements.

Table 1. Demographics of patients with inflammatory myositis

Patient	Diagnosis	Gender	Age (years)	Mobility	Current Diet	ASHA NOMS swallowing level scale	Globus symptom	Reports dysphagia for		
								Solids	Liquids	Secretion
1	DM	M	71	A	RD	5	Present			
2	DM	F	57	I	SD	3	Present	√	√	
3	DM	M	57	I	SD	3	Present	√		
4	PM	M	66	I	SD	3	Present	√		
5	PM	M	40	I	RD	7	Absent			
6	DM	F	53	I	RD	7	Absent			
7	DM	F	59	I	RD	7	Absent			
8	DM	F	30	I	RD	7	Absent	√	√	
9	DM	F	35	I	RD	7	Absent			√

DM: Dermatomyositis, PM: Polymyositis, M: Male, F: Female, I: Independent, A: Uses mobility aid, RD: Regular diet, SD: Soft diet

Table 2. VFSS findings in patients with inflammatory myositis

Patient	Aspiration (VFSS)	Penetration (VFSS)	Pharyngeal residue (VFSS)		UES pressure (mmHg)	UES residual pressure (mmHg)
			Vallecular pouch	Pyriiform sinus		
1	Absent	Absent	√	√	Normal	Abnormal
2	Present	Absent	√	√	Normal	Abnormal
3	Present	Present	√	√	Normal	Abnormal
4	Present	Absent	√		Normal	Abnormal
5	Absent	Absent			Normal	Normal
6	Absent	Absent			Decreased	Normal
7	Absent	Absent			Normal	Normal
8	Absent	Absent			Normal	Normal
9	Absent	Absent			Normal	Abnormal

P 3-115

Change in the precuneus with recovery of impaired consciousness in a patient with HI-BI

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Yeungnam University Medical Center, Department of Rehabilitation Medicine¹

Objectives

We report on the application of diffusion tensor tractography (DTT) to the ascending reticular activating system (ARAS) of a patient and observing a change in the precuneus with concomitant recovery of impaired consciousness in a patient with hypoxic-ischemic brain injury (HI-BI).

Case presentation

A 50-year-old male patient suffered cardiac arrest induced by an ST-segment elevation myocardial infarction. At eight months after onset, when he started rehabilitation at our hospital, the patient was a vegetative state (VS) with a Coma Recovery Scale-Revised (CRS-R) score of 5. He underwent comprehensive rehabilitation including transcranial direct current stimulation (anode at posterior parietal cortex). After two months of rehabilitation, his consciousness had recovered to a minimally conscious state (MCS) with a CRS-R score of 15. As a Result, he was able to perform partial grasp-release of his left hand spontaneously and partial flexion-extension of his left great toe on verbal command. On 8-month DTT, decreased neural connectivity of the upper ARAS between the thalamic intralaminar nucleus and the cerebral cortex was observed in both prefrontal and parietal cortices. In contrast to the 8-month DTT, the 10-month DTT revealed increased neural connectivity of the upper ARAS in the left parietal lobe (especially in the precuneus) and the body of the corpus callosum.

Conclusions

Improvement in connectivity in the precuneus was demonstrated in a HI-BI patient who showed recovery from VS to MCS. It appears that the increased neural connectivity to the precuneus contributed to recovery from VS to MCS in this patient.

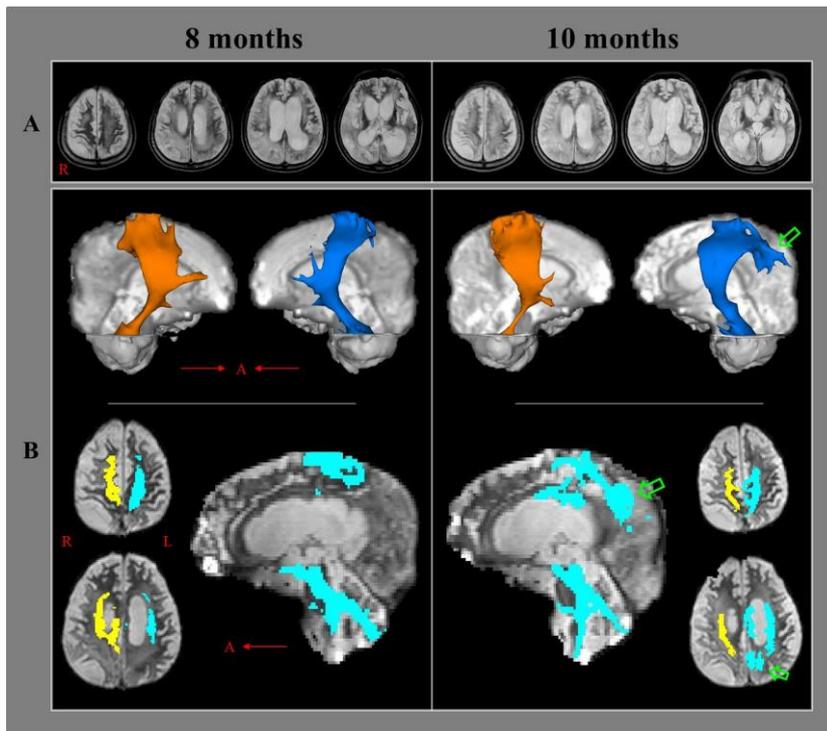


Fig. 1. (A) Brain magnetic resonance images at eight months after onset show leukomalactic lesions in the fronto-parieto-temporo-occipital lobes in both hemispheres. (B) Results of diffusion tensor tractography (DTT) of the upper ascending reticular activating system between the thalamic intralaminar nucleus and the cerebral cortex. On 8-month DTT, decreased neural connectivity of the upper ARAS is present in both the prefrontal and parietal cortices. Compared with the 8-month DTT Results, the 10-month DTT revealed increased neural connectivity of the upper ARAS in the left parietal lobe (especially in the precuneus [arrows]) and the body of the corpus callosum.

Neurogenic fever due to injury of the hypothalamus in a stroke patient

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College of Medicine, Yeungnam University, Department of Rehabilitation Medicine¹

Objectives

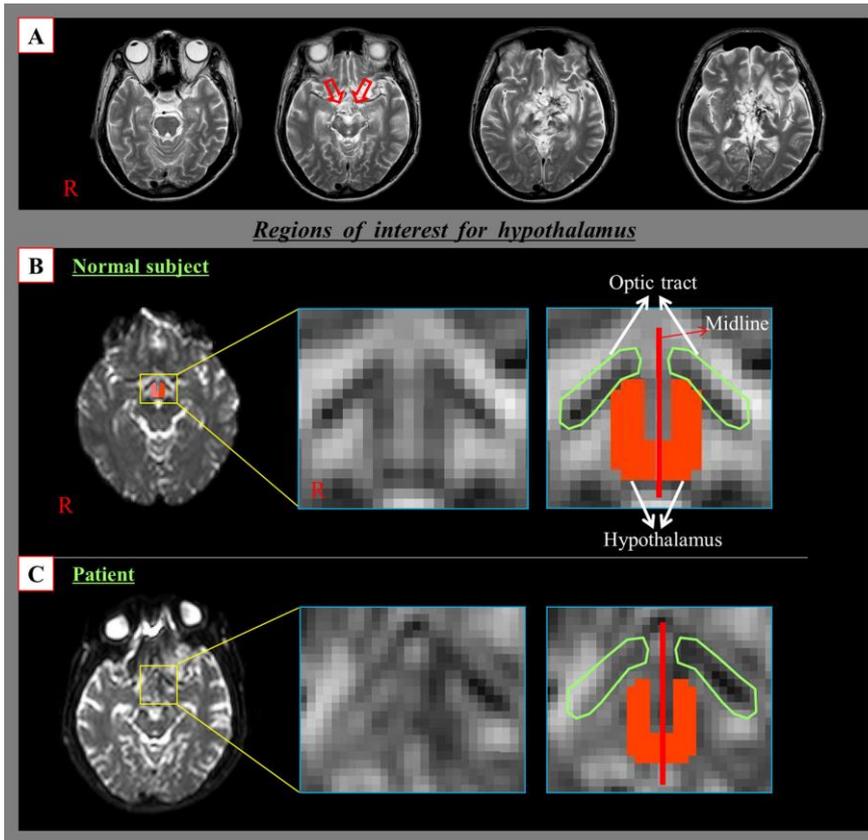
We report on a stroke patient with neurogenic fever due to injury of the hypothalamus, demonstrated by using diffusion tensor imaging (DTI).

Case description

A 28-year-old male patient with intraventricular hemorrhage and intracerebral hemorrhage in the left basal ganglia underwent extraventricular drainage and ventriculoperitoneal shunting for hydrocephalus. At thirty months after onset, he was admitted to the rehabilitation department of our university hospital. Brain magnetic resonance imaging showed leukomalactic lesions in the hypothalamus, bilateral medial temporal lobe, and bilateral basal ganglia. He showed intermittent high body temperature (maximum: 39.5°C, range 38.5°C~39.2°C), but did not show any infection signs upon physical examination or after assessing his white blood cell count and inflammatory enzyme levels such as erythrocyte sedimentation rate and C-reactive protein. In addition, 8 age-matched normal (control) subjects (4 male, mean age, 26.6 years; range, 21–29 years) were enrolled in the study. DTI was performed at thirty months after onset, and fractional anisotropy (FA) and apparent diffusion coefficient (ADC) values were obtained for the hypothalamus. The FA and ADC values of the patient were lower and higher, respectively, by more than two standard deviations from the control values.

Conclusions

Injury of the hypothalamus was demonstrated in a stroke patient with neurogenic fever. Our Results suggest that evaluation of the hypothalamus using DTI would be helpful in patients show unexplained fever following brain injury.



(A) T2-weighted brain magnetic resonance images show leukomalactic lesions in the hypothalamus (arrows), bilateral medial temporal lobe, and bilateral basal ganglia. (B) Regions of interest for the hypothalamus were localized by using the optic tract (anterior boundary), the mammillary body (posterior boundary), and the midline (medial boundary) at the level of the upper midbrain in the patient and a representative normal subject.

P 3-117

Oral apraxia due to injury of the corticofugal tract from secondary motor area in a stroke patient

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Objectives

No study has reported that the relation of the Oral apraxia (OA) and injury of the corticofugal tracts (CFTs) in stroke patients using Diffusion tensor tractography (DTT). We report on a stroke patient who showed OA due to injury of the CFT from the secondary motor area.

Methods

A 56-year-old male patient presented with severe dysarthria at the onset of a striatocapsular infarct in left hemisphere. He showed that paralysis on right face, reduced range of motion of the jaw and teeth, reduced range of motion and weakness of lips, and weakness and motion limitation of tongue. Diffusion tensor imaging data were acquired at one week after onset. On DTT, the integrity of the CBT and CFT from the supplementary motor area (SMA) was well-preserved in both hemispheres, however tearing and narrowing of the CFT from the dorsal premotor cortex (dPMC) at the subcortical white matter were observed in left hemispheres

Conclusions

Using DTT, we found that injury of the CFT from the secondary motor area in stroke patients with OA. Therefore, we believe that our Results suggest the necessity of evaluation of the CBT and CFTs from the secondary motor area for stroke patients with dysarthria.

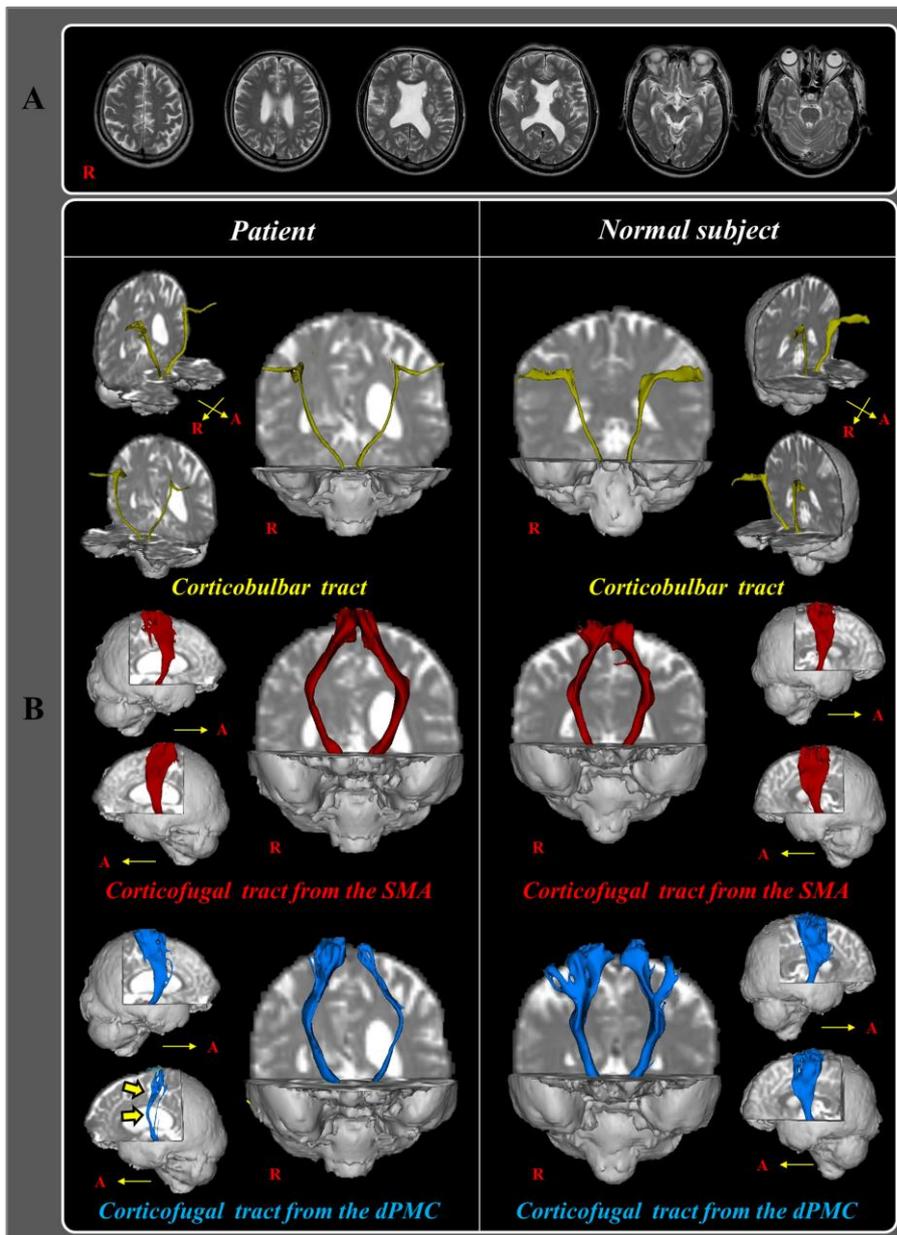


Fig. 1. A. T2-weighted brain MR images at a week after onset show leukomalatic lesions in the left striatocapsular region. B. On one-week diffusion tensor tractography, the integrity of the corticobulbar tract and corticofugal tract from the supplementary motor area is preserved in both hemispheres. However, narrowing and tearing (arrow) is observed in the right corticofugal tract from the dorsal premotor cortex (dPMC) compared with a normal subject (56-year old male).

Sign of the buttock; A valuable physical examination in the hemiplegic limbs of post-stroke patients

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Introduction

'Sign of the buttock', first described by Cyriax, is a combination of restricted straight leg raise and limited passive hip flexion with a bent knee. This sign indicates conditions such as osteomyelitis, sacral fracture, septic arthritis, neoplasm, and septic bursitis. In patients with stroke, various factors (e.g. language disturbance, cognitive impairment and affected side sensory and motor deficit) make hard to detect problems of the hemiplegic lower limb. We report 2 cases associated with hip pathology of the hemiplegic lower limb.

Case 1.

A 78-year-old man was newly diagnosed with right striatocapsular infarction. He complained of persistent left hip pain for 8 days. There was a fever 1 day before the left hip pain onset. Laboratory findings at the time of fever were neutrophilic leukocytosis, elevated CRP and ESR. Left hip radiography revealed osteoarthritis of both hip joints (Figure 1A). Empirical antibiotics treatment was started due to unknown cause fever. 10 days after admission, he was transferred to our department for comprehensive rehabilitation. A physical examination revealed the restricted straight leg raise and limited passive hip flexion with a bent knee (sign of the buttock positive). We performed hip magnetic resonance imaging (MRI), and it showed evidence of septic arthritis (Figure 1B). He transferred to the division of infectious diseases and used intravenous (IV) antibiotics for 6 weeks. And IV antibiotics changed to oral antibiotics for 3 months. Since then the laboratory findings and symptoms have been normalized.

Case 2.

