

# Relationship between the Balance and Mobility in Stroke Rehabilitation Patients

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## Abstract

Stroke survivors might develop multiple impairment and disabilities; for example motor deficits, difficulties in activities of daily living, mobility, balance, and walking problems. The purpose of the prospective study was to study the relationship between the balance and mobility in stroke rehabilitation patients. Thirty-two stroke patients were enrolled; the Berg Balance Scale (BBS) and Barthel Index (BI) were used to assess patients on the admission and at the time of discharge from the rehabilitation program. There was very strong statistical correlation between the BBS on admission and the BI on admission ( $r\ 0.93, p < 0.01$ ). The BBS on admission was also highly correlated with the BI at the time of discharge ( $r\ 0.85, p < 0.01$ ). The mobility subscale of the BI on admission and at the time of discharge showed correlation ( $p < 0.01$ ) with the BBS on admission ( $r\ 0.90, r\ 0.80$ , respectively). The stairs subscale of the BI on admission and at the time of discharge had correlation ( $p < 0.01$ ) with the BBS on admission ( $r\ 0.66, r\ 0.77$ , respectively). The associations among gain of the BBS with gain of BI (total score  $r\ 0.69, p < 0.01$  and mobility score  $r\ 0.70; p < 0.01$ ) were moderate. There was poor correlation between gain of the BBS and stairs score.

It was concluded that the balance ability was highly correlated with the mobility. The results of this study would be the basic data for further studies about balance and falling in stroke patients.

**Key words:** stroke, Berg Balance Scale (BBS), Barthel Index (BI)

## Introduction

Factors influencing the recovery after stroke include disability on admission, urinary incontinence, weakness, age, and balance.<sup>(1-5)</sup> Good trunk balance is an important factor for mobility and activity of daily living (ADL).<sup>(6,7)</sup> The relationship between balance ability and functional performance (walking and ADL) is important in stroke patients in rehabilitation setting.

The assessment tool of dynamic balance performance is the Berg Balance Scale (BBS). This tool includes 14 functional tasks related to balance function that is frequently used in everyday life. Each task is graded on a five-point scale (0-4). The maximal score for the BBS is 56. The BBS has good validity and reliability for measuring balance in the stroke patients.<sup>(8)</sup> The functional ability is assessed by using the Barthel In-

dex (BI) which is the most widely used activity of daily living : feeding, transfer from bed to wheelchair, grooming, toilet use, bathing, dressing, bladder and bowels control, mobility, and stairs climbing.<sup>(9)</sup> The maximal score is 100. The objective of this research was to study the relationship between the balance and mobility in stroke patients.

### Methods

The prospective study recruited stroke patients, consecutively admitted to Prasat Neurological Institute during March-August 2009, and approved by the ethics committee of the Institute. The inclusion criteria were the stroke patients aged more than 18 years with stable vital signs for 48 hours, ability to maintain sitting position for at least 30 minutes, ability to follow commands, and be co-operative. The exclusion criteria were stroke patients with severe or progressive stroke, visual problems, bedridden, orthopedic problems, for example, osteoarthritis, gout or medical problems affecting balance, and refusal to participate. The informed consents were obtained from all participating subjects. Thirty-five stroke patients were included in this study. Three persons who developed progressive stroke during admission were excluded. Finally thirty-two stroke patients were recruited in the study. After collection of personal data, the patients underwent clinical evaluation. The Berg Balance Scale and Barthel Index were assessed within 24 hours of admission and at the time of discharge from a rehabilitation program.

### Data analysis

Descriptive statistics of the stroke patients on admission were employed and reported in terms of mean and standard deviation (SD). Correlations among the Berg Balance Scale, Barthel Index (total BI score, mobility score, stairs score) were analyzed by Spearman's correlation. P-value less than 0.05 was

considered as showing a significant difference.

