Falls in individuals with stroke during inpatient rehabilitation at a tertiary care hospital in Saudi Arabia

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ABSTRACT

الأهداف : تحديد معدل حدوث السقوط وعوامل الخطر لدى المرضى الذين يعانون من السكتة الدماغية أثناء مرحلة إعادة التأهيل داخل مستشفى تأهيلي من الدرجة الثالثة .

الطريقة : قمنا بإجراء تحليل تراجعي لجميع المرضى المصابين بسكتة دماغية ويخضعون لبرنامج التأهيل الطبي داخل مستشفى التأهيل بمدينة الملك فهد الطبية من يناير 2011 إلى يونيو 2013 . وشملت البيانات التي تم جمعها المتغيرات الديموغرافية ،نوع السكتة الدماغية ،الأمراض المصاحبة ،خصائص السقوط ،العوامل التي تؤثر على السقوط ومدة الإقامة في المستشفى . تم تحليل البيانات وصفيا وحيث تم استخدام اختبار Pearson chi-square لتحديد أي علاقة ذات دلالة بين المتغيرات النوعية . كما تم استخدام الانحدار اللوجستي ثنائي الاستجابة لتقييم تنبؤ السقوط خلال فترة إعادة التأهيل .

النتائج : من بين 146 مريض منوم في مستشفى التأهيل بعد السكتة الدماغية كان هناك 36 مريضا قد سقطوا خلال فترة إعادة التأهيل . الأغلبية لم يتعرضوا لاصابات بعد السقوط . ارتبطت حالات السقوط بشكل كبير مع الفئة العمرية (p=0.048)، ونوع السكتة الدماغية (p=0.005) والتاريخ السابق لسكتة دماغية (p=0.020) . كما تبين أن جانب الدماغ المتأثر بالسكتة الدماغية (p=0.011) وتقييم مخاطر السقوط ذات دلالة إحصائية لنتائج السقوط (p=0.005) . كما كان طول مدة الإقامة بالمستشفى (LOS) مرتبطًا أيضًا بنتائج السقوط (p=0.044) .

الخاتمة : تم تحديد العمر، السكتة الدماغية النزيفية، جانب الدماغ المتأثر بالسكتة الدماغية والتاريخ السابق لسكتة دماغية كعوامل الخطر المرتبطة بالسقوط فترة التأهيل الطبي . يميل المرضى المصابين بسكتة دماغية إلى البقاء لفترة أطول في التنويم لإعادة التأهيل . نظرًا لاختلاف الانظمة الصحية والاختلافات الثقافية والبيئية، فان بناء وتطوير نظام اقليمي لمنع السقوط لدى المرضى المنومين بعد السكتة الدماغية قد يساعد في الحد من السقوط ومخاطره .

Objectives: To determine the incidence and risk factors of falls in individuals with stroke undergoing inpatient rehabilitation.

Methods: Retrospective analysis of all patients with stroke admitted to from January 2011 to June 2013 was carried out in Inpatient rehabilitation Unit at King Fahad Medical City, Riyadh, Kingdom of Saudi Arabia. Data collected included demographic variables, types of stroke, comorbidities, characteristics of falls, factors affecting falls and length of hospital stay. Data was descriptively analyzed. The Pearson Chi-square test was used to determine any significant relationship between the categorical variables. Binary logistic regression was used to evaluate predictors of falls during rehabilitation.

Results: Out of 146 stroke survivors, 36 patients had a fall during inpatient rehabilitation. Majority did not sustain any injury. Fall status was significantly associated with age group (p=0.048), type of stroke (p=0.005) and previous history of stroke (p=0.020). The side of stroke (p=0.011) and fall risk were statistically significantly related to fall outcomes (p=0.005). Length of hospital stay (LOS) was also associated with fall outcome (p=0.044).