An 82-year-old man was newly diagnosed with right middle cerebral artery infarction. He was transferred to our department for comprehensive rehabilitation. On physical examination, he showed positive sign of the buttock. There was no left hip pain at rest. History taking revealed that he had fallen down when the stroke occurred. Left hip radiography revealed no definite abnormality (Figure 2A). Whole body bone scan was performed to find hidden fractures. It shows increased radio-uptake on left femoral head (Figure 2B). Hip MRI suggests subchondral insufficiency fracture (Figure 2C, D). A bone densitometry was carried out, which revealed osteoporosis. The patient limited the weight bearing on the left leg for one month and then began the partial weight bearing exercise. The patient followed-up at 8 weeks revealed a normal clinical examination and absence of symptoms.

Discussion

We described the two cases associated with hip joint pathology in hemiplegic limb. In acute stroke management period, the patients needed bed rest, but these problem were found through detailed physical examination after they were transferred to rehabilitation department. These disease requires a modification of the strategy of stroke rehabilitation. It was initially detected by means of a valuable screening test, sign of the buttock. It is very simple and useful test identifying hip or pelvis pathology.



Figure 1. (A) Hip radiography revealed an calcifications near both acetabulum rim, suggests osteoarthritis of both hip joints. (B) Contrast enhanced T1-weighted MRI of the left hip showed enhancement of gluteus minimus (arrow) and iliopsoas muscles (arrow head).

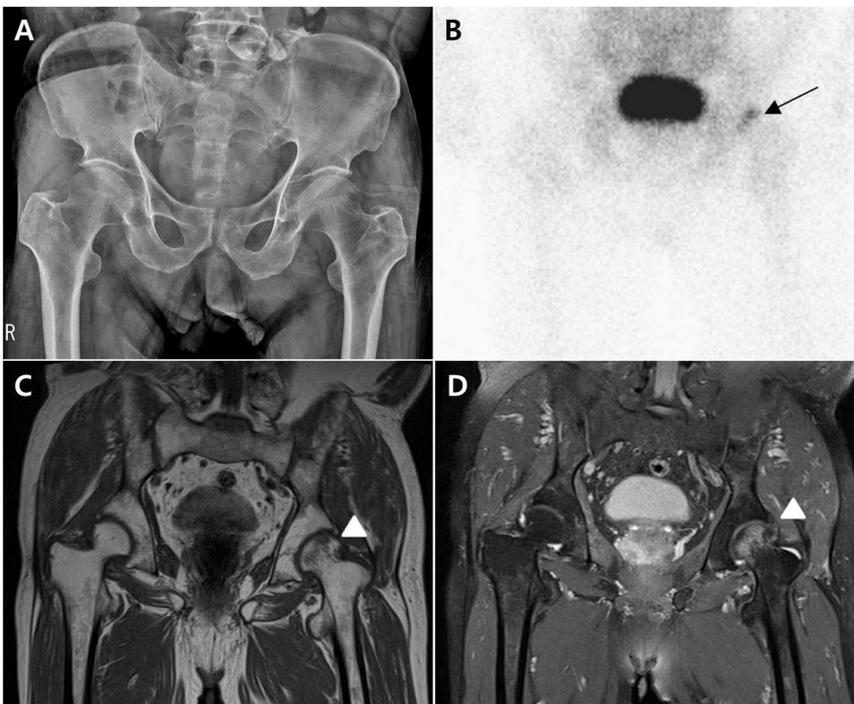


Figure 2. (A) Hip radiography revealed no definite abnormality. (B) Whole body bone scan showed hot spot at the left femur head (arrow). (C, D) On MRI of the left hip, a diffuse bone marrow edema pattern (arrow head) is seen, with low signal intensity on T1-weighted imaging (C) and high signal intensity on T2-weighted imaging (D).

Effect of hand-free CTAR exercise on and degree of aspiration in dysphagia: A report of 2 cases

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Introduction

Dysphagia is a common occurrence in neurological diseases and leads to various complications, such as dehydration, aspiration pneumonia and malnutrition. Weakening of the suprahyoid muscles in the anterior neck region is known to affect opening of the upper esophageal sphincter and lead to aspiration. Therefore, therapeutic exercises to strengthen the suprahyoid muscles are important for patients with aspiration or a high risk of aspiration. The Shaker exercise is effective in increasing hyoid motion, decreasing aspiration, and opening the upper esophageal sphincter. Chin-tuck-resistance and chin to chest exercises serve the same Purpose as the Shaker exercise, but can be performed while sitting. It can also activate suprahyoid muscles nearly similar to the Shaker exercise. However, since these exercises can be carried out by hand, using a tool that provides resistance such as a resilient ball or a resistance bar, at least one hand is required to have proper function and strength. Therefore, patients who are unable to functionally use both hands for various reasons, such as limb paralysis, spinal cord injuries, traumatic or acquired brain injuries, are limited by their conditions. The Purpose of this study was to investigate the effect of CTAR exercise using hand-free resistance bar on hyoid movement and aspiration in patients with dysphagia, who had difficulty in functional use of both hands.

CASE REPORT

This study recruited two men with dysphagia after stroke, aged 57 and 62 years respectively. They had difficulty using both hands properly because of paralysis of the left upper extremity and rheumatoid arthritis of the right hand in patient 1 and paralysis of both upper extremities in patient 2. This study investigated the effect of 4 weeks of hand-free CTAR exercise on hyoid movement and aspiration. The exercise involved isotonic and isometric parts. In isometric CTAR, the patients were asked to chin tuck against the device 3 times for 60 s each, with no repetition. In isotonic CTAR, the patient performed 30 consecutive repetitions by strongly pressing against the resistance device and then releasing it. (Figure 1) Based on videofluoroscopic swallowing study, the degree of aspiration was measured using the Penetration-Aspiration Scale (PAS) and two-dimensional motion analysis of the hyoid bone. After post-intervention, the hyoid movements in both patients improved by 0.16, 0.22 cm (anterior movement), 0.26, 0.28

cm (superior movement) and PAS scores decreased by 2 and 2 points, respectively.(Table 1)

Conclusion

This study confirms that hand-free CTAR exercise is applicable and helpful in improving hyoid movement and reducing aspiration in patients with dysphagia after stroke. Therefore, this exercise can be introduced as an intervention for improving the swallowing function in patients with dysphagia who have difficulty using both hands.

Table 1. Changes in parameters before and after treatment

	patient 1			patient2		
	Before treatment	After treatment	Improvement rate(%)	Before treatment	After treatment	Improvement rate(%)
Anterior movement of the hyoid bone (cm)	1.45	1.61	11.0	1.54	1.76	14.2
Superior movement of the hyoid bone (cm)	1.55	1.81	16.7	1.63	1.91	17.1
PAS	6	4		6	4	

PAS: penetration-aspiration scale



Figure 1. Hand-free chin-tuck-resistance exercise

Misleading diagnosis in alcoholic patients complaining of lower limb weakness : a case report of MBD

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Introduction

Marchiafava-Bignami disease (MBD), Wernicke's encephalopathy (WE) and alcohol related polyneuropathy (ARP) are distinct diseases and all have strong relationship with chronic alcoholism. MBD is classically characterized by acute edema and necrosis of corpus callosum and subsequent symmetric demyelination and atrophy of this structure. To the best of our knowledge, MBD patient whose WE was diagnosed earlier is not previously reported in Northeast Asian patients. And this patient co-occurs with MBD and ARP. Moreover, We present a case of MBD with cortical involvement which was associated with poor prognosis.

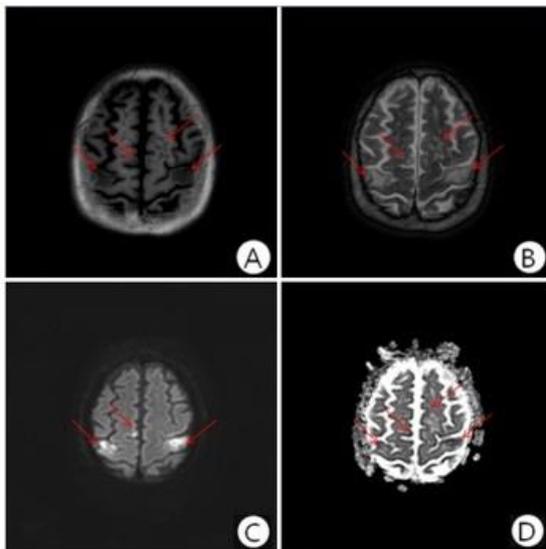
Case report

A 70-year-old male was admitted to our hospital neurology department with 6 months history of impaired walking, weakness of upper and lower limbs, ataxia and dysarthria aggravated on the day of admission. Three years ago, He also presented to our hospital with complaints of altered mentality and ataxia of both lower limbs. In brain MRI, T2-weighted image(T2WI) and fluid attenuated inversion recovery (FLAIR) image showed high signal intensity in the bilateral periventricular and periaqueductal area. After that event, the family reported that impaired walking and weakness of upper and lower limbs started gradually in the last 6 months ago and have been sitting or lying down. Since then, He didn't eat food and only drank the alcohol. In this time, his muscle strength was checked at 3/5 in the both upper and 2/5 in both lower limbs. The patient scored 0 on the Korean version of modified barthel index and 9 on the mini mental status examination Korea(MMSE-K), suggestive of total dependency of ADL and cognitive dysfunction. The initial nutrition evaluation was executed and revealed high risk of malnutrition. The laboratory datas revealed hypoproteinemia and hypoalbuminemia (total protein, 5.3 g/dl; albumin, 2.8g/dl). However, his serum level of vitamin B1(7.6 µg/dl) and vitamin B12(1016 pg/ml) was in the normal range. Before we did MR imaging, we suspected WE as before. However MR imaging showed hypointensities in T1WI and hyperintensities in T2WI in the body, splenium of corpus callosum, both precentral gyrus and both frontal cortex. Corresponding region in axial diffusion-weighted MR image (DWI) and FLAIR image showed hyperintensities with a decreased apparent diffusion coefficient (ADC) image.(figure1,2) The patient was eventually diagnosed with MBD. Despite the normal level of serum vitamins, the patient was treated with intravenous high-dose vitamin treatments and inserted L-tube for hyperalimentation. NCS-EMG was executed for

evaluating upper and lower limbs weakness and electrophysiological findings are suggestive of axonal demyelinating sensorimotor polyneuropathy, compatible with ARP.

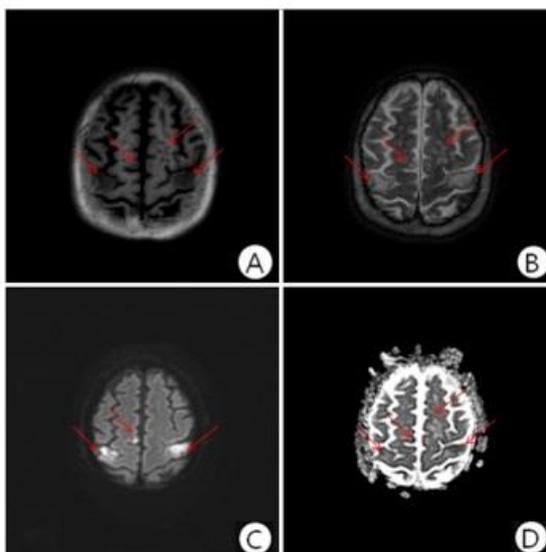
Conclusions

We suppose that co-occurrence of MBD and ARP in chronic alcoholic patient whose WE was diagnosed earlier is very rare report. And MBD which present poor prognosis is associated with cortical involvement.



MR imaging at cortex level showed hypointensities in T1WI(A) & hyperintensities in T2WI(B) in both precentral gyrus and both frontal cortex. Corresponding region in axial DWI(C) showed hyperintensities with a decreased ADC image(D). Arrow in (A), (B), (C), (D)

Figure.1 MRI of the patient when MBD was diagnosed.



MR imaging at cortex level showed hypointensities in T1WI(A) & hyperintensities in T2WI(B) in both precentral gyrus and both frontal cortex. Corresponding region in axial DWI(C) showed hyperintensities with a decreased ADC image(D). Arrow in (A), (B), (C), (D)

Figure.2 MRI of the patient when MBD was diagnosed.

Correction of dropped head syndrome using Intramuscular stimulation and physiotherapy

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Objective

Dropped head syndrome (DHS) is characterized by severe weakness of the cervical paraspinal muscles. DHS is associated with many neurological and muscular disorders, such as Parkinson disease, cervical dystonia, myasthenia gravis, and myopathies, etc. This deformity has significant implications on the quality of life. Use of cervical collar and targeted physiotherapy are considered by some to be first-line treatments to avoid the potential morbidity of surgery, but still there are many controversies in management. In this study, we present a patient whose symptom of DHS was effectively improved using intramuscular stimulation and physiotherapy.

Patient and Methods

A 79-year-old woman initially visited the Department of Rehabilitation on April 6th, 2018 for weakness of neck extension muscles since last September. She could not actively extend her neck at all while standing. Physical examination of the anterior and posterior neck may reveal barely palpable muscles, which signifies atrophy and contracture of the soft tissues. Firstly, not only active but passive cervical extensions were limited and inducing pain, but after stretching anterior muscles several times, it allowed the neck to passively extend. Muscle bulk and power were normal in all four limbs including shoulder girdles. The patient refused muscle enzyme level, MRI, and electromyography studies because of her advanced age. But she presented parkinsonian features, such as a masked face, tremors, bradykinesia, and short steppaged gaits. Thus she was referred to the neurology department and before the definite diagnosis was made, she got intramuscular stimulation at both sternocleidomastoid muscles three times with intervals of 1 week and instructed to stretch her anterior muscles every day. She tried neck collar, but she gave up because of inconvenience. After three intramuscular stimulation was done, her pain and muscle tightness during passive neck extension were reduced and the active movement of neck extensors started to be observed at the upright position. From April 17th, she started physiotherapy for neck extensor strengthening and anterior neck flexor stretching on every Tuesday.

Results

After 4 weeks of intensive physiotherapy coupled with 3 times of intramuscular stimulation, the patient was able to raise her head and maintain a horizontal gaze for 3 to 4 minutes. It Resulted in considerable improvements to activities of daily living. Finally

she was diagnosed as Parkinsonism and she started to get madopar 50mg twice a day on middle of May, but the improvement was observed before medication started.

Conclusion

In recent studies, parkinsonian medications were known to be ineffective at DHS symptoms. Also, in fragile population, surgical interventions cannot avoid a risk of a serious complication. This case shows the efficacy of the physiotherapy and intramuscular stimulation to chronic DHS in elderly patients with parkinsonism.



Fig. 1. Initial clinical photograph of of a woman with weakness of the posterior neck musculature



Fig. 2. Initial lateral radiograph of the cervical spine in neutral (slightly supported)



Fig. 3. Final clinical photograph of of the same patient

Paradoxical Reaction During Treatment of Complicated Tuberculous Meningitis: A Case Report

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Introduction

The paradoxical reaction in tuberculosis (TB) treatment is defined as deterioration of initial lesion or development of new lesion despite of absence of any other cause of treatment failure. It is uncommon to encounter in rehabilitation setting but can affect significantly patients' clinical course. The authors experienced a case of TB meningitis with paradoxical reaction in the course of anti-TB treatment and rehabilitation afterward. The patient also had underlying ulcerative colitis (UC), and was accompanied by pulmonary TB and neurosyphilis. Hereby the authors report a case of TB meningitis in which unusual clinical course was observed because of paradoxical reaction.

Case report

A 51-year-old male was hospitalized under impression of left anterior cerebral artery (ACA) infarction. He had a long history of UC in remission. Cerebrospinal fluid (CSF) study was performed because severe headache and motor deterioration was found despite regular management of ACA infarction. Eventually he was diagnosed as neurosyphilis and TB meningitis. Meanwhile pulmonary TB was also demonstrated in chest radiograph and CT. Penicillin G anti-TB medication were administered and his condition was improved and transferred to department of rehabilitation medicine. During the course of rehabilitation, cognitive decline and abnormal behavior were evident and brain MRI showed multifocal ring enhancing nodular lesions that were not observed in initial MRI. Paradoxical reaction was suspected and steroid therapy was started. Gradually the patient's functional and neurologic status was improved and lesion size was decreased in follow up MRI. After weaning of four weeks course of steroid treatment, the patient was transferred to local rehabilitation hospital. At 3 months follow up to outpatient clinic, he showed further improvement functionally and neurologically.

