Risk factors related to falling in stroke patients: a cross-sectional study

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Abstract. [Purpose] The purpose of this study was to investigate a comprehensive understanding of the factors associated with falls in poststroke patients. [Subjects] Forty-eight stroke patients (22 males and 26 females; age 63.79 years) participated in this study. [Methods] This study applied a cross-sectional design. Fear of falling [Falls Efficacy Scale (FES)], balance function [Berg Balance Scale (BBS) and Modified Rivermead Mobility Index (MRMI)], ADL performance level [Modified Barthel Index (MBI)] and cognitive function [Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Populations (LOTCA-G)] were assessed. [Results] Falls efficacy was moderately correlated with ADL performance, balance, and cognition. In addition, stepwise linear regression analysis revealed that ADL performance was the explanatory variable closely associated with falls efficacy in stroke patients. [Conclusion] ADL performance was the primary explanatory variable of falls efficacy according to regression analysis. Thus, we suggest that these results may be used as basic data for developing rehabilitation programs for prevention of falls in stroke patients.
Key words: Activities of daily living, Fall, Stroke

INTRODUCTION

Falling is one of the most common complications of stroke patients[1, 2], and falling can lead to reduction of independence of activities of daily living such as eating, bathing, dressing, toileting, and transferring in patients[3]. In addition, falling is a leading cause of fractures for 23–50% of stroke patients[4]. Thus, understanding of falls risk is necessary for prevention of dependent ADL and secondary injuries. Pevious studies demonstrated that depression and cognitive and physical function were associated with falling in stroke patients[2, 4, 5]. Krishchiunas and Savitskas reported that falls can interfere with functional recovery in stroke patients[6], and Cho and Lee demonstrated that impaired dynamic balance ability is associated with falls in stroke patients[2]. In particular, falling leads to the fear of falling and serious injuries such as a hip fracture and head injury[7]. Although some factors associated with falling of stroke patients have been identified, the factors that can predict prevented falls in stroke patients are still unclear. Thus, the purpose of this study was to investigate and comprehensively understand the factors associated with falls in poststroke patients.

SUBJECTS AND METHODS

This study was a cross-sectional study using retrospective analysis of records from patients admitted to a rehabilitation department. Fifty-four stroke patients participated in this study. All patients underwent a standardized rehabilitation program consisting of physical and occupational therapy. The objectives and requirements of the study were explained to all patients, and they signed informed consent forms. This study, a retrospective review of the patients' medical records, was approved by the Institutional Review Board of SunMoon University (SM-201410-030-2). Initial screening was performed using a medical chart. Participants with a previous history of dementia, significant difficulties in language expression or comprehension, presence of other neurological disease, or inability to provide informed consent were excluded. Six participants were excluded because of difficulties in language expression (n=2), previous history of dementia (n=2), and the inability to provide informed consent (n=2). Thus, 48 participants were included in the final analysis. The fear of falling and balance were evaluated by physical therapists, and ADL performance and cognitive function were evaluated by occupational therapists. Fear of Falling was evaluated using the Falls Efficacy Scale (FES). The FES was designed to assess the degree

of perceived efficacy at avoiding a fall during each of 10 relatively non-hazardous activities of daily living (taking a bath or shower, reaching into cabinets or closets, preparing meals that do not require carrying heavy or hot objects, walking around the house, getting in and out of bed, answering the door or telephone, getting in and out of a chair, getting dressed and undressed, light housekeeping, and simple shopping). Each response was scored on a scale of 1 (completely confident) to 10 (no confidence), with a high score indicating low falls self-efficacy[8]. Balance was evaluated using the Berg Balance Scale (BBS) and Modified Rivermead Mobility Index (MRMI). The BBS is a valid and reliable instrument for measurement of both the static and dynamic aspects of balance in elderly people after stroke[9]. The MRMI assesses 8 aspects of mobility ranging from turning over in bed to managing stairs. Lennon and Johnson tested the MRMI for face and content validity, and found that it had responsiveness (effect size = 1.15), test-retest reliability (r = 0.731), inter-rater reliability (ICC = 0.98), and internal consistency (Cronbach's alpha = 0.93)[10]. ADL performance level was evaluated using the Modified Barthel Index (MBI). The MBI is a measure of ADL that shows the degree of independence of a patient. It covers 10 domains of functioning (activities): bowel control, bladder control, grooming, toilet use, feeding, transfers, walking, dressing, climbing stairs, and bathing[11]. Cognitive function was evaluated using the Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Populations (LOTCA-G). The LOTCA-G provides information about the patient's abilities and deficiencies and about their capacity to cope with daily and occupational tasks[12]. LOTCA-G consists of 7 major areas containing 24 items. The areas investigated include orientation, perception, praxis, visuomotor organization, thinking operation, memory, attention, and concentration. Each subset is scored, and the total score ranges from 24 to 104. Data were analyzed using SPSS for Windows version 12.0 (SPSS Inc., Chicago, IL, USA). Pearson correlation coefficients were used to evaluate the relationships among the variables. Stepwise linear regression analysis was used to elucidate the explanatory factor associated with falling. Statistical significance was accepted for values of $p < 0.05$. Data are presented as the mean with standard deviation (SD) values.

