Balance and gait analysis of senior tumble-prone patients with cerebrovascular disease

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Abstract: This study aims to observe the tumble status for senior patients with cerebrovascular disease, and to analyze the balance and gait condition in order to provide the basis for clinical prevention and nursing care. A total of 48 senior patients with cerebrovascular disease were investigated with the Tinetti balance and gait evaluation, and the relation between tumble occurrence and balance ability was interrogated. The total score of balance evaluation value and gait value for 89.1% of the senior patients with cerebrovascular disease was fewer than 19 points, which indicated a risk of tumble. The majority of patients could not complete the immediate standing balance well, turning stand balance, mild chest-pushed balance and eyes-closed standing balance. The occurrence of immediate standing balance and turning stand balance fewer than three times was less frequent than the occurrence of tumble for one time, which had significant difference ($P<0.05$). The senior patients with cerebrovascular disease and immediate standing balance and turning stand balance could easily tumble many times, which was crucial for the nursing staff to carry out preventive strategies. Detailed observations of balance and gait function for senior patients were described, which provided a promising basis for designing appropriate nursing measures.

Keywords: Senior people, cerebrovascular disease, tumble, balance, prevention.

INTRODUCTION

The control of balance depends on combined and coordinated performance of visual sense, accurate sensory input of bathyesthesia and vestibular system, central nervous system processing, sense signal output and motoneuron (Jang and Lee, 2016). In the situation of diseases and drug administration where one process may be blocked as a result of suddenly altered environmental cues, the reaction of judgment and selection process becomes slowed down, thus unable to generate appropriate responses and causing a tumble (Zhang *et al*., 2011). Aging results in a discordant gait pattern, balance stability and muscle strength. One of the major tumble-associated risk factors for senior patients is the declined coordination of various physiological functions. Elderly patients with cerebrovascular disorders readily develop the tumble, due to the poor physical health, lagged responses, slow reaction, reeling gait and dizzy giddy. All the above-discussed factors vitally affect elderly patients' physical and mental health as well as their ability of self-care (Kapustnik *et al*., 2014). The current study was proposed to analyze and evaluate the balance function for senior patients with cerebrovascular disease and tumble history in the People's Hospital of Zhengzhou from March 2012 to March 2013. The correlation between balancing ability and tumble for patients with cerebrovascular disease could supply theoretical basis for the targeted nursing measures.

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MATERIALS AND METHODS

General materials

The current study recruited senior patients with cerebrovascular disease in People's Hospital of Zhengzhou from March 2012 to March 2014. All patients were diagnosed with the clinical criteria approved by *The 4th National Cerebrovascular Disease Conference*, and further confirmed by cranial CT or MRI. Patients with tumble history in the last 12 months could walk independently. Tumble was defined as knees and hands that fell and touched the ground unintentionally, including from stairs, shelf or bicycle (Kong, 2011). Patients with acute disease stage for 4 weeks, more than 65 years old, or with MMSE screened intelligence scores not less than 24 points were all excluded.

Methods

General information

The general information was collected, including name, gender, age, education level, marital status, living alone or not, history of drinking, smoking, disease and medication compliance.

Tumble situation research

The tumble frequency, time, location, activity, premonitory symptom or not, falling site and injured area were investigated.

Measurement

Tinetti balance and gait evaluation measurement, which included a total of 16 parameters. The first 9 parameters were sitting balance, stand-up balance, trying-to-stand-up

balance, immediate stand-up balance, stand-up balance, tender push reaction, eye-closing stand-up balance, Turning stand balance and sit-down balance. The last 7 parameters were for gait evaluation that included walk start, gait length and height, gait symmetry, path deviation, body stability and walk posture. Single parameters were scored 0~2 points and the total score was 28 points, including 16 points of balance function evaluation and 12 points of gait evaluation. Fewer points corresponded to a higher risk of tumbling. A score fewer than 19 points was considered to have a tumble risk.

STATISTICAL ANALYSIS

The SPSS 12.0 software was employed to statistically analyze the data. x^2 test was adopted for counting data. $P<0.05$ was considered significant difference.

RESULTS

Basic results

A total of 48 patients with cerebrovascular disease were enrolled and investigated, which included 40 male patients and 8 female patients. The age ranged from 81 to 92 years old, with an average age of (83.96±4.13) years old. The patients were diagnosed with 3~11 chronic diseases: 81.3% patients with heart disease, 49.6% patients with chronic obstructive emphysema, 54.7% patients with hypertension, 31.8% patients with diabetes, 19.1% patients with cervialspondylosis, 72.3% patients with hearing impairment and 49.6% patients with visual impairment.

