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Factors Affecting Complications and Mortality of Stroke Patients in Stroke Care Unit

Samad Shams Vahdati[1], Alireza Ala[1], Sina Hejazian[1], Elyar Sadeghi Hokmabadi[2], Taraneh Majidi[3], Faezeh Ghanbari[1], Naeimeh Hosseinzadeh[1]

ABSTRACT

Objective: Stroke remains the second greatest cause of mortality worldwide, causing more than 5 million deaths annually. Hypertension (HTN), diabetes mellitus (DM), male sex, and an age >60 years have been associated with a higher incidence of stroke.

Materials and Methods: The clinical data of 896 patients of the stroke care unit (SCU) of Tabriz University of Medical Sciences in Iran were retrieved and studied to examine the correlation between clinical features and complications.

Results: Patients who presented with dysarthria, loss of consciousness, and vertigo had a significantly higher risk of mortality. A history of HTN, DM, ischemic heart disease, congestive heart failure, or carotid stenosis also meaningfully contributed to higher rates of mortality. The main complications associated with higher risks of mortality included aspiration pneumonia, pulmonary embolism, urinary tract infection, sepsis, bedsores, myocardial infarction, gastrointestinal bleeding, hydrocephaly, and brain herniation.

Conclusion: Age and several other factors played a significant role in increasing the in-hospital mortality of patients admitted to the SCU. However, no significant correlation was observed between mortality and sex, previous cerebrovascular accident, or the length of in-hospital stay.

Keywords: Mortality, stroke, stroke center

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[1]Department of Emergency Medicine, Emergency Research Team, Tabriz University of Medical Sciences, Tabriz, Iran
[2]Department of Neurology, Fellowship of Neurointervention, Neuroscience Research Center, Tabriz University of Medical Sciences, Tabriz, Iran
[3]Kidney Research Center, Tabriz University of Medical Sciences, Tabriz, Iran

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Correspondence
Naeimeh Hosseinzadeh, Tabriz University of Medical Sciences, Emergency Research Team, Tabriz, Iran
Phone: +989147666658
e-mail: n.hosseinzadeh1@gmail.com

INTRODUCTION

Stroke continues to be the second leading cause of mortality worldwide, causing more than 5 million deaths a year (1). The prevalence of acute stroke/chronic stroke is increasing due to the growing population and recent therapeutic advances in developed countries. In low- and middle-income countries, the morbidity and mortality rate of stroke patients is notably higher, making this disease the second leading cause of disability-adjusted life years lost worldwide (2, 3).

According to a report published by the National Heart, Lung, and Blood Institute of the USA, the major risk factors for stroke are hypertension (HTN), diabetes mellitus (DM), heart and blood vessel disease, a high level of low-density lipoprotein cholesterol, smoking, brain aneurysm, arteriovenous malformations, infection, inflammatory disease, and age (4–6). Stroke is divided into types based on the origin and the cause of the lesion: hemorrhagic, atherosclerotic ischemic, or embolic ischemic stroke. Hemorrhagic stroke includes intracerebral hemorrhage and subarachnoid hemorrhage (7, 8).

Although ischemic stroke is the most prevalent type, hemorrhagic stroke is reported to be the most deadly. In recent years, due to changes in lifestyle and environmental factors, the incidence of stroke among adults has significantly evolved (9–11). Mortality is predominantly seen among men aged >75 years who experience hemorrhagic stroke (12).

Based on current knowledge, cigarette smoking, a previous history of stroke, female sex, greater age, coronary heart disease, DM, and HTN are associated with a higher mortality rate among stroke patients (11, 13). Stroke is more common among men, but often more severe in women who are frequently older when they experience a stroke. These findings, along with some advances, such as the use of recombinant tissue plasminogen activator, have helped specialists to significantly reduce the mortality rate of stroke patients (14). Nonetheless, the in-hospital mortality rate is reported to be as high as 3% to 18%, which is a significant portion of all patients (15).

Upon in-hospital admission, the patient is under close observation, and a significant proportion of cardiac, respiratory, and vascular complications could be controlled if identified quickly and properly. Therefore, this study was designed to analyze the most important factors affecting in-hospital mortality of stroke patients, with the aim of minimizing the adjustable risk factors and reducing the in-hospital death rate.

MATERIALS and METHODS

This retrospective, cross-sectional study was performed using the medical records of all patients who were admitted to the stroke care unit between March 2019 and March 2020 with the diagnosis of stroke. Patients with post-traumatic stroke, death after discharge from the stroke unit, and those with incomplete medical records were excluded. A total of 896 patients were enrolled. All of the data were extracted from the stroke registry of the neuroscience research center of Tabriz University of Medical Sciences.

