Awareness and Functional Outcome of Hip Fracture-Related Falls among Patients with a History of Recurrent Falling

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ABSTRACT: **Background:** There is little evidence about awareness and functional outcome of hip fracture-related falls among patients with a history of recurrent falling.

Objectives: To measure the awareness of recurrent falling in patients and to compare their functional outcomes with those who suffered hip fracture after a sporadic isolated fall.

Methods: A prospective comparative study of patients after a hip fracture-related fall was conducted. Awareness of falls was measured and functional outcome was assessed by total and motor Functional Independence Measure (FIM) score changes and efficiency and scores at admission and on discharge.

Results: Of 97 eligible participants, 49 (50.5%) were recurrent fallers. Of these recurrent falls, 19 (38.8%) were not reported, 16 (32.7%) were reported but no action was taken, and 7 (14.3%) were reported and a partial assessment performed. A full assessment was performed in only 7 cases (14.3%). FIM scores on admission and discharge were significantly higher in once-fallers. A multiple linear regression analysis showed that being a once-faller was independently associated with higher total FIM at admission (β coefficient = 0.290, $P = 0.004$), higher motor FIM at admission (β coefficient = 0.295, $P = 0.003$), higher total FIM at discharge (β Coefficient = 0.264, $P = 0.009$), and higher motor FIM at discharge (β coefficient = 0.230, $P = 0.023$).

Conclusions: Awareness of the syndrome of recurrent falling is extremely low. Recurrent falls before a hip fracture-related fall is associated with substantial loss of functional independence. Being a recurrent faller adversely affects rehabilitation outcome of hip fracture patients.

IMAJ 2018; 20: 38–42

KEY WORDS: recurrent falls, awareness, hip fracture, rehabilitation, functional recovery

Falls and fall-related injuries are a common and serious problem among older adults as such events can result in disability, chronic pain and loss of independence, reduced quality of life, and in severe cases, even death [1]. Although most falls cause no serious injury, falls may result in different types of fractures, most commonly hip fractures, which are almost always secondary to falls [1]. Hip fracture is one of the most devastating injuries experienced by elderly people and may lead to permanent disability, admission to institutional care, or death [2]. Efficient fall prevention programs aimed at reducing the incidence of hip fracture should target elderly people at increased risk of falling [3].

A small number of falls have a single cause, but in most cases many different causes, resulting from the interactions between intrinsic or extrinsic risk factors, may be identified. Recurrent falls, defined as two or more falls in a 6 month period, have a high prevalence of approximately 25% of older adults and are a major cause of morbidity and mortality [4,5]. Reported risk factors associated with recurrent falls are: age > 85 years, male gender, use of psychoactive drugs, polypharmacy, fear of falling, depression, cognitive decline, poorer independence in activities of the daily living, and diagnosis of dementia [1,2,6,7].

Because recurrent fallers are more likely to experience injury from repeated episodes, they constitute an important group to target for preventive efforts [8,9]. Preventing falls in these patients is the main preventive step in reducing hip fractures and associated morbidity and disability. Identification, diagnosis, and implementation of fall-prevention procedures have been shown to be safe and effective in some older people suffering from recurrent falls [10,11].

Studies concerning the epidemiology of hip fracture-related falls among patients with a history of recurrent falling are limited; therefore, the present study aims to assess the prevalence and awareness to the syndrome of recurrent falling in elderly patients who suffered from recurrent falls before being hospitalized for a fall-related hip fracture. There is also little information about the recovery of patients with a history of recurrent falling who sustained a hip fracture-related fall. Therefore, another objective of the current study was to measure functional recovery after rehabilitation. For this purpose, we compared the short-term functional outcomes in adults with a history of recurrent falling following hip fracture-related fall with the short-term functional outcomes in adults who suffered a hip fracture related to a sporadic isolated fall.