### Results

The characteristics of thirty-two stroke patients were shown in Table 1. Of which 65.60 percent were men and 34.40 percent were married. The mean age was 55.09, 11.88 years. The most common type of stroke was infarction (87.50%). The percentages of the patients who suffered from weakness in each side were equal. The comorbid diseases of stroke patients were hypercholesterolemia (75.00%), hypertension (71.90%) and diabetes (34.40%). The clinical evaluation as shown in Table 2 reported the means and standard deviations of the BBS and BI, showing their improvements of balance and functional ability. The same table showed the mobility and stair subscales of

Table 1 Demographic data of the patients

	n (cases)	%
<b>Gender</b>		
male	21	65.60
female	11	34.40
<b>Age (mean 55.09, SD 11.88)</b>		
<b>Marital status</b>		
single	4	12.50
married	26	81.30
widow/divorced/ separated	2	6.30
<b>Type of stroke</b>		
infarction	28	87.50
hemorrhage	4	12.50
<b>Weakness</b>		
left	16	50.00
right	16	50.00
<b>Comorbid diseases</b>		
hypertension	23	71.90
hypercholesterolemia	24	75.00
diabetes	11	34.40
cardiac disease	2	6.30

**Table 2** Comparison of the average score on admission with at the time of discharge

	Score (Mean, SD)		
	Admission	Discharge	Gain
BBS	24.72, 18.02	32.59 17.43	7.87, 6.13
BI	60.47, 19.15	72.97, 19.95	12.50, 9.76
Mobility	5.47, 5.44	10.31, 4.57	4.84, 3.47
Stairs	1.41, 3.17	2.97, 3.78	1.56, 2.36

**Table 3** Spearman's correlation among BBS on admission with BI (total score, mobility score and stairs score) on admission and at the time of discharge. (n = 32 cases)

Spearman's correlation	BBS on admission	BI at		Mobility		Stairs	
		admission	discharge	admission	discharge	admission	discharge
BBS on admission	1.00	0.93(*)	0.85(*)	0.90(*)	0.80(*)	0.66(*)	0.77(*)
		1.00	0.90(*)	0.87(*)	0.83(*)	0.67(*)	0.75(*)
			1.00	0.83(*)	0.91(*)	0.63(*)	0.88(*)
				1.00	0.83(*)	0.66(*)	0.75(*)
					1.00	0.55(*)	0.76(*)
						1.00	0.72(*)
							1.00

\*p < 0.01

**Table 4** Spearman's correlation among score gained of BBS in comparison with gain of BI (total score, mobility score and stairs score) (n = 32 cases)

Score gained	BBS	BI	Mobility	Stairs
BBS	1.00	0.69(*)	0.70(*)	0.29
		1.00	0.60(*)	0.71(*)
			1.00	0.23
				1.00

\*p < 0.01

BI on admission and at the time of discharge.

Regarding to the BBS on admission and the BI on admission and at the time of discharge as shown in Table 3, a strong statistical correlation ( $p < 0.01$ ) was found among them ( $r 0.93$ ,  $r 0.85$ , respectively). The mobility and stairs subscale of the BI on admission and at the time of discharge also had correlation with

the BBS on admission significantly (very strong on mobility  $r 0.90$ ,  $r 0.80$ , moderately strong on stairs  $r 0.66$ ,  $r 0.77$ , respectively).

The associations among gain of the BBS with gain of BI (total score and mobility score) showed moderately strong statistical correlation at 0.01 level of significance ( $r 0.69$ ,  $r 0.70$ , respectively). There

was poor correlation between gain of the BBS and gain of stairs score as shown in Table 4.

## Discussion

The balance control is diminished in the hemiplegic and hemiparetic stroke patients.<sup>(10,11)</sup> Stroke patients have postural control problems such as loss of anticipatory activation during voluntary movements,<sup>(12)</sup> increase sway during standing more on the hemiparetic side,<sup>(13)</sup> and decrease stability during weight shifting while standing.<sup>(14)</sup> All of these could result in the clinical presentations including loss of static and dynamic stability and decreased functional abilities. Trunk balance control in acute stroke is a functional outcome predictor.<sup>(2)</sup> The balance training program is an important part of stroke rehabilitation. The BBS is valid and reliable in stroke patients.<sup>(15)</sup> The physicians can quantify the improvements in balance after stroke rehabilitation. The functional performance can be assessed by using the BI which indicate independent in ADL and mobility.

The previous study reported that the maximum walking speed of stroke patients was related to the sway path of the center of feet pressure in standing and the isokinetic muscle strength of the hemiparetic limb.<sup>(16)</sup> The other study found that the postural control in standing closely related to walking ability and the BI in stroke patients.<sup>(14)</sup> Another study reported that the BBS strongly predicted ambulatory activity levels in hemiparetic patients; the poorest balance would have the lowest ambulatory activity levels.<sup>(17)</sup> The findings of this study were high correlations among the BBS on admission, BI, mobility and stairs subscale of BI on admission and discharge. The associations among gain of the BBS with gain of BI (total score and mobility score) were high. This study demonstrated that the balance ability was highly correlated with the mobility. Poor correlation between gain of the BBS and the stairs subscale of the BI was found in

this study. It may be due to less number of the patients who were able to climb stairs.

