Falls After Stroke: A Follow-up after Ten Years in Lund Stroke Register

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Objectives: To evaluate incidence of self-reported falls and associated factors in a ten-year perspective after stroke. *Methods:* From a population-based cohort of first-ever stroke patients (n = 416) included in the Lund Stroke Register between March 1, 2001, and February 28, 2002, we performed a follow up of all 145 survivors ten years after stroke. We collected data on age, gender, main stroke type, living and housing situation, general health status (question 1 in the Short Form Health Survey (SF-36), dizziness, physical activity, Barthel Index, mobility aids, moving ability inside/outside, and health-related quality of life as defined by the EuroQol 3 dimension scale (EQ-5D-3L). Factors that may relate to falls were compared between those who had experienced falls after stroke or not. *Results:* Ten years after stroke, 49 patients (34 %) reported falls and 96 patients (66 %) reported no falls. Compared to patients with no falls, those who reported falls were older (median age 83.3 years vs 75.6 years; $p < 0.001$), more often lived alone, were more dependent in daily living, had less physical activity, poorer general health status, more often needed mobility aids, were more often unable to move alone outside, and had poorer health-related quality of life in all items in EQ-5D-3L except pain/discomfort. *Conclusions:* Falls had occurred in approximately one third of the participants ten years after the stroke, and were strongly associated with several measures of frailty. Our results indicate that fall prevention should in particular focus on those at high risk of falls.

Key Words: Cohort—Epidemiology—Stroke—Fall—Longitudinal study—Risk Factors—Outcome

Introduction

Even though treatment and rehabilitation after stroke have improved during the last decades, falls after stroke continue to be a serious concern. Studies in several countries have reported factors associated with falls after stroke, and survivors after stroke have been found to be at risk for falls in all post-stroke stages.[1] Falls have been reported among 40% of patients already within the first year after stroke and related to poor postural control training,[2] impaired reactive balance control,[3] and poor upper limb function.[4] From a review covering studies in 11 countries, the risk of falls after stroke was associated with the following factors: impaired mobility, reduced balance, sedative or psychotropic medication, disability in self-care, depression, cognitive impairment, and prior history of falls.[5] A review of 13 studies evaluating factors influencing the possibilities to reduce falls up to two years after stroke, concluded that effective interventions are needed to prevent falls after stroke,[6] and already six months after stroke more attention has been recommended regarding emotional and social consequences, in addition to strategies to improve physical function to prevent falls.[7]

However, long-term studies of the incidence of falls after stroke are few. A study of home-living stroke patients up to ten years after stroke concluded that the risk of falling was more than two times higher among long-term stroke survivors compared with age- and gender-matched control subjects, and the fall risk related

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mainly to mobility and depressive symptoms.[8] Age, sex, previous history of falls and atrial fibrillation have been associated with increased risk of falls and fractures at various time points up to 10 years after stroke onset.[9] Fear of falls may restrict activities in daily life and negatively affect recovery after stroke and strategies for fall prevention are needed.[10]

To summarize, previous studies found factors that increase the risk of falls after stroke, but these factors seem to vary, possibly related to study methods such as length of time from stroke onset until follow-up and type of stroke patients included. Consequently, there is a need to detect the most important factors for long-term risk of falls to be followed-up among patients after stroke.

We therefore analysed the incidence of falls by stroke patients' self-reports at the ten-year follow-up to identify factors that may be related to falls after stroke including non-modifiable and potentially modifiable factors.

