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Original Article

Fear of Falling in Patients with Chronic Stroke: Differences of Functional Gait and Balance Measures According to the Level of Concern about Falling

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ABSTRACT

Background: In this study we investigated the differences of functional gait and balance measures between patients with chronic stroke with different level of concern about falling.

Methods: Fifty-four patients with chronic stroke participated in this observational, cross-sectional study. The level of concern relating to falls was assessed by using the Falls Efficacy Scale-International. Thirty-three patients were classified as slightly concerned about falling, while twenty-one patients were highly concerned. Patients performed functional gait and balance tests including Berg Balance Scale, Timed Up & Go test, 10 Meter Walking Test and Functional Gait Assessment. The difference in outcome measures between the two groups was determined by an independent t-test.

Results: All functional gait and balance tests of patients with high concern about falling were poorer than those for patients with slight concern.

Conclusion: The level of concern relating to falls may influence gait and balance performance in individuals with chronic stroke and should be addressed in traditional gait and balance rehabilitation programs.

Introduction

Falling is a common complication during all stages after stroke and may have severe consequences, both physically and psychosocially [1-3]. The physical consequences of falls include increased risk of fractures, especially of the hip, and soft tissue injuries may significantly decrease the level of physical activity and independent mobility [2,3].

The most recognized psychological consequence of falls is fear of falling (FOF) [1]. FOF is defined as "a lasting concern about falling that leads to an individual avoiding activities that he/she remains capable of performing" or "low self-confidence" [4]. Concerns of falling can be devastating in stroke patients by limiting activities and mobility, diminishing the sense of well-being, and reducing social interaction [5,6]. Moreover, concern relating to falls can become a risk factor for falls because it decreases physical conditioning and reduces mobility [5-8].

It has been demonstrated that FOF influences gait and balance in older adults [5].A decreased gait velocity and step length, and increased double support time and step width has been also reported in older adults with fear of falling [5].

Rosen et al. identified significant, positive correlations between falls self-efficacy and balance and gait velocity in patients with stroke [9]. Schinkel-Ivy et al. also investigated the relationships between gait velocity, reactive stepping tasks, FOF, and balance confidence in patients with stroke [8]. However, no previous study identified the differences of various clinical measures of

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gait and balance between individuals with chronic stroke with different level of concern relating to falls.

The idea that fear of falling can lead to restriction of mobility emphasizes the need to study the effects that such fear has on patients with stroke.

In a rehabilitation program, special attention should be given to gait and balance impairments in patients with stroke because it often continues into the chronic phases of stroke in spite of early rehabilitation care [10,11]. The results of this study may contribute to the understanding of the factors that determine gait and balance deficits and assist in the design of appropriate treatment programs and to improve gait and balance post-stroke. The aim of the current study was to determine the differences of the functional gait and balance measures between patients with chronic stroke with different levels of concern relating to falls.

It was hypothesized that, compared to patients with slight concern of falling, those with high concern would exhibit poorer performance on all functional gait and balance tests, including Berg Balance Scale (BBS), Timed Up & Go test (TUG), 10 Meters Walking Test (10 MWT) and Functional Gait Assessment (FGA).

Methods

The study design was observational and cross-sectional. A convenience sample of 54 patients with chronic stroke was recruited from rehabilitation clinics. A physician screened patients based on inclusion and exclusion criteria. The diagnosis of stroke was defined according to the World Health Organization (WHO) definition [12]. The inclusion criteria for the study were a history of first-ever stroke greater than 6 months ago, a Mini-Mental State Examination score above 25 [13] and the presence of FOF. The presence of FOF was evaluated by asking participants if they were afraid of falling (yes or no). The exclusion criteria for the study were a history of psychiatric illness and an inability to understand instructions due to severe aphasia or cognitive impairments.