These findings would be beneficial to evaluation of stroke rehabilitation patients. The results of this study would be basic data for further studies about balance and falling in stroke patients.

## Conclusion

*This study shows that the balance ability is highly correlated with the mobility. Both BBS and BI are useful, valid and reliable to assess stroke patients. More studies are needed to test whether good balance control can prevent fall after stroke or not.*

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## ความสัมพันธ์ระหว่างความสามารถในการทรงตัวกับการเคลื่อนไหวในผู้ป่วยโรคหลอดเลือดสมอง

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**บทคัดย่อ**

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ผู้ป่วยโรคหลอดเลือดสมองมักมีปัญหาเรื่องความสามารถ เช่น กล้ามเนื้ออ่อนแรง ความยากลำบาก  
ในการประกอบกิจวัตรประจำวัน การเคลื่อนไหว การทรงตัว และปัญหาในการเดิน วัตถุประสงค์ของการ  
ศึกษานี้เพื่อศึกษาความสัมพันธ์ระหว่างความสามารถในการเคลื่อนไหวก้าวในผู้ป่วยโรคหลอดเลือด  
สมอง ผู้ป่วยโรคหลอดเลือดสมองจำนวน 32 คนที่เข้ารับการวินิจฉัยในหอผู้ป่วย สถาบันประสาทวิทยา ได้  
รับการทดสอบการทรงตัวโดยใช้แบบทดสอบการทรงตัวของบิร็ก และประเมินความสามารถในการ  
ประกอบกิจวัตรประจำวันโดยใช้ดัชนีบาร์เทลมเมื่อแรกเริ่มและจำหน้าแยกออกจากโปรแกรมการฟื้นฟูสมรรถภาพ  
พบว่าความสามารถและความสามารถในการประกอบกิจวัตรประจำวันเมื่อแรกเริ่มและจำหน้ามีความสัมพันธ์  
อย่างมีนัยสำคัญ ( $p < 0.01$ ) กับอ้อมแขนและมีนัยสำคัญทางสถิติ ( $r = 0.93$ ,  $r = 0.85$ , ตามลำดับ) การ  
เคลื่อนไหวก้าวเมื่อแรกเริ่มและจำหน้ามีความสัมพันธ์อย่างมีนัยสำคัญกับการทรงตัวเมื่อแรกเริ่ม ( $r = 0.90$ ,  $r = 0.80$ ,  
ตามลำดับ) การขึ้นบันไดเมื่อแรกเริ่มและจำหน้ามีความสัมพันธ์อย่างมีนัยสำคัญกับการทรงตัวเมื่อแรกเริ่ม  
เช่นเดียวกัน ( $r = 0.66$ ,  $r = 0.77$ , ตามลำดับ) เมื่อผ่านโปรแกรมการฟื้นฟูสมรรถภาพ การเพิ่มขึ้นของการทรงตัว  
และความสามารถในการประกอบกิจวัตรประจำวันในภาพรวมและคะแนนการเคลื่อนไหวก้าวมีความสัมพันธ์  
อย่างมีนัยสำคัญกันในระดับปานกลางโดยมีนัยสำคัญทางสถิติ ( $r = 0.69$ ,  $p < 0.01$ ;  $r = 0.70$ ,  $p < 0.01$  ตามลำดับ)  
การเพิ่มขึ้นของคะแนนการทรงตัวกับคะแนนการขึ้นบันไดมีระดับความสัมพันธ์กันต่ำมาก

สรุปได้ว่าความสามารถในการทรงตัวมีความสัมพันธ์กันอย่างมากกับการเคลื่อนไหวก้าว ผลการศึกษานี้จะ  
เป็นประโยชน์ในด้านเป็นข้อมูลพื้นฐานในการศึกษาเรื่องการทรงตัวและการเดินในผู้ป่วยโรคหลอดเลือด  
สมองต่อไป

**คำสำคัญ:** แบบทดสอบการทรงตัวของบิร็ก, โรคหลอดเลือดสมอง, ดัชนีบาร์เทลม