Tumble occurrence situation

During the 12-month period, there were 30 patients who tumbled once that counted for 62.5%, 6 patients who tumbled twice counting for 12.5% and 12 patients who felt three times counting for 31.25%. Among these assessed patients, 7s had trauma, including 5 cases with injury on head.

Relation between occurrence of falling and balance ability

This survey illustrated that the total score after balance and gait evaluation for 87.4% of the patients with cerebrovascular disease was fewer than 19 points, which indicated a risk of tumble. Most patients performed well the immediate standing balance, turn stand balance, tender push reaction and eye-closed stand balance. However, the gait stability was poor, due to the gait start, gait length, gait height and body stability condition. In these senior patients with cerebrovascular disease, one-sixth of the patients had dragging gait and one side tilt, due to the cerebral apoplexy sequelae. From the movement balance and gait test of patients who tumbled once and three times, the immediate stand movement balance and turning stand balance were significantly different ($P<0.05$). The main frequency and movement balance factors were shown in table 1.

DISCUSSION

Senile cerebrovascular disease is a type of common clinical disorder, which is a generic term for vasculopathy that disrupts blood supply to brain. The epidemiological morbidity in Chinese populations is 182 in 100,000 and the prevalence incidence reaches 620 in 100,000. It thus becomes a vital disease that seriously threatens human health and welfare. Particularly when a stroke occurs, patients may experience serious problems of impaired movement and balance. This may also be a consequence of the aging process that compromises the body response to environmental alterations, declines body movement and balance, and results in degenerated changes of visual, vestibular and oncology. The ability of postural control is significantly reduced for people older than 70 years old, and rapidly deteriorates for people above 80 years old (Gao *et al*., 2010). Therefore, senile patients with cerebrovascular disease at high risk of tumbling. Nursing staff could adopt corresponding approaches based on the movement, balance and gait ability. The cerebrovascular disease patients older than 80 are recommended to undergo more physical activity, especially posture changes.

Tumble prevention by targeted measures based on assessment

While on the posture of turning stand action, mostly patients with senile cerebrovascular diseases maintained good stability with non-coherent action and non-columnar rotation that consumed more than 3 seconds and required more steps. Assistance is greatly needed for patients who tumble multiple times. Patients who tumbled once had relatively better ability to maintain a stable position. Therefore, patients who tumbled many times had an increased risk and received main attention for nursing instruction (Gu *et al*., 2013). The two groups of patients lost their scores mainly on ability to stand after turning, movement and balance with eyes closed, reaction to gently push, movement and balance after starting walking and body balance stability. Given the above movement and balance disorders, corresponding nursing instructions and reasonably recommended exercise should be taken in order to reduce the possibility of tumbling. These programs include muscle strength improvement, related disease treatment, drug treatment, better environment, equipment support and health education (Tan *et al*., 2005).

Nursing measures for patients with senile cerebrovascular disease

Importance of tumble prevention awareness

The elderly patients with cerebrovascular disorders and their families should participate in programs that increases their awareness of tumble prevention. A related

Table 1: Comparison of main factors related to tumble frequency and movement balance ability

Test Name	Details	Tumble Frequency n (%)		Total	x^2	P
		Once	More than or equal to 3 times			
Immediate stand (the first 5 s)	Doddered	3(6.25)	7(14.58)	10(20.83)	6.23	P<0.05
	Need assistance	16(33.33)	8(16.76)	24(50.00)		
	Without assist	11(22.92)	3(6.25)	14(29.17)		
Stand balance	Doddered	4(8.33)	2(4.17)	6(12.50)	3.18	P>0.05
	Stable gait was more than 4 inches, or relying on assistance	9(18.75)	10(20.63)19	19(39.58)		
	Stable	17(35.42)	6(12.50)	23(47.92)		
Standing-up balance	Cannot do without help	6(12.50)	3(6.25)	9(18.75)	0.08	P>0.05
	With the assistance of arm	13(27.08)	8(16.67)	21(43.75)		
	Don't need help	11(22.92)	7(14.58)	18(37.50)		
Tender chest push reaction	Stable	7(14.58)	6(12.50)	13(27.08)	2.04	P>0.05
	Doddered	18(37.50)	7(14.58)	25(52.08)		
	Immediately fell down	5(10.42)	5(10.42)	10(20.84)		
Turn stand balance	Incoherent movement	17(35.42)	8(16.67)	25(52.09)	0.40	P>0.05
	Coherent movement	13(27.08)	9(18.75)	22(45.83)		
	Unstable movement	10(20.83)	12(25.00)	22(45.83)	5.03	P<0.05
	Stable movement	20(41.67)	6(12.50)	26(54.17)		
Eye-closed stand balance	Normal	11(22.92)	6(12.50)	17(35.42)	0.05	P>0.05
	Abnormal	19(39.58)	12(25.00)	31(64.58)		
Sitting-down balance	Unstable	10(20.83)	5(10.42)	15(31.25)	1.04	P>0.05
	Need arm assistance or unstable movement	9(18.75)	8(16.67)	17(35.42)		
	Stable movement	11(22.92)	5(10.42)	16(33.34)		
Gait start	Delay or hesitation	19(39.58)	12(25.00)	31(64.58)	0.05	P>0.05
	Without hesitation	11(22.92)	6(12.50)	17(35.42)		
Body stability	Doddered or need walking aid	9(18.75)	4(8.33)	13(27.08)	0.23	P>0.05
	Without dodder and oscillating arm, With bent knees	13(27.08)	8(16.67)	21(43.75)		
	Normal	8(16.67)	5(10.42)	13(27.09)		