Methods

Study cohort

The Lund Stroke Register (LSR) was started in 2001, and all 416 patients were consecutively included after a first-ever stroke onset between March 1, 2001, and February 28, 2002. LSR covers the population of eight municipalities with 234 505 inhabitants (December 31, 2001) representing the local catchment area of Skåne University Hospital, Lund (SUSL), Sweden. After 16 months, stroke survivors had been followed-up and some previously reported physical factors,[11,12] that may be related to falls reported at 10 years were registered. Ten years after stroke, all 145 survivors accepted to be followed up regarding functional status and patient-reported outcome,[13] secondary prevention and lifestyle indices after stroke.[14]

Procedure

The 145 participants were invited to a follow-up at SUSL ten years after stroke. They were informed that the follow-up could alternatively take place in their own home or a nursing home if they preferred. All participants gave informed consent to participate in the study and questions regarding falls and related factors were included in the questionnaire. The question regarding fall was; *Have you fallen after you had stroke?* The patient replied yes or no to this question. Spouses or significant others were invited to accompany the participants at the follow-up session, and to assist in replying to questions if the participant had communication problems. Three participants had moved approximately 250 km from the study area. They were followed-up in cooperation with a physician or a nurse in the district where they lived at the time of follow-up.

The following factors related to physical status, health and living situation were included in the questionnaire:

Living alone or not, housing situation (own home with or without home care, or in a nursing home), health status according to question 1 in the Short Form Health Survey (SF-36),[15] dizziness (feeling faint, weak or unsteady) and for our patients we used the Swedish word for dizziness (yrsel), physical activity (measured by frequency weekly and length of time), type of mobility aids, and moving ability inside/outside. Based on the Barthel Index questionnaire,[16] the activities of daily living were summarized into three groups; independence (score 95−100), moderate dependence (score 60−90) and major dependence (score 0−55).[17] Furthermore, health status as defined by the EuroQol dimension scale (EQ-5D-3L) questionnaire was also used at the follow-up after ten years to specify and compare factors regarding mobility, self-care, usual activities, pain/discomfort, and anxiety/depression between the patients who had fallen or not.[18]

Results from some questions at the follow-up 16 months after stroke were compared to examine if differences in the physical status and the living situation between those who had fallen and those who had not fallen ten years after stroke were detectable already 16 months after stroke (Table 3). The factors examined were living alone, housing situation, general health, physical activity and Barthel Index.

Statistics

The factors specified in Table 1, 2 and 3 were analyzed using the SPSS Statistical Software, version 25, to compare those who had fallen vs. those who had not fallen. Age was analyzed by Mann-Whitney U Test and other factors by Fisher's exact test. P values ≤ 0.05 were considered statistically significant. Our study was underpowered for a proper analysis using multiple logistic regression requiring inclusion of several variables as confirmed by a statistician consulted.

Ethical considerations

The ten-year follow-up was approved by The Regional Ethical Review Board in Lund, Sweden, Registration No. 2011/278. All 145 participants accepted registration in the Lund Stroke Register and gave written informed consent when they were in the hospital care after stroke. The participants were also informed that they could withdraw their participation from the registry if they preferred, but no patients in our study have withdrawn the consent. At the follow-ups, participants with newly detected health problems considered needing further medical investigation were referred to their general practitioners. If an urgent medical intervention was considered needed, a neurologist at SUSL was consulted.

Results

At the follow-up 10 years after stroke all 145 ten-year survivors participated and 49 participants (34%) reported