RESULTS

The clinical characteristics of the patients (22 females and 26 males; average age 63.79 years) are shown in Table 1. Correlations between falls efficacy and variables are summarized in Table 2. Falls efficacy was moderately correlated with ADL performance (r=0.782, p<0.001), balance (BBS: r=0.669, p<0.001; MRMI: r=0.545, p<0.001), and cognition (r=0.667, p<0.001). In addition, stepwise linear regression analysis revealed that ADL performance (r^2=0.758, F=37.742, p<0.001) was the explanatory variable closely associated with falls efficacy in stroke patients.

DISCUSSION

Falls are common and recurrent problem in stroke patients and older adults[4, 13]. In particular, in the field of stroke rehabilitation, it is important to consider a variety of factors that can lead to a fall, such as the fear of fall-

Table 1. Demographic data of the subjects (N=48)

Variables	Mean±SD
Gender	
Female /male (%)	22/26 (54.2/45.8)
Affect side	
Left / right (%)	24/24 (50/50)
Type of stroke	
Infarction/ hemorrhage (%)	31/17 (64.6/35.4)
Age, years	63.7±10.7
Duration, days	389.1±236.1
MAS-U/E (0/1/1+/2)	26/12/5/5
MAS-L/E (0/1/1+)	32/8/8
LOTCA -G, points	87.5±11.9
MBI, points	58.6±13.7
FES, points	64.1±18.5
MRMI, points	34.1±4.4
BBS, points	37.2±11.1

SD: standard deviation; Duration: Days between stroke onset and assessment; MAS: Modified Ashworth Scale; LOTCA-G: Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population; MBI: Modified Barthel Index; FES: Falls Efficacy Scale; MRMI, Modified Rivermead mobility Index; BBS: Berg Balance Scale

Table 2. Correlation between variables (N=48)

	FES	BBS	MRMI	LOTCA-G	MBI
FES					
BBS	0.669**				
MRMI	0.545**	0.703**			
LOTCA-G	0.667**	0.425**	0.409**		
MBI	0.782**	0.558**	0.372**	0.462**	

FES: Falls Efficacy Scale; BBS: Berg Balance Scale; MRMI: Modified Rivermead mobility Index; LOTCA-G: Loewenstein Occupational Therapy Cognitive Assessment for Geriatric Population; MBI: Modified Barthel Index
**p<0.01

ing, balance impairment, and cognitive dysfunction[4, 14]. In addition, better understanding of the factors related to prevention of falling may assist in the development of stroke rehabilitation strategies and enhancement of independent ambulation[4, 6]. Thus, the current study examined the risk factors associated with falling in poststroke patients. In the current study, falls efficacy was positively correlated with ADL performance, balance, and cognition. These findings are consistent with previous results indicating that impairment of cognitive function and impairment of balance and self-care are the risk factors associated with falls[15, 16]. Another interesting finding of the current study was that regression analysis revealed that ADL performance was the primary explanatory variable of falls efficacy. The ultimate goal of stroke rehabilitation is for stroke patients to be able to independently perform ADL after returning to their communities and homes[17, 18], and prevention of falls is one of the most important factors for recovery of independent ADL performance[14]. Thus, we suggest that detailed assessment of the ability of stroke patients to perform ADL is necessary, and ADL training should be emphasized for prevention of fall in stroke rehabilitation. In particular, monitoring of the ADL level may be helpful for predicting falls in stroke patients. Present study has several limitations. First, because a small number of subjects were recruited, the results of this study cannot be generalized to all stroke patients. Second, despite the fact that several factors, such as changes in level of awareness, use of medication, lack of incontinence in the environment, and increased age, may contribute to falling[19], it was not considered in this study. Further investigation is required on this issue. In conclusion, we found that the ADL level may be useful for monitoring falls in poststroke patients. We suggest that these results may be used as basic information for developing rehabilitation programs for prevention of falls in stroke patients.

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