Participants were also asked about their falling history, including the number of falls during the previous six months. The local university provided ethics approval, and all patients signed an approved consent form prior to participation. After that functional gait and balance was assessed using several tests. The valid and reliable Berg Balance Scale (BBS) measured balance during 14 balance tasks. Each task was graded from 0 to 4 and the test included scores ranging from 0 to 56. Higher scores reflect better balance [14,15]. Functional mobility was evaluated using the TUG. In this test, the time needed to get up from a chair, walk forward three meters, turn around, and walk back to sit on the same chair was measured [16]. In the 10 MWT, the preferred gait speed was measured over a distance of 10 meters [17]. Three performances were recorded and the average was calculated. FGA was also used to evaluate postural stability during various walking tasks. The FGA is a 10-item walking test that was developed to evaluate an individual's ability to respond to changing task demands during walking [18]. The performance on the items of the FGA was measured on a four-point ordinal scale (0-3), with higher scores indicating better performance. The maximum score for the test was 30 [18]. The FGA is considered a reliable tool for assessing functional balance during walking in patients with stroke [19].

The level of concern about falling was assessed using the Falls Efficacy Scale-International (FES-I). In this self-reported questionnaire, the patient determines the level of concern relating to falls during 16 daily living activities, including social activities that may contribute to quality of life [20,21]. The level of concern about falling for each activity was scored on a four-point scale (1=not at all concerned, 4=very concerned), and the total score range was 16–64. According to previous literature, the FES-I is a reliable tool for evaluating the level of concern relating to falls in elderly people [21].

Statistical Analysis

Participants were divided into two groups. Group A included people who were slightly concerned about falling, and Group B included those who were very concerned about falling. The scores of the FES-I determined the group allocation. A score of 20 was set as the cut-off point for distribution, based on previous literatures [6,22]. Group A was comprised of participants with scores less than or equal to 20, and Group B included participants with scores greater than 20.

Descriptive statistics were used to characterize the study population. Group differences in age, height, weight, stroke onset, and number of falls were evaluated using an independent t-test. A chi-square test was used to evaluate the group differences in gender, stroke severity, and stroke type. Normal distribution of outcome measures was evaluated using the Shapiro-Wilk test. The difference of the outcome measures between the two groups was evaluated using an independent t-test. Statistical analyses were performed using SPSS statistics software (Version 16 for Windows). For all analyses, alpha was adjusted using the Bonferroni method. Therefore, for the purpose of this study, the adjusted alpha was set at 0.01.

Results

Characteristics of participants are shown in Table 1.

The difference in outcome measures between the two groups is also presented in Table 2.

The results of independent t-tests indicated that the mean values of BBS, TUG, 10 MWT and FGA were statistically significant between the two groups. Patients with slight concern of falling had a significantly higher BBS score than the patients with high concern ($P<0.004$). The TUG test was significantly lower in patients with slight concern of falling compared to patients with high concern ($P<0.001$). Walking speed according to 10 MWT was significantly higher in patients with slight concern about falling compared with patients with high concern ($P<0.004$). Postural stability during various walking tasks that was evaluated using FGA was also significantly higher in patients with slight concern about falling

Table 1: General characteristics of participants

	Group A Low FOF(n=33)	Group B High FOF(n=21)	Groups difference P value
Age (years)	57.15 (10.18)	56.04 (11.98)	0.71
Sex (M/F)	17/16	9/12	0.58
Weight (kg)	68.33 (8.81)	67.64 (9.8)	0.78
Height (cm)	168.18 (5.98)	167.23 (6.39)	0.58
Time since stroke (months)	12.39 (4.47)	11.14 (3.39)	0.27
Hemi-paretic side, R/L	21/12	12/9	0.77
Stroke type (ischemic, hemorrhagic)	27/6	15/6	0.5
Stroke severity (Modified Ranking Scale) (number/score)	4(1), 18(2), 11(3)	5(1),10(2), 6(3)	0.53
Number of falls	0.81 (0.8)	0.9 (0.88)	0.71

Values are mean (SD) for age, weight, height, time since stroke and number of falls. Values are number for sex, hemi-paretic side, stroke type and stroke severity. Group differences were evaluated using an independent t-test or chi-square analysis; M: Male; F: Female; R: Right; L: Left

Table 2: Comparisons of outcome measures between the two groups

Variable	Group A Low FOF(n=33)	Group B High FOF(n=21)	Groups difference
	Mean±SD	Mean±SD	P value
Berg Balance Scale	46.36±3.91	43.38 (2.95)	0.004*
10 Meter walk test (cm/s)	59.35±9.69	51±10.07	0.004*
Timed up & go test (s)	19.66±2.77	22.8±2.68	0.001*
Functional gait assessment	23.27±2.56	21.04±2.39	0.002*

Statistical methods: group differences were evaluated using an independent t test. *The Bonferroni corrected alpha was 0.01.

compared with patients with high concern (P<0.002).