The records were analyzed using data of gender, age, symptoms, computed tomography imaging findings, previous medical conditions, drug history, neurologic and other complications, smoking, alcohol use, and other characteristics using SPSS Statistics for Windows, Version 26.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to provide the demographic information of the patients and the results were presented as number, frequency, and median and IQR. Quantitative findings were compared using the Mann-Whitney U test and qualitative findings were assessed using a chi-squared test. Pearson's and Spearman's correlation tests were used to analyze parametric and non-parametric data. A p value of <0.05 was considered significant.

Ethics Approval

This study was approved by the regional research ethics committee (no.: IR.TBZMED.1399.832).

RESULTS

Demographic Features

Of the 896 SCU patients, 225 died in hospital; the mortality rate was 25.1%. Kolmogorov-Smirnov testing revealed non-normal distribution (p value<0.001). The median age of the discharged patients was 68 years with an IQR of 55-78 years. The median age and IQR of the patients who died was 73 with an IQR of 64-81 years. In all, 43.9% (n=393) of the patients were female and 56.1% (n=503) were male, but no significant difference in mortality rate was observed between the groups (p value=0.720). Age as a non-modifiable risk factor for stroke was only weakly associated with the mortality rate (p value <0.001; correlation coefficient=0.178).

It was further noted that 556 patients had a positive finding on their first imaging: 266 were seen to have had an ischemic stroke and 290 patients were diagnosed with hemorrhagic stroke. A total of 191 of patients with positive imaging findings expired in hospital (Table 1).

Signs and Symptoms

As shown in Table 2, the signs and symptoms seen in each group. The most prevalent were vomiting, aphasia, dysarthria, LOC, ataxia, vertigo, and headache, as well as other less prevalent symptoms, like diplopia and blurred vision.

Only LOC had a moderate correlation with mortality, and dysarthria demonstrated an inverse correlation (p value <0.001, correlation coefficient=0.368; and p value <0.001, correlation coefficient=-0.132, respectively). Comparisons of other symptoms between the 2 groups did not yield significant results (Table 2).

Table 1. Outcome based on initial imaging

First imaging finding	Outcome	
	Discharge count	Exitus count
Normal	301	34
Ischemic	178	88
Hemorrhagic	187	103

Table 2. Signs and symptoms

	Outcome		
	Discharge count	Exitus count	p
Vomiting			0.928
No	506	169	
Yes	165	56	
Aphasia			0.275
No	665	221	
Yes	6	4	
Dysarthria			<0.001**
No	210	103	
Yes	461	122	
Loss of consciousness			<0.001**
No	520	85	
Yes	151	140	
Ataxia			0.327
No	599	206	
Yes	72	19	
Vertigo			0.001*
No	587	214	
Yes	84	11	
Headache			0.816
No	541	183	
Yes	130	42	
Other symptoms			0.491
No	379	133	
Yes	292	92	

*: Pv is less than 0.05; **: Pv is less than 0.001

Previous Medical Conditions and Mortality

As shown in Table 3, among our 896 stroke patients, 22 types of medical conditions were studied and only 5 were found to be meaningfully associated with higher risk of mortality. The mortality of stroke patients was associated with the history of carotid artery stenosis (p value=0.005; correlation coefficient=0.095), congestive heart failure (p value=0.007; correlation coefficient =0.089), HTN (p value <0.001; correlation coefficient=0.121), DM (p value=0.005; correlation coefficient=0.094), and ischemic heart disease (p value <0.001; correlation coefficient=0.118) (Table 3).

Table 3. Correlation between mortality and previous medical conditions and risk factors

	Outcome		p		Outcome		p
	Discharge count	Exitus count			Discharge count	Exitus count	
Snoring			0.103	Previous transient ischemic attack			0.218
No	480	148		No	661	224	
Yes	191	77		Yes	10	1	
Alcohol consumption			0.145	Previous cerebrovascular accident			0.528
No	659	224		No	538	176	
Yes	12	1		Yes	133	49	
Addiction			0.879	Carotid artery stenosis			0.005*
No	658	221		No	670	221	
Yes	13	4		Yes	1	4	
Substance abuse			0.148	Myocardial infarction			0.357
No	634	218		No	662	220	
Yes	37	7		Yes	9	5	
Smoking			0.174	Congestive heart failure			0.007*
No	624	215		No	658	213	
Yes	47	10		Yes	13	12	
Oral contraceptive use			0.178	Artificial heart valve			0.331
No	660	224		No	663	224	
Yes	11	1		Yes	8	1	
Head and neck trauma			0.097	Hypertension			<0.001**
No	670	223		No	243	52	
Yes	1	2		Yes	428	173	
Peripheral vascular disease			–	Diabetes mellitus			0.005*
No	671	225		No	543	162	
Deep vein thrombosis			0.241	Yes	128	63	
No	657	223		Ischemic heart disease			<0.001**
Yes	14	2		No	556	162	
Vertebrobasilar insufficiency			–	Yes	115	63	
No	671	225		Atrial fibrillation			0.176
Hyperlipidemia			0.082	No	574	184	
No	622	216		Yes	97	41	
Yes	49	9		Valvular hear disease			0.708
				No	663	223	
				Yes	8	2	

*: Pv is less than 0.05; **: Pv is less than 0.001

Complications Contributing to Mortality Rate

As shown in Table 4, the most prevalent complications among the patients who died during their in-hospital stay were a urinary tract infection (43.1%), sepsis (33.3%), and aspiration pneumonia (30.2%).

