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Original article

The Risk of Falls in Patients with Cerebrovascular Disease

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SUMMARY

Introduction/Aim. Patient falls in hospital conditions are among the most common serious adverse events following a cerebrovascular insult at all stages of the disease. The aim of this study was to investigate the risk of falls in patients with cerebrovascular disease.
Methods. A clinical case-control observational study was conducted in this investigation. The sample consisted of patients who suffered from cerebrovascular diseases and were admitted to the Special Hospital for Cerebrovascular Diseases "Sveti Sava" in Belgrade, in the period from February 3, 2018, to June 28, 2019. The Morse questionnaire was used to assess a fall risk. All statistical calculations were performed using the standard commercial software package SPSS, version 21.0.
Results. Most of the subjects with a cerebrovascular insult (505 (90.0%)) had a high risk of falls, i.e. they had the Morse score values ≥ 45. The mean Morse score of the subjects in the study was 67.07 ± 21.08. The risk of falling, according to the Morse score, is the highest among subjects diagnosed with bleeding (95.7%: 96.7%) and left-sided neurological deficit (91.7%:90.8%) in both examined groups.
Conclusion. It is of great importance to organizing training programs for patients, healthcare providers, and medical staff to prevent falls in hospital conditions.

Keywords: **Morse scale, stroke patients, falls**

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INTRODUCTION

According to the World Health Organization (WHO), cerebrovascular disease is one of the major public health problems today. According to the Global Burden of Disease Study, cerebrovascular disease is the leading cause of mortality and disability worldwide (1). Patient falls in hospital conditions are among the most common serious adverse events following a cerebrovascular insult at all stages of the disease (2, 3). It is estimated that the incidence of falls in cerebrovascular disease survivors varies from 19% in the acute phase of the disease to 73% in the first six months after the cerebrovascular insult (4, 5). Institute of Public Health Serbia records a fall rate of 0.1 to 0.5 per 1000 hospitalized patients, pointing to inadequate reporting by healthcare facilities (6). WHO estimates that more than 646,000 fatal falls occur annually in the general population, making falls the second leading cause of unintentional death after traffic accidents (1). More than 80% of deaths occur in low- and middle-income countries (7, 8). Fall injuries of hospitalized patients have been reported in 5% of patients, with resulting fractures and severe injuries. According to data in the literature, the risk of hip fracture is four times higher in cerebrovascular disease than in other neurologic diseases (9).

The Centers for Disease Control and Prevention (hereafter CDC) and previously conducted multicenter studies confirm that falls are the major financial burden on society, accounting for 75% of all medical expenditures per year, and 7.8% of expenditures are spent treating fall injuries in hospital settings (10). In the United States, more than $50 billion is spent on the treatment of fall complications, while the Republic of Finland spends $3611 per person, i.e Australia spends $1049 (11). The hospital's total cost of patient falls is over $30,000 per year (12).

Falls in hospitalized patients have a multifactorial etiology influenced by internal and external factors (13). Pathophysiologically, falls may be the result of biological responses and functional incapacity, but may also be the result of cumulative problems in patients with cerebrovascular disease. An increased tendency to fall is due to altered sensitivity, thinking ability, prolonged reaction times, impaired balance and mobility, and altered blood pressure regulation due to the weakening of the baroreceptor reflex (12, 14).

It is estimated that effective fall prevention strategies would reduce the incidence of falls by 20%, which would help save more than $120 million in health care costs each year (9, 10, 15).

Therefore, it is essential to assess the risk of falls in patients under hospital conditions and use the information to develop strategies for prevention and timely rehabilitation. In this context, the aim of this study was to investigate the risk of falls in patients with cerebrovascular disease.

METHOD

Type of study

A clinical case-control observational study was conducted in this investigation. The sample consisted of patients who suffered from cerebrovascular diseases and were admitted to the Special Hospital for Cerebrovascular Diseases "Sveti Sava" in Belgrade, in the period from February 3, 2018 to June 28, 2019. Two groups of respondents were observed.

One group (case) consisted of subjects who suffered from cerebrovascular disease and experienced a fall during hospitalization, and the second group (control) consisted of subjects who suffered from cerebrovascular disease and did not experience a fall during hospitalization. If a subject in the control group experienced a fall during hospitalization, they were transferred to the "fall" group, and a second subject was selected for the control group. The groups were matched for sex, age and diagnosis (transient ischemic attack, ischemic stroke, hemorrhagic stroke). The patient or his legal representative had signed an informed consent form to participate in the study. Inclusion criteria were followed in selecting subjects for the study, i.e they were excluded from the study.