Conclusion: Age, hemorrhagic stroke, laterality of stroke and previous history of stroke were identified as risk factors associated with falls. Injured patients tend to stay longer for inpatient rehabilitation. Due to different culturual, environmental and health system variations, development of regional guidelines for fall prevention in stroke survivors can help to reduce the risk of falls.

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During the acute management of a hospitalized patient, the focus is usually on treatment of admission diagnosis. Conditions associated with secondary complications due to immobility are often overlooked; for example, nutrition, skin care, oral hygiene, aspiration, bladder and bowel care, muscular conditioning, equipment needs, environmental comfort and ambulation. During acute treatment, since activities of most patients are confined to bed, the mobility of patient is not a priority concern. Consequently, drugs often prescribed during acute phase of treatment are without the consideration of their potential side effects that may lead to fall. Similarly, a commonly used admission order is "activity as tolerated". Such orders are ambiguous and may predispose the patients to fall if there is no objective assessment regarding mobility and risk of fall. Stroke survivors are unique, as they may not only have motor weakness, but can have associated sensory problems, visual-perceptual deficits, cognitive impairment, incoordination, cardiovascular risk factors (atrial fibrillation, hypotensive disorders) and psychological impairments. They may be on medications which are associated with high risk of falls such as antiepileptics, anticholingergics, antidepressants, sleep medications, and blood pressure lowering medications.[1] On the other hand, the indications for use of these medications may be a direct risk of fall as well, for example, falls due to post stroke epilepsy or during urine urgency. Hence, falls remains a far more complex aspect of stroke care than it is usually perceived. It is usually considered to be a non-medical or a mechanical event in stroke care and expected to be addressed by nursing or therapists solely. This perception may be attributed to its poor emphasizes in undergraduate or post graduate medical education, which rarely gets attention of physicians in their practice. Fall is one of the serious medical complications that stroke patients may concur during or after their hospitalization, as it affects quality of life.

Stroke survivors often experience diverse cognitive and physical deficits, making them high-risk candidates for falls.[2] Falls are serious events for patients with stroke admitted for inpatient rehabilitation as they are associated with considerable morbidity.[3] These consequences have a negative effect on the rehabilitation outcomes and may result in extended hospitalization and increased medical expense.[3] Falls may also induce

a fear of falling again, possibly leading to further restrictions in mobility, which may negatively impact participation in the rehabilitation program. Moreover, such psychological changes may result in self-induced restriction in activities, even after discharge from inpatient rehabilitation, thus negatively affecting the quality of life of stroke survivors. Given the impact of falls in stroke survivors, it is important to identify and monitor predisposing factors for falls during inpatient rehabilitation.[4]

Different studies analyzing falls in patients with stroke were conducted in acute stroke units, stroke rehabilitation units, and the community.[4-7] Stroke survivors have a high risk of fall (1.3-6.5 falls/person/year), with the highest rates occurring upon hospital discharge (8.7 falls/person/year).[8] Fall frequency rates of 25-39% have been reported for patients undergoing stroke rehabilitation.[9,10] Studies report that risk factors for falls in stroke rehabilitation units include male gender, poor performance in activities of daily living, bilateral motor deficit, neglect, aphasia, medication side effects, impaired balance, incoordination, history of falls, and cognitive impairment.[7] Injuries resulting from falls may range from minor trauma such as soft tissue injury, to severe injuries such as fracture or intracranial hemorrhage. Although incidence of severe injury is reported to be less than 4%; it is important to note that, with increased incidence of falls, hip fracture risk increases to 4 folds due to loss of bone mineral density and existence of neurological deficit on the weaker side.[7]

