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Determinants of In-Hospital Mortality After Acute Stroke: A Cross-Sectional Study at a Tertiary Care Centre, Peshawar, Pakistan

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Abstract

Objective: To determine the predictors of in-hospital mortality in patients admitted with acute stroke.

Methodology: This was a cross-sectional study carried out at the Department of Medicine, Hayatabad Medical Complex, Peshawar, Pakistan, from 10.6.2023 to 31.12.2025. Patients of stroke, 18 years and above, with documented radiological evidence of stroke were included in the study. A total of 159 patients meeting the inclusion and exclusion criteria were enrolled. All patients underwent a thorough clinical assessment at the time of admission, including history (demographics, time of onset, comorbidities), examination [Glasgow Coma Scale (GCS), National Institutes of Health Stroke Scale (NIHSS)], and relevant investigations (neuroimaging and serum creatinine). The patients were assessed daily for the development of complications until discharge or death. All information was recorded on a pre-designed proforma.

Results: Overall, the in-hospital mortality was 11.9% (n=19). Most had an ischemic stroke (n = 119, 74.8%). Hypertension was the most common comorbidity (n = 106, 66.7%), and aspiration pneumonia was the most common complication (n = 68, 42.8%). A low GCS on admission independently predicted mortality in both univariate and multivariable analyses (AOR = 0.75, 95% CI: 0.562 – 1.000, p = 0.050). Although significant in univariate analysis, NIHSS, the presence of any complication, and aspiration pneumonia did not remain significant after adjustment for other risk factors.

Conclusion: Low GCS on admission was an independent risk factor for mortality in acute stroke. The development of aspiration pneumonia predicted mortality alone but did not remain significant after adjustment for other risk factors, including GCS.

Keywords: Glasgow coma scale, mortality, Pakistan, pneumonia, risk factors, stroke

Introduction

Stroke has been defined by the World Health Organization (WHO) as "rapidly developing focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death before that, with no obvious cause other than that of vascular origin".[1] The global incidence of stroke is around 150-200/100,000 individuals, whereas in Pakistan, the annual incidence of stroke is around 250/100,000.[2,3] As the second most common cause of death, stroke is a known culprit of adult disability in the world, and two-thirds of all stroke deaths have been found to occur in low-income and middle-income countries.[4] There is significant variation in stroke mortality from country to country.[5] It has been estimated by the WHO that by the year 2030, stroke will account for 7.9 percent of all deaths.[6]

Stroke mortality is a very good indicator to evaluate the efficiency of a stroke care unit, and in-hospital mortality is even a more significant indicator.[7] Numerous stroke centers have been developed worldwide to reduce mortality with timely rescue and rehabilitation.[8] A study conducted at a tertiary care center in eastern Nepal reported the in-hospital mortality rate for stroke to be 14.7% in the general ward group and 6.9% for patients managed at the stroke care unit.[9]

There is limited data available on the mortality of stroke in Pakistan, but a cross-sectional study done on 400 patients in Northwest, Peshawar, Pakistan, reported the mortality rate to be 16 percent, with increasing age, co-morbid conditions, and poor Glasgow coma scale on presentation identified as the most common poor prognostic factors.[10] Results of a prospective cohort analysis done on 246 patients at a tertiary care center in Sri Lanka reported that low GCS and hemorrhagic stroke subtype had the highest association with in-hospital death.[7] A cohort study done in Uganda demonstrated low GCS, stroke severity, longer hospital stay, and hemorrhagic stroke subtype to be associated with higher mortality.[6]

There are quite a few epidemiological studies on stroke conducted in Pakistan, and there remains a deficit of research conducted on its prognostic factors. Most regional and local studies have focused on determining the risk factors for acute stroke. Data on predictors of in-hospital mortality of stroke patients is limited. Therefore, this study shall help bridge the gap and identify predictors of in-hospital mortality due to stroke in Peshawar, Pakistan. It is vital that predictors of in-hospital mortality after acute stroke are ascertained, as it will help the treating physicians risk-stratify patients with stroke on time and ensure close monitoring of the high-risk patients. This shall eventually translate into decreased morbidity and mortality after stroke.