Discussion

When paradoxical reactions occur, it is common not to change the anti-TB drugs. Steroids can be administered when the severe symptoms are not controlled. A case of paradoxical reaction in TB meningitis has been reported previously but it was not complicated with other pathologic conditions. In this case, decision to use steroid was difficult because of the possibility of deterioration of neurosyphilis. Eradication of neurosyphilis was confirmed by repeated CSF studies. When a paradoxical reaction occurs, treatment failure, drug resistance, decreased compliance, and co-infection of other strains should

be ruled out and treatment decisions must be made carefully. However, delay in steroid therapy may cause permanent neurologic and functional deficits. Clinicians should be aware of possibility of paradoxical reaction when the patient is clinically or radiographically deteriorated during the treatment course of TB meningitis.

Progressive movement disorder after ischemic stroke on thalamus - A case report

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Introduction

A wide variety of complications develop after ischemic stroke. Among them, Abnormal involuntary movement (AIM) is a rare complication and can be divided into two subtypes such as transient and permanent. The transient type of AIM usually appears immediately after the stroke, and the permanent type may appear after several months to years of stroke. Pharmacological treatment (mainly levodopa) is known to be sensitive on permanent type of AIM.

Case

We report a 57-year-old female case of AIM after thalamic stroke which slowly progress and intractable to medication. She had been suffered from hemiparesis caused by acute infarction on right cerebellar and left thalamus and received rehabilitation treatment for 5weeks. At the time of discharge, muscle power on the involved side was good grade and modified Barthel Index (MBI) score was 67 points. At 10 weeks after the stroke attack, involuntary tremor-like movement was developed at her right upper limb and progressed slowly in the involved body part as well as severity. It ceased during sleep or if patient is not conscious of the tremor. However, when she was instructed to keep her hand stay still, she became aware of her hand and the tremor appears at low amplitude. It was exacerbated by specific posture such as elbow flexion and tasks of reaching and grasping. The MBI score was decreased to 41 in spite of maintenance of muscle power of right upper limb. At first, clonazepam was used but the symptom was worsened without improvement. Therefore, brain MRI was performed and there was no interval change. Then, clonazepam dose was increased and levodopa, carbidopa and propranolol were added at each visit. But the symptom continued to progress without response to the medication. Primidone was added, but stopped due to side effects such as dysarthria and deconditioning. The symptom had been aggravated up to about 5months after the onset despite medication and is now continuing without improvement or worsening of symptom.

Conclusion

Although there are several reports of abnormal involuntary movement disorder after stroke with improvement from levodopa administration, this case is slowly progressive and intractable to the medication when compared with previously reported cases. Further studies on the treatment for stroke-induced permanent type of AIM not well-responding to therapy may be needed.

Sick sinus syndrome combined in Wallenberg syndrome

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Background

Lateral medullary infarction causes Wallenberg syndrome with various symptoms including ataxia, numbness of either the ipsilateral face or the contralateral body, vertigo, and dysphagia. However, rare cases present with cardiac complications, which can cause life-threatening Result. Nuclei of the medulla play an important role in the autonomic regulation of the cardiovascular functions and in particular, the nucleus of the solitary tract is involved in the sympathetic and parasympathetic outflow. So, Lesions in this area like Wallenberg syndrome can therefore lead to cardiac dysfunction. Wallenberg syndrome can affect the central sympathetic neurons which normally inhibit the nucleus of the solitary tract. So, the disinhibition of the nucleus tractus solitarii may led to an increase of parasympathetic outflow Resulting in bradycardia and sick sinus syndrome. As this can cause unexpected sudden death, clinicians should pay attention to sick sinus syndrome combined in Wallenberg syndrome.

Case report

A 55-year-old man visited our cardiovascular center for palpitation two times in 2010, 2013 respectively. At that time, he got cardiac function test including electrocardiogram (ECG), Holter, exercise stress test, and transthoracic echocardiography and all tests showed normal range. After that, his symptom subsided that he didn't get medical treatment and check up anymore. Four years later, he visited our hospital again due to dizziness, left facial numbness, and vomiting. In the Brain MRI, it showed acute infarction in left lateral medulla oblongata (Figure 1). So, he was admitted to department of neurology and began dual anti platelet therapy including aspirin and clopidogrel. One week later, he was transferred to our department for rehabilitation. However, he constantly complaint relapsed palpitation and lasting dizziness that we performed ECG and 24 hour Holter again to see any abnormalities. In Holter, we could find increased RR interval with average of 831ms (Figure 2), frequent 1,712 beat of bradycardia (≤ 60 bpm), and sick sinus syndrome with maximal pause of 1.9 second (Figure 3). So, we proceeded consult with cardiovascular department and decided to implant pacemaker if sinus pause lasts more than three second with symptom progression. Fortunately, his symptoms disappeared. Two weeks later, follow up Holter showed relatively decreased RR interval with average of 771ms (Figure 2), 745 beat of bradycardia (≤ 60 bpm) and no sick sinus syndrome with maximal pause of 1.18 second. So, cardiologist recommended to observe his symptoms without any medical interventions.

Conclusion

Because bradycardia and sick sinus syndrome are far less common than tachycardia in Wallenberg syndrome, clinicians could ignore when ECG shows normal sinus rhythm.

However, as it can cause unexpected sudden death if we do not perform appropriate medical intervention, clinicians should consider further evaluation including Holter to check sick sinus syndrome.

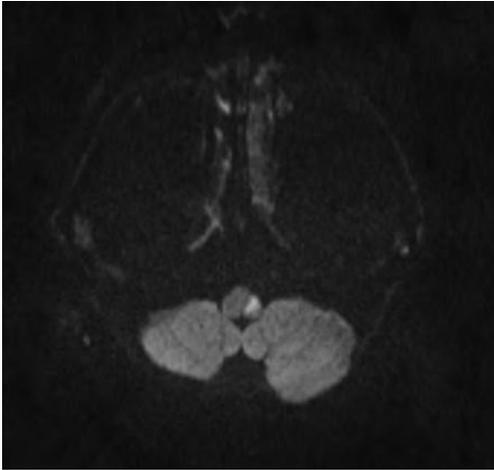


Fig 1. Brain MR

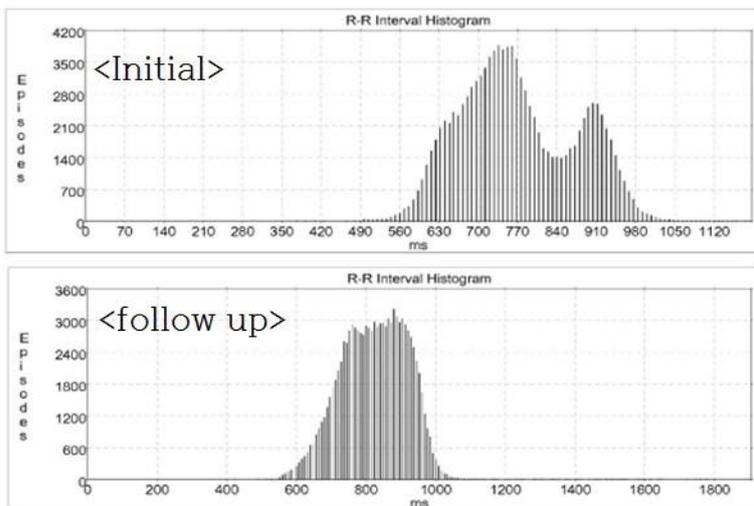


Fig 2. Initial and follow up RR interval in Holter

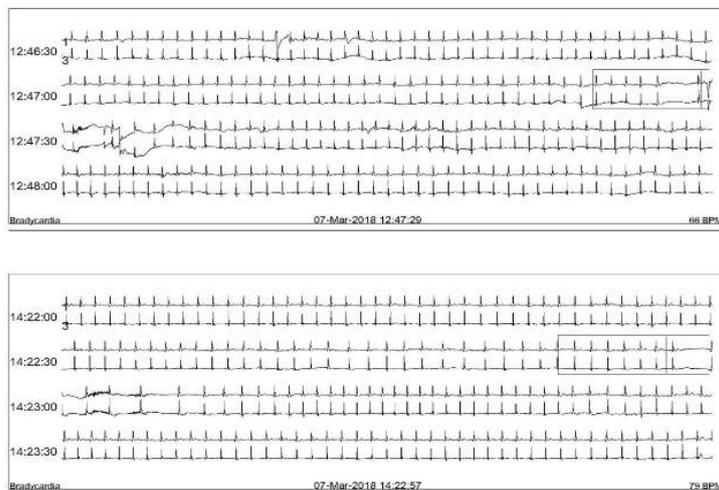


Fig 3. Holter presenting sick sinus syndrome

Cerebellar Mutism Resulting From Cerebellar Intracranial Hemorrhage in An 11-year-old Male Child

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Introduction

Cerebellar mutism is a rare neurological condition characterized by speechlessness. It is reported that most cases Result from posterior fossa surgery for brain tumor in children. Cerebellar mutism can be divided into two phases: the mutistic phase and the post-mutistic phase. The duration of the mutistic phase is variable, lasting from a few days to several months. During the mutistic phase, high-pitched crying is the only form of vocalization, frequently accompanied by behavioral disorders and emotional disorders such as emotional lability, apathy and autistic like behavior. Three subtypes are reported in the post-mutistic phase: dysarthria accompanied by a higher language disorder; language disorder without dysarthria; and behavioral disturbance after mutism.

Case report

An 11-year-old male child presented symptoms of vomiting followed by loss of consciousness. The patient showed deep stupor mentality and brain computed tomography(CT) and angiography showed a spontaneous intracranial hemorrhage on the vermis and right hemisphere of cerebellum with intraventricular hemorrhage in both lateral and 3rd ventricles and crowding of vascularity of posterior fossa. Suboccipital craniectomy and removal of ICH was carried out on the day of the incident. The patient was transferred to rehabilitation department on 48 days post-ictus. He had bilateral weakness, mutism, cognitive defect, ataxia, dysmetria, oropharyngeal dyspraxia due to involuntary tongue movement, dysphagia and voiding difficulties. In the mutistic phase, the patient was only able to vocalize high pitched sounds. In the Language and Speech Evaluation, abnormalities were detected in breathing, speaking, resonance and articulation. The patient scored 40 points, one to seven percentile, in The Korean Version Boston Naming Test for Children (K-BNT-C). Because of the patient had mutism, the examination was conducted as an analogy between words and lips. Language therapy was carried out to improve voice breathing and oro-motor function. In the post-mutistic phase, about three weeks after initiating treatment, the patient was able to speak using vowels, though the patient's speech was still difficult to understand. About seven weeks after initiating treatment the patient was able to pronounce a consonant sound and three syllables. In our most recent evaluation, about four months after initiating treatment, the patient scored 47 points, 42~51 percentile in K-BNT-C. In receptive and expressive vocabulary delay test (REVT), the patient scored 122 points, below ten percentile in receptive vocabulary, 104 points, below ten percentile in expressive vocabulary. The

patient had dysarthria and higher language disorder. The patient frequently omitted grammatical elements and talked slowly with short sentences.

Conclusion

This case reports treatment progress of a language impairment of a rare neurological condition, cerebellar mutism due to posterior fossa surgery for cerebellar ICH.

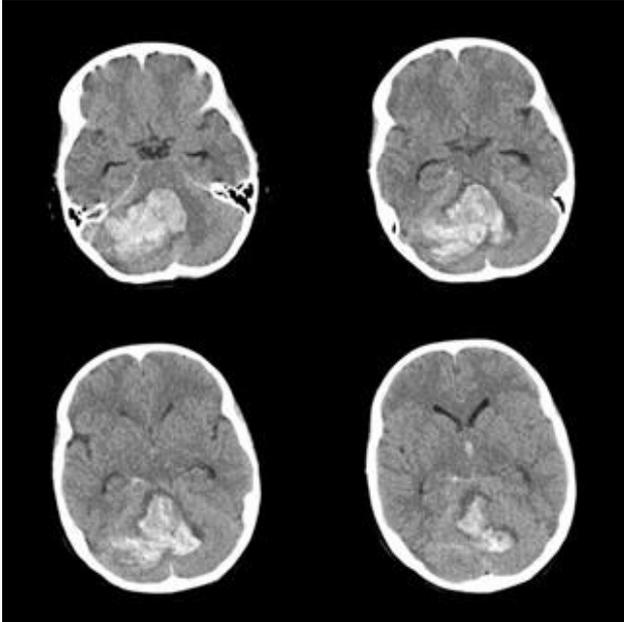


Fig 1. Axial brain CT images. Large amount ICH on the vermis and right cerebellum.

Dysphagia Associated with Cranial Neuropathy after DRESS Syndrome : A Case Report

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Drug Rash with Eosinophilia and Systemic Symptoms (DRESS) syndrome is a severe adverse drug reaction. The clinical triad consists of fever, skin rash and internal organ involvement. To our knowledge, there has been no reported case of cranial neuropathy after DRESS syndrome. We would like to report a case of dysphagia associated with cranial neuropathy after DRESS syndrome. A 47-year-old man with complaints of fever, diarrhea and myalgia was admitted. The patient was diagnosed as pancreatitis by abdominal CT and applied antibiotics. He was treated by cefotaxime for 2 days, meropenem for 8 days, levofloxacin and metronidazole for 4 days in time order. At first 2 days after cefotaxime use, skin rash developed in the whole body. By discontinuing the antibiotics, skin rash showed improvements but fever persisted and pleural effusion developed. In serial laboratory studies, eosinophil count increased from 3.2% to 51.3% in 14 days which was suspicious for DRESS syndrome caused by antibiotics. When eosinophil was at the highest level, the patient complained of newly onset swallowing difficulty. Video fluoroscopic swallowing study (VFSS) was done and the Result showed severe dysphagia. Nasal penetration, residue in vallecular and pyriform sinus, coating of pharyngeal wall, subglottic aspiration after swallow and no epiglottis movement were found by VFSS (Fig. 1). Functional Dysphagia Scale (FDS) was 60, Penetration-Aspiration Scale (PAS) was 8. The patient started tubal feeding and swallowing therapy. To find out the reason for dysphagia brain MRI, laryngoscopy and endoscopy were done. There were no abnormal findings in brain and vocal cord. In endoscopy, there was no esophagitis which could cause dysphagia. In neurologic examination, motor, sensory and deep tendon reflexes were normal. Pathologic reflex was absent. But in cranial nerve examination, right soft palate sagging, slight facial palsy and decreased gag reflex were found. Thus, electrophysiologic studies were conducted. In blink reflex test, there were latency delay in bilateral facial and trigeminal nerve. In facial nerve conduction study, bilateral nasalis muscle amplitude were decreased. Finally the patient diagnosed as multiple cranial neuropathy caused by DRESS syndrome and started steroid therapy. Follow up VFSS was done every week interval. After 2 weeks of steroid therapy, VFSS showed improvement in epiglottis movement and decreased vallecular and pyriform sinus residue. Also, there were no subglottic aspiration (Fig. 2). FDS and PAS improved to 34 and 5 each. By the VFSS Result, the patient could start oral feeding by adjusting viscosity. This case report demonstrates a rare case of cranial neuropathy after DRESS syndrome. Corticosteroid can be considered as a treatment. As dysphagia can improve dramatically after the steroid use, serial VFSS is essential to evaluate swallowing function in patient with cranial neuropathy after DRESS syndrome.

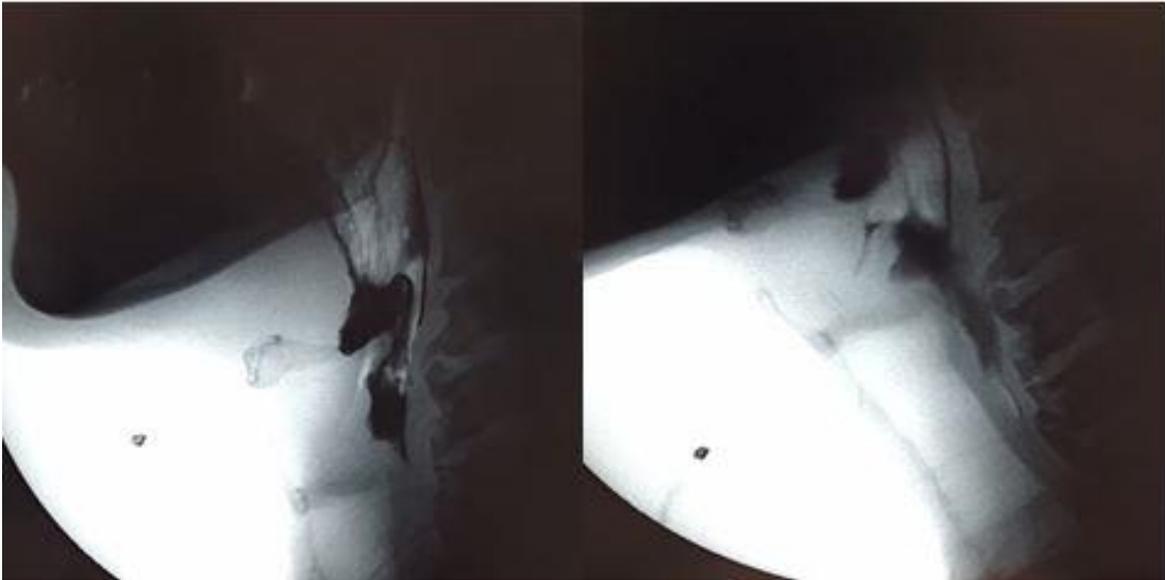


Fig. 1 Initial VFSS showed no epiglottis movement, nasal penetration, vallecular and pyriform sinus residue, coating of pharyngeal wall and subglottic aspiration.