Table 1. *Characteristics of the 145 stroke survivors at the ten-year follow-up*

	Fall N = 49 (34%)	No fall N = 96 (66%)	*p*-value
Age after 10 years (range)	56.7−95.9	27.7−97.1	<0.001
mean/median	81.1/83.3	73.9/75.6	
Gender			N.S.
Male	24 (49.0%)	62 (64.6%)	
Female	25 (51.0%)	34 (35.4%)	
Main stroke type			N.S.
Cerebral Infarction	44 (89.8%)	82 (85.4%)	
Intracerebral Haemorrhage	3 (6.2%)	7 (7.3%)	
Subarachnoid Haemorrhage	1 (2.0%)	7 (7.3%)	
Undefined	1 (2.0%)	0	
Living alone	26 (53.1%)	36 (37.5%)	N.S.
Housing situation			<0.001
Own home, no home care	20 (40.8%)	79 (82.2 %)	
Own home, with home care	20 (40.8%)	11 (11.5%)	
Nursing home	9 (18.4%)	6 (6.3%)	
General health - SF36 question 1			<0.001
Excellent/very good /good	21 (42.9%)	69 (71.9%)	
Fairly good	13 (26.5%)	22 (22.9%)	
Bad	13 (26.5%)	1 (1.0%)	
No reply	2 (4.1%)	4 (4.2%)	
Dizziness	34 (69.4%)	35 (36.5%)	<0.001
Physical Activity, frequency			N.S.
Never	17 (34.7%)	15 (15.6%)	
<1/week	2 (4.1%)	4 (4.2%)	
1/week	4 (8.2%)	8 (8.3%)	
2−3/week	7 (14.2%)	17 (17.7%)	
>/=4/week	19 (38.8%)	52 (54.2%)	
Physical Activity, time			0.038
Never	17 (34.7%)	15 (15.6%)	
<15 min	2 (4.1%)	2 (2.1%)	
16−30 min	13 (26.5%)	24 (25.0%)	
31 min−60 min	11 (22.4%)	41 (42.7%)	
>60 min	6 (12.3%)	14 (14.6%)	
Barthel Index Groups			0.001
Independency (BI 95−100)	26 (53.1%)	80 (83.4%)	
Moderate dependency (BI 60−90)	11 (22.4%)	8 (8.3%)	
Major dependency (BI 0−55)	12 (24.5%)	8 (8.3%)	
Mobility Aids			<0.001
No	10 (20.4%)	71 (74.0%)	
Cane or crutch	3 (6.1%)	5 (5.2%)	
Rolling walker	20 (40.8%)	12 (12.5%)	
Electric powered wheelchair	5 (10.2%)	0	
Manual wheel chair	11 (22.5%)	8 (8.3%)	
Moving inside/outside			<0.001
Alone inside/outside, possibly aid	28 (57.1%)	84 (87.5%)	
Alone inside/not outside, possibly aid	11 (22.4%)	5 (5.2%)	
Dependent on help/confined to bed	10 (20.5%)	7 (7.3%)	

falls after stroke. A majority of those who reported falls did not remember when the falls had occurred and consequently information about time of falls was not registered. There were no significant differences between the two groups regarding main stroke type. The median age at the 10 year follow-up for the total group was 78.1 years (range 27.7−97.1) and there was a significant difference in age between the group reporting falls (median 83.3) and the group reporting no falls (median 75.6) ($p < 0.001$). Factors examined that may be co-morbidities related to falls are described in Table 1 and Table 2. Among those who had fallen, fractures caused by falls were reported in arm/leg by 7 (14%), and 8 (16%) reported hip fractures. A majority (51%) described that falls had occurred indoors, 20% reported falls outdoors, and 29% both outdoors and indoors.

Table 2. *EQ-5D-3L - 145 stroke survivors at the ten-year follow-up*

	Fall N = 49 (34%)	No fall N = 96 (66%)	*p*-value
Mobility			<0.001
No problem	10 (20.4%)	61 (63.6%)	
Some problem	27 (55.1%)	27 (28.1%)	
Dependent on help	12 (24.5%)	8 (8.3%)	
Self-care			<0.001
No problem	23 (46.9%)	82 (85.4%)	
Some problem	14 (28.6%)	6 (6.3%)	
Dependent on help	12 (24.5%)	8 (8.3%)	
Usual activities			<0.001
No problem	17 (34.7%)	71 (74.0%)	
Some problem	11 (22.4%)	14 (14.5%)	
Dependent on help	21 (42.9%)	11 (11.5%)	
Pain/Discomfort			N.S.
No	27 (55.1%)	56 (58.3%)	
Moderate	19 (38.8%)	37 (38.6%)	
Extreme	3 (6.1%)	3 (3.1%)	
Anxiety/depression			0.021
Not at all	29 (59.2%)	74 (77.1%)	
To some extent	18 (36.7%)	22 (22.9%)	
High degree	2 (4.1%)	0	