Methodology

This cross-sectional study was carried out at the Department of Medicine, Hayatabad Medical Complex, Peshawar, from 10.06.2023 to 31.12.2025. The institutional review and ethical board of Hayatabad Medical Complex, Peshawar, approved the study. (No. 1310, dated: 06.06.2023). The inclusion criteria were patients suffering from a new-onset stroke who were 18 years and older with documented radiological evidence of stroke. Stroke was defined as an acute disturbance in neurological function due to interruption of blood supply to the brain or bleeding within the brain parenchyma lasting longer than 24 hours, which was determined through history and clinical examination, and classified through radiological evidence of infarct or bleed available on CT scan or MRI brain. In-Hospital mortality was defined as the death of the patient during hospital admission. The exclusion criteria included all patients who had recurrent stroke or those who were admitted to another hospital facility prior to admission to the concerned hospital. The sample size was 159, calculated using the EPI-Info calculator, keeping the frequency of deaths in stroke around 11.7% a 5% absolute precision, and a 95% confidence level.7

Patients or attendants of patients meeting the inclusion and exclusion criteria were informed about the study. Those who consented were enrolled in the study through a consecutive sampling technique after obtaining written informed consent from the patient/next of kin. The date of admission and the time between symptom onset and admission were noted. All patients underwent initial assessment in the form of history (including a detailed enquiry of co-morbid conditions such as diabetes, hypertension, and ischemic heart disease) and physical examination (assessment of GCS and NIHSS score on admission). The type of stroke was noted from the CT SCAN/ MRI of the brain. All patients received standard, guideline-directed treatment, with modification as needed at the discretion of the attending consultant. Participants had a daily clinical assessment for new onset of fever, respiratory symptoms, decline in oxygen saturation, decline in GCS, or seizures till discharge or death. Patients who developed fever, respiratory symptoms, or a decline in O2 saturation had a chest x-ray repeated to look for changes of aspiration pneumonia. Patients who developed fits or had a decline in GCS had a repeat CT brain to exclude hemorrhagic transformation. All participants had their serum creatinine checked at admission and daily thereafter. Aspiration pneumonia was defined as the development of either fever, respiratory symptoms, or a decline in oxygen saturation accompanied by signs of pneumonia (bronchial breathing, crackles) on examination and/or new infiltrates on chest x-ray. Acute kidney injury was defined as a rise in the serum creatinine of $\geq$ 0.3 mg/dl within 48 hours, or a 1.5 times increase in serum creatinine from baseline within 7 days.

Statistical Package for Social Sciences (SPSS, v21) was used to analyze the data. All quantitative variables were found to have a non-normal distribution by the

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Shapiro-Wilk test and are presented as median and interquartile range. Categorical variables are presented as frequencies and percentages. The significance of the association of different variables and in-hospital mortality from stroke was determined by the Mann-Whitney test and chi-square test/Fisher's Exact test. A multivariable logistic regression model incorporating only the significant risk factors from univariate analysis was employed to determine the adjusted odds for non-survival from acute stroke. A p-value of less than or equal to 0.05 was taken as significant during all analyses.

Results

Of the total 159, male (n = 81, 50.9%) and female (n = 78, 49.1%) patients were equally represented. The median age was 60 years (IQR: 50 – 70), and the median Glasgow Coma Scale (GCS) was 10 (IQR: 5 – 13). Most of the patients had ischemic stroke (n = 119, 74.8%). Most patients had at least one comorbidity (n = 121, 76.1%), with hypertension being the most frequent (n = 106, 66.7%). Almost half (n = 81, 50.9%) developed at least one complication, the most common being aspiration pneumonia (n = 68, 42.8%). The median length of stay was 4 days (IQR: 3 – 7), and 11.9% patients (n = 19) did not survive. Table 1 summarizes the characteristics of the study participants.