Fig. 2 Follow up VFSS showed improvement in epiglottis movement and decreased vallecular and pyriform sinus residue and no subglottic aspiration.

P 3-127

Recovery of ideomotor apraxia and superior longitudinal fasciculus injury in a stroke patient

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Objectives

No previous study has reported on the recovery of an injured superior longitudinal fasciculus (SLF). In this study, we report on a stroke patient who showed recovery of ideomotor apraxia (IMA) concurrent with recovery of an injured SLF as demonstrated by serial diffusion tensor tractography (DTT).

Methods

A 50-year-old male patient presented with right hemiparesis at the onset of an infarct in the left middle cerebral artery territory. At two weeks after infarct onset, he started rehabilitation and exhibited appropriate response to instruction and an intact ideational plan for motor performance; however, he was uncheckable on Mini-Mental State Examination and showed global aphasia (aphasia quotient 12th percentile) on the Western Aphasia Battery. During 3 weeks of rehabilitation, his ideomotor apraxia test score improved from uncheckable at two weeks after onset to full score at five weeks after onset (full score: 40, cut-off value: 32). On DTT at 2-weeks post-onset, the left SLF fibers showed injury at the inferior parietal lobule (IPL) area. By contrast, the injured left SLF was elongated to the left IPL area on 5-week DTT. In addition, the voxel number of the left SLF was higher on 5-week DTT than on 2-week DTT.

Conclusion

Recovery of an injured SLF concurrent with recovery of IMA was demonstrated in a patient with cerebral infarct. We believe that the recovery of an injured left SLF is an IMA recovery mechanism in patients with brain injury.

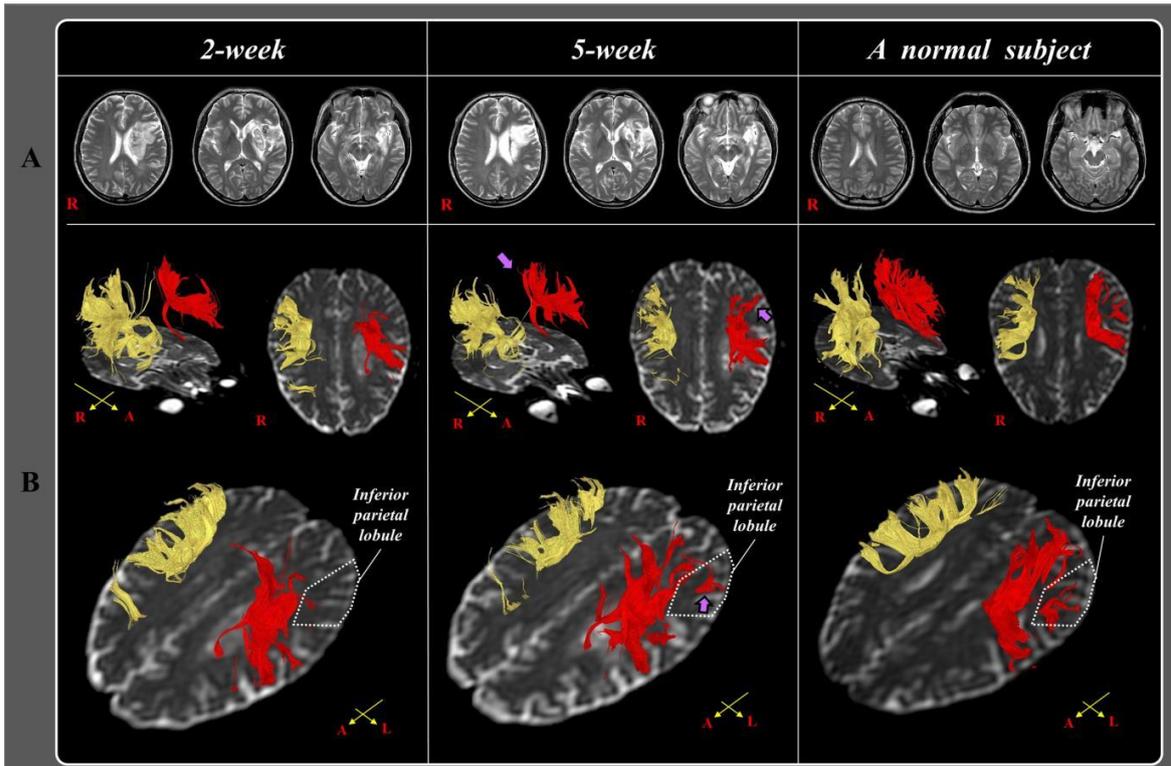


Fig. 1. A: T2-weighted brain MR images at two weeks and five weeks after onset show leukomalactic lesions in the left middle cerebral artery territory. B: Results of diffusion tensor tractography (DTT). The left superior longitudinal fasciculus (SLF) shows injury in the inferior parietal lobule (IPL) area on 2-week DTT. By contrast, the injured left SLF extends to the left IPL area on 5-week DTT (purple arrows)

A Case of Serotonin Syndrome Due to Amantadine and Bupropion in Cerebral Infarction

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Kyung Hee University Medical Center, Department of Rehabilitation Medicine¹

Serotonin syndrome is caused by an excessive increase in serotonergic activity in the central nervous system. It is a potentially life-threatening disease that characterized by mental status changes, autonomic overactivity, and neuromuscular abnormalities. Amantadine is an anti-viral agent as well as an anti-parkinsonism agent. It can increase serotonergic activity. bupropion, well-known its brand names wellbutrin, is a agent usually used as an antidepressant and smoking cessation aid. It is classified as norepinephrine-dopamine reuptake inhibitor. Although the pharmacological action of bupropion is not fully understood, it is thought that it may increase serotonin activity. However, serotonin syndrome related to amantadine and bupropion have rarely been reported. We report a case of 49-year-old stroke patient who developed serotonin syndrome due to amantadine and bupropion. A 49-year-old female patient was admitted to the department of physical medicine and rehabilitation for stroke rehabilitation. She has infarction in both cerebellum, left lateral thalamus & left midbrain. She took amantadine for 7 days to control ataxia symptoms and took bupropion for 14 days to control depression mood. She complained of auditory hallucination and visual hallucination. On the following day, the rigidity and tremor of both upper and lower limbs were worsened. Mental status became drowsy and abnormal behavior was observed. Symptoms were more aggravated and abnormal behavior was so severe that we needed a body restraint. There were unremarkable findings in brain magnetic resonance imaging and computed tomography. Symptoms were aggravated. Body temperature rose to 38 °C. Laboratory test revealed lactate dehydrogenase (LD) 737 U/L (normal up to 271 U/L), creatinine kinase (CK) 14339 U/L (normal up to 145 U/L). The clinical feature and laboratory data led to a diagnosis of serotonin syndrome with neuroleptic malignant syndrome. She admitted to the intensive care unit and stopped all medications except for aspirin. Dantrolene and lorazepam were used to control the symptoms. Two weeks after discontinuation of the drug, the rigidity and tremor of both upper and lower limbs improved and no auditory hallucinations or visual hallucinations were observed. In laboratory data, LD 167 U/L and CK 61 U/L returned to normal values. This is a rare case of serotonin syndrome due to amantadine and bupropion. Taking amantadine and bupropion seems to be synergistic in increasing serotonergic activity.

Treatment of pathologic laughing with duloxetine in stroke patients

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Introduction

Pathologic laughing, a type of emotional incontinence, refers to a condition characterized by uncontrolled episodes of laughter caused by neurologic disturbance. This pathologic state can cause social dysfunction exacerbated by the inappropriate expression of feelings, and it does not improve spontaneously once it occurs. Several medications including selective serotonin reuptake inhibitors have been tried for treatment but the effect is still controversy. Duloxetine, a dual reuptake inhibitor of serotonin and norepinephrine, has been reported to be effective in mood disorder. However, there has been no study on the effects of duloxetine on post-stroke pathologic laughing. Here we present seven cases of pathologic laughing after stroke treated with duloxetine.

Case

Pathologic laughing was defined if patients showed following features: first, laughing could not be controlled voluntarily; second, laughing was triggered by nonspecific stimuli; third, laughing was irrelevant to the preceding emotional state. Medical records and history of patients were reviewed and only those with no previous history of neurologic or psychiatric disorders or drug addiction were selected. Clinical characteristics of the patients are shown in Table 1. Duloxetine was started on an initial dose of 30 mg once daily. The dose was increased 60 mg once daily after one week except two patients. The pathologic laughing scale was assessed daily from when duloxetine was administered. All patients showed a change of score within two weeks after administration (Table 2). After duloxetine administration, all patients reported subjective improvement of symptom. There was no deterioration of the pathologic laughing score in all patients and the change of the score was more than 50% in four patients. No serious side effects were observed in all patients.

Conclusion

Duloxetine is effective in improving pathologic laughing in post stroke patients. This study is meaningful as the first study to investigate the effects of duloxetine in pathologic laughing cases of post stroke patients. As this study is a pilot study without a control group, further controlled study is needed.

Table 1. Clinical characteristics of the patients

	Sex	Age	Etiology	Lesion location	MMSE	Medication in Use
Patient 1	M	47	Hemorrhage	Pons	28	Atomoxetine 10mg#1
Patient 2	F	40	Infarction	Pons	25	None
Patient 3	F	37	Infarction	Pons	30	None
Patient 4	F	38	Infarction	Pons	25	None
Patient 5	F	54	Hemorrhage	Pons	30	None
Patient 6	F	46	Hemorrhage	Pons	30	None
Patient 7	M	44	Hemorrhage	Pons	29	None

MMSE, Mini Mental State Exam

Table 2. Dose and Effects of Duloxetine for Each Patient

	Dose	Initial PL score	Final PL score	Days to respond	Side effect
Patient 1	30mg#1	8	6	3	None
Patient 2	30mg#1 → 60mg#1	12	7	13	None
Patient 3	30mg#1	8	3	14	None
Patient 4	30mg#1 → 60mg#1	16	12	9	None
Patient 5	30mg#1 → 60mg#1	12	0	14	None
Patient 6	30mg#1 → 60mg#1	21	8	4	None
Patient 7	30mg#1 → 60mg#1	4	2	13	None

PL, Pathologic Laughing

Case report : Decannulation in minimally conscious state due to brain hemorrhage patient

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Introduction

For patients with a minimally conscious state (MCS) due to severe brain damage with an endotracheal tube, the timing of decannulation of the endotracheal tube is often delayed because of poor communication and self expectoration. This case is the successful decannulation of the endotracheal tube which has been inserted for 8 months through a respiratory rehabilitation program in MCS patients due to severe brain injury.

Case presentation

A 60-year-old male patient who had Lt. hemiplegia d/t Rt. parieto-temporal lobe ICH & IVH occurred on February 13, 2016, was hospitalized from October 25 to December 9, 2016 for comprehensive rehabilitation treatment. Other than diabetes, he had no history of hypertension, tuberculosis, hepatitis, and recurrent pneumonia. At the time of admission to our hospital, the patient was in MCS, so MMSE evaluation was not possible and CRS-R was 11 point : Auditory 2, Visual 4, Motor 2, Oromotor 1, Communication 0, Arousal 2. He had difficulty in self expectoration, but the peak cough flow was measured to be 230 L/min when coughing was induced using citric acid. On the 2nd day of hospitalization, we consulted otorhinolaryngology and started corking training after confirming that there was no finding of causing obstruction of the upper airway including Vocal cord palsy and Subglottic obstruction. After that, we continued corking training until corking was successful for 72 hours and, on November 4, 2016, decannulation was performed in cooperation with otolaryngology. During the following hospitalization period, decannulation was maintained well without complications. There was no respiratory complications such as pneumonia until he was re-hospitalized 3 months later.

Conclusion

This patient had endotracheal tube for more than 8 months and never attempted decannulation. After administration to our hospital, decannulation was performed and we educated caregiver to prevent complications. Oral suction was carried out 2 ~ 3 times a day to manage the airway secretion of the patient. When he was coughing, assist cough was performed to induce smooth sputum expectoration. In addition, we performed lung capacity training 3 times a day through a cough machine to help with sputum expectoration. Oral hygiene management for infection prevention was conducted more than 4 times a day with hexamedine. These training made it possible for the patient to remain well without pneumonia and O2 saturation decline. Generally, in case of severe brain damage with low consciousness level or severe cognitive decline, the decannulation time of the endotracheal tube is often delayed. This is because many clinicians are worried that the airway management can be difficult after decannulation. Even in this

case, however, active respiratory rehabilitation with caregiver education and training for the management of airway secretions can move up the decannulation time and therefore, the quality of life is expected to be improved.

Intrathecal Baclofen Pump in a Bilateral Craniectomy Patient with Severe Brain Injury: A Case Report

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Objective

Intrathecal Baclofen pump (ITB) has been widely used for controlling spasticity in patients with a variety of upper motor neuron lesions. Here we present a case where ITB pump was successfully utilized in the management of a bilateral craniectomy patient with severe traumatic brain injury.

Methods

An 18-year old female patient was admitted to the emergency trauma center of our medical center on August 28, 2017 after a motorcycle accident. She was in a vegetative state upon arrival, and her initial GCS score was E1 V(T) M1. Initial brain CT revealed traumatic subdural hemorrhage on both fronto-temporo-parietal convexity and multiple skull fracture. The patient underwent an emergent bilateral craniectomy and was referred to the rehabilitation department on September 21, 2017. Initial BBS, MBI, MMSE were 0, 0, 0 respectively, and Ranchos Los Amigos cognitive scale was level 1. Spasticity of MAS grade 3 to 4 was observed in both upper and lower extremities, and Disability Assessment Score (DAS) was checked to be 3 (severe disability) in hygiene, dressing limb position, and pain. Carer Burden Scale (CBS) taken from the patient's mother who was the main caregiver was 'very difficult' in all categories. The patient suffered from episodes of high spiking fever and excessive sweating without evidence of infection, and serum myoglobin was elevated up to 128ng/ml (normal range: 14~106ng/ml), which were thought to be caused by severe spasticity.

Results

After oral anti-spastic medication showed no effect on the patient, she underwent ITB pump insertion upon successful trials. A dose of 100ug/day of Baclofen was continuously injected. Follow up MAS grade was 1+ in the upper extremities and 1 in the lower extremities. DAS showed improvement to 1 (mild disability) and CBS was also improved to 'slightly difficult' in all categories. Her follow up GCS was E2 V(T) M3, and there was no change in mental status, BBS, MBI, MMSE, or Ranchos Los Amigos cognitive scale.

Discussion To our knowledge, this is the first case reported where ITB pump was successfully utilized in a severe traumatic brain injury patient after bilateral craniectomy. ITB may be an effective treatment even in patients with severe brain damage. Rehabilitation should be personalized for each patient regardless of severity, and spasticity control, contracture prevention, and pressure sore prevention may be some factors that are especially important when caring for bed-ridden patients. As shown in

this case where ITB was meaningful in a patient in vegetative state for more than 6 months, ITB may be a useful treatment for severely injured patients with poor recovery pattern. Improvement in spasticity led to improvement in the caregiver's burden, which ultimately Resulted in higher satisfaction of the caregiver. When possible, ITB should be considered for treatment of uncontrolled spasticity regardless of the patient's recovery pattern.

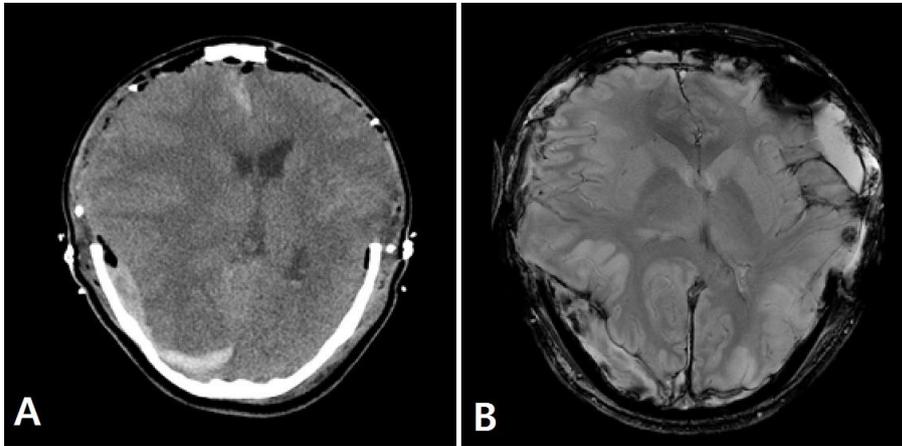


Fig 1. Brain imaging after bilateral craniectomy revealed severe traumatic brain injury. Brain CT showed traumatic subdural hemorrhage on both fronto-temporo-parietal convexity and severe brain edema (A). A GRE image on brain MRI showed diffuse axonal injury (B).