study illustrated that sport-environment-adjustment centered training had an indirect role in improving tumble prevention, even exceeding the effect of the sports and environment alone.

Prevention of cerebrovascular disease for senile patients

Various measures can be taken to reduce the likelihood of injuring the movement balance function and the occurrence of tumble. These detailed approaches included timely uptake of medications, controlling and monitoring of blood pressure, blood sugar, blood lipid and blood viscosity. Importance should be placed on preclinical symptoms indicative of cerebrovascular diseases, including headache, dizziness, fatigue, decline of movement balance function, sleep disorder and memory loss (Sun *et al*., 2016). Regular physical examinations at hospital should be done on time. Good habits of life, reasonable diet and a peaceful mind should be established. Reasonable exercise should be performed regularly.

Rational usage of auxiliary tool

Walking aids and other auxiliary tools need to be employed to assist patients with unstable gait. Walking aids are the tool to support body weight, keep movement balance and assist walking. For patients with immediate instability, use of a four-foot and three-foot cane is advised that provides better stability and effective support, satisfying the needs for patients with slow walking speed. Nursing staff should pay attention to the height of the cane. General speaking, the distance of cane hand to ground should be the same as greater trochanter of standing position to ground, or the distance from hand with elbow had a 20 to 30 degree while using cane to ground or floor. The height should be designed specifically for each patient depending upon their physical needs (Gao, 2000).

Specific sports training

The specific sports training included low strength exercise training, lower limb training, walking and aerobics exercise. The patients who tumbled many times had

dysfunctional ability of turning stand, which indicated decreased physical and coordinated limbs and body function. For example, patients with cerebrovascular diseases had changed muscle tension and extra pyramidal system function. The targeted sports training in this case was stretching training, muscle strengthening training, movement balance training and walk training (Lida *et al*., 2012). The purpose of stretching training is warm-up, relaxation and flexibility improvement, whereas the strength training is to enhance gluteus maximus, gluteus medius, quadriceps femoris and tibialis anterior muscle, and to have moderate resistance movement with heavy weights or elastic belt. The walking posture should also be guided, such as a 7.0~8.0m distance of sight line, heal reaching floor first, back muscle stretching and natural pendulum hip. Movement balance training included one leg standing, toe to heal walk and transverse walk (Huang *et al*., 1997).

Daily posture training

People don't maintain a posture for a long time and constantly change positions for some activity. Therefore, daily activity training was vital and necessary to carry out (Zhu *et al*., 2007). For example, chair sitting training could be performed. While patients are sitting down, body turning should be fully and slowly to avoid falling backward and cause occipitalis injury. If patients had difficulty to stand up from chair, the physical training therapy for quadriceps femoris muscle and coordination of movement should be performed. High seat chair with armrest should be adopted as well. There are many types of exercise in stand training, such as truck control training, movement balance coordination and speed training. These could improve walking ability, society activity skills and strengthen the overall state of physical and mental function. The outdoor training is also encouraged to increase the quality of life. However, it must be noted that outdoor activity imposes a greater risk of tumbling than indoor activity, largely due to the uneven outdoor ground, thus requiring extra care from nursing staff and family members. Correction should be done timely for patients with hearing and vision difficulties Suitable shoes should be wore and slippers are not recommended.

CONCLUSION

The elderly had a greater risk of tumbling because of their impaired posture control ability, vision loss, physical weakness and cerebrovascular disease. Movement balance improvement is an effective measure to prevent tumble. For senile patients with cerebrovascular disease, the balance exercise should be performed, followed by constant evaluation and assessment of the disease. At the same time, the physical and mental conditions of the patients should also be confirmed. When patients did not feel well, then the Exercise should be terminated immediately or shifted to more mild exercise when patients do not feel well to avoid aggravating heart burden and causing the cerebral anoxia that reduces cerebral blood supply. Effective prevention of tumbling is thus clinically and socially important for senile patients.

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