

P 2-97

Ergometer Elicit Effective Aerobic Exercise in Stroke patients with Slow Speed as much as Treadmill

Young Tae Jeon^{1*}, Eun Young Han^{1†}, Bo Ryun Kim¹, So Young Lee¹, Jong Hyun Kim¹, Won Bin Kim¹, Ho Min Yoon¹

Jeju National University Hospital, Department of Rehabilitation Medicine¹

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 < 0.8 m/s versus walking speed > 0.8 m/s. b: walking speed > 0.8 m/s versus control group. c: walking speed < 0.8 m/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.