Table 3. *Status of 145 ten-year survivors 16 months after stroke, falls registered ten years after stroke*

	Fall N = 49 (34%)	No Fall N = 96 (66%)	*p*-value
Living alone	12 (24.5%)	24 (25.0%)	N.S.
Housing situation			N.S.
Own home, no home care	42 (85.7%)	89 (92.7%)	
Own home with home care	7 (14.3%)	4 (4.2.%)	
Nursing home	0	3 (3.1%)	
General health - SF36 question 1			N.S.
Excellent, very good, good	24 (49.0%)	63 (65.6%)	
Fairly good	18 (36.7%)	29 (30.2%)	
Bad	6 (12.2%)	4 (4.2%)	
Missing	1 (2.0%)	0	
Physical activity, frequency			N.S.
Never	7 (14.3%)	9 (9.4%)	
<1/week	1 (2.0%)	3 (3.1%)	
1/week	2 (4.1%)	4 (4.2%)	
2−3/week	9 (18.4%)	22 (22.9%)	
=/>4/week	29 (59.2%)	58 (60.4%)	
Missing	1 (2.0%)	0	
Physical activity, time			N.S.
Never	7 (14.3%)	9 (9.4%)	
<15 min	2 (4.1%)	0	
16−30 min	8 (16.3%)	23 (24.0%)	
31 min−1 h	25 (51.0%)	50 (52.1%)	
>1 h	6 (12.3%)	14 (14.5%)	
Missing	1 (2.0%)	0	
Barthel Index Groups			N.S.
Independency (BI 95−100)	38 (77.5%)	86 (89.6%)	
Moderate dependency (BI 60−90)	9 (18.4%)	6 (6.3%)	
Major dependency (BI 0−55)	2 (4.1%)	4 (4.1%)	

Regarding mobility aids, 20.4% in the fall group could walk without mobility aids vs. 74.0% in the no-fall group ($p < 0.001$) and 87.5% in the no-fall group could be moving independently inside/outside, which was possible only for 57.1% of those who had fallen. Never active in physical activity was reported by 15.6% in the no-fall group and 34.7% by those who had fallen. A large proportion of those who had not fallen (57.3%) were active 31 min up to 1 h or more, but only 34.7 % in the fall group, when comparing the time the participants were physically active ($p = 0.038$). According to the Barthel Index we found that 83.4% with no falls were independent in their activities of daily living, but only 53.1% in the group who had fallen ($p < 0.001$). (Table 1)

Regarding the living situation, 40.8% in the fall group were living in own home without home care vs. 82.2% in the no-fall group ($p < 0.001$), and 53.1% in the fall group were living alone, compared to 37.5% with no falls. General health, described as excellent/very good/good, was reported by 42.9% with falls and 71.9% with no falls ($p < 0.001$). Dizziness was reported by 69.4% in the fall group vs. 36.5% in the no-fall-group ($p < 0.001$) (Table 1).

In Table 2, EQ-5D-3L specifies health outcome by using three levels (No problem / Some problem / Dependent on help), and by comparing these factors between the two groups. Pain/discomfort was the only factor that did not differ significantly between the two groups, but the group with no falls reported better health status in mobility, self-care, usual activities, and anxiety/depression.

When comparing factors registered at the follow-up 16 months after stroke that may be associated with falls, there were no significant differences between the two groups reporting falls or no falls at the ten-year follow-up. The health status and activities followed up among the ten-year survivors at 16 months are specified in Table 3: Living alone, Housing situation, General health, Physical activity/frequency, Physical activity/time, and Barthel Index. Some of these factors showed somewhat (but not significantly) lower values already at 16 months after stroke in the group reporting that they had fallen compared to the group reporting no falls at the 10-year follow-up.