Discussion

The aim of the current study was to determine the differences of the functional gait and balance measures between individuals with chronic stroke with different level of concern relating to falls.

It was hypothesized that, compared to patients with slight concern about falls, those with high concern would exhibit poorer performance on all functional gait and balance tests.

The current study found higher gait and balance performance levels in terms of BBS, TUG, 10 MWT and FGA in patients with slight concern about falling compared to those with high concern. A study by Schmid et al., indicated that patients with chronic stroke with FOF had significantly decreased balance compared to patients with no FOF [7]. Interestingly, results from investigations in patients with acute stroke appear to differ [23,24]. Some studies identified no significant differences in BBS scores between patients with acute stroke who did and did not FOF [23,24]. While Schmid et al. demonstrated that BBS scores were significantly higher in patients with chronic stroke without FOF compared to those with FOF [7], the findings of this study indicated that BBS scores are also different between patients with chronic stroke relative to their level of concern about falling. The difference between the studies may be because of the decrease level of functional balance in patients with acute stroke. In such conditions, the presence of FOF may not have a significant effect on functional balance measures.

The findings of the current study indicated that walking speed based on 10 MWT was higher in patients with slight concern relating to falls compared to those with high concern. Rosen et al. reported significant, positive correlations between FES (Swedish version) and self-selected gait velocity and also maximum gait velocity in patients with stroke [9]. Because falls often occur during walking [25], patients with high concern relating to falls may decrease walking speed to reduce the risk of falling.

The TUG test is divided into three mobility tasks: rising from a chair, walking, and turning [17]. These tasks are demonstrated to be impaired post-stroke [26], and according to the current study, they might be compromised due to high level of FOF. The time for completion of TUG test also increased in patients with Parkinson disease with FOF compared to those without FOF.

In this study, postural stability during various walking tasks or walking adaptability was evaluated using FGA. Impaired walking adaptability after a stroke increases the risk of falling [27]. Since most falls are resulted from a slip, a trip, or a misplaced step during walking, it was suggested that in patients with stroke the ability to adjust walking to task and environmental demands is reduced [27]. The current findings indicated that walking adaptability according to FGA was different between patients with different level of concern relating to falls. This demonstrates that the level of concern about falling may influence the stability during various walking tasks. To the best of the authors' knowledge, this is the first study to investigate the influence of the level of FOF on walking adaptability in individuals with stroke. It should be noted that the items of the FGA encompass four areas of walking adaptability, including: postural transitions (horizontal head turns, vertical head turns,

gait and pivot turns, narrow base of support, ambulate backwards); obstacle negotiation (step over obstacle); temporal demands (change speed); and terrain demands (stairs) [19,27].

Some limitations of the study need to be addressed. The cross-sectional nature of the study did not allow identification of causation. It was not clear whether FOF influences functional gait and balance, or gait and balance deficits lead to FOF. Longitudinal studies need to be performed to clarify this issue. As all patients who participated in this study were able to walk and perform all tests independently without assistive devices, the study sample was likely representative of highly functioning patients. This might limit the ability to generalize the results of the study. Only gait and balance performance was evaluated in this study because of the importance of gait and balance rehabilitation in treatment programs for patients with stroke. Future studies are needed to investigate the influence of FOF on other stroke-specific impairments in individuals with acute and chronic stroke.

Conclusion

Overall, patients with chronic stroke and slight concern of falling had a better gait and balance performance compared to those with high concern. These results are potentially clinically relevant. It would be interesting to study whether reducing FOF would improve gait and balance performance in patients with stroke. It would also be useful to have the measurement of FOF be a part of assessment of gait and balance performance in these patients.

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