The inclusion criteria for the study were: a respondent was any patient who suffered from a cerebrovascular disease for the first time (transient ischemic attack, ischemic stroke, hemorrhagic cerebral insult), regardless of sex and age; a respondent was in the acute phase of the disease and was hospitalized; a respondent (or the patient's legal representative) signed the informed consent form.

Exclusion criteria for the study: a subject who had a cerebrovascular event before the current hospitalization or had multiple hospitalizations with a

diagnosis of cerebrovascular disease; a respondent had a severe neurologic deficit or any of the accompanying neurologic conditions (neurodegenerative, demyelinating, movement disorders, tumors, cranial nerve syndromes, epilepsy, brain injury, etc.) before the cerebrovascular event; a respondent had a diagnosed cognitive disorder (dementia, depression, psychosis, etc.); a respondent had one of the ophthalmological, audiovestibular, orthopedic (spinal deformities, etc.) or systemic diseases (arthritis, etc.); a subject or their legal representative did not sign the consent form. The subject may be excluded from the study at any time at his/her request or if one or more exclusion criteria for the study were present. The research protocol was designed for the needs of this study and included several questionnaires to assess the neurological and functional status of the subject. These questionnaires are standardized, translated into Serbian, and published in good practice guides.

Assessment of the condition using the questionnaires was always performed by competent experts. Assessment by questionnaire was performed one day after the experienced fall in the subjects of the "fall" group and in the subjects of the control group depending on the agreement of the subject and duration of hospitalization that did not differ by more than +/- one day compared to the duration of hospitalization of the subjects of the "fall" group.

The Morse questionnaire was used to assess fall risk. The Morse code is standardized and translated into Serbian and the author Janisa Morse's consent was obtained and used for research purposes. The Morse questionnaire follows six parameters: previous falls, other medical diagnoses, mobility aids, intravenous therapy, walking ability, and mental status. The score ranges from 0 to 125 points and quantifies fall risk in three categories: low fall risk (from 0 to 24 points), moderate fall risk (from 25 to 44 points), and high fall risk (45 or more points) (16).

The research was approved by the Ethics Committee of the Special Hospital for Cerebrovascular Diseases "Sveti Sava" in Belgrade under the official number 03/2256. There were no conflicts of interest of the principal investigator for the research under full ethical and professional responsibility. Ethical principles about patient rights were respected and professional secrecy was maintained. The data were used for research purposes only.

Variables

The variables measured in the study are: demographic characteristics: gender, age, marital status, place of residence; socioeconomic characteristics: education, occupation, material status; level of care: general, semi-intensive, intensive; type of cerebrovascular disease: transient ischemic attack, ischemic stroke, hemorrhagic stroke.

Clinical findings/screening: Morse score, lateralization side (right, left, without lateralization), brain region affected by cerebrovascular disease (according to scan findings); risk factors for falls: previous falls, other diagnoses, mobility aids, intravenous therapy, type of movement, mental status; fall data: number of falls, order of falls in hospital, day of hospitalization when fall occurred, location and time of fall, consequences of fall.

Statistical data processing

Data were presented using the methods of descriptive statistics: tabulation, graphical representation, measures of central tendency, and measures of variability. Statistical data processing of continuous variables is presented as mean ± standard deviation and categorical variables as the proportion of respondents with a given outcome. Differences in the parameters between two groups of patients were evaluated by the Independent samples t-test or the Mann-Whitney U-test (depending on the distribution). To compare differences in frequencies of categorical variables, the Chi-square (χ^2) test was used. Context-dependent variables and a number of independent variables were examined or analyzed by bivariate and multivariate logistic regression. For risk assessment, the OR (odds ratio) with a 95% confidence interval was used. All results were considered statistically significant if the probability was less than 5% ($p < 0.05$). All statistical calculations were performed using the standard commercial software package SPSS, version 21.0. (The Statistical Package for Social Sciences software (SPSS Inc, version 20.0, Chicago, IL).

RESULTS

A prospective clinical case-control study included 561 patients diagnosed with acute stroke, of whom 252 patients (44.9%) suffered a fall during hospitalization. The subjects were divided into two

groups, a group of patients who experienced a fall during hospitalization and a control group of patients without verified falls. During the observation period, 9,182 patients were hospitalized with acute stroke. The number of days of hospitalization was 128,548 days. The incidence of falls was 2.74%, while the fall rate was 1.96.