Stroke is a common neurological problem in Kingdom of Saudi Arabia. The annual crude incidence of stroke is reported to be 43.8 per 100,000 of the population.[11] This was similar to the preliminary results of an ongoing stroke registry based on a survey in the Eastern province of Kingdom of Saudi Arabia, in which the crude stroke incidence rate was approximately 40 per 100,000 per year with a male-to-female ratio of approximately 2:1. In Kingdom of Saudi Arabia, only few studies have highlighted the rehabilitation perspectives of patients with stroke.[3] The risk factors for falls may vary from one population to another due to differences in health care models and cultural or environmental variations. The aim of the study was to determine the incidence and risk factors of falls in stroke survivors receiving inpatient rehabilitation at a tertiary care facility in the region. Based on the previous literature, falls was defined as "an event that results in a person coming to rest unintentionally on the ground or other lower level, not as a result of a major intrinsic event or overwhelming hazard."[12]

Methods. *Inclusion criteria.* All patients with stroke admitted for inpatient rehabilitation between June 2011-June 2013 were included.

Exclusion criteria. All patients with stroke who were unable to complete their rehabilitation either due to death or transfer to another medical service were excluded.

Setting. This retrospective study was conducted at the stroke rehabilitation unit at King Fahad Medical City (KFMC) in Riyadh, Kingdom of Saudi Arabia.

Statistical analysis. Patients were grouped by the type of stroke (hemorrhagic versus non-hemorrhagic), and by the laterality of stroke (left, right, or bilateral). All categorical variables, such as gender, age group, falling status and type of stroke, were presented as numbers and percentages. Continuous variables, such as age and hospital stay, were expressed as mean±standard deviation. The Pearson chi-square test or Fisher exact test was used to analyze the data depending on whether the cell expected frequency was smaller than 5 in cross-tabulation, and to determine any significant relationship between the categorical variables. Binary logistic regression was used to evaluate predictors of falls during rehabilitation. A *p*-value<0.05 was considered statistically significant. All data were entered and analyzed using the Statistical Package for the Social Science (SPSS) Version 22 (IBM Corp., Armonk, NY, USA).

Results. Out of 146 stroke survivors included in our study, almost one fourth had a fall during inpatient rehabilitation (**Table 1**). Nearly one third of the patients were younger than 65 years of age. Majority did not sustain any injury as a result of fall (**Table 2**). Fall risk was determined by Morse scores. Morse score is classified as high risk (>45), moderate risk (25-44) and low risk (<24) for falls. As shown in **Table 1**, fall status was significantly associated with age group (*p*=0.048), type of stroke (*p*=0.005) and previous history of stroke (*p*=0.020). The side of stroke (*p*=0.011) and fall risk were statistically significantly related to fall outcomes (*p*=0.005) (**Table 3**). Two third of the patients injured as a result of fall had high Morse scores. Furthermore, the LOS was also statistically significantly associated with patients' fall outcome (*p*=0.044). The average hospital stay of patients with injury was 70 days, which was comparatively higher than the average LOS of patients without injury (approximately 52 days). Patients aged >65 years were approximately 3 times more likely to have an increased chance of falling during stroke rehabilitations than were patients aged <65 years (**Table 4**). Hemorrhagic stroke was an independent risk

factor, and it was 3.5 times more likely to affect patients' fall risk. Furthermore, a previous history of stroke showed a high odds ratio, and it was an independent risk factor of patients' fall status.

Discussion. Twenty four point seven percent of patients in our study had a fall, which is nearly average of what is previously reported in the international literature. The incidence of falls in acute care setting is comparatively less (8-22%) as compared to inpatient rehabilitation which ranges from 10-47%.[13-16] The higher incidence of falls during inpatient rehabilitation compared to acute hospitalization could be due to increased mobilization, regained abilities with recovery, and longer LOS in the rehabilitation hospital than in acute care. Even though incidence of falls tends to

Table 1 - Characteristics of the study population and a comparison of fallers and non-fallers.

