Original Article

Comprehensive approach for community-based integrated care reduces risk of falls after fracture

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Abstract

Objectives: The aim of this study was to examine whether the risk of falls could be reduced among patients in our ward using the standing test for imbalance and disequilibrium (SIDE). **Methods:** The study participants were 97 inpatients (24 men, 73 women; mean age, 81.9±9.0 years) who had been diagnosed with spinal compression or hip or other fractures in a ward for community-based integrated care in Japan. The participants took part in six daily 40-min rehabilitation training sessions per week. We investigated patient data obtained from medical records, including duration of stay in the ward, discharge destination, and SIDE level at admission and discharge. We compared indices at admission and discharge using Fisher's exact test (*P*<0.05). **Results:** The mean duration of stay was 38.5±15.9 days, and 83.5% of the patients were discharged home. Significant increases in SIDE levels were observed at discharge compared with admission (*P*<0.001). **Conclusions:** The results of the present study suggest that exercises in the ward reduce the risk of falls.

Keywords: Prevention of falls, Balance ability, Sub-acute ward, Rehabilitation

Introduction

Falls and fall-related injuries, which increase with deterioration of gait, can cause serious problems for older adults¹. Falls often occur during posture changes between standing and walking. Falls result in not only physical injuries such as fracture, but also an increased fear of falling, which can limit activities of daily living (ADL)^{2,3}; this is referred to as post-fall syndrome⁴. Post-fall syndrome is associated with a number of adverse consequences, including restricted mobility and activity levels, as well as the development of deconditioning⁵⁻⁹, reduced social interaction^{2,10,11}, subsequent falls^{3,12-14}, and a poor quality of life, which has been shown to be associated with further declines in physical, psychological, and cognitive function^{11,14}.

Conventional fall prevention programs include gait, balance, and functional training, strength/resistance, flexibility, and endurance exercises, and dance and other general physical activities¹⁵. Other programs that have been utilized include vision and multifactorial interventions, environmental modifications, drug/nutritional supplements, and gait-stabilizing devices¹⁶.

We started a 45-bed ward for community-based integrated care in our center in October 2014. This ward was established by the Ministry of Health, Labor and

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Welfare of Japan in April 2014. In our ward, a variety of medical specialists treat inpatients who tend to recover with gait training, activities involving changing body position or transferring to a bed or chair, as well as other ADL, and fall prevention education for short-term recovery. In this ward, inpatients can be hospitalized for up to 2 months, and those with spinal compression and hip or other fractures comprise the primary population. In this retrospective study, we focused on the effect of fall prevention among patients in this ward. We aimed to examine whether the risk of falls could be reduced among patients in this ward using the standing test for imbalance and disequilibrium (SIDE), which is a discriminative

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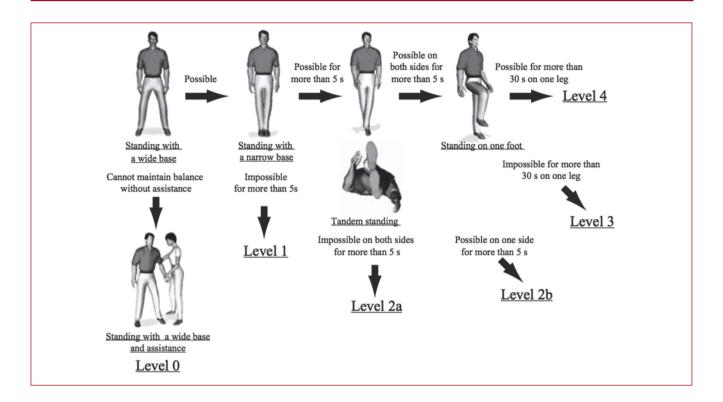


Figure 1. Flowchart to determine level on the standing test for imbalance and disequilibrium (SIDE). **SIDE** levels are arranged in order of difficulty; no additional levels should be included after a patient loses balance at a certain level and requires assistance. The risk of falls increases with the level of difficulty of the test. **Level 0:** A standing position with a wide base cannot be maintained by a patient without assistance. Grasping something for support or being assisted by a caregiver is always required to maintain a standing position. **Level 1:** A standing position with a wide base can be maintained without assistance, but standing with a narrow base cannot be maintained for more than 5 s. Balance is lost in a standing position with a narrow base: bringing the legs close together such that feet are in contact with each other medially at both the heel and forefoot. **Level 2a:** A standing position with narrow base can be maintained by a patient for more than 5 s, but a tandem standing position cannot be maintained for more than 5 s with either leg position. The tandem standing position involves standing with the heel of one foot placed at the toe of the other foot in a straight line (either foot may be in front). **Level 2b:** A tandem standing position can be maintained with either leg in the front for more than 5 s, but standing on either leg for more than 30 s with either leg.

measure of the ability to maintain static postural control and prevent in-hospital falls.