The median GCS at presentation in those who did not survive [05 (IQR: 03 – 08) was significantly lower than that of those who survived [10 (IQR: 06 – 13)] (p = 0.002). Similarly, the non-survivors had a significantly higher NIHSS score at presentation [25 (IQR: 13 – 30)] than survivors [13 (IQR: 5.3 – 24.5)] (p = 0.007). A significantly higher proportion (17.3%, n = 14, versus 6.4%, n = 5) of those who developed at least one complication did not survive (p = 0.035). Of the complications, only aspiration pneumonia showed a significant association with mortality. Compared to those without pneumonia, a greater proportion of those with pneumonia [19.1% (n = 13) versus 6.6% (n = 6)] succumbed to the stroke (p = 0.016). Mortality from stroke was not associated with age, gender, comorbidities, type of stroke, time between symptom onset and admission, length of stay, or development of acute kidney injury, hemorrhagic transformation, or seizures during hospital stay. (Table 2)

Multivariable logistic regression analysis showed that lower GCS was an independent risk factor for increased mortality (AOR = 0.75, 95% CI: 0.562 – 1.000, p = 0.050), indicating that a one-point increase in GCS reduces the odds of mortality by 25%. Although significant in univariate analysis, NIHSS score (AOR = 0.959, 95% CI: 0.873 – 1.054, p = 0.390) lost significance after adjustment for other risk factors. Likewise, the presence of complications (AOR = 1.293, 95% CI: 0.126 – 13.251, p = 0.829) and aspiration pneumonia (AOR = 1.894, 95% CI: 0.209 – 17.122, p = 0.570) were not significant independent predictors of mortality after adjustment for other risk factors. (Table 3)

Table 1. Baseline characteristics of study population (n=159)

Variables	Median (IQR) / No. (%)
Age (years)	60 (50 - 70)
NIHSS score on arrival	14 (7 – 26)
GCS on arrival	10 (5 – 13)
Serum Creatinine (mg/dl)	1.0 (0.7 – 1.2)
Time between symptom onset and admission (hours)	8 (3 – 24)
Length of stay (days)	04 (3 - 7)
Gender	
Male	81 (50.9%)
Female	78 (49.1%)
Comorbid conditions	
No	38 (23.9%)
Yes	121 (76.1%)
Diabetes Mellitus	
No	112 (70.4%)
Yes	47 (29.6%)
Hypertension	

No	53 (33.3%)
Yes	106 (66.7%)
Ischemic Heart Disease	
No	134 (84.3%)
Yes	25 (15.7%)
Type of stroke	
Ischemic	119 (74.8%)
Hemorrhagic	40 (25.2%)
Thrombolysed*	
No	101 (84.9%)
Yes	18 (15.1%)
Complications	
No	78 (49.1%)
Yes	81 (50.9%)
Aspiration pneumonia	
No	91(57.2%)
Yes	68 (42.8%)
Seizures	
No	149 (93.7%)
Yes	10 (6.3%)
Hemorrhagic transformation*	
No	05 (4.2%)
Yes	114 (95.8%)
Acute kidney injury	
No	129 (81.1%)
Yes	30 (18.9%)
Outcome	
Survived	140 (88.1%)
Not Survived	19 (11.9%)

**Ischemic stroke*

IQR: Interquartile range; NIHSS: National Institutes of Health Stroke Scale; GCS: Glasgow Coma Scale

Discussion

As a second leading cause of death annually worldwide, stroke is a significant contributor to adult morbidity and mortality. According to the WHO, stroke is responsible for 9.7% deaths annually in Pakistan, with an incidence rate of 250 per 100,000 individuals.[11] The current cross-sectional study assesses the factors determining in-hospital mortality amongst patients with acute stroke admitted to a tertiary care hospital. The in-hospital mortality rate observed in our study was 11.9%, which is consistent with similar studies from tertiary care settings in developing countries. A prospective cohort study conducted on 246 stroke patients in Sri Lanka, published in PLOS Global Public Health in 2023, reported the in-hospital mortality rate for acute stroke to be 11.7%.[7] Another systematic review published by EB Silva et al reported the in-hospital stroke mortality rate ranging from 7.13% to 11.7%.[12] The slightly higher mortality rate reported in our study is representative of a tertiary care referral center, where often patients present late and have a greater degree