CHARACTERISTICS OF RESPONDENTS ACCORDING TO FALL RISK - MORSE SCORE

Using the Morse Scale to assess fall risk, it was found that most of the subjects with a cerebrovascular insult (505 (90.0%)) had a high risk of falls, i.e, they had Morse score values ≥ 45. The mean Morse score of the subjects in the study was 67.07 ± 21.08.

The mean Morse score for the subjects who experienced a fall during hospitalization was 67.86 ± 21.34, whereas it was 66.42 ± 20.86 for the control subjects. There was no statistically significant difference in the mean Morse score values between the tested groups (t = 0.801, p = 0.801) (Table 1).

Table 1. *Difference in Morse score in relation to the tested groups*

Morse score	n	min	max	$\bar{x}$	sd
Fall	252	15	125	67.86	21.34
Control	309	15	125	66.42	20.86

There was no statistically significant difference in the level of fall risk with respect to the studied groups (χ^2 = 0.750, df = 2, r = 0.687). In both groups, the largest number of respondents had a high risk of falling (88.9% and 90.9%).

In relation to gender, the mean Morse score values were slightly higher in females than in males in both groups studied, although there was no statistical significance between the groups in the mean Morse score values in relation to gender (Table 2).

There was no statistically significant difference in the levels (categories) of fall risk in relation to gender in the studied groups. More female subjects were at high risk of falls in both groups (90.6% and 94.5%) (Table 3).

Table 2. *The difference in the mean values of the Morse score in relation to gender*

Morse score		n	$\bar{x}$	sd	p
Fall	**Men**	188	67.42	21.35	0.579
	Women	64	69.14	21.52	
Control	**Men**	218	65.87	21.53	0.472
	Women	91	67.75	19.19	

The Kruxall-Wallis test revealed a statistically significant difference in mean Morse score between different age groups in subjects who had experienced a fall (r = 0.012). The youngest (45 - 55 years) and oldest age groups of respondents (85 years and older) had higher mean Morse score values (Md = 75; Md = 70) compared with other age groups (Table 4). In the control group, there was no statistically significant difference in the mean Morse score values with respect to the age groups of the subjects (r = 0.249).

The Morse score in relation to the clinical characteristics of the subjects is shown in Table 5.

Table 3. *Fall risk in relation to the gender of the respondents*

Fall risk	Fall				Control			
	Men		Women		Men		Women	
	n	%	n	%	n	%	n	%
Minimal	7	2.7	6	3.1	5	2.3	1	1.1
Medium	21	9.0	22	6.3	18	8.3	4	4.4
High	224	88.3	281	90.6	195	8.4	86	94.5
p	0.774				0.368			

Table 4. *The difference in average Morse score values in relation to age categories*

Age		Morse score				
		Lower	Upper	Median	sd	p
Fall	45 - 54	60	90	75	6.51	0.678
	55 - 64	55	70	60	3.1	
	65 - 74	62.6	70	70	2.12	
	75 - 84	70	70	70	0.99	
	85+	70	80	70	3.14	

Table 5. *Morse score in relation to the clinical characteristics of the subjects*

Diagnosis		Morse score						
		minimum		medium		high		p
		N	%	N	%	N	%	
Fall	Ischemia	7	3.1	20	8.7	202	88.2	0.518
	Hemorrhage	0	0	1	4.3	22	95.7	
Control	Ischemia	5	1.8	22	7.9	252	90.3	0.245
	Hemorrhage	1	3.3	0	0	29	96.7	
Neurological deficit		Morse score						
		minimum		medium		high		p
		N	%	N	%	N	%	
Fall	Right side	3	5.2	6	10.3	49	84.5	0.380
	Left side	3	1.9	10	6.4	144	91.7	
	Without lateralization	1	2.7	5	13.5	31	83.8	
Control	Right side	0	0	8	8.3	88	91.7	0.541
	Left side	5	2.9	11	6.3	158	90.8	
	Without lateralization	1	2.6	3	7.7	35	89.7	
Care level		Morse score						
		minimum		medium		high		p
		n	%	n	%	n	%	
Fall	General	4	4.3	14	15.2	74	80.4	0.015
	Semi-intensive	3	2.4	7	5.5	117	92.1	
	Intensive	0	0	0	0	33	100	
Control	General	2	0.9	11	10.5	92	87.6	0.340
	Semi-intensive	2	1.3	8	5.1	147	93.6	
	Intensive	2	4.3	3	6.4	42	89.2	
Day of hospitalization		Morse score						
		minimum		medium		high		p
		n	%	n	%	n	%	
Up to 16 days		7	100	21	100	208	88.1	0.711
16 - 22		0	0	0	0	14	6.3	
More than 22 days		0	0	0	0	2	0.9	

