

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, Cerebellopontine 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