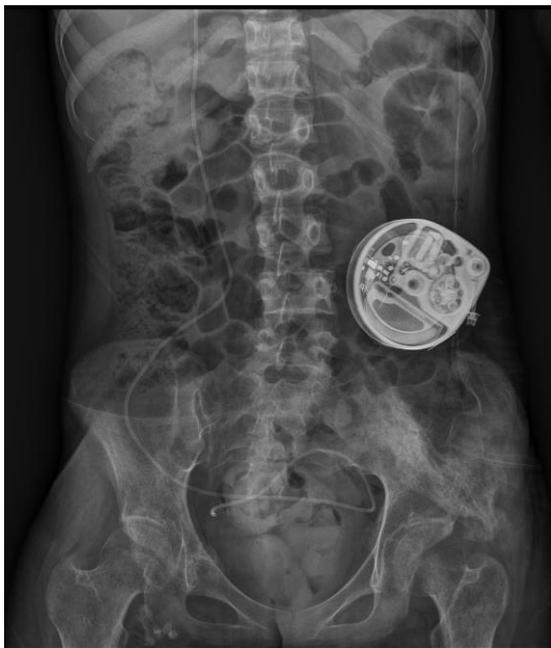


Fig 2. Simple Abdomen x-ray after intrathecal Baclofen pump insertion showed proper positioning of the device. A dose of 100ug/day of Baclofen was continuously injected.

P 3-132

Consistent severe motor weakness due to limb-kinetic and callosal apraxias in a patient with ICH

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Objectives

We report on a stroke patient with chronic severe motor weakness due to combined limb kinetic and callosal apraxias following injury of the corticofugal tract (CFT) from the secondary motor area and corpus callosum (CC) fibers, diagnosed by diffusion tensor tractography (DTT).

Case description

A 66-year old right-handed female underwent CT guided stereotactic drainage extraventricular drainage for intraventricular hemorrhage and coiling of the right unruptured middle communicating artery. She also underwent conservative management for an intracerebral hemorrhage in the right prefrontal cortex and CC. Three weeks after onset, she developed complete paralysis of the left upper and lower extremities. She underwent comprehensive rehabilitation including drugs for recovery of apraxia for two months. However, her left hemiplegia did not significantly improve, with mild recovery of the left lower extremity (the left upper extremity; 0, the left hip flexor; 0 -> 1, the left knee extensor; 0 -> 2-, and the left ankle dorsiflexor; 0 -> 2-). On 2-month DTT, the CFT from the secondary motor area showed narrowing and partial tearing in the right hemisphere. The integrity of the CST was preserved in both hemispheres. However, injuries of the CC fibers from the primary motor cortex and secondary motor area were observed in both hemispheres.

Conclusions

Using DTT, injuries of the CFT from the secondary motor area and CC fibers were diagnosed in a stroke patient with consistent severe motor weakness due to limb-kinetic and callosal apraxias.

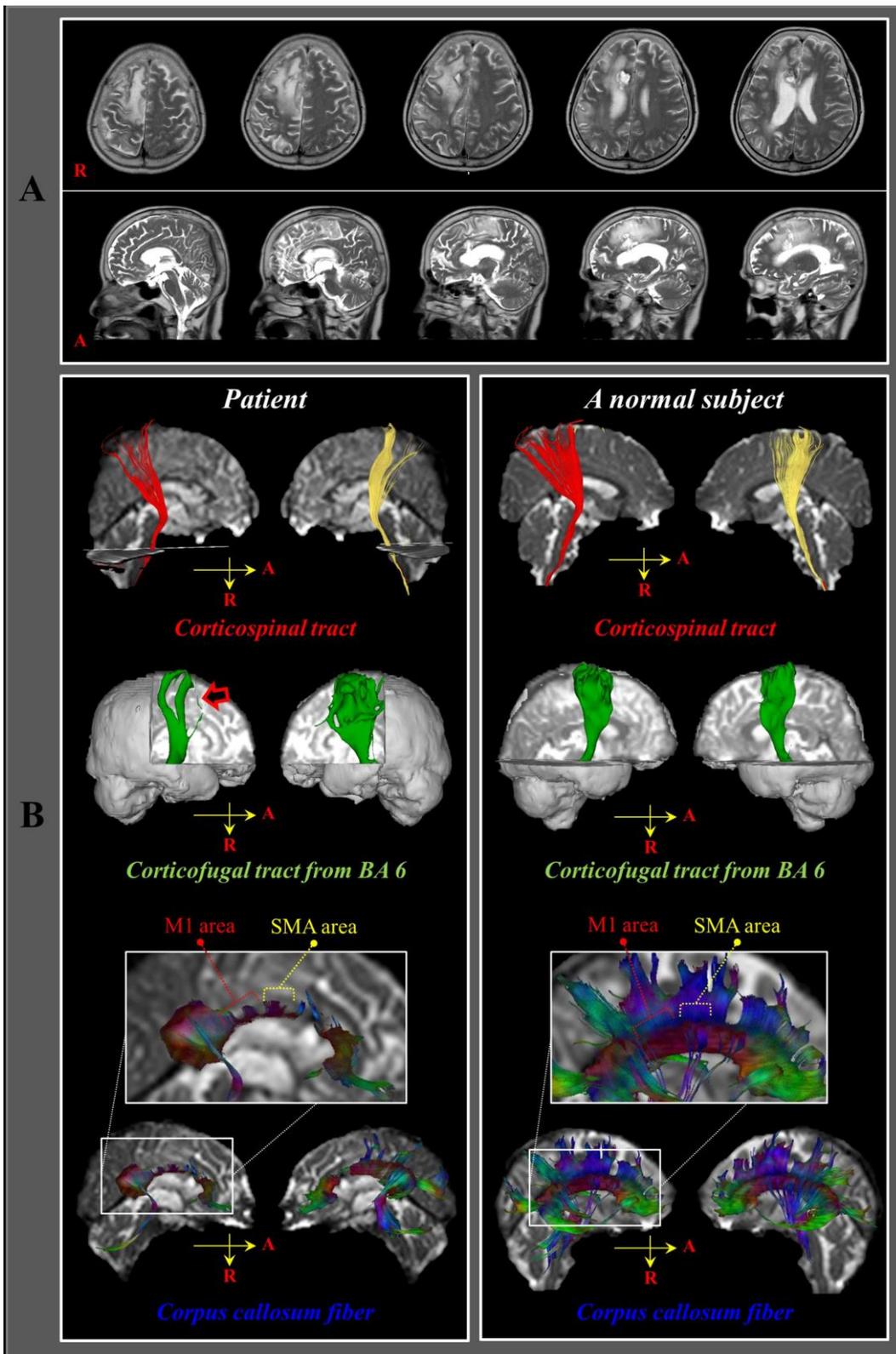


Fig 1. (A) T2-wrighted MR images at three weeks after onset show intracerebral hemorrhage in the right prefrontal cortex and corpus callosum (arrows). (B) On two-month diffusion tensor tractography, the integrity of the corticospinal tract is preserved in both hemispheres. However, narrowing and partial tearing (arrow) is observed in the right corticofugal tract from the secondary motor area (SMA) compared with a normal subject (55-year old female). Injuries of the corpus callosum fibers from the primary sensori-motor cortex (SM1), SMA, and prefrontal cortex in both hemispheres are observed.

Medial thalamic infarction presenting with vertical gaze palsy: A Case Report

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Inha University School of Medicine, Department of Physical & Rehabilitation Medicine¹

Introduction

Although the supranuclear pathways for vertical gaze control are not well defined, vertical gaze palsy has been known to be associated with midbrain lesions. Associated midbrain structures are mesencephalic rostral interstitial nucleus of the medial longitudinal fasciculus, the interstitial nucleus of Cajal, and the posterior commissure. Rarely, vertical gaze palsies can be a manifestation of paramedian thalamic infarction. We report a rare complication case of a patient presenting with vertical gaze palsy secondary to isolated medial thalamic infarct.

Case presentation

A 63-year-old man experienced an acute onset of dysarthria and left side weakness. He has a history of left p-com aneurysm clipping operation, diabetes, hypertension. At admission, the patient was alert and oriented to time, place, and person. A physical examination revealed a vertical gaze palsy involving with bilateral upward gaze palsy and moderate restriction of downward gaze (Fig. 1). Lesion at nuclear oculomotor can be excluded because there were no sign of ptosis, dilated pupil on light reflex test and adduction palsy in this patient. Horizontal gaze was intact. He had left hemianopsia. He had a left hemiparesis with motor power 4/5 and his gait was ataxic. The pain sensation of the left limb was reduced. A magnetic resonance imaging (MRI) scan showed an acute right median thalamic infarct and left occipital lobe. No abnormality was present in the midbrain (Fig. 2). Stenosis of the both PCA artery was seen on magnetic resonance angiography and confirmed by catheter angiography. The etiology of stroke was thought to be due to small vessel disease secondary to uncontrolled diabetes and hypertension. Intravenous tissue plasminogen activator was applied at hyperacute state. Atrial fibrillation was detected in 24hr holter monitoring. Patient was managed symptomatically and received rehabilitation. After 2 weeks of treatment, downward gaze slightly improved but upward gaze did not show any change (Fig. 3).

Conclusions

A prominent clinical finding in our patient was an acute isolated vertical gaze palsy. An acute onset vertical gaze palsy is most often due to midbrain infarction. However, MRI showed right thalamic infarct. Previous studies revealed that the frontal eye fields traverse the medial thalamus. Also, the internal medullary lamina has reciprocal connections with the frontal and supplementary eye fields. So, interruption of these fibers could induce in vertical gaze impairments. We report very rare case of vertical gaze palsy with thalamic infarct.



Fig. 1. Limitation of eye movement to upward and downward position.

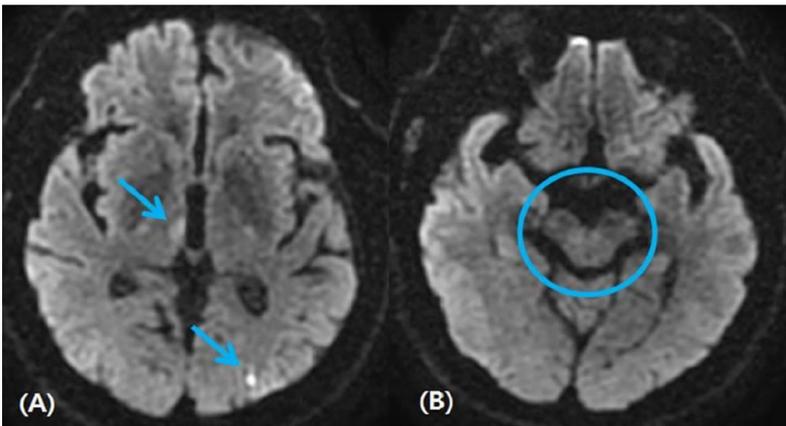


Fig. 2: (A) Brain diffusion MRI revealing right thalamic and left occipital lobe infarcts. (B) Brain diffusion MRI did not reveal evidence of ischemia of the midbrain.

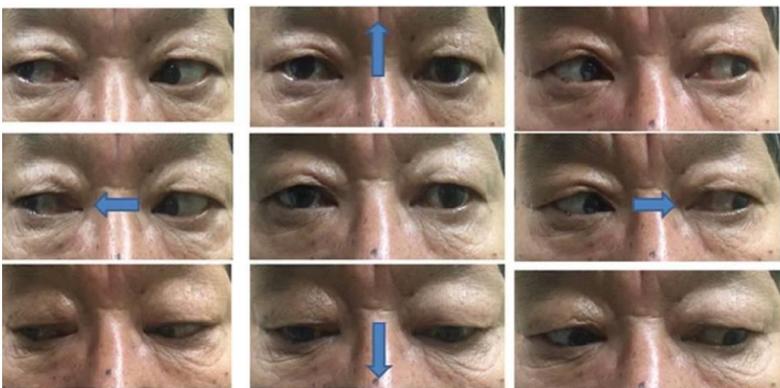


Fig. 3. Limitation of eye movement to up and down position on 2 weeks follow up.

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Paraparesis due to combined injury of CRT and CFT from the secondary motor area in mild TBI

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Objectives

We report on a patient who showed paraparesis due to combined injuries of the corticoreticulospinal tract (CRT) and corticofugal tract (CFT) from the secondary motor area following mild traumatic brain injury (TBI), demonstrated on diffusion tensor tractography (DTT).

Methods

A 46-year-old female suffered head trauma Resulting from in car accident. When she was in a passenger seat in a bus, she was thrown from the seat approximately 1~2 meters while the bus was turning a corner and struck her head on the bus floor. She began to feel weakness in both legs at 4~5 days after TBI. Although she underwent whole spine MRI and electromyography at a university hospital, the exact pathology of the paraparesis was not determined. When she was admitted to the rehabilitation department of our university hospital at five months after the crash, she showed paraparesis in both legs (manual muscle test: 3+/4-) and could not walk independently. In addition, movements of the both legs were slow, clumsy, and mutilated. Motor evoked potentials for hand and leg muscles were normal. On DTT, partial tears of the CRT and the CFT from the supplementary motor area of the subcortical white matter were observed in both hemispheres; however, the integrity of the corticospinal tract was well-preserved in both hemispheres.

Conclusions

Injuries of the CRT and the CFT from the supplementary motor area in both hemispheres were demonstrated in a patient with paraparesis following mild TBI.

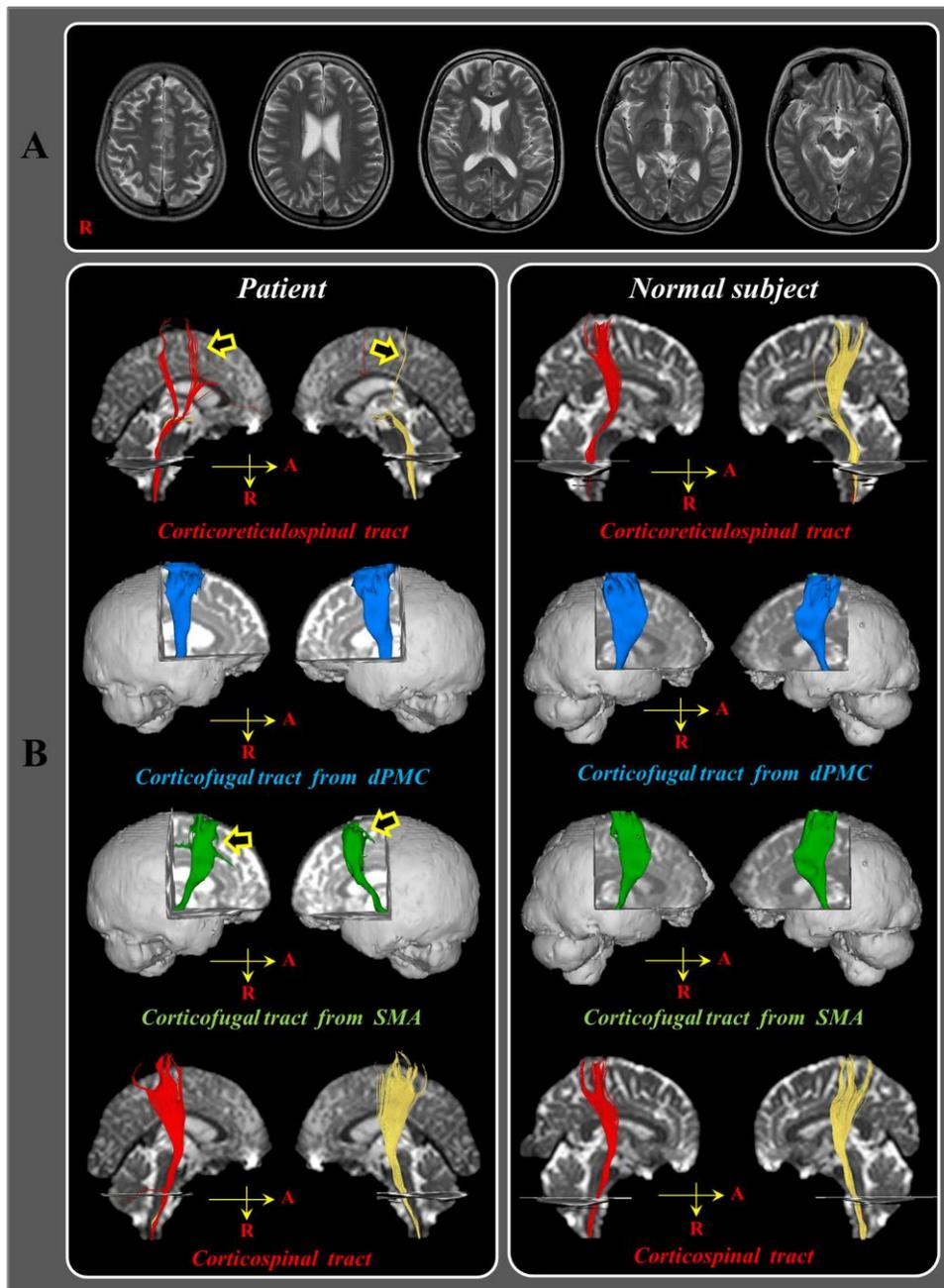


Fig.1 A. T2-weighted brain magnetic resonance images at three months after onset show no abnormality. B. On three-month diffusion tensor tractography, partial tears (arrows) of the corticoreticulospinal tract and the corticofugal tract from the supplementary motor area of the subcortical white matter are visible in both hemispheres, whereas the integrity of the corticospinal tract is preserved in both hemispheres.