Table 6. *The difference in the average values of the Morse score in relation to the clinical characteristics of the subjects*

Diagnosis		Morse score					
		n	min	max	$\bar{x}$	sd	p
Fall	Ischemia	229	15	15	67.38	21.49	0.286
	Hemorrhage	23	35	125	72.61	19.71	
Control	Ischemia	279	15	125	66.40	20.94	0.952
	Hemorrhage	30	15	125	66.67	20.44	
Neurological deficit		**Morse score**					
		n	**min**	**max**	$\bar{x}$	**sd**	**p**
Fall	Right side	58	15	100	62.50	19.15	0.176
	Left side	157	15	25	69.75	21.22	
	Without lateralization	37	15	125	68.24	24.22	
Control	Right side	96	35	125	67.24	19.23	0.796
	Left side	174	15	125	66.18	21.63	
	Without lateralization	39	15	125	65.42	21.64	
Level of care		**Morse score**					
		n	**min**	**max**	$\bar{x}$	**sd**	**p**
Fall	General	92	15	125	63.91	20.25	0.074
	Semi-intensive	127	15	125	70.00	20.65	
	Intensive	33	15	125	70.61	22.38	
Control	General	105	15	125	63.43	23.47	0.089
	Semi-intensive	157	15	125	68.63	20.00	
	Intensive	47	15	125	65.74	19.11	

When considering the risk of falls according to the Morse score in relation to the diagnosis, it is noticeable that the number of subjects who experienced a fall was slightly higher than in the control group and that the subjects in the group with a high risk according to the Morse score had the diagnosis of hemorrhage (95.7%: 96.7%), whereas the subjects with an intermediate risk of falls had the diagnosis of ischemia were present in the control group, too.

In terms of neurological deficit, it can be noted that most of the respondents who experienced a fall and were in the high-risk group according to the Morse score had a left neurological deficit (91.7%), while the respondents who were in the medium-risk group had the most falls without lateralization. As for the control group, in the high fall risk group, most respondents had a right-sided neurological deficit (91.7%), as well as in the moderate fall risk group, where 8.3% had a right-sided neurological deficit. In terms of the level of care, there was a statistically significant difference in fall risk in the group of respondents who experienced a fall (r = 0.015). The highest risk of falls in this group was among respondents who were in the intensive care unit (100%), followed by those in the semi-intensive care unit (92%). In the largest number of high-risk respondents (88.1%), the fall occurred in the first 16 days of hospitalization (r = 0.711).

The difference in the mean scores of the Morse score in relation to the clinical characteristics of the subjects is shown in Table 6. There was no statistically significant difference in mean Morse score values in relation to diagnosis, neurological deficit, or between specific categories of the level of care.

Regarding the day of hospitalization when the fall occurred, the research results indicated that a longer hospital stay increased the risk of a fall, i.e. the highest average Morse score values were recorded in those who were hospitalized for more than 22 days, but the difference was not statistically significant (r = 0.678).

DISCUSSION

Patient falls in hospitals are a serious problem and are considered a challenge to patient safety. They can lead to numerous negative consequences, such as injuries and prolonged rehabilitation time, increased length of hospital stay, higher health care costs, and legal consequences (15, 16). It is known that 30% of falls in hospitals result in some type of injury, while serious consequences occur in an average of 3% to 6% of patients (17). Falls in hospitals are the most commonly reported critical incidents and can have tragic consequences that affect morbidity and mortality (18). Falls in the hospital may be influenced by several factors. Many studies suggest that a decrease in hospitalizations is due to a combination of many risk factors, including acute illnesses and long-term consequences of these illnesses, the aging process, and side effects of medications and the hospital environment that are unknown to patients. There is also data that neurologic patients are at high risk of falls and that falls are more common in neurologic units. Studies on falls show that falls in neurological patients are related to gait and balance problems and medication use (19 - 23).