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Table 2. Comparison of different variables in survived/non-survived patients

Variables		Outcome		P-value
		Survived (n=140)	Not Survived (n=19)	P-value
Age		60 (50 – 70.8)	60 (32 – 65)	0.113
Length of stay		04 (03 – 06)	05 (03 – 07)	0.179
Glasgow Coma Scale		10 (06 – 13)	05 (03 – 08)	0.002
NIHSS score		13 (5.3 – 24.5)	25 (13 – 30)	0.007
S. Creatinine		1.0 (0.7 – 1.2)	1.0 (0.7 – 1.3)	0.879
Time between symptom onset		09 (03 – 24)	4 (2 – 24)	0.338
Gender	Male	72 (88.9%)	09 (11.1%)	0.740
	Female	68 (87.2%)	10 (12.8%)	
Comorbid conditions	No	36 (94.7%)	02 (5.3%)	0.249#
	Yes	104 (86%)	17 (14%)	
Diabetes Mellitus	No	98 (87.5%)	14 (12.5%)	0.741
	Yes	42 (89.4%)	05 (10.6%)	
Hypertension	No	47 (88.7%)	06 (11.3%)	0.863
	Yes	93 (87.7%)	13 (12.3%)	
Ischemic heart disease	No	119 (88.8%)	15 (11.2%)	0.505#
	Yes	21 (84 %)	04 (16%)	
Type of stroke	Ischemic	108 (90.8%)	11 (9.2%)	0.090#
	Hemorrhagic	32 (80%)	08 (20%)	
Thrombolysed*	No	90 (89.1%)	11 (10.9%)	0.213#
	Yes	18 (100%)	00 (0%)	
Complications	No	73 (93.6%)	05 (6.4%)	0.035
	Yes	67 (82.7%)	14 (17.3%)	
Aspiration pneumonia	No	85 (93.4%)	06 (6.6%)	0.016
	Yes	55 (80.9%)	13 (19.1%)	
Seizures	No	133 (89.3%)	16 (10.7%)	0.101#
	Yes	07 (70%)	03 (30%)	
Hemorrhagic transformation*	No	104 (91.2%)	10 (8.8%)	0.390#
	Yes	04 (80%)	1 (20%)	
Acute kidney injury	No	114 (88.4%)	15 (11.6%)	0.760#
	Yes	26 (86.7%)	04 (13.3%)	

**Ischemic stroke*

NIHSS: National Institutes of Health Stroke Scale

of stroke severity, which can contribute further to the morbidity and mortality.

Glasgow Coma Scale on arrival was an independent predictor of in-hospital mortality in our study, according to the results of the multivariate logistic regression. In a prospective cohort analysis by VS Ranasinghe et all, GCS on admission was identified as one of the only

Table 3. Multivariable logistic regression analysis of risk factors for mortality from acute stroke.

Variables		AOR	95% CI	p-value
GCS		0.750	0.562 – 1.000	0.05
NIHSS		0.959	0.873 – 1.054	0.39
Complications	No			0.83
	Yes	1.293	0.126 – 13.251	
Comorbid conditions	No			0.57
	Yes	1.894	0.209 – 17.122	

AOR: Adjusted odds ratio; CI: Confidence interval; GCS: Glasgow Coma Scale; NIHSS: National Institutes of Health Stroke Scale

two independent determinants of in-hospital mortality.[7] Another retrospective cohort study conducted in Ethiopia by Admas et al reported that stroke patients with severe impairment of GCS (3–8) were 2.38 times more likely to die than those having mild to moderate or no impairment of GCS.[13] The relationship between low GCS and mortality is conceivable. Any impairment of GCS is proportionate to the extent of brain damage. The lower the GCS, the greater the chance of brainstem compromise and the greater likelihood of patients developing complications such as seizures, raised intracranial pressure, and aspiration pneumonia that could contribute to death.