Displacement of T-tube and trachea obstruction caused by enlargement of thyroid

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Kwangju Christian Hospital , Department of Rehabilitation Medicine¹

Introduction

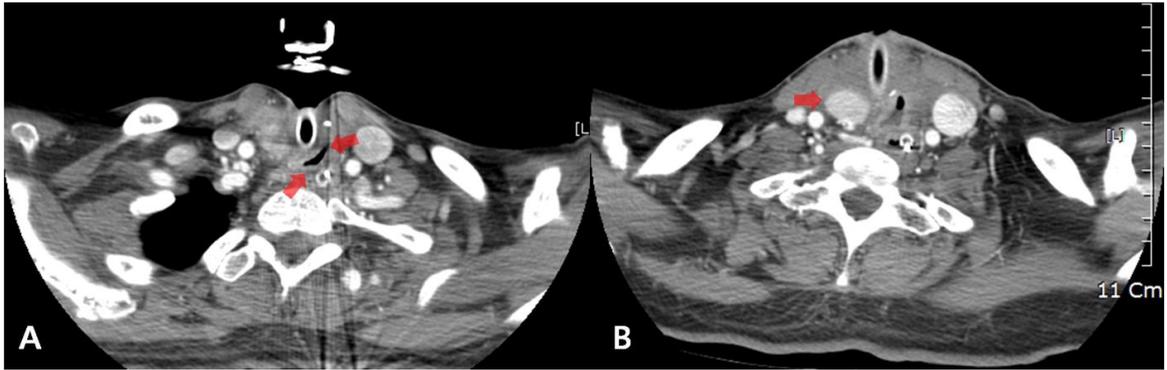
An unidirectional tracheostomy speaking valve prevents expiratory airflow through the tracheostomy tube, providing expiratory flow through the larynx and upper airway, and restoring positive subglottic air pressure. It doesn't have an inflating valve so that it can't fit tight allowing it to move easily and be displaced. So careful observation is required in cases where priority is given to airway management. In this case, we introduce the displacement of the speech tube caused by a thyroid nodule, one of the well-known causes of airway compression and deviation.

Case

41-year-old female patient, S/P Lobectomy of Lt. lobe of thyroid, SAH, ruptured aneurysm clipping, cranioplasty, was hospitalized in speech tube insertion status. The patient was evaluated as quadriplegia, alert mental status, 16 points on K-MMSE and 13 points on MBI. She effectively coughed and the amount of secretion was small without stenosis and engorging granular tissue on fiberoptic airway evaluation. After replacing the speech tube, there was no abnormality of respiration, but after 12 hours, wheezing began to be heard and the patient complained of dyspnea accompanied by cyanosis. We tried to replace the original t-tube, spontaneous breathing disappeared and returned 10 minutes after cardiac compression. On the neck CT scan, the airway was deviated to the left and narrowed due to a thyroid nodule, and the t-tube could not reach the trachea precisely. Therefore through the operation, the existing tracheostomy site was sutured and a new tracheostomy was performed above. [Fig.1]

Conclusion

In general, the tracheostomy tube can be replaced easily. In our hospital, airway evaluation is usually done in cooperation with ENT before airway-tube removal and change. Sudden obstruction of the airway may be caused if the pressure is constantly causing airway deformation as in this case.



[Fig.1] A. Displacement, compression and collapse of trachea adjacent to tracheostomy tube, B. enlarged right lobe of thyroid

Delayed Onset Asymmetrical Swan-Neck Deformity in a Post-Stroke Patient : A Case Report

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Introduction

Swan neck deformity(SND) is characterized by hyperextension of the proximal interphalangeal(PIP) joint and flexion of the metacarpophalangeal(MCP) and distal interphalangeal joint(DIP). Though it is frequently reported to be caused by rheumatoid arthritis, four major categories of clinical conditions including rheumatologic diseases, neurologic problems, hypermobility syndromes and traumatic causes were reported to be associated with SND. We present a case of the post-stroke patient mainly presenting with left side weakness showing delayed onset SND on his right hand.

Case report

A-45-year old right-handed male was admitted to the department of rehabilitation medicine at our hospital for comprehensive rehabilitation therapy. 9 months ago, He suffered from left basal ganglia and intraventricular hemorrhage.(Fig.1.) There was hyperextension of PIP joint and flexion of DIP joint on his 3rd, 4th finger showing a swan-neck deformity with his left hand spared (Fig.2.). There was no previous history of rheumatologic diseases and no evidence of traumatic injury on right hand. At the time of admission, he was bed-ridden state and relied on wheelchair for functional mobility with the K-MMSE of 14. Muscle strength in the right and left upper extremity was graded as three and zero, respectively. The spasticity of the both upper extremity was difficult to evaluate accurately due to poor cooperation. On physical examination, there was no evidence of swelling or erythema on finger joint. But, the patient present pain while we passively flex and extend the finger joint. Additionally, burnell-littler test showed positive suggesting intrinsic muscle tightness. The laboratory test revealed normal CRP, ESR, negative rheumatoid factor and anti-CCP antibody. Radiographic finding of both hands was normal except periarticular osteopenia. Ultrasonography of the finger showed no evidence of synovitis of MCP, PIP joints, and a thickening of the dorsal sided PIP joint capsule and tendinosis of central hood of extensor tendons of the right 3rd and 4th fingers were noted. As his symptoms might be attributed to intrinsic muscle spasticity causing stretching of the PIP volar plate over time, MRI of the brain was done. A newly appeared enhanced lesion in left internal capsule in axial T2-weighted MRI images was found, 9 months after the onset.(Fig.3.)

Discussion

At first, we thought that musculoskeletal disorders might be attributed to the development of ipsilateral SND in our post-stroke patient. However, the opposite side of the brain lesion was proved to be the cause. Although not common, neurologic disorders such as cerebrovascular accident can develop SND. It seems that intrinsic muscle

hyperactivity seems to be predominant mechanism. For the clinicians, it is important to know the stroke as the possible cause of this deformity so that early diagnosis and timely intervention that leads to better functional outcome can be applied.

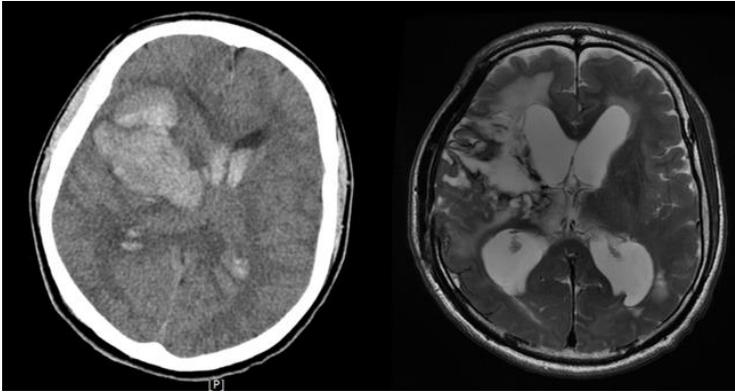


fig1. CT scan of brain demonstrating large intracerebral and intraventricular hemorrhage and T2-weighted fast spine echo MRI of brain taken 3 weeks after the onset.



fig2. Asymmetrical swan-neck deformity of the right hand



fig3. T2-weighted FLAIR axial MRI taken 9 months after the onset shows ventriculomegaly, tissue loss and encephalomalacia in the right deep gray matters as well as infarction in left BG (arrow)

Case report: Improvement of functional level due to use of Methylphenidate in hypoxic brain injury

Jung Hyun Cha^{1*}, Hyun Seok Lee^{1†}, Yong Kyun Kim¹, Kyun Yeon Lee¹

Myongji Hospital, Department of Rehabilitation Medicine¹

Introduction

A hypoxic brain injury is a type of brain injury that occurs when there is a disruption in supply of oxygen to the brain by many different causes, such as cardiac or respiratory arrest. This brain injury can influence the overall parts of the brain so that its recovery process can be different from stroke. Methylphenidate is a drug of choice with ADHD patients. Previous studies revealed that children with low attention and coordination had a functional improvement after methylphenidate was used. In addition, this medicine is also used to improve the concentration and awareness of adult patients with a brain injury. However, there are not many reports of methylphenidate improving functional level in hypoxic brain injury patients.

Case presentation

A 30 year old female patient who had a hypoxic brain injury on Sep. 17, 2017, had been hospitalized for comprehensive rehabilitation treatment from Nov. 14 to Dec. 22, 2017. She had no history of high blood pressure, diabetes, tuberculosis, and hepatitis. At the outbreak of her disease, she had loss of consciousness and hospitalized in local hospital. On Chest X-ray, tension pneumothorax was observed and after both chest tube insertion, cardiac arrest occurred. After 10-minute of CPR, she came to be ROSC. After this event, she had received rehabilitation treatment for about 1 month. When hospitalized at this department of rehabilitation medicine, her MMSE was 9 points and her MMT was U/Ex (G/G) & L/Ex (F+/F+). On Brain MRI, only hypoxic brain injury was observed. However, due to cognitive decline and poor motor coordination, her gait was made possible only with moderate assist. Also, her MBI was 22 points and she needed maximal assist to ADL. She continued to have rehabilitation treatment, but didn't show a large improvement because of her low attention and poor motor coordination. Accordingly, in order to improve her attention and motor coordination in treatment, Methylphenidate 5mg QD began to be used from Nov. 24, 2017. After no side effects were found, it was increased to 5mg BID from Nov. 29. For three months after her disease occurrence, there had been no big improvement. But right after the use of this medicine, she began to be improved fast. On Dec. 6, her f/u MMSE was improved to be 15 points. At the time of discharge, her functional level was increased to supervision gait and MBI score increased from 22 to 90.

Conclusion

This patient didn't have a large decline in muscle power after her hypoxic brain injury, but because of decline in cognition, attention and motor coordination, she showed low functional level and maximal assist in ADL. However, after Methylphenidate was used, her attention, fine motor control, and core muscle coordination were improved. Within

one month until discharging from this hospital, her overall functions were improved. This Result shows that use of Methylphenidate can improve attention and motor coordination in hypoxic brain injury.

Neuromuscular Electrical Stimulation for the Dysphasic Stroke Patient with Cardiac Pacemaker

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Introduction

Electromagnetic interference (EMI), in medical field, means disturbance generated by external source to implanted electrical devices' function. It should be taken into account when medical practice has possible risk. This is the first case report that magnet mode change of pacemaker is applied to reduce EMI risk of patient with dysphasia.

Case

A 72-year-old male, visited emergency room on 4th, August, 2017 due to dysphasia and left hemiparesis. Manual muscle test grade of left extremity was grossly F+~G. He showed severe dysphasia and dysarthria. He was diagnosed as pure motor lacunar syndrome based on clinical symptoms. Levin tube was applied on admission day. The first videofluoroscopic swallowing study (VFSS) was done at 10th hospital day and large amount of thin water was aspirated over vocal cord. (Fig 1. A) We intended to do neuromuscular electrical stimulation (NMES) of pharyngeal muscle for dysphasia, but we should consider EMI to cardiac pacemaker in his chest. The patient was diagnosed as sick sinus syndrome on April, 2016 and DDD type cardiac pacemaker (ACCOLADE™ MRI L331, Boston scientific, USA) was implanted. (Fig 1. B) On 13th hospital day after the written permission of patient, first NMES was carried out for 30 minutes after the technician changed pacemaker to asynchronous mode, with in-situ monitoring of cardiologist to manage the possible emergency. There were no problems during treatment and thereafter, we decided to maintain NMES under cardiologist's monitoring. On the next day, we taped magnet on the pacemaker like fig. 2 to change its mode. Until his discharge on 37th hospital day, NMES was applied daily with magnet mode and electrocardiogram was checked after every NMES session. After discharge, the patient maintained NMES daily during week under attendance of rehabilitation doctor. After 4th VFSS on November, 2017, Levin tube was removed and oral feeding was restarted. Mild penetration was seen on the test, but clinical symptom and pharyngeal movement was improved.

Discussion

Dysphagia after stroke is quite common, and cardiac problem causing pacemaker Introduction is also common predisposing factor for stroke. If these two conditions are combined, it is difficult to decide the best rehabilitation tool. Traditionally, NMES applying to pacemaker patient is contraindicated. However, NMES for dysphagia after stroke is known as treatment choice. The mode change of pacemaker is another option for the dysphagic stroke patient with cardiac pacemaker under meticulous monitoring of

heart condition. Magnetic mode was available since early models of pacemaker but its use is limited, probably due to doctor's unfamiliarity. For this reason, this first case report, NMES with magnet mode change of pacemaker to dysphagia with cardiac pacemaker patient, could be a guidance to make a plan for patients under the risk of EMI.

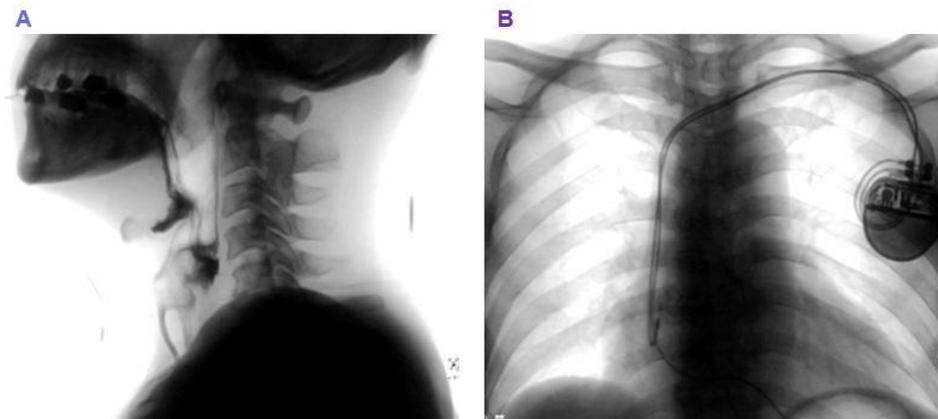


Fig 1. (A) A VFSS lateral view VFSS on 2017.08.14. The picture showed aspirated thin water to trachea. (B) VFSS AP view. Implanted cardiac pacemaker and its two leads toward right atrium & right ventricle.



Fig 2. Pacemaker location and NMES treatment with magnet.

The importance of early oral intake attempts and swallowing rehabilitation after PEG insertion

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Introduction

Generally, Percutaneous endoscopic gastrostomy (PEG) is widely used to provide nutritional support in patients with continuing swallowing difficulties because of its safety and low probability of the complications. And yet, South Korean patients and carers have a wrong perception of the insertion of PEG tube, as a step of giving up the treatment of the patients' swallowing, and doctors tend to concentrate their treatment on preventing complications that may occur when the PEG tube is maintained, rather than thinking of its removal through active swallowing rehabilitation when the PEG tube is inserted. This case was that of a patient in whom swallowing disorder improved when early oral intake attempts and continuous swallowing rehabilitation were made despite the relatively undesirable Result of a videofluoroscopic swallowing study (VFSS) conducted after the insertion of PEG tube.