Methods

Participants

A total of 511 inpatients (205 men, 306 women; mean age, 81.1±8.8 years) were discharged from a ward in our center between October 1, 2014 and September 30, 2016. These inpatients had been diagnosed with fracture, osteoarthritis, spinal canal stenosis, Parkinson's disease, diabetic neuropathy, normal pressure hydrocephalus, multiple cerebral infarction, heart failure, aspiration pneumonia or cancer; all inpatients had undergone rehabilitation. The participants chosen for inclusion in this study were 97 inpatients (24 men, 73 women; mean age, 81.9±9.0 years) who had been diagnosed with spinal compression, hip fracture (femoral neck or trochanteric fracture) or other

fractures (e.g., humerus, patella, or lower leg fracture). This study was approved by the Medical Ethics Committee of the National Center for Geriatrics and Gerontology (No. 830) on May 25, 2015, and written informed consent was obtained from all participants.

Interventions

Participants took part in six daily 40-min rehabilitation training sessions per week. The rehabilitation programs were: 1) individual fall risk assessment: a health care professional, such as nurse, physiotherapist, or occupational therapist conducted an assessment of fall risk and then provided recommendations on avoiding falls; 2) strength and balance training: training in special exercises to build strength and improve balance; 3) home assessment and safety improvement: assessing and modifying the home environment or having someone visit the home to demonstrate ways to protect against falling; 4) medication

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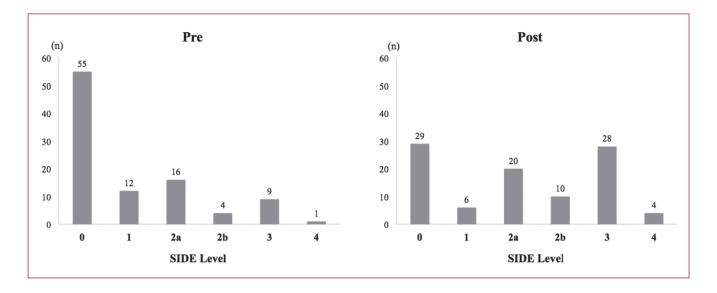


Figure 2. Comparison of the number of pre- and post-SIDE levels among the participants.

review and management: having a professional (i.e., a board-certificated rehabilitation physician/pharmacist) review medications that affect balance and help manage medications to prevent falls; 5) gait training: receiving gait training from a physiotherapist; and 6) fall prevention education: receiving education that explains how to reduce fall likelihood. In addition to these fall prevention approaches, we performed usual ADL exercises, such as self-lifting and transferring from a bed to a chair.

In accordance with the Guidelines for Safety Management and Promotion in Rehabilitation Medicine, all patients who could not engage in physical exercise or who met the following exclusion criteria were excluded: (1) resting heart rate <40 bpm or >120 bpm; (2) resting systolic blood pressure <70 mmHg or >200 mmHg; (3) resting diastolic blood pressure >120 mmHg; (4) the presence of effort angina; (5) serious bradycardia or tachycardia after atrial fibrillation; (6) failure of circulation immediately after myocardial infarction; (7) serious arrhythmia; (8) chest pain at rest; (9) palpitations, breathlessness, or chest pain before rehabilitation; (10) vertigo, diaphoresis, or nausea in a sitting position; (11) resting body temperature <38.0°C; or (12) resting percutaneous arterial blood oxygen saturation (SpO₂) <90%¹⁷.

Outcome measures

We investigated patient data obtained from medical records, including duration of stay in the ward, discharge destination, SIDE level at admission (pre) and discharge (post), and functional independence measure (FIM) total score.

The SIDE is discriminative measure developed for fall prevention that identifies balance deficits. SIDE levels are based on how well a patient can maintain a sequence of postures (wide-base, narrow-base, tandem standing, and

one-foot stance) (Figure 1)18.

The FIM is an evaluation of the degree of independence in ADL based on a 7-point scale, with 7 indicating complete independence, 6 indicating modified independence with concern for time and safety, requiring devices and time, 5 indicating supervision (the patient can carry out more than 90% of the cognitive items independently), 4 indicating that the patient can carry out over 75% of the items independently (75-90% of the cognitive items carried out independently), 3 indicating that the patient can carry out 50-74% of the items independently, 2 indicating that the patient can carry out 25-49% of the items independently, and 1 indicating a need for total assistance, in which the patient can carry out less than 25% of the items independently 19. The FIM is composed of a 13-item motor subscale (eating, grooming, bathing, upper body dressing, lower body dressing, toileting, bladder management, bowel management, bed transfer, toilet transfer, bath transfer, locomotion [ambulatory only] and stairs) and a 5-item cognition subscale (cognitive comprehension, expression, social, interaction, problem solving and memory).

Statistical analysis

Based on the SIDE level, patients were classified into either a high-risk group (High risk; levels O, 1 and 2a) or a low-risk group (Low risk; levels 2b, 3 and 4). The pre- and post-SIDE levels were then compared between each SIDE level, and the two groups were compared using Fisher's exact test. We also compared pre- and post-FIM total scores and FIM ambulatory scores using a paired *t* test. Statistical analysis was conducted using SPSS Statistics (version 24 for Mac; IBM, Chicago, IL, USA), with the significance level set at *P*<0.05.