Co-morbid conditions such as diabetes mellitus, hypertension, ischemic heart disease, and atrial fibrillation did not emerge as independent determinants of mortality in the results of our multivariate regression, although they may be contributing factors to the development of stroke. A study on the global trends and variations in stroke mortality risk factors by D Song et al revealed high systolic blood pressure as the strongest risk factor contributing to 58.7% of ischemic stroke-related deaths globally.[14] This lack of significance of these individual conditions may be due to the fact that their effect on the prognosis of stroke is largely indicated by the GCS and NIHSS score, which ultimately translate morbidity and are reflective of stroke severity. Therefore, these conditions lose their individual significance in the final analysis.

Thrombolysis was not reported as significant according to the results of our analysis, although 100 percent of the patients who were thrombolysed survived. A study conducted by Kartick et al evaluated the role of intravenous thrombolysis in first ischemic stroke and concluded that thrombolysis significantly reduced the incidence of adverse events but did not necessarily reduce mortality.[15] The fact that thrombolysis was insubstantial at the end may be because only a small proportion of patients were thrombolysed in the study; the effect was overshadowed by risk factors such as GCS and aspiration pneumonia, which were greater in magnitude.

A substantially higher proportion of patients who developed aspiration pneumonia did not survive. A study conducted on the impact of pneumonia on the outcome of patients hospitalized for acute stroke by I. L. Katzan et al reported the unadjusted 30-day mortality rate to be 6 times higher in patients who developed pneumonia post stroke.[16]

Strengths and limitations

This study significantly contributes to stroke mortality data and addresses an important local evidence gap, as a properly documented stroke registry does not exist in Pakistan, particularly in Khyber Pakhtunkhwa. It focused on clinically relevant and frequently monitored predictors of mortality. The identification of GCS on admission as a predictor of poor outcome has profound clinical implications. The multivariable regression analysis adds to the strength and robustness of the study results.

Because this study is a cross-sectional study, causality cannot be inferred. Owing to the single-center setting and limited sample size, the results of the study cannot be generalized. Glasgow Coma Scale and NIHSS scores are largely subjective assessment tools, so the utility of these scores in determining stroke severity can at times be questionable, as these are subject to evaluator bias. The time recorded from symptom onset to admission to the hospital was a history-based data obtained from the attendants of the patient in most cases, which was also influenced by recall bias. Multi-center prospective cohort studies with a larger sample, longer follow-up, objective and standardized measures of stroke onset and severity, and inclusion of potential confounding factors like lesion size and location, intensive care, and swallowing screening are recommended to validate the findings of this study and improve its generalizability. This may also pave the way for a locally applicable prediction model for stroke outcome.

Conclusion

Overall, 11.9% patients did not survive following admission for acute stroke. The GCS at admission was an independent risk factor for in-hospital mortality, with

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a one-point increase in GCS reducing the risk of death from stroke by 25%. Although significant in univariate analysis, NIHSS and the development of complications did not remain significant following adjustment for other risk factors. Larger, multi-center prospective studies with longer follow-up and inclusion of confounders like lesion size and location are warranted to validate the findings of this study.