PATIENTS AND METHODS

Data was collected over a 6 month period at the Fliman Rehabilitation Geriatric Hospital, a 150 bed public geriatric

facility affiliated with the Rappaport Faculty of Medicine, Technion–Israel Institute of Technology and located in Haifa, Israel. All patients over 65 years of age admitted consecutively to the five geriatric rehabilitation wards after a hip fracture-related fall were included in the study. Because it was expected that some of the patients would have a history of dementia or would present with delirium, impaired cognition was not an exclusion criterion. The only exclusion criteria were non-ambulatory status before hip fracture and unwillingness to participate. We obtained approval for the study from the institutional review board at our institution and from the Israeli Ministry of Health.

RESEARCH DESIGN

A fall was defined as "an unintentional change in position resulting in coming to rest at a lower level or on the ground." Falls due to overwhelming forces such as motor vehicle accidents or seizures were not considered for the study. Patients, families, or caregivers were asked about the circumstances that led to falling: location, time, and height (from standing, sitting or lying positions, or higher). Patients were also asked whether they had fallen in the previous year. The definition of recurrent faller was: at least two falls within 6 months. This definition has shown the greater predictive value of fall risk profiles [12].

Awareness of recurrent falls was categorized into four levels.

- Level 1: Falls not reported to a healthcare professional
- Level 2: Falls reported to a healthcare professional, but no action taken
- Level 3: Falls reported to a healthcare professional, and a partial assessment performed
- Level 4: Falls reported to a healthcare professional, and a full assessment performed

A full assessment included investigating all areas of potentially modifiable risk factors for falls, such as psychotropic and cardiovascular drug use, auditory acuity, visual acuity, balance and gait disorders, risk of malnutrition, disability, cognitive impairment, social risk, and home safety [13]. A full assessment also included action taken according to diagnosis.

We approached all potential participants in the hospital after hip fracture surgery. Assignment to groups was conducted after the baseline evaluation. Patients with a history of recurrent falling before the hip fracture-related fall were included in the first group and those who suffered a hip fracture related to a sporadic isolated fall were in the second group.

Baseline information was gathered during the in-person interview to ascertain ambulatory function just before the hip fracture, co-morbidity, and the aforementioned cognitive screening assessment. We used the Clinical Dementia Rating Scale (CDR) to assess patients with cognitive impairment [14]. The CDR uses clinical scoring rules where CDR 0 = no dementia and CDR 0.5, 1, 2, or 3 indicates questionable, mild, moderate, or severe dementia respectively. Co-morbid conditions were obtained from the participant or proxy respondent (in an interview) and from the medical chart using a list derived from the Charlson Comorbidity Index [15]. Reassessment using the same measures was obtained at discharge from the hospital.

The Functional Independence Measure (FIM) was the primary study outcome measure. The FIM is a performance-based disability measure that assesses level of disability in terms of assistance required to perform basic activities of daily living [16,17]. It consists of 18 items designed to assess the amount of assistance required to safely perform self-care (6 items), sphincter control (2 items), transfers (3 items), locomotion (2 items), communication (2 items), social adjustment and cooperation (3 items), and cognition and problem solving (3 items). Good reliability and validity have been demonstrated in studies involving orthopedic conditions, elderly adults, and individuals with cognitive impairment [16,17]. Validity and reliability of the FIM was established specifically among adults receiving inpatient rehabilitation following hip fracture and reported an average increase of 18 points on the FIM for adults following primary total hip arthroplasty [15,17]. The FIM motor score (13 items) was also used because previous studies have reported that the FIM cognition score has low responsiveness [16,17]. The FIM was completed by trained nurse on admission day and at discharge from rehabilitation. The rate of functional gain (FIM efficiency) was calculated as total FIM change (discharge FIM score minus admission FIM score) divided by length of rehabilitation stay (days).