Characteristics	Total	Fall status Fallers n (%)	Non-fallers	P-value
Number of patients	146 (100)	36 (24.7)	110 (75.3)	0.891
Age (years) (Mean±SD)	59.9±13.16	59.64±9.45	59.99±14.39	
Gender				
Male	96 (65.8)	28 (77.8)	68 (61.8)	0.080
Female	50 (34.2)	8 (22.2)	42 (38.2)	
Age Group				
≤65 years	98 (67.1)	29 (80.6)	69 (62.7)	*0.048
>65 years	48 (32.9)	7 (19.4)	41 (37.3)	
Type of stroke				
Hemorrhagic	20 (13.7)	10 (27.8)	10 (9.1)	*0.005
Ischemic stroke	126 (86.3)	26 (72.2)	100 (90.9)	
Side of Stroke				
Left	69 (47.3)	20 (55.6)	49 (44.5)	
Right	68 (46.6)	12 (33.3)	56 (50.9)	0.111
Bilateral	9 (6.2)	4 (11.1)	5 (4.5)	
HTN	120 (82.1)	30 (83.3)	90 (81.8)	0.837
DM	98 (67.1)	26 (72.2)	72 (65.5)	0.453
Previous stroke	29 (19.8)	12 (33.3)	17 (15.5)	*0.020
Communication disorder	81 (55.4)	24 (66.7)	67 (60.9)	0.560
Neglect	5 (3.4)	3 (8.3)	2 (1.8)	0.062
Visual deficit	9 (6.1)	3 (8.3)	6 (5.5)	0.533
Antidepressant use	36 (24.5)	9 (25)	27 (24.5)	0.956
Antihypertensive use	118 (80.8)	30 (83.3)	88 (80)	0.659
Diuretic use	20 (13.6)	5 (13.9)	15 (13.6)	0.969
Benzodiazepine use	7 (4.7)	2 (5.6)	5 (4.5)	0.806
Anticonvulsant use	14 (9.5)	4 (11.1)	10 (9.1)	0.747
Length of hospital stay (days)	51.15±24.6	55.47±21.6	49.75±25.5	0.282

SD - standard deviation, HTN - hypertension, DM - diabetes mellitus. *means significant difference.

Table 2 - Characteristics of falls in stroke survivors receiving inpatient rehabilitation at a tertiary care facility in the region. N=36

Characteristics	n (%)
Number of falls	
One time	30 (83.3)
2 times	5 (13.9)
3 times	1 (2.8)
Time of falls	
7:00 AM-7:00 PM	21 (58.3)
7:00 PM-7:00 AM	15 (41.7)
Fall from	
Bed	19 (52.8)
Chair/wheelchair	10 (27.8)
Commode	5 (13.9)
Others	2 (5.6)
Fall type	
Assisted	9 (25)
Observed	4 (11.1)
Unobserved	23 (63.9)
Fall location	
Patient's room	29 (80.6)
Therapy area	1 (2.8)
Home	6 (16.7)
Fall outcome	
Injury	7 (19.4)
No injury	29 (80.6)

Table 3 - Association between fall outcomes and clinical observations.

Variables	Outcomes of falls		P-value
	Injured (n=7)	Non-injured (n=29)	
	n (%)		
Age (years) (Mean±SD)	61.00±10.23	59.31±9.42	0.678
Gender			
Male	7 (100)	21 (72.4)	0.115
Female	0 (0)	8 (27.6)	
Type of stroke			
Hemorrhagic	2 (28.6)	8 (27.6)	0.958
Ischemic stroke	5 (71.4)	21 (72.4)	
Side of stroke			
Left	3 (42.9)	17 (58.6)	
Right	1 (14.2)	11 (37.9)	*0.011
Bilateral	3 (42.9)	1 (3.4)	
HTN	5 (71.4)	25 (86.2%)	0.346
DM	5 (71.4)	21 (72.4)	0.958
Previous stroke	4 (57.1)	8 (27.6)	0.137
Communication disorder	4 (57.1)	20 (69)	0.551
Patient fall risk			
High (Morse score >45)	5 (71.4)	17 (58.6)	
Moderate (Morse score 25-44)	2 (28.6)	11 (37.9)	*0.005
Low (Morse score ≤24)	0.0	1 (3.4)	
Number of falls			
One time	5 (71.4)	25 (86.2)	
Second time	2 (28.6)	3 (10.3)	0.419
Third time	0.0	1 (3.4)	
Fall time			
7 AM-7 PM	3 (42.9)	18 (62.1)	
7 PM-7 AM	4 (57.1)	11 (37.9)	*0.035
Length of hospital stay (days) (Mean±SD)	70.14±30.62	51.93±17.88	*0.044

