Falls in Stroke Patients: Risk Factors and Risk Management

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ABSTRACT:

Background: Falls are common events among hospital inpatients and constitute a major health problem in the rehabilitation setting. Many risk factors for falls have been identified for stroke patients, such as muscle weakness, medication side effects, hypoglycemia, hypotension, etc.
Objectives: To assess the risk factors for falls among patients hospitalized for rehabilitation following acute stroke.
Methods: In a retrospective study of 56 falls over a period of 5 years in 41 stroke patients hospitalized for rehabilitation we surveyed the nurses' safety risk assessment of the fall. Thirty patients fell once, 9 patients twice and 2 patients four times. The data were obtained from the medical and nursing records. Safety precautions were taken by the nurses for the entire group of patients.
Results: Most of the falls occurred among male patients who had reduced muscular tone (70%), paralysis (54%) and/ or hypoesthesia in the involved side of the body. Patients who suffered from hemiplegia fell more often than those with hemiparesis (Wilcoxon rank sum test, $P = 0.04$, one-sided). Forty-eight percent of the falls occurred during the first month after the last stroke, 70% during the morning or the afternoon, and 62% occurred close to the patient's bed. In 89% of falls the patients used hypoglycemic, anti-hypertensive, tranquilizing or neuroleptic drugs. Communication disorders (29%), hemianopia or blindness (21%) and visuospatial agnosia (18%) were incremental risk factors for falls. Fifty percent of the falls were caused by either an intrinsic or extrinsic mechanism.
Conclusions: These data suggest that the group of stroke patients at risk for falls in a rehabilitation department can be identified by a variety of impairment and functional assessments. The information may be potentially useful for designing interventions directed at reducing fall frequency among stroke survivors.

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KEY WORDS: falls, stroke patients, risk factors, risk management, rehabilitation

Falling is one of the most frequent complications seen in stroke patients in the acute period [1-5]. Thus, finding ways to prevent falls, especially among individuals prone to repeated falls, is urgent. Identifying high risk hospitalized patients is a major component of prevention programs; risk factors for falls in different populations of stroke patients have already been studied to some extent [3,4,6]. The cumulative effect of multiple risk factors contributes to the tendency of falls more than the potential effect of each factor alone.

The rate of post-stroke falls in western countries ranges from 8.9/1000 [2] to 15.9/1000 patients/day [7], while in China and Thailand there are fewer falls, 5.5/1000 [8] to 3.4/1000 [9] respectively. Ugur et al. [10] and Gücüyener et al. [11] found a significant increase in falls in individuals above the age of 60.

Stroke patients who undergo rehabilitation often suffer from a variety of cognitive and physical deficits, placing them at high risk of falling. Nyberg and Gustafson [6] found that in stroke rehabilitation patients, unsafe gait, wheelchair confinement and confusion were significant risk factors for falls. Fallers also presented with symptoms of visuospatial hemineglect and dyspraxia. In the stroke population, various other factors have been associated with increased frequency of falling, such as advanced age [1], female gender, poor balance, gait disorders, attacks of syncope, postural hypotension [4], and medication usage [4,12]. Saverino and colleagues [13] recorded 40 falls in 32 patients hospitalized in a rehabilitation center. A consistent number of the fallers were patients with cognitive disorders: 93% were receiving more than one drug, 76% were taking antihypertensive and 28% antidepressant or sedative drugs. In the faller group, 76% had visual disorders, 52% had sensitive disorders and 76% communication disturbances. Intrinsic falls due to sensory-motor and cognitive impairment occurred in 35% of cases, and extrinsic falls caused by environmental factors occurred in 12.5%. Falls that occur during transfers, or while sitting in a wheelchair or on some other kind of furniture can be considered extrinsic [14].

The objective of the present study was to investigate the incidence of falls, identify risk factors in patients hospitalized as a result of acute stroke, and survey the caregivers' assessment of their implementation of precaution measures to prevent the fall.

PATIENTS AND METHODS

The stroke patients described in this study were consecutively admitted to our rehabilitation department and subsequently experienced a fall. The survey was conducted over a 5 year

period. The study was retrospective and was performed in the rehabilitation department of a general hospital in the Western Galilee region of northern Israel. All patients needed further rehabilitation and hospital stay after the acute phase. The patients were admitted after selection from acute care departments, usually several days to 2 weeks following stroke. They were studied from the time of admission to the rehabilitation department until discharge. The data were collected either during or after hospital discharge.

A fall was defined as an event, documented in an incidence report, where the body was displaced to a level of knee height or lower through an uncontrolled, involuntary action. The nursing staff is required by hospital policy to report all falls occurring in the hospital. All incident reports completed by the nursing staff were reviewed and the data were extracted. We surveyed the safety risk assessment made by the nurses of the fall occurrence. Patient characteristics were obtained from medical and nursing records compiled upon admission to the rehabilitation department, including gender and age of the patient, history of previous stroke, existence of neurological deficits in the involved limbs (plegia or paresis, hypo- or hypermuscular tone, hypo- or hyperesthesia), visuospatial neglect, visual impairments (hemi-anopia or blindness), communication disorders, tremor or ataxia, and previous fractures or operations in the lower limbs. We recorded the drugs taken by the patient (antihypertensives, hypoglycemics, benzodiazepines, major psychotropic drugs), and collected data on the circumstances surrounding the fall (time of day, place, patient's activity before the fall, external reasons), and the resultant injuries.