97	Pre		Post		_ ,
	n	Rate (%)	n	Rate (%)	P value
SIDE Level (n)					< 0.001
0	55	56.7%	29	29.9%	
1	12	12.4%	6	6.2%	
2a	16	16.5%	20	20.6%	
2b	4	4.1%	10	10.3%	
3	9	9.3%	28	28.9%	
4	1	1.0%	4	4.1%	

Table 1. Comparison of the Number and Ratio of Pre- and Post-SIDE Levels among the Participants (n=97).

Results

Regarding the participants' characteristics, the mean duration of stay was 38.5 ± 15.9 days (range, 7-81 days). As for the disease ratios, 56% of the inpatients had suffered a spinal compression fracture, 27% a hip fracture and 17% another type of fracture. In addition, 83.5% of the participants (n=81) had been discharged home, and the other 16.5% (n=16) had been discharged to a care facility. No participants had died in the ward or been transferred to another hospital.

Significant differences (P<0.001) were observed between pre- (level 0, n=55; level 1, n=12; level 2a, n=16; level 2b, n=4; level 3, n=9; level 4, n=1) and post-SIDE levels (level 0, n=29; level 1, n=6; level 2a, n=20; level 2b, n=10; level 3, n=28; level 4, n=4) (Figure 2 & Table 1). Significant differences (P<0.001) were also found between the high- and low-risk groups in pre- (high risk, n=83; low risk, n=14) and post-SIDE levels (high risk, n=55; low risk, n=42). Moreover, significant differences were observed in pre- and post-FIM total scores (pre-, 73.1 \pm 32.6 points; post-, 86.2 \pm 32.9 points; P<0.001) and FIM ambulatory scores (pre-, 2.5 \pm 2.1 points; post-, 4.4 \pm 2.1 points; P<0.001).

Discussion

In this study, we examined whether the risk of falls could be reduced among patients in a ward for community-based integrated care. We found that FIM scores and SIDE level improved at discharge compared with at admission. Furthermore, regarding the SIDE, the number of level O, 1 and 2a patients that had a high risk of falls decreased, and the number of level 2b, 3 and 4 patients that had a low risk of falls increased.

Ganz et al.²⁰ identified the prognostic value of risk factors for future falls among older patients. They found that patients who had fallen or who had a gait or balance problem were at higher risk of future falls, and the only clinically identifiable risk factors were impairment of gait or balance, excluding fall

history. Chu et al.²¹ investigated balance impairment in 1517 community-dwelling elderly persons. They found that 401 new falls occurred in 297 persons over a 12-month follow-up period, with a fall rate (number of falls per 100 persons) of 26.4%. In regard to posture control ability, 1.0% of the non-fallers and 4.4% of the fallers failed to stand with their feet together (eyes open), and 20.3% of the non-fallers and 41.0% of the fallers failed to maintain a tandem standing position. Although balance control ability showed a high sensitivity for prediction of falls, Tinetti balance scores for fallers (14.28±0.193) were found to be almost the same as those for non-fallers (15.46±0.05). These findings suggest that to predict future falls, it is important to examine whether community-dwelling persons can maintain their posture while standing²¹.

The SIDE is a discriminative measure developed to identify balance deficits that may cause falls and can be applied to a variety of populations¹⁷. It focuses on static standing balance and classifies patients based on limitations in balance control. SIDE level 2a indicates that a patient can maintain a standing position with a narrow base (= standing with their feet together), while SIDE level 2b indicates that a patient can maintain a tandem standing position. Teranishi et al.22 investigated SIDE levels and FIM at the time of admission, as well as history of falls for 14 days from the beginning of hospitalization in a convalescent rehabilitation ward. Of the 545 patients, 36 experienced a fall, with a fall rate of 4.72%. Although no significant differences were found in FIM ambulatory scores between the fall/non-fall groups (P=0.15), significant differences were found in SIDE levels (P=0.01). For the SIDE level, a complete separation of all non-fall patients was seen at levels of 2b or higher²².

Although the SIDE has shown much higher prediction accuracy and is more useful for predicting future falls than the FIM ambulatory score, to our knowledge, no previous studies have analyzed the risk of falls using the SIDE. The results of the present study showed that SIDE levels

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improved at discharge compared with admission, suggesting that the risk of falls was reduced among patients in this ward.

Study limitations

This study had several limitations. First, we did not investigate the level of medical care, the rehabilitation programs, or the treatment of fall risk factors, and the intervention only consisted of staff education within the ward. Second, we did not assess the number of falls or fall-related injuries, or new fractures and mortality after discharge. In future studies, we plan to investigate medical care and rehabilitation programs and follow up study participants in relation to falls and fall-related injuries. Furthermore, we plan to compare outcomes between multiple wards.

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