STATISTICAL METHODS

Baseline characteristics were examined to determine pre-fracture functional status, co-morbidities, and health status. Categorical data are presented as proportions. A chi-square test was used to compare differences in categorical variables. The prevalence and awareness were analyzed using a chi-square test for trends. The primary analysis examined recovery over time as measured according to FIM and FIM motor score. We examined functional recovery at each evaluation point (admission and discharge) using all participants available at that time period. Overall change within groups was examined by paired samples *t*-test or Wilcoxon Signed Rank Test, and differences in changes among groups were measured by independent samples *t*-test or Mann–Whitney U test. To test associations between gender and FIM measures, a multiple regression analysis was applied using possible confounders. All variables were entered in a single stage. The statistical significance level was set to 0.05.

RESULTS

The data of 97 patients admitted consecutively to our five geriatric rehabilitation wards after a hip fracture-related fall were available. A total of 16 patients (16.5%) were diagnosed as hav-

ing a femoral neck hip fracture, 47 (48.5%) were diagnosed as having an intertrochanteric hip fracture, and 34 (35.1%) were diagnosed as having a subtrochanteric hip fracture. A total of 49 patients (50.5%) were recurrent fallers. The clinical and demographic characteristics, as well as surgical and hospital data, of these patients are shown in Table 1.

Table 2 shows the awareness of the study subjects who had suffered from recurrent falls before being hospitalized for a fall-related hip fracture. Our analysis showed that in 19 cases of recurrent fallers (38.8%), falls were not reported to a healthcare professional. In 16 cases (32.7%), falls were reported to a healthcare professional but no action was taken. In 7 cases (14.3%), falls were reported to a healthcare professional and only a partial assessment was performed. Only in 7 cases (14.3%) were falls reported to a healthcare professional and a full assessment performed.

The mean age of the recurrent fallers was 82.5 ± 8.6 years, and the mean age of the once-fallers was 78.9 ± 10.0 years. The mean length of stay in our wards was longer for the recurrent fallers than for the once-fallers (34.4 ± 19.7 vs. 27.7 ± 13.7 days). As expected, recurrent fallers had a significantly higher incidence of co-morbidities, visual impairment, cognitive impairment, and usage of walking aids. Recurrent fallers were also treated with more medications in general and more psychotropic drugs in particular.

Total and motor FIM scores at hospital admission were significantly higher in the once-fallers group (60.1 ± 13.0 vs. 51.0 ± 16.9 and 38.8 ± 11.3 vs. 31.69 ± 11.72, respectively) (P = 0.012 and P = 0.010, respectively). In addition, once-fallers were discharged with significantly higher total motor (79.4 ± 17.4 vs. 68.6 ± 22.0, P = 0.005) and FIM scores (56.3 ± 15.1 vs. 48.7± 17.3, P = 0.014) compared to recurrent fallers [Table 3].There were no significant differences between groups in FIM gains and FIM efficiency.

As the group of once-fallers had lower prevalence of co-morbidities, we carried out a multiple linear regression analysis

Table 1. Baseline surgical and hospital characteristics of the participants (once-fallers vs. recurrent fallers) (N=97)