Other studies have also shown that neurological patients have a higher risk of falls and that the neurological department ranks third in the incidence of falls after the oncology and rehabilitation departments. The main causes of falls are wet floors, poor lighting, inappropriate footwear, walking barefoot, slippery floors, postural and gait disorders, wheelchair failure, fainting, and dizziness.The most common complications of such falls are lesions, fractures, lacerations and hematomas, fractures, contusions, soft tissue damage, trauma, abrasions, lacerations, head injuries, and chest injuries. Other studies have shown that factors such as age, stroke, dementia, Parkinson's disease, peripheral neuropathy, depression, dizziness, postural dysfunction, gait dysfunction, balance dysfunction disorders, fear of falling, use of psychotropic drugs, treatment with antidepressants, neuroleptics, cardiovascular drugs, use of antihypertensive medications, altered level of consciousness, use of walking aids, lower extremity weakness, muscle weakness, use of inappropriate walking aids, loss of sensation, bowel and bladder problems, and significant vision loss increase the risk of falls in neurologic patients (24).

A study examining the frequency of falls and several variables and their association with falls during hospitalization in a stroke unit found that 13% of patients fell at least once. Factors significantly associated with falls were male gender, use of a walker, and postural control assessed by a modified version of the Posture Assessment Scale for Stroke Patients. No association was found with age or stroke severity (25).

Another study showed that treatment with neurotropic medications, especially opioids, in the acute phase after stroke is associated with impaired postural control. Because impaired postural control is a major cause of falls in patients with acute stroke, these results suggest that opioids should be used more cautiously (26). Other studies have shown that female subjects are more likely to fall in hospital conditions when the spectrum of all neurologic conditions is considered (27 - 29), whereas the incidence of falls in male subjects is higher for cerebrovascular conditions (30). This result is a consequence of the more frequent occurrence of cerebrovascular disease in the male population. Similar results were found in other studies in which the average age of patients who fell in hospitals ranged from 66 to 76 years. It follows that age is an important predictor of the occurrence of falls (31 - 34).

The first step in fall prevention is to identify patients at risk. In this sense, risk factors are considered crucial for identifying patients at risk for falls and selecting effective fall-prevention interventions. A number of risk factors that influence patient falls have been identified in the literature. A combination of modifiable patient-related factors such as improvement in vision, assistance with walking, regular toileting program, and medication modification should definitely be considered (35 - 37).

It should also be kept in mind that the hospital environment is significantly different from the home environment, hospital patients are generally weaker due to hospitalization, so the measures to reduce falls in hospital patients should be different from those in the home environment (38).

Many studies report that health professionals are responsible for protective and preventive measures to eliminate and reduce the risk of falls and that it is of great importance to comprehensively understand and systematically apply the principles of fall prevention (39).

CONCLUSION

By identifying fall risk factors and assessing fall risk, we can prevent patient falls in the hospital setting and thereby provide better quality health care. It is useful to identify patients at higher risk of falls in order to take preventive measures. On the other hand, it is of great importance to organize training programs for patients, healthcare providers, and medical staff to prevent falls in hospital conditions.

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Rizik od padova kod pacijenata sa cerebrovaskularnom bolešću

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S A Ž E T A K

Uvod/cilj. Padovi pacijenata u bolničkim uslovima među najčešćim su ozbiljnim neželjenim događajima nakon cerebrovaskularnog insulta u svim stadijumima bolesti. Cilj ove studije bio je da se ispita rizik od padova kod pacijenata sa cerebrovaskularnom bolešću.
Metode. U ovom istraživanju je sprovedena klinička studija slučaja i kontrole. Uzorak su činili pacijenti koji su bolovali od cerebrovaskularnih bolesti primljeni u Specijalnu bolnicu za cerebrovaskularne bolesti „Sveti Sava" u Beogradu u periodu od 3. februara 2018. do 28. juna 2019. godine. Za procenu rizika od pada korišćen je Morzeov upitnik. Svi statistički proračuni obavljeni su korišćenjem standardnog komercijalnog softverskog paketa SPSS, verzija 21.0.
Rezultati. Većina ispitanika sa cerebrovaskularnim insultom – njih 505, tj. 90,0% – imala je visok rizik od pada, odnosno imali su vrednosti Morzeovog skora ≥ 45. Prosečna Morzeova ocena ispitanika u studiji bila je 67,07 ± 21,08. Rizik od pada, prema Morzeovom skoru, najveći je kod ispitanika sa dijagnozom krvarenja (95,7% : 96,7%) i levostranog neurološkog deficita (91,7% : 90,8%) u obema ispitivanim grupama.
Zaključak. Od velike je važnosti da se organizuju programi obuke za pacijente, zdravstvene radnike i medicinsko osoblje kako bi se sprečili padovi u bolničkim uslovima.

Ključne reči: **Morzeova skala, pacijenti sa moždanim udarom, padovi**