Case presentation

A male patient aged 36 diagnosed quadriplegia due to ruptured P-com aneurysm was admitted to our hospital for dysphagia rehabilitation from January 30 through March 12, 2018. Percutaneous Endoscopic Gastrostomy (PEG) was conducted with the patient on November 09, 2017 and then, no VFSS examination was conducted. After the hospitalization, VFSS was conducted on February 1, 2018 and as a Result of a measurement, at semi-solid 8cc, the remnant 60% and post-swallowing aspiration was observed. Later, dinner was started from dysphagia stage 1 diet, and he was discharged from the hospital after receiving swallowing rehabilitation therapy, including vital stim. And then, he was hospitalized again in our hospital on June 19, 2018 and VFSS was conducted on June 21, 2018. As a Result of an examination, at semi-solid 4/8cc, the remnant was 10%, and the post-swallowing aspiration (-) was observed, and at liquid 4cc, pre+during swallowing aspiration (+) was observed (Table 1)(Figure 1). After the examination, now, he has lunch and dinner through dysphagia stage 2 diet, and PEG removal is considered by allowing even the oral intakes of breakfast in the future.

Conclusion

This patient had aspiration at semi-solid 8cc in VFSS conducted at the time of his first hospitalization, so it was hard to attempt oral intakes. And yet, early oral intake was started with active swallowing rehabilitation, and since there was no complication like aspiration, later, so we were able to raise dietary stage. As a Result, he could be in a state in which he could intake dysphagia stage 2 diet twice a day. Judging from this Result, the process of active swallowing rehabilitation and early oral intake attempts, so that PEG removal can be made even after PEG insertion, can show a better Result in the prognosis.

In addition, if this treatment process is generalized, the existing wrong perception that the patients and carers think that PEG insertion is a process of giving up the treatment of swallowing disorders will be corrected.

Table 1. Comparison between 18.02.01 and 18.06.21 videofluoroscopic swallowing study Result

시행날짜	Oral phase time	Pharyngeal phase time	Semi-solid 8cc	Liquid 4cc
18.02.01	20sec	10sec	Rem. 60% Post-swallowing aspiration (+)	
18.06.21	10sec	1sec	Rem. 10% Post-swallowing aspiration (-)	Pre, during-swallowing aspiration (+)

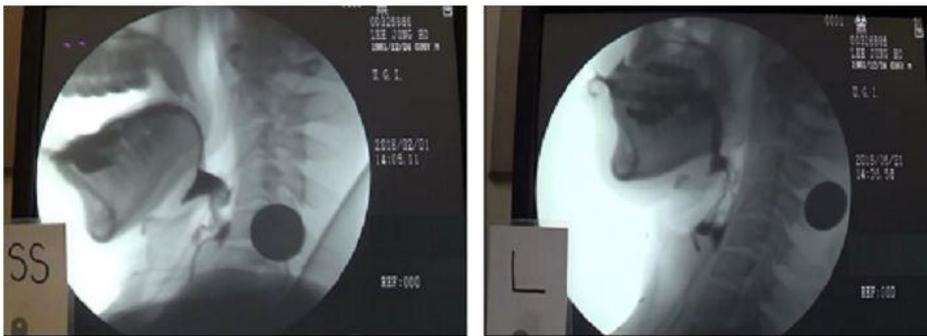


Figure 1. 18.02.01(left) and 18.06.21(right) videofluoroscopic swallowing study Result

Holmes tremor treated with anticholinergics : A Case Report

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Introduction

Dopaminergics has been used as treatment of choice for Holmes tremor (HT). Anticholinergics was also regarded to be an option of treatment, but only a few cases have been reported to have successfully treated with anticholinergics. We report a case that a patient with HT, who had not responded to dopaminergics and got a dramatic improvement after taking anticholinergics.

Case report

In August 2017, a 58-years-old woman with previously healthy condition was admitted to the department of neurology through the emergency unit with headache and vomiting. Since then, her mental status changed due to ruptured PCoA aneurysms. She underwent coil embolization, burr hole trephination and SDH removal. In October 2017, hydrocephalus was found in CT. So we gradually tapered the VP shunt pressure from 120mmH₂O to 40mmH₂O. One month later, hand tremor occurred on the left (Resting and postural tremor, 3.5-4Hz, moderate amplitude < 1cm). This tremor was measured as grade 2 when we used the Fahn-Tolosa-Marin scale(FTM) part A. Laboratory Results including serum electrolytes, urea, free T4 were within normal limits. No interval changes were found in the EEG from Oct. 2017. Clonazepam, propranolol and levodopa were tried for alleviating tremor. They however had no effect on her tremor. In March 2018, we prescribed procyclidine at a dose of 5mg, three times a day. The effect was so dramatic that the amplitude of HT began to decrease after 2 days of taking procyclidine.

Conclusion

We report a case of dopaminergics-resistant HT that was treated with anticholinergics. In this case, we found out that anticholinergics could be a plausible option of treatment for HT, when HT is resistant to dopaminergics.

Recurrent spontaneous intracerebral hemorrhage in CADASIL patient; A case report

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Bucheon, St. Mary's Hospital, Department of Rehabilitation Medicine¹

Background

Cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) is a rare hereditary, autosomal dominant, cerebral small vessel disease caused by mutations in the NOTCH3 gene. The disease is clinically characterized by migraine, subcortical ischemic events, psychiatric disorders, and cognitive impairment eventually leading to dementia and disability. While CADASIL is considered as a primarily ischemic form of vascular dementia, spontaneous intracerebral hemorrhage (ICH) has recently been reported in association with CADASIL. In this study, we report CADASIL patient presenting with recurrent ICH.

Case description

A 39-year-old right-handed man was admitted to our hospital with chief complaint of right side motor weakness and motor aphasia. He also showed pseudobulbar affect in which he showed uncontrollable episodes of laughing in inappropriate situation. Initial computed tomography (CT) scan showed a left thalamic ICH (Figure 1A). History taking revealed that this was his second attack that he had developed a spontaneous hematoma in the right basal ganglia five months ago and recovered without prominent neurological deficit after weeks of conservative care. He had had no specific underlying disease or trauma history previously, except that he had family history of stroke. His guardian reported that his mother, maternal aunt and uncle had cerebral stroke and disability in their late 40s (Figure 2). At this hospitalization, his initial blood pressure was 160/110 mmHg and anti-hypertensive medication was taken thereafter. All the other clinical and laboratory examination including HbA1c, coagulation profile, and lipid profile except for triglyceride level were normal. Considering relatively young age, identification of the underlying cause of stroke was essential to prevent further strokes. For thorough evaluation of brain parenchyma, brain magnetic resonance imaging was performed. MRI scans documented chronic ischemic change, leukomalacia in both periventricular white matter and microbleeds at both basal ganglia and thalamus (Figure 1B, 1C). Due to the characteristic MRI imaging, family history, and emotional incontinence, the suspicion of CADASIL was raised, and genetic testing was conducted, revealing heterozygous mutation of the NOTCH3 gene (c.994C>T mutation in exon 6), which leads to an arginine-to-cysteine substitution (p.Arg332Cys). The Result of genetic testing was consistent with the diagnosis of CADASIL.

Conclusion

CADASIL can manifest with atypical clinical findings suggesting that CADASIL should always be considered in the differential diagnosis of young patient with recurrent ICH, mood disorder, and positive family history.

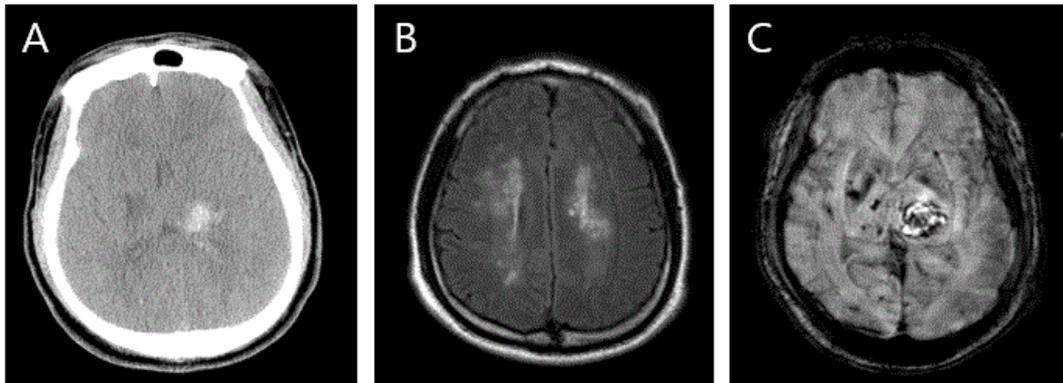


Figure 1. CT and MRI findings in CADASIL patient (A) CT scan shows intracerebral hemorrhage in left thalamus (B) MRI (T2 weighted image) shows chronic ischemic change and leukomalacia in both periventricular white matter (C) MRI (Susceptibility Weighted Image) shows several microbleeds at both basal ganglia and thalamus

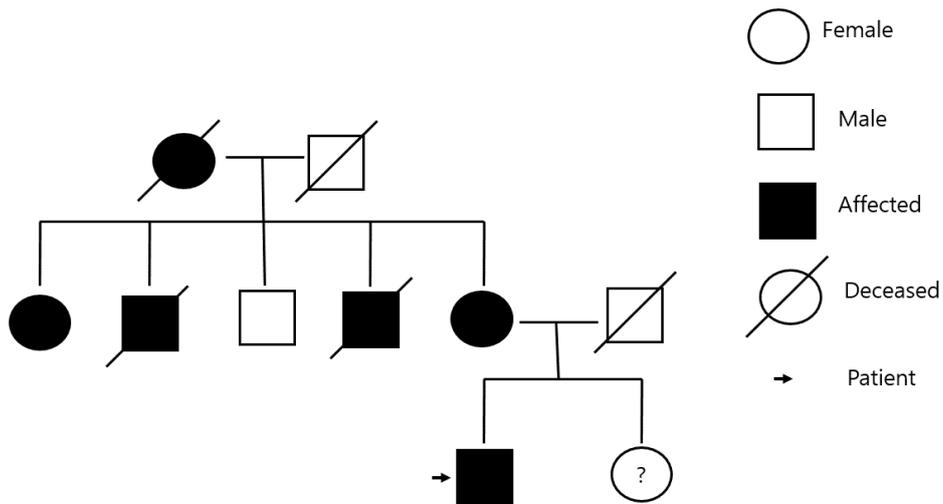


Figure 2. Pedigree tree of CADASIL patient

A case of cerebral infarction due to hypovolemic shock with massive blood loss

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Introduction

Cerebral infarction is usually classified as thrombotic, embolic or lacunar infarction according to pathophysiology. Hypovolemic shock usually causes decreased perfusion of the whole brain, which is hypoxic-ischemic brain injury, which denotes global exposure to and injury from hypoxia. We report a case of the cerebral infarction caused by hypovolemic shock due to massive blood loss after change of percutaneous endoscopic gastrostomy (PEG) tube.

Case report

A 58-year-old man with an old stroke had a PEG tube with severe dysphagia. Because of the long-term use of PEG tube, change of the PEG tube was needed. After change of PEG tube, massive hematemesis occurred. He lost consciousness, and his systolic blood pressure decreased to 40 mmHg and diastolic blood pressure decreased to 16 mmHg and hypovolemic shock occurred. PEG tube regurgitation was performed to confirm upper gastrointestinal (GI) bleeding and a large amount of bleeding was confirmed. Emergency upper GI endoscopy was performed and a large amount of blood was collected across the PEG site. Angiography was performed to stop continuous bleeding. In angiography, Lt. gastric artery bleeding was confirmed and embolization was done. Thereafter, vital was stabilized, and there was no active bleeding at the follow up endoscopy. However, he didn't regain consciousness and seizure occurred 3 days later. We suspected hypoxic-ischemic brain injury due to hypovolemic shock, and MRI was performed to confirm the hypoxic-ischemic brain injury. However, MRI showed recent cerebral infarction in right middle cerebral artery (MCA) and both anterior cerebral arteries (ACA) with cerebral edema. It also showed severe both internal carotid artery (ICA) stenosis. Ultrasonography was performed to discriminate the cardiac emboli, but no specific findings were observed. Since then, he had improved arousal by rehabilitation, but activities of daily living and cognitive function have been severely compromised compared to the previous state.

Conclusion

Hypovolemic shock is known to cause diffuse brain injury due to hypoperfusion and we define it as hypoxic-ischemic brain injury. Not all areas of the brain are equally susceptible to the injurious effects of hypoxia and hypoxia-ischemia. There is the brain area vulnerable to hypoxia, such as superior brainstem, cerebellum, white matter and subcortical structures supplied by the distal branches of deep and superficial penetrating blood vessels and watershed areas. Pathophysiologic processes occurring in hypoxic-ischemic brain injury also are characteristic of the ischemic stroke. However, in general,

hypoxia causes general damage to the brain and ischemic stroke is used to denote injury Resulting from focal or multifocal ischemia that occurring in one or a few specific vascular territories. In this case, we confirmed that hypovolemic shock could cause cerebral infarction due to hypoperfusion depending on the patient's vessel state.

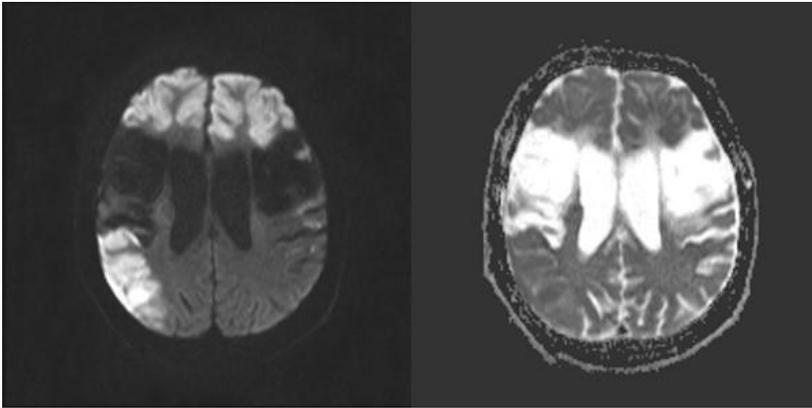


Fig. 1. Both ACA and Rt. MCA infarction with cerebral edema in brain MR



Fig. 2. Both ICA near occlusion in MR angiography

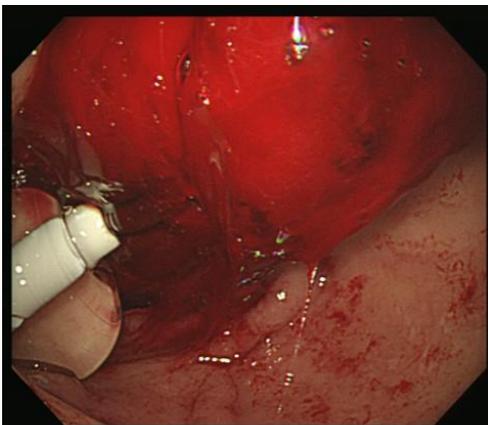


Fig. 3. Massive GI bleeding after PEG change.

Diffusion tensor tractographic findings in a patient with locked-in syndrome

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Objectives

We report on Results of diffusion tensor tractography (DTT) of the corticospinal tract (CST) and the ascending reticular activating system (ARAS) in a patient with locked-in syndrome (LIS) following traumatic brain injury (TBI).

Case report

A 50-year-old female suffered head trauma Resulting from a pedestrian–car accident and underwent conservative management for multiple contusional cerebral hemorrhages at the neurosurgery department of a university hospital. She was transferred to the rehabilitation department of the same university hospital five weeks after her initial injury. Complete weakness of all four extremities was detected on physical examination (Manual Muscle Test: right 0/0, left 0/0). She displayed alert consciousness during daytime and was able to move her eyeballs and, close and open her eyes. However, her cognition was not checkable due to severe quadriplegia and aphasia. DTT at 5 weeks after injury revealed that the CST was discontinued at the midbrain level in both hemispheres. However, the lower dorsal and upper ARAS showed intact configurations except for decreased neural connectivity to the prefrontal lobe of the upper ARAS in both hemispheres.

Conclusions

DTT was used to observe the CST and ARAS in a patient with LIS following TBI. We believe that DTT-based analysis of the CST and ARAS is helpful for precise diagnosis of LIS following brain injury.