Patient characteristics and potential predictor variables for falling	Once-fallers (n=48)	Recurrent fallers (n=49)	*P* value
Socio-demographic characteristics			
Age (mean ± SD)	79.0 ± 10.0	82.5 ± 8.6	0.08
Female, n (%)	30 (62.5%)	42 (85.7%)	0.01
Living setting			
Private home or apartment, n (%)	45 (93.8%)	40 (81.6%)	0.07
Boardcare/assisted living, n (%)	3 (6.3%)	5 (10.2%)	0.48
Nursing home, n (%)	0 (0.0%)	5 (10.2%)	0.02
Chronic diseases and medication use			
Number of chronic diseases (mean ± SD)	8.8 ± 3.7	12.2 ± 3.9	0.001
Charlson Comorbidity Index (mean ± SD)	5.1 ± 1.5	5.9 ± 1.7	0.04
Medication use, n (mean ± SD)	4.9 ± 3.8	7.7 ± 4.0	0.001
Number of psychotropic drugs used, n (mean ± SD)	0.4 ± 0.6	0.7 ± 0.8	0.05
Physical impairments and general health			
Involuntary loss of urine, n (%)	8 (16.0%)	13 (26.5%)	0.20
Body mass index (kg/m^2) (mean± SD)	28.0 ± 5.4	28.5 ± 6.1	0.82
Visual impairment, n (%)	8 (16.0%)	18 (36.7%)	0.02
auditory loss, n (%)	17 (34.0%)	11 (22.4%)	0.20
Post-stroke state, n (%)	8 (16.7%)	7 (14.3%)	0.75
Parkinson's disease, n (%)	1 (2.0%)	5 (20.0%)	0.09
Diabetes mellitus, n (%)	14 (29.2%)	17 (34.7%)	0.56
Activity and mobility			
Number of functional limitations, (0–6) (mean ± SD)	4.9 ± 1.6	4.3 ± 1.6	0.07
Walking aid, n (%)	11 (22.0%)	29 (59.2%)	0.001
Psychosocial functioning			
Cognitive impairment (CDR score 1), n (%)	4 (8.0%)	11 (22.4%)	0.04
Cognitive impairment (CDR score 2), n (%)	1 (2.0%)	7 (14.3%)	0.02
Cognitive impairment (CDR score 3), n (%)	1 (2.0%)	3 (6.1%)	0.30
Depression, n (%)	11 (22.9%)	19 (38.8%)	0.09
Living alone, n (%)	22 (44.0%)	23 (46.9%)	0.77
Fracture type, n (%)			
Femoral neck	6 (12.5%)	10 (20.4%)	0.40
Intertrochanteric	23 (47.9%)	24 (49.0%)	0.77
Subtrochanteric	19 (39.6%)	15 (30.6%)	0.33
Surgical fixation, n (%)			
Cannulated screws	12 (29.2%)	7 (14.3%)	0.15
Hemi-arthroplasty	28 (58.3%)	20 (40.8%)	0.13
Compression screw and sliding plate	6 (12.5%)	20 (40.8%)	0.001
Long gamma nail	2 (4.2%)	2 (4.1%)	0.98
Postoperative weight bearing status, n (%)			
Weight bearing as tolerated	30 (62.5%)	28 (57.1%)	0.62
Restricted weight bearing	13 (27.1%)	14 (28.6%)	0.95
No ambulatory in hospital	5 (10.4%)	7 (14.3%)	0.51
Rehabilitation period, (Mean ± SD)			
Time until start of postoperative rehabilitation, days	7.4 ± 3.9	7.8 ± 5.0	0.77
Time in rehabilitation hospital, days	27.7 ± 13.7	34.4 ± 19.7	0.09

To compare the background characteristics of the once-fallers (n=48) and recurrent fallers (n=49), a *t*-test was used for continuous variables with a normal distribution, a Mann–Whitney test was used for continuous variables with skewed distribution, and a chi-square test was used for categorical variables

Fracture type, surgical fixation, and postoperative weight-bearing status were analyzed using a chi-square test. Rehabilitation period was analyzed using the Mann–Whitney U test

IQR = interquartile range. CDR = Clinical Dementia Rating Scale

Table 2. Awareness to the syndrome of recurrent falls among recurrent fallers (N=49)

Awareness level to the syndrome of recurrent falling	n (%)
Level 1: Falls not reported	19 (38.8%)
Level 2: Falls reported, but no action taken	16 (32.7%)
Level 3: Falls reported and a partial assessment performed	7 (14.3%)
Level 4: Falls reported and a full assessment performed	7 (14.3%)

Table 3. Functional recovery over time of the participants (once-fallers vs. recurrent fallers), unadjusted association