References

1. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke 2013;44(7):2064-89. DOI: 10.1161/STR.0b013e318296aeca.
2. Sveinsson OA, Kjartansson O, Valdimarsson EM. Cerebral ischemia/infarction: epidemiology, causes and symptoms. Laeknabladid 2014;100(5):271-9. DOI: 10.17992/lbl.2014.05.543.
3. Farooq A, Venketasubramanian N, Wasay M. Stroke care in Pakistan. Cerebrovasc Dis Extra 2021;11(3):118-21. DOI: 10.1159/000519554.
4. Lavados PM, Hennis AJM, Fernandes JG, Medina MT, Legetic B, Hoppe A, et al. Stroke epidemiology, prevention, and management strategies at a regional level: Latin America and the Caribbean. Lancet Neurol 2007;6(4):362-72. DOI: 10.1016/S1474-4422(07)70003-0.
5. Gebreyohannes EA, Bhagavathula AS, Abebe TB, Seid MA, Haile KT. In-hospital mortality among ischemic stroke patients in Gondar University Hospital: a retrospective cohort study. Stroke Res Treat 2019;2019:7275063. DOI: 10.1155/2019/7275063.
6. Namale G, Kamacooko O, Makhoba A, Mugabi T, Ndagire M, Ssanyu P, et al. Predictors of 30-day and 90-day mortality among hemorrhagic and ischemic stroke patients in urban Uganda: a prospective hospital-based cohort study. BMC Cardiovasc Disord 2020;20(1):442. DOI: 10.1186/s12872-020-01724-6.
7. Ranasinghe VS, Pathirage M, Gawarammana IB. Predictors of in-hospital mortality in stroke patients. PLOS Glob Public Health 2023;3(2):e0001278. DOI: 10.1371/journal.pgph.0001278.
8. Braga P, Ibarra A, Rega I. Prediction of early mortality after acute stroke. J Stroke Cerebrovasc Dis 2002;11(1):15-22. DOI: 10.1053/jscd.2002.123970.
9. Shah B, Bartaula B, Adhikari J, Neupane HS, Shah BP, Poudel G. Predictors of in-hospital mortality of acute ischemic stroke in adult population. J Neurosci Rural Pract 2017;8(4):591-4. DOI: 10.4103/jnrp.jnrp_265_17.
10. Khan MSA, Ahmad S, Ghafoor B, Shah MH, Mumtaz H, Ahmad W, et al. Inpatient assessment of the neurological outcome of acute stroke patients based on the National Institute of Health Stroke Scale (NIHSS). Ann Med Surg (Lond) 2022;82:104770. DOI: 10.1016/j.amsu.2022.104770.
11. Shahid S, Marsool AD, Sajjad M, Saifullah M, Alam MA, Ahmed SI, et al. Epidemiology of stroke in Pakistan and its provinces, 1990-2021: findings from the global burden of disease study 2021. Glob Epidemiol 2025;10:100211. DOI: 10.1016/j.gloepi.2025.100211.
12. Silva Neto EB da, Silva WMM da, Carlini WA, Silva LKC, Ribeiro GDMS, Santos JM, et al. How can we predict mortality in acute stroke? Rev Assoc Med Bras (1992) 2025;71(5):e20250057. DOI: 10.1590/1806-9282.20250057.
13. Admas M, Teshome M, Petrucka P, Telayneh AT, Alamirew NM. In-hospital mortality and its predictors among adult stroke patients admitted in Debre Markos Comprehensive Specialized Hospital, Northwest Ethiopia. SAGE Open Med 2022;10:20503121221122465. DOI: 10.1177/20503121221122465.
14. Song D, Xu D, Zhang K, Lou Y, Du Y, An Y, et al. Stroke mortality risk factors: global trends and regional variations (1990-2021). J Am Heart Assoc 2025;14(12):e042107. DOI: 10.1161/JAHA.125.042107.
15. Ghosh KC, Bhattacharya R, Ghosh S, Mahata M, Das S, Das S, et al. Predictors of severity and outcome and roles of intravenous thrombolysis and biomarkers in

Authors' Contribution Statement

AH contributed to the conception, design, acquisition, analysis, interpretation of data, drafting of the manuscript, and critical review of the manuscript. FR contributed to the design, acquisition, analysis, interpretation of data, critical review of the manuscript, and final approval of the version to be published. ST contributed to the acquisition, analysis, and interpretation of data. SAQ contributed to the analysis, interpretation of data, and drafting of the manuscript. AB contributed to the analysis, interpretation of data, and drafting of the manuscript. HN contributed to the acquisition, interpretation of data, and drafting of the manuscript. All authors are accountable for their work and ensure the accuracy and integrity of the study.

Conflict of Interest

Authors declared no conflict of interest

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None

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.