The existence of either motor or sensory deficits, dysphasia or aphasia, visual field or visuospatial disorders were tested and recorded by a physician, a specialist in physical medicine and rehabilitation upon admission to the rehabilitation department. The physician also recorded the drugs used by the patient, specifically on the day of the fall. The major psychotropic drugs were antipsychotic, antidepressant, and hypnotic-anxiolytic medications.

RISK MANAGEMENT

Safety precautions were taken for the entire group of patients. All beds were equipped with brakes on their wheels. Eighty percent of the patients were instructed on how to use their personal alarm button, 75% were taught how to get off the height-adjusted bed. When the rehabilitation process started, 58% of the patients were familiar with the department's physical set-up. For 44% there was a need to keep the bed side-rails elevated, to prevent falls. Only 6% of the patients were warned about a slippery floor. There was no difference between days of the week or the different shifts. Unfortunately, four nurse reports were missing for technical reasons, so the safety precaution assessment mentioned above was conducted only in 52 falls occurring in 38 patients.

DATA ANALYSIS

Quantity data were presented as mean ± SD. Qualitative data were presented as frequencies and percentages. Chi-square test or Fisher's exact test and Wilcoxon rank sum test were used to compare the number of falls between patients who had only one fall and those with more than one fall. P values below 0.05 were taken to indicate statistical significance. SPSS for windows version 11.5 (Chicago, IL) was used for the statistical analysis.

RESULTS

There were 56 falls (35 in men and 21 in women) in 41 patients registered during the period studied. The mean age of the patients was 67 ± 8.9 years, although in 36 falls (61%) older patients were involved as compared to 22 falls (39%) in patients younger than 65 years old (over 65 years old is considered the geriatric age).

Forty-one patients suffered falls, of whom 30 patients fell once, 9 fell twice and 2 fell four times. Fifteen falls occurred in patients who had recurrent stroke, among them 2 who were hospitalized after their fourth stroke.

In 50 of the 56 fall incidents (89%) the patients took medication on the day of falling. These drugs – hypoglycemic, antihypertensive, antipsychotic, antidepressant, anxiolytic or sedatives – may influence the central nervous system. Due to the small number of falls in patients who did not receive medication, we could not reach statistical conclusions.

In 39 fall cases (70%) there was reduced muscular tone on the involved side, but the difference between falls in patients with or without hypotonus was not significant (Wilcoxon rank sum test, $P = 0.542$, one-sided). In 30 cases (54%) the patient suffered from hemiplegia, and 26 (46%) from hemiparesis. The difference between the number of fall accidents among hemiplegics as compared to the number of falls among hemiparetics was significant (Wilcoxon rank sum test, $P = 0.04$, one-sided). Twenty-six fall accidents (46%) were registered in stroke patients suffering from hemimypoesthesia, but data concerning touch sensation were available in only 9 of those with motor or mixed aphasia. Sixteen falls (29%) were caused by intrinsic or cognitive mechanisms such as wrong judgment, psychomotor disorders, or mental disease. Communication disorders (different types of aphasia) were found on admission in 16 fall events (29%); hemianopia or blindness in one eye in 12 events that occurred in 48 patients in whom we could check the visual field (25%), and visuospatial agnosia in 10 events (18%) were most probably incremental risks for falls. Notably, in nine cases the fine-touch sensation and in eight cases the visual field could not be tested at admission to the rehabilitation department owing to insufficient cooperation of the patient. In nine cases patients had previous orthopedic problems in at least one of

Table 1. Clinical risk factors for falls

Risk factors	No. of falls	%
Medications	50	89
Reduced muscular tone	39	70
Hemiplegia	30	54
Hemiparesis	26	46
Hemihypoesthesia	26*	43
Intrinsic mechanism	16	29
Communication disorders	16	29
Hemianopia/blindness	12**	25
Visuospatial agnosia	10	18

* Twenty-six fall accidents out of 47
** Twelve fall accidents out of 48

Table 2. Non-clinical factors associated with falls

Other factors	No. of falls	%
Close to patient's bed	35	62
Treatment hour	24	43
Leisure time	15	27
Extrinsic mechanism	12	21

the lower limbs while in six cases there were other problems on the non-paralytic side.

The most frequent location for patient falls was close to the patient's own bed: 35 falls (62%); the next frequent location was the bathroom/toilet (11 falls), the corridor (8 falls), the physiotherapy institute (1 fall), and the dining room (1 fall).

The peak frequencies of 24 falls (43%) were recorded during the rehabilitation treatment hour, from 8 a.m. to 1 p.m. Fifteen falls (27%) occurred during leisure time (from 4 p.m. to 8 p.m.), 10 falls (18%) at night and 7 (12%) during rest hours in the afternoon. Twelve falls (21%) were caused by extrinsic mechanisms such as inappropriate transfer by a family member, instability of the wheelchair, or wet floor. Twenty-seven falls (48%) occurred between the first and fourth week after stroke onset, 21 (37%) between the fifth and eighth week, and 8 (14%) in the ninth week or later; it should be noted that in our department most patients were discharged from the rehabilitation department 4–6 weeks after stroke.

