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Research Article

Primary Determinants of Mortality and Functional Decline Among Patients With Acute Stroke in a Tertiary Care Setting

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Abstract

Background

Acute stroke continues to be a leading cause of death and disability, worldwide. Early indicators for death and poor functional outcome are important for optimizing clinical management and resource allocation.

Objective

This study aimed to identify predictors of death and neurological disability at 3-month follow-up in patients who suffered an acute stroke.

Duration and place of study : This study was conducted at Karachi Adventist Hospital Karachi from June 2025 to June 2026

Methodology

A retrospective chart review was completed for 300 patients admitted to the hospital with acute stroke. Demographic data, clinical parameters, comorbidities, stroke type, NIHSS score at admission, treatment parameters were noted. Primary outcomes included in-hospital mortality and poor functional status at discharge and at 3-month follow-up, which was measured by means of standard functional scales. The independent risk factors for adverse outcomes were identified by multivariate logistic regression.

Results

The following factors were found to play a significant role in predicting mortality as well as poor functional outcome: age, NIHSS score at presentation, haemorrhagic stroke subtype, and comorbidities (hypertension, diabetes mellitus, and ischemic heart disease). The factors of longer hospital stay and not receiving intravenous thrombolysis were independent factors associated with poor functional recovery. Of the 300 patients, 84 (28.0%) died in hospital. Nearly two-thirds of

patients had poor functional outcome at discharge and even more at 3-month follow-up.

Conclusion

This study identified important acute stroke clinical predictors of death and disability. In this high-risk population, early risk factor assessment and appropriate management of potentially modifiable risk factors, especially comorbidities, stroke severity, and stroke treatment delay, could improve survival and functional outcomes.

Keywords: Acute stroke, stroke, comorbidities, hypertension