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Fall risk prediction using contractility ratio of core muscle measured by US on mild stroke patients

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Introduction

Trunk is the largest part of human body, playing a significant role in stabilization and movement of different body parts. Poor trunk muscle control in stroke patients leads to decreased functional movement and increased risk of fall. In other studies, dynamic components are not considered because only the thickness is measured during trunk muscle evaluation using ultrasound. However, in the case of balance or fall risk, it is assumed that the dynamic component of motion should be considered rather than just the thickness because it is related to the movement of the patient. In this study, we measured contractility and contractility ratio in addition to simple thickness to confirm that the dynamic component of the trunk muscle is useful in assessing the balance and risk of falls for stroke patients.

Method

This study included 55 acute stroke patients treated at the rehabilitation department and their scores of manual muscle test(MMT) in the affected legs were 4 or more. To measure the contractility 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), transversus abdominis(TA), Erector spinae(ES). Contractility was calculated by dividing the active thickness by the resting thickness. Contractility ratio was calculated by dividing the non-paretic side contractility by paretic side contractility. For the functional evaluation of trunk balance, Berg balance scale(BBS) were conducted. And the stroke patients were divided into Group A (BBS score≥46) as a low fall risk group and Group B(BBS score<46) to identify difference in various ultrasound thickness parameter of trunk muscles. We used Mann-Whitney U-test to compare the contractility ratio between high fall risk group and low fall risk group.

Result

Subject characteristics are summarized in Table 1. The average age of the subject was 64.75±13.68 years. The subjects' duration from onest to evaluation was 11.44±10.60, and

that of hospitalization period was 15.91±11.94 days. In the comparison of the simple resting thickness, only non-paretic side and paretic side of ES showed a siginificant difference between the two groups. For contractility, the paretic side of TA and the non-paretic side and paretic side of ES showed a significant difference between the two groups. For contractility ratio, All muscles showed a significant difference between the two groups. (Table2)

Conclusion

In initial evaluation of stroke patients, Simple thickness measurements do not accurately reflect fall risk. The contractility, which reflects the dynamic component, and the contractility ratio, which reflects the difference of contractility between the two sides, are useful tools for predicting fall, especially in thin abdominal muscles.

Table 1. Demographics and characteristics of patients (n=55)

Characteristics	Value
Sex Male : Female	34 (55.6) : 21 (44.4)
Age (yr)	64.75±13.68
BMI (kg/m²)	23.43±2.62
Duration of onset to exam (days)	11.44±10.60
Hospitalization period (days)	15.91±11.94

Stroke type
  Infarction
  Hemorrhage
	
	42
	13

Side of lesion
  Right
  Left
	
	34 (42.2)
	21 (51.1)

Smoking Yes : No	12 (31.1) : 43 (68.9)
Cardiovascular disease Yes : No	5 (6.7) : 50 (93.3)
NIHSS on admission	3.42±3.44
mRS on admission	1.92±1.38
BBS	46.85±7.95

Values are presented as mean±SD or number (%).

BMI, body mass index; NIHSS, National Institutes of Health Stroke Scale; mRS, modified Rankin scale;

BBS, Berg balance scale.

Table 2. Comparison of Contractility ratio groups High fall risk group and Low fall risk group with Berg balance test

	High fall risk group(n=19)	Low fall risk group(n=36)	p-value
Rectus Abdominis M.			
NPS thickness(mm)	6.94±2.20	7.95±2.23	0.117
PS thickness(mm)	6.86±2.45	7.81±2.36	0.103
NPS contractility	1.23±0.13	1.16±1.10	0.061
PS Contractility	1.10±0.09	1.10±0.10	0.852
Contractility ratio	1.11±0.09	1.06±0.06	0.001**
Transversus abdominis M.			
NPS thickness(mm)	2.91±1.36	3.30±1.34	0.125
PS thickness(mm)	2.76±1.34	3.13±1.26	0.172
NPS contractility	1.57±3.55	1.65±0.51	0.979
PS Contractility	1.28±0.27	1.51±0.47	0.026*
Contractility ratio	1.25±0.33	1.09±0.14	0.000**
Erector spinae M.			
NPS thickness(mm)	33.7±4.27	39.5±6.15	0.001*
PS thickness(mm)	33.9±4.02	38.1±6.55	0.019*
NPS contractility	1.20±0.13	1.18±0.09	0.019*
PS Contractility	1.10±0.07	1.14±0.09	0.028*
Contractility ratio	1.10±0.07	1.04±0.04	0.002**

Values are presented as mean±standard deviation.

Non-paretic side; NPS, paretic side; PS, muscle; M.

*p<0.05, **p<0.01 by Mann-Whitney U-test.