Discussion

We found that about a third of the participants followed up ten years after stroke had experienced falls. These results indicate that falls are a common problem among stroke survivors, especially among the oldest persons. The fact that the group who had experienced falls was considerably older than those who had not fallen indicates a need to consider further preventive and rehabilitation measures among the oldest stroke patients, as suggested in another study.[19] It has also been emphasized that stroke survivors should be encouraged to participate in meaningful activities and thus reduce sitting time and engage in activities, particularly individuals with arm impairment and/or those with a fear of falling.[20] There are also associations between dizziness and falls as well as other factors including vascular disease, drugs, physical performance, and activity[21] indicating that reported dizziness needs consideration when following up stroke survivors in a long-term perspective.

There are several studies from different countries reporting follow-up of falls among stroke patients. However, the occurrence of falls was in most studies primarily examined early after stroke or up to two years after stroke. We found only a few long-term studies including falls[8,9] and there is a knowledge gap regarding factors that may need to be followed-up to prevent falls in a long-term perspective after stroke. Falls may affect health and well-being among stroke survivors, and cause implications regarding independence and quality of life after stroke.[22] It has also been found from a study of 116 519 patients with a first episode of stroke between 2003 and 2017, that the incidence of fractures after stroke was 41.07 per 1000 person-years. The conclusion was that all levels of stroke severity (mild, moderate, severe stroke), and living alone at the time of stroke could be risk factors for fracture.[23] Therefore, several questions were included in our ten-year follow-up to find possible factors that may influence the risk of falls and need further observation after stroke to prevent falls.

Mobility aids and help from family/friends or assistants was reported more often among those who had fallen and/or had dizziness, particularly considering that 53.1% of them were living alone after ten years. Assistance to stimulate physical activity is also important in recovery after stroke as reported in a previous study,[24] and may improve balance and walking ability. Follow-up and further rehabilitation for the elderly stroke patients with these risk factors after the acute care could possibly decrease the risk for falls.

Falls and risk of falls have important consequences on several aspects after stroke. The Public Health Agency of Sweden has reported that accidental falls among elderly people is a growing public health problem, resulting in high costs for society and significant deterioration in quality of life for individuals.[25] There are sometimes deficiencies in follow-up after discharge from the stroke unit, which is important to detect the need of further rehabilitation to prevent falls.[26] A follow-up study up to 2.5 years after stroke concluded that the long-term health-related quality of life of stroke survivors may be positively influenced by reducing the risk of falls and improving emotional well-being.[27] Elderly with a history of stroke are at higher risk for falling because they are more likely to walk less and be less mobile, which accelerates osteoporosis, thereby increasing the risk of fall-related injuries.[28] Consequently, effective prevention of falls should be undertaken. Guidelines are important for continuous development of stroke care including

rehabilitation as well as structured follow-up after discharge from the hospital.[29]

Strengths and limitations

Strengths of our study include the population-based design with both urban and rural participants, no survivors lost to the follow-up at ten years, and the methodology using a combination of communication with the participants and their relatives, if the patients had difficulties to reply. Limitations in our study were; I) results were based on self-reports and not validated by other sources with the consequence that the definition of falls may have differed between participants, II) recall bias may have occurred because some patients may have forgotten falls, III) data on the timing of the falls during the ten-year follow up were not collected, IV) the study was underpowered for a multiple regression analysis and adjustment for multiple possible confounders. The analysis identifies associations; further studies are needed to identify possible risk factors and predictors, V) factors related to falls may change over time after the index stroke.

Conclusion

Falls after stroke were commonly reported. Individuals reporting falls ten years after stroke had higher age, generally lower functional status, lower physical activity and lower self-perceived health than those who reported not having fallen. This indicates that stroke patients need follow-up regarding risk for falls and preventive measures targeting fall risk.

Declaration of Competing Interest

None.

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