The mortality of the stroke patients was not significantly associated with aspiration pneumonia (p value <0.001; correlation coefficient=0.248), pulmonary thromboembolism (p value=0.024; correlation coefficient=0.076), urinary tract infection (p value <0.001; correlation coefficient=0.124), sepsis (p value <0.001; correlation coefficient=0.241), bedsores (p value <0.001; correlation coefficient=0.132), myocardial infarction (p value <0.001; correlation coefficient=0.097), gastrointestinal bleeding (p value <0.001; correlation coefficient=0.137), hydrocephalus (p value <0.001; correlation coefficient=0.195), or brain herniation (p value < 0.001; correlation coefficient=0.265) (Table 4).

There was also an inverse correlation between mortality risk of stroke and duration of hospitalization (p value<0.001; correlation coefficient=-0.156).

Table 4. Main causes of mortality or complication

	Outcome		
	Discharge count	Exitus count	p
Aspiration pneumonia			<0.001**
No	605	157	
Yes	66	68	
Deep vein thrombosis			0.347
No	659	223	
Yes	12	2	
Pulmonary thromboembolism			0.024*
No	666	219	
Yes	5	6	
Urinary tract infection			<0.001**
No	472	128	
Yes	199	97	
Sepsis			<0.001**
No	589	150	
Yes	82	75	
Bedsores/pressure ulcers			<0.001**
No	635	195	
Yes	36	30	
Myocardial infarction			0.004*
No	668	219	
Yes	3	6	
Gastrointestinal bleeding			<0.001**
No	665	213	
Yes	6	12	
Seizure			0.556
No	647	215	
Yes	24	10	
Rebleeding			0.743
No	669	224	
Yes	2	1	
Hydrocephalus			<0.001**
No	648	193	
Yes	23	32	
Vasospasm			–
No	671	225	
Brain herniation			<0.001**
No	654	186	
Yes	17	39	

*: Pv is less than 0.05; **: Pv is less than 0.001

DISCUSSION

This study analyzed the clinical data of patients from a referral stroke center. Factors associated with increased mortality risk among stroke patients were determined based on the current knowledge (16) and patient data regarding any previous stroke, sex, age, cardiovascular disease, in-hospital length of stay, and cerebrovascular accidents. We observed a significant increase in the chance of in-hospital mortality with age, as well as myocardial infarction. However, we did not find any significant correlation related to sex, previous cerebrovascular accidents, or the length of hospital stay.

As in the literature (8), the most important predictors of mortality were a Glasgow Coma Scale (GCS) score of <8, age >60 years, and an elevated ICT. Similarly, we observed a significant increase in the risk of mortality among patients with a GCS of <15 or brain herniation. Moreover, hemorrhagic stroke patients had a greater risk of death in comparison with ischemic stroke patients.

HTN and DM have been reported to be associated with higher rates of in-hospital complications and mortality (17, 18). However, we only observed a significant increase in the mortality rate among diabetic patients; HTN did not play a significant role in a greater risk of death.

Infections, including aspiration pneumonia, urinary tract infection, and sepsis, played a significant role, as reported in previous studies (19–21).

The results of this study are a contribution to the limited evidence available that correlates clinical presentations, previous medical conditions, and complications of stroke patients admitted to a referral stroke center. We observed a greater risk of mortality among patients who presented with LOC, which may be due to greater damage to a more delicate and vital part of the nervous system. Dysarthria was associated with a lower mortality rate; since the patients were conscious and able to speak, it was an indication that the injury was not extensive enough to cause complete aphasia or LOC.

Evidence from a referral SCU center, a special unit with specialist and subspecialist physicians and experienced nurses, could be valuable to further understanding. Preventing hospital complications and providing close monitoring could help to minimize the in-hospital mortality rate of stroke patients around the world.

CONCLUSION

Individual lifestyle improvements and control of factors known to be associated with stroke could minimize stroke incidence and mortality. Furthermore, close observation in hospital can effectively mediate a significant portion of cardiac, respiratory, and vascular complications, if identified quickly and properly.

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Ethics Committee Approval: All of data was extracted from Tabriz Stroke Registry. This study was approved by Tabriz University of medical sciences with document no: 65753.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

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Author Contributions: Concept – SSV; Design – SSV; Supervision – AA; Resource – SSV, ESH; Materials – ESH; Data Collection and/or Processing – SH; Analysis and/or Interpretation – NH; Literature Search – TM; Writing – SH; Critical Reviews – FG.

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