SD - standard deviation, HTN - hypertension, DM - diabetes mellitus, *means significant difference

decline over years among stroke survivors, the risk of falls after stroke is much higher as compared to general population of elderly people. Interestingly, system reviews and meta-analyses show that there is little evidence to support interventions, such as exercise, for preventing falls post stroke; however vitamin D and bisphosphonates have shown significant reduction in falls.[17,18] The number of studies examining post stroke falls are limited or specific to a subgroup, rendering the need of further research to replicate these results before these recommendations are adapted in clinical practice.

It is reported that stroke survivors have twice the risk of fall as compare to other population.[1] The mean age of patients in our study group is around 60 years which is consistent with other studies in Kingdom of Saudi Arabia; however, it is lower than other Middle Eastern and Western countries.[19] There was no mean age difference between fallers and non-fallers in our study; however, analysis showed that the risk of fall in patients above 65 years of age was 3 times as compared to patients younger than 65 years. This is consistent with previous studies which report that risk of falls increases with increasing age.[20] Results from the Behavioral risk factor surveillance survey, conducted by the Centers for Disease Control and Prevention, indicated that, 15.9% of adults aged 65 years or older reported falling in the first 3 months.[21] Males are at higher risk of falls as compared

to females; however, Jørgensen et al,[20] reported that the incidence is equal in both gender. In our study, males had nearly 3/4 th of the total falls. Out of 50 females included in our study, 8 females sustained a fall during inpatient rehabilitation. It is interesting to note that none of the females had any injuries during falls. This may be attributed to the fact that, even if a bedside caregiver is not required, females prefer to be accompanied by a care giver during their inpatient rehabilitation, as a cultural norm, whereas males may or may not have bedside caregiver at all times. Laterality of stroke was strongly associated with outcomes of falls (injury or no injury) in our study. Fifty five point five percent of the fallers had left hemispheric stroke. Similar findings were reported by Alemdaroğlu et al,[22] who found that patients with left hemispheric stroke were more likely to fall within 6 months of discharge from a rehabilitation hospital than were those with right hemispheric stroke. One possible

Table 4 - Significant independent risk factors of fallers undergoing stroke rehabilitation.

Characteristics	OR	95% CI	*P*-value
Age >65 years	2.889	1.01-7.78	*0.035
Stroke type-hemorrhagic	3.416	1.22-9.53	*0.019
Previous stroke history	3.473	1.33-9.03	*0.011
OR - odds ratio, CI - confidence interval			

explanation is that right hemispheric lesions tend to be better supervised given their impaired judgment and lack of insight into their problems, compared with persons with left hemispheric lesions who usually have communication deficits but visuomotor perceptual deficits are not considerable. Our study did not show any significant association between fall status and neglect, visual deficits or communication disorder. This is in contrast to previous studies which showed a higher incidence of falls in patients who had an inability to follow commands or had visual impairment.[23,24] Visual deficits are of particular significance as they increase the likelihood of falls due to loss of depth perception and impaired visual spatial judgments.