Only in two cases were there minor injuries such as bruises or small wounds due to a fall. The major clinical risk factors for falls are shown in Table 1, and the non-clinical influencing factors in Table 2.

DISCUSSION

From a preventive point of view, the identification of patients prone to falls and the identification of individual risk factors are crucial as these would be the focus of targeted intervention measures. We noted that the major clinical risk factor associated with falls was the use of drugs such as antihyperglycemics, antihypertensives, antipsychotics, antidepressants, anxiolytics or sedatives on the day of the fall event, followed by hypotonus, paralysis or hypoesthesia in the involved side, and intrinsic or cognitive reasons. Other risk factors to take into account are visual, visuospatial and communication disorders. All these clinical symptoms and signs were found on admission to rehabilitation treatment.

Our results partially confirm those in the literature. Among the risk factors noted by Nyberg and Gustafson [14] were visuospatial, hemineglect, and the use of diuretics, antidepressants and sedatives. Kwolek and Lewicka [15] as well as Tutuarima et al. [3] found that restriction of sleeping pill and psychotropic pill use could prevent falls. The use of medications that diminish blood glucose level or blood pressure and affect central nervous system function eventually reduces the stroke patient's vigilance or attention and leads to increased risk of falling [16,17].

A comparative study by Foucault et al. [18] over 19 months with 44 stroke patients revealed that the existence of sensitivity disorders, spatial neglect and sedative treatment are factors that predict falls.

Sze and co-researchers [8] who investigated the risk factors of falls among Chinese stroke inpatients during rehabilitation found that 85% of the falls occurred in daytime and 71% close to their own bed. According to Tutuarima et al. [3], 45% of falls occurred during the day, 51% in the patient's room and 20% during the visit to the toilet or bathroom. Mackintosh and colleagues [1], who evaluated the incidence, circumstances and consequences of falls that occur in stroke patients at home after their rehabilitation, found that the falls occurred most frequently during the day, while walking indoors or transferring from wheelchair to chair or to bed and vice versa, either in the bedroom or the living/dining areas. Byers et al. [20] examined the charts of 202 stroke patients who experienced falls in acute care settings and found that falls during the night shift occurred nearly twice as often as during day or evening shifts. The time of day when falls occur varies among the reports. Most falls in one study occurred between 6 a.m. and noon and between noon and 6 p.m. [11]. Some studies reported that the time interval between 11 p.m. in the evening and 7 a.m. is the most risky for falls [21], while others observed that the time between 6 a.m. and 10 a.m. and between 4 p.m. and 8 p.m. were the most risky [22].

In our study most of the falls occurred indoors, most frequently in the patient's room, during transfer from sitting to standing position or the reverse, and only a minority of falls occurred in the bathroom/toilet. The fall event occurred more frequently during activity time, in the morning or the afternoon. Falls were less frequent between 6 p.m. and 6 a.m., most probably because of limited activity.

Some patients with stroke must make a substantial effort simply to stand and walk. Anything that reduces attention, such as impulsivity [23], anxiety or depression, puts them at risk and may explain why those patients are more likely to fall [24]. Apart from perceptual difficulties, hemiplegic gait itself – characterized by slower, shorter steps, lack of smoothness and asymmetry – affects balance [2]. The stance is asymmetrical, with about 70% of the total body weight shifted onto the unaffected leg, and postural sway is increased [25]. These facts explain why hemiplegic patients tend to fall more often than hemiparetics.

This article focuses on the different risk factors for falls in stroke patients. In hemiplegia, balance control can also be impaired by medications that reduce efficient functioning, by hypotonus, paresis, hypoesthesia, by a broad spectrum of ophthalmologic and visuospatial disorders, and by environmental hazards.

Our results support the usefulness of clinical assessment of stroke as a predictor of falls. Since the likelihood of falls increases with the number of risk factors, prevention should address as many risk factors as possible and should involve the entire multidisciplinary team. Interventions to consider in rehabilitation departments are:

- paying more attention to patients with hemiplegia than to those with hemiparesis
- eventual reduction of psychotropic drug quantity
- control of blood glucose level and blood pressure at least once a day and drug adaptation according to the results obtained
- use of stable wheelchairs with all the devices necessary to prevent the patients who are prone to fall from standing up without supervision or slipping from the chair
- instructing the family how to transfer patients from bed to wheelchair and back
- identification of patients prone to fall in order to place them as close as possible to the nurses' station.

CONCLUSIONS

The risk for falling among stroke patients in the acute period is relatively moderate. The identification of categories of patients at high risk for falling is an important step towards implementing these prevention measures and improving the quality of hospital care. Falling and fear of falling is an important issue that needs to be dealt with by the multidisciplinary team [2], and fall prevention strategies should be developed and included in rehabilitation programs. The fact that no severe injuries have occurred in our unit would suggest that falls are not as serious a problem as previously suspected, though they can potentially occur.

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