Functional Variable	Once-fallers (n=48)	Recurrent fallers (n=49)	*P* value
Total FIM at admission ± SD	60.1 ± 13.0	51.0 ± 16.9	0.01
Total FIM at discharge ± SD	79.4 ± 17.4	68.6 ± 22.0	0.005
Motor FIM score at admission ± SD	38.8 ± 11.3	31.7 ± 11.7	0.01
Motor FIM score at discharge ± SD	56.3 ± 15.1	48.7 ± 17.3	0.01
Total FIM score change ± SD	19.3 ± 15.6	17.6 ± 14.0	0.60
Motor FIM score change ± SD	17.6 ± 14.2	17.0 ± 13.6	0.89
Total FIM-efficiency* ± SD	0.76 ± 0.76	0.62 ± 0.57	0.22
Motor FIM-efficiency* ± SD	0.69 ± 0.66	0.60 ± 0.59	0.39

SD = standard deviation, FIM = Functional Independence Measure

*FIM efficiency = total FIM change, divided by length of rehabilitation stay (days)

Table 4. Association between baseline characteristics and study outcomes for the participants (once-fallers and recurrent fallers), adjusted analyses

Characteristic	Total FIM at admission		Total FIM at discharge		Motor FIM at admission		Motor FIM at discharge	
	Beta coefficient (95% CI)	*P* value	Beta coefficient (95%CI)	*P* value	Beta coefficient (95%CI)	*P* value	Beta coefficient (95%CI)	*P* value
Recurrent Fallers	-0.29	0.004	-0.26	0.01	-0.29	0.003	-0.23	0.023
Female	-0.17	0.10	-0.05	0.62	-0.06	0.57	-0.006	0.95
Age	-0.01	0.93	-0.23	0.03	-0.02	0.83	-0.16	0.16
Charlson Comorbidity Index ≥ 2	-0.003	0.98	0.03	0.80	-0.01	0.94	-0.002	0.99
Diabetes mellitus	0.11	0.28	0.13	0.19	0.10	0.32	0.13	0.20
Stroke	0.02	0.86	-0.09	0.38	-0.04	0.68	-0.06	0.58
Depression	-0.16	0.12	0.04	0.69	-0.17	0.11	0.03	0.80
Nursing home resident	-0.10	0.34	-0.17	0.10	-0.11	0.27	-0.17	0.10

FIM = Functional Independence Measure, 95%CI = 95% confidence interval

to test for predictors of total and motor FIM scores at discharge. This evaluation showed [Table 4] that being a once-faller was independently associated with better total and motor FIM scores at admission (β coefficient = -0.290, $P = 0.004$ and β coefficient = -0.264, $P = 0.009$, respectively). Being a once-faller was also independently associated with better total and motor FIM scores at discharge (β coefficient = -0.295, $P = 0.003$ and β coefficient = -0.230, $P = 0.023$, respectively). None of the other variables tested, including age, gender, Charlson Comorbidity Index ≥ 2, diabetes mellitus, stroke, depression, and dwelling in a nursing home were predictive of higher FIM scores at admission or discharge.

DISCUSSION

The present prospective study of a consecutive cohort of patients who were hospitalized for rehabilitation after a hip fracture surgery focused on the relationship between falling pattern (recurrent falling vs. sporadic isolated fall) and rehabilitation outcome as assessed by the FIM score. Results of the univariate analysis suggest that although there were no significant differences between groups regarding functional gains during rehabilitation, recurrent falling is associated with worse total and motor FIM scores at admission and discharge.

These results remained statistically significant after using multiple regression analysis, accounting for the effect of different confounders, such as age, gender, nursing home residence, cognitive status, and various co-morbidities. These findings support our assumption that functional rehabilitation outcomes for adults with a history of recurrent falling following hip fracture-related falls are inferior compared to patients who suffered a hip fracture after a sporadic isolated fall. To the best of our knowledge, this is the first study to compare the effects of fall incidence of patients after a hip fracture-related fall on rehabilitation outcomes and suggest that functional outcome is negatively affected.