The type of stroke is not known to be associated with fall risk; however, it had strong association with fall status (fallers or non-fallers) in our study.[16] Hemorrhagic stroke was identified as an independent risk factor, and it was 3.5 times more likely to affect patients' fall risk during inpatient rehabilitation. Anti-epileptics are commonly used prophylactically in patients with hemorrhagic stroke, and are associated with falls due their sedative effects; however, definite conclusions cannot be established from our study due to lack of statistical significance, even though nearly one third of patients using anti-epileptics had a fall during their rehabilitation course. Similarly, almost 25% of the patients using benzodiazepines, antihypertensive, diuretics and antidepressants fell during their rehabilitation course; however, medication use was not found to be significantly associated with fall status. Also, diabetes and hypertension had no significant association with fall status. There are several types of drugs which are associated with significant risk of falls including sedatives and hypnotics, antidepressants and benzodiazepines.[25] Antidepressants have shown to have the strongest association with falls.[26] An increased likelihood of falls was reportedly associated with neuroleptics, antipsychotics, and nonsteroidal anti-inflammatory drug. Campbell et al,[27] reported a 66% reduction in falls when psychotropic drugs were gradually withdrawn compared with those who continued on them. Drug prescriptions

for stroke survivors require close attention as drug metabolism, efficacy and adverse drug reactions vary between different patients. Additionally, side effects of drugs may increase the risk of falls due to associated neurological and cognitive impairment as a sequel of stroke. In our study, history of previous stroke was identified as an independent risk factor of patients' fall status. This brings attention to various scoring systems used for determining risk of falls; most of which do not include history of previous stroke. As per the American Heart Association Guidelines for stroke rehabilitation, the most commonly used assessment instrument in the 43 prevention studies reviewed was the Morse fall scale.[28] Morse score showed statistical significance with patients' fall outcomes in our study. Sixty one percent of fallers had high Morse score (>45), out of which 22% sustained injury. Morse fall scale is validated for use in hospitalized patients and is a common screening instrument for screening falls in elderly patients.[29] In our study, Morse scale was used as it is approved by the institution and conventionally used across the hospital; however, there are numerous other scales which can be used in fall risk assessment specifically in stroke patients, including Falls efficacy scale (FES), Stroke assessment of fall risk, Fall risk assessment tool (FRAT), or Tinetti performance oriented mobility assessment.[30-33] Falls efficacy scale has been found to be a simple and valuable scale because it predicts falling risks within the first 6 months after discharge.[34]

Most of the falls in our study were unwitnessed and they took place during day time and inside patients' room from the bed. There are limited number of studies regarding timing of falls. In one study, it was reported that 85% of the falls are reported to be during day time.[32] However, in other types of brain injuries, falls are usually during night time which may be attributed to altered sleep wake cycle.[35] There is no bed alarm system at our facility but they are commonly used in hospitalized patients. Falls were reduced by 20-60% in hospitals where alarm systems were used as primary intervention.[36] One of the 2 cluster randomized studies included alarms as a part of fall prevention program. One trial was effective but, the other did not reduce falls.[37,38] In our study 20% of the falls had injury. This is consistent with previous reported studies which report that the injury rates related to falls among patients undergoing inpatient rehabilitation range from 13-29%.[9,39] The details of injuries was beyond the scope of our research; however, stroke patients have a 4-fold increased risk of hip fracture associated with a high incidence of falls.[7]

Literature review indicates that the falls increase the length of stay regardless of the degree of harm.[40,41] This

is also similar to our study, where the average LOS of fallers was around 55 days as compared to non-fallers who had an average LOS of 49 days, but was not found to be statistically significant. Among those who sustained a fall, there was a signficant statistical signficance of LOS between injured and non-injured. The length of hospital stay of stroke survivors who sustained injuries was 19 days on average as compared to the ones who did not sustain any injuries. This may be attributed to more time required for their treatment of injury, recovery and regaining the decline in function post falls.

In conclusion, age, hemorrhagic stroke, laterality of stroke and previous history of stroke were identified as risk factors associated with falls. Injured patients tend to stay longer for inpatient rehabilitation. Large multicentered studies are required on patients with stroke undergoing inpatient rehabilitation to determine the impact of falls in the Saudi population. Due to different cultureual, environmental and health system variations, development of regional guidelines for fall prevention in stroke survivors can help to reduce the risk of falls.

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Ethical Consent