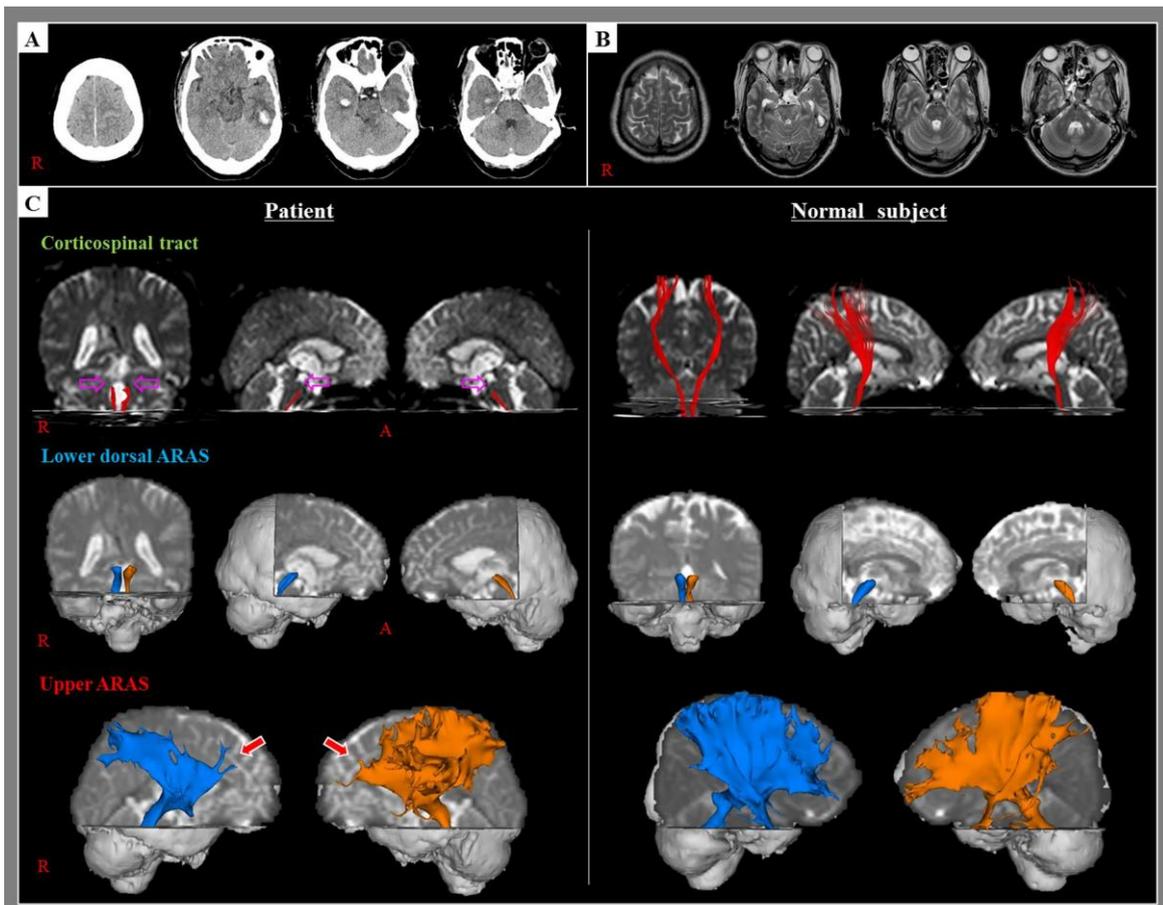


Fig. 1. (A) Brain computed tomography images taken at onset show multiple cerebral contusional hemorrhages. (B) Brain magnetic resonance images taken at 5 weeks after onset show multiple small leukomalactic lesions in the subcortical white matter including that in the left frontal area and the right thalamus. (C) Results of diffusion tensor tractography (DTT) for the corticospinal tract (CST) and ascending reticular activating system (ARAS). The CST is discontinued at the midbrain level (pink arrows) in both hemispheres compared to that in a normal subject (51-year-old female). However, the lower dorsal and upper ARAS showed intact configurations except for decreased neural connectivity to the prefrontal lobe of the upper ARAS (red arrows) in both hemispheres compared to a normal subject (48-year-old female).

Incidental bladder diverticulum in stroke patient with benign prostatic hyperplasia: a case report

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Introduction

Bladder diverticulum is herniation of the bladder mucosa and submucosa through bladder wall with multifactorial causes that can either be acquired or be congenital. It often has no symptom and is diagnosed by chance during examination for other reason, but it sometimes leads to various urinary symptoms, such as urinary difficulty, retention, hesitancy, etc. We incidentally found the bladder diverticulum in stroke patient with new-onset urinary symptoms.

Case reports

A 79-year-old male with acute lateral medullary infarction complained new-onset urinary difficulty, frequency, and retention after voiding from three days after stroke. He has had mild benign prostatic hyperplasia (BPH) and were taking medicine for 6 years without any urinary symptom. More than 100 ml of residual urine after voiding was checked with the feeling of retention, the difficulties in initiation, and also the frequency. Urology consultation and adding medication did not help him. We conducted the voiding cystourethrography (VCUG) and found two round spaces filled with dye. Computerized tomography (CT) was, then, done and confirmed one of the two as a diverticulum on the upper right side of the true bladder. He underwent diverticulectomy and after 2 weeks of foley catheter, his urinary symptoms disappeared. VCUG was performed again after the surgery and had non-specific findings, except the trabeculation of the wall.

Discussion

Bladder diverticulum is made and grown gradually during various urinary obstructive conditions and he, even had no symptom, had having BPH (one of the urinary obstructive conditions) for several years. So if neuropathic bladder was impressed in stroke patients with BPH, bladder diverticulum can be one of the causes of it. Neuropathic bladder was reported after lateral medullary infarction and in this case, stroke might aggravated his neuropathic bladder, so that the symptoms were expressed.

Conclusion

We report an incidental bladder diverticulum in stroke patient with BPH who complained new-onset urinary symptoms.



The VCUG before the surgery.



The VCUG after the surgery.



Effect of Intrathecal Baclofen Therapy Compared with DBS in Patients with Dystonic Cerebral palsy

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ABSTRACT

Dystonia is a symptom defined by involuntary and irregular contractions of the muscles, which cause movement disorders and postural problems. It is also common for these patients to have later changes in the musculoskeletal system and pain due to spasticity, dyskinesia, and dystonia. However, there remains no permanently effective treatment for patients with severe dystonia. Deep brain stimulation (DBS) in globus pallidus interna (GPi) is a good option for controlling dystonia. Intrathecal baclofen (ITB) has been known to reduce spasticity which did not respond to oral medications and botulinum toxin treatment. Many studies of ITB treatment have reported significant decreases in dystonia. We report a case that showed remarkable improvement in terms of the Short form 36 Health Survey version 2 (SF36), dystonia rating scale (DRS), modified Barthel index (MBI) and Visual analog scale (VAS) for pain after ITB pump (ITBP) implantation compared with DBS in patients with dystonic CP.

CASE REPORT

A 35-year-old female patient came to the rehabilitation clinics at our hospital with posterior neck pain and right upper extremity pain. She was experiencing severe dystonia in her neck and bilateral upper extremities; the DRS showed 66 on the dystonia movement scale, and 19 on the disability scale. In terms of spasticity, right upper extremity scored grade 2, left upper extremity scored 1+ and both lower extremities scored grade 1 on the MAS. She had 53 points on the MBI. She also suffered from pain in the posterior neck pain and both shoulder pain with a VAS of 8 scores. Although she has been treated with oral medication, it was no improvement for pain. After DBS was performed on the GPi, therapeutic outcomes were evaluated through DRS, MBI, SF36 and VAS. On the dystonia movement scale of DBS, the patient scored 66 before DBS, but 3, 6 and 12 months later, she scored 72 which was worse than pre-DBS state. On the disability scale of DBS, the patient scored 19 before DBS, 27 one year after DBS and 22 six years after DBS (Table 1). MBI gradually decreased and it show persistent deterioration of functional level after DBS (Table 2). Spasticity was increased than pre-DBS state. The ITBP was operated for this patient who showed definitive positive response to the ITB test trials, and no adverse events. After the ITBP, starting with 50 µg, dose gradually increased to 130 µg. On the dystonia movement scale, the patient scored 72 before ITBP, but 3 months later, she scored 63. Two year later, the patient scored 64, which was no aggravation of dystonia. On the disability scale, the patient scored 22 before ITBP, but two year later, she scored 20 (Table 1). ADL was also improved in the MBI after the ITBP

(Table 2). Although she had severe posterior neck and shoulder pain scored VAS 8 before the ITBP, the pain score decreased to VAS 1 after the ITBP (Table 3). Post-ITBP satisfaction showed high scores when compared to post-DBS in all the items of SF36 (Table 3)

Table 1. Changes in dystonia rating scale after deep brain stimulation and intrathecal baclofen pump implantation

Dystonia rating scale	Pre-DBS	Post-DBS					ITB test trial		Post-ITBP			
		3 mo	6 mo	12 mo	24 mo	72 mo	Bolus inj.	Infusion	3 mo	6 mo	12 mo	24 mo
Dystonia movement scale	66	72	72	72	70	75	64.5	64.5	63	63	65	64
Disability scale	19	30	26	27	25	22	23	23	21	21	19	20

Mo, Months; DBS, Deep brain stimulation; ITB, Intrathecal baclofen; ITBP, Intrathecal baclofen pump implantation.

Table 2. Changes in modified Barthel index after deep brain stimulation and intrathecal baclofen pump implantation

	Pre-DBS	Post-DBS		ITB test trial	Post-ITBP		
		6 months	72 months		6 months	12 months	24 months
MBI	53	34	27	55	54	51	51

MBI, Modified Barthel index; DBS, Deep brain stimulation; ITB, Intrathecal baclofen; ITBP, Intrathecal baclofen pump implantation.

Table 3. Comparison of the patient's response to the deep brain stimulation and Intrathecal baclofen pump implantation

	Post-DBS	Post-ITBP
Pain (VAS)	8	1
SF36		
Physical functioning	0	50
Role limitations due to physical health	0	75
Bodily pain	22.5	67.5
General health	60	70
Vitality	12.5	62.5
Social functioning	25	100
Role limitations due to emotional problems	0	100
Emotional well being	15	75
Physical component score	20.63	65.63
Mental component score	13.13	84.38

VAS, Visual analog scale; SF36, Short form 36 Health Survey version 2; DBS, Deep brain stimulation; ITBP, Intrathecal baclofen pump implantation.]

An Elderly Case of Post Viral Cerebellar Ataxia after Type B Influenza Virus Infection

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Post viral cerebellar ataxia is a clinical syndrome defined by the rapid onset of cerebellar dysfunction, which manifests primarily as gait disturbance and incoordination. It typically occurs in association with a benign viral illness or vaccination. Although influenza virus was known as a causative agents of post viral cerebellar ataxia in child or young adult, the cases of post viral cerebellar ataxia after influenza infection in the elderly have rarely been reported. We report the case of a 71-year-old patient who had post viral cerebellar ataxia after type B influenza infection. A 71-year-old male patient was admitted at our hospital with a 2-months history of limb and gait ataxia. Two months before coming to the hospital, he got type B influenza infection and presented symptoms of fever, sore throat, myalgia. The symptoms had been improved in 2 weeks, however he developed gait ataxia and looked staggering when he walked. One month later, he suddenly appeared unable to stand and walk, and he also complained severe dizziness, nausea, vomiting and dysphagia. He had no history of any medical or neurological illness. On the neurological examination at admission, he was alert and well oriented. Cranial nerve examination was normal without nystagmus. Cerebellar function test showed remarkable dysmetria and dysdiadochokinesia especially, in the left upper and lower extremities. Gait ataxia was severe enough for him not to walk by himself. Finger-to-nose test, heel-to-shin test found were positive, but, because standing was unable, Romberg's test and tandem gait test could not be performed. Motor power of both lower extremities on manual muscle test was checked as the normal grade but loss of deep tendon reflexes. Electromyography was performed to exclude peripheral neuropathy, but there were no obvious abnormal findings. Blood tests revealed no specific abnormal findings. The serological tests for detection of antibody were all negative. Cerebrospinal fluid examination revealed a cell count of 6 white blood cells with 24% neutrophils, protein 39 mg/dL, glucose 67 mg/dL (serum glucose 95 mg/dL). There was no abnormality on brain magnetic resonance imaging with contrast enhancement. The clinical features and laboratory data led to a diagnosis of post viral cerebellar ataxia. His symptoms improved after treated with steroids and IVIG. He was able to walk and discharged to home. Most Influenza infection is known to cause post viral cerebellar ataxia in children, but we have found it could be rare in elderly as well.

P 3-147

A New Quantitative MAS Based on Joint Angle Data Measured With IMU Sensors for Spasticity

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Background & Objective

Quantitative measurement of spasticity has not been developed yet. Modified Ashworth scale (MAS) had long been used to measure the spasticity, but it is not quantitative. Recently developed modified Tardieu scale (mTS) seems to be quantitative but the inter and intra-rater reliability is low especially in the angle of catch (AOC) measurement. Since spasticity causes major disabilities in brain injured patients, it is necessary to develop a quantitative scale for spasticity measurement. Joint angle during passive range of motion (ROM) can be quantitatively measured with recently developed inertial measurement unit (IMU) sensors. With IMU sensors attached to the spastic limb during the measurement of mTS and MAS, a new quantitative MAS measurement is suggested.

Methods

Patients with spastic upper or lower limb were included. With IMU sensors securely attached to the proximal and distal segments, two independent examiners measured spasticity using standard Methodology for measuring MAS and MTS. Each limb was examined for 5 times. The two examiners rated the spasticity in MAS and angle of catch for MTS. The data driven during the examination were stored in a PC based system and using MATLAB program the angles of total range of motion, AOC, and acceleration rate of the movements were calculated. For measured MAS, inter and intra-rater reliability was calculated. From the data driven with IMU sensors, an angle-time curve was plotted. From this curve, authors could classify the patterns of curve that correspond to the MAS grade. AOC measured manually (or conventionally) was compared to the IMU data.

Results

Inter and intra-rater reliability using IMU for MAS and AOC measurement was higher compared to manual examination. Especially, AOC measured with IMU was more consistent than manual examination. Based on angle-time curve by IMU data, it was possible to classify spasticity and a new quantitative MAS and AOC can be easily defined. (Fig 1. & 2)

Conclusion

Spasticity measurement using IMU sensors provides an Objective measurement Method. MAS and AOC measured with IMU sensors were highly reliable. With the angle-time curve, a new standardized IMU-based MAS could be provided.

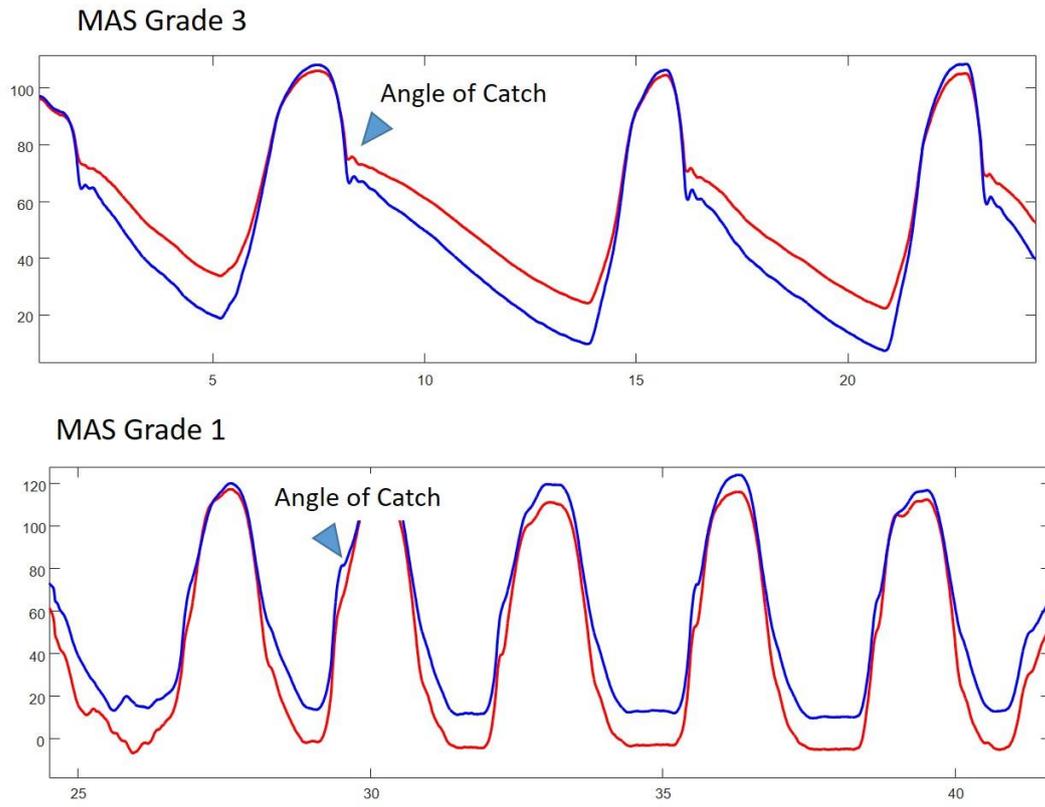


fig1&2. Angle-time curve of MAS 3 (upper) and 1 (lower) driven from joint angle data measured with IMU sensors during passive ROM