The results that show that suffering from recurrent falls prior to the fracture is a negative predictor for successful functional recovery are not surprising considering that recurrent fallers sustaining hip fractures are generally described as more vulnerable, having higher baseline morbidity and post-fracture mortality rates [18-20]. The marked functional loss is alarming, although the recurrent fallers had higher incidence of co-morbidities, visual impairment, cognitive impairment, prescribed medications, and walking aid use.

The present study also assessed the awareness to the syndrome of recurrent falling in our elderly patients who suffered from recurrent falls before being hospitalized for a fall related hip fracture. We found that awareness by the patients, families, and healthcare professionals to this syndrome is extremely low. The results are in accordance with one large study conducted in London, which demonstrated that 40% of patients who fell were not evaluated in a hospital [21]. In our study among recurrent fallers, 38.7% of falls were not reported to a healthcare professional, 32.6% of falls were reported but no action was taken, and only 14.3% of falls were reported and a partial assessment performed. A full assessment was performed only in 14.3% cases.

We think that most falls are not reported to medical services for a number of reasons: patients fail to report them, caregivers may fail to recognize their significance, and close relatives might ignore such events. Much more surprising is unawareness by healthcare professionals. Current NICE guidelines and Joint American Geriatrics Society, British Geriatrics Society and American Academy of Orthopaedic Surgeons guidelines for fall prevention states that, "all patients who fall should be offered a multifactorial falls risk assessment, offered by a healthcare professional experienced in the management and assessment of falls" [5,22]. It is also recommended that clinicians consider risk of fracture and evidence of osteoporosis.

It is clear from the evidence that older people presenting with falls and injuries will benefit from a full multidisciplinary assessment. But, lack of awareness of how to manage falls of older people in the community is a major barrier to uptake of services. In Israel, access to multidisciplinary geriatric services is highly variable. A basic simplified approach has to be embed-

ded in routine practice with readily available expert multidisciplinary assessment and intervention programs. Local pathways of care should be developed across the country to address this. The magnitude of the problem should lead to the development and organization of fall prevention services as a major challenge to healthcare providers. These challenges, if achieved, will improve the quality of care for older people.

The present study is advantageous in the sense that it is a prospective study that comprised a large enough sample of patients, all of whom had a hip fracture-related fall and underwent a rehabilitation program in a ward dedicated to the rehabilitation of elderly hip fracture patients. Above all, to the best of our knowledge, this study is the first to focus on the specific role of falling pattern (recurrent falling vs. sporadic, isolated fall) on rehabilitation. Another advantage is the use of the FIM as a structured assessment tool. The scale has known advantages over other widely used scales [23,24]. The use of the FIM to analyze our data is advantageous as it shows lower ceiling and floor effects compared to other scales. FIM results probably help with measuring greater accuracy the functional gains during rehabilitation.

Nevertheless, certain limitations should be considered. First, the study cohort was restricted to elderly patients hospitalized for rehabilitation after a hip fracture-related fall. Assessing the awareness to the syndrome of recurrent falling only in this cohort misses a huge number of community-dwelling elderly who have fallen but did not sustain a hip fracture. Second, although the study sample was not big, this study provides helpful preliminary data for recovery of function in the rehabilitation setting. Third, although the natural history of functional recovery was described, mediators of improvement cannot be concluded. For example, it is unknown what rehabilitation therapy or expertise was similar in both groups, although we did compare the time, in days, patients spent in rehabilitation and in our hospital. Such patients usually receive the same rehabilitation program.

CONCLUSIONS

In summary, elderly patients who suffered from recurrent falls before being hospitalized for a fall related hip fracture had little recovery of functional status compared to adults who suffered hip fracture related to a sporadic isolated fall. These results call for the investigation of potential specific interventions in elderly patients suffering from recurrent falls. Much work is needed to determine the type and quantity of rehabilitation needed to optimize functional recovery in these frail patients. Another important point revealed in this study is that most falls are undetected by medical services, and that awareness of families and healthcare professionals to the syndrome of recurrent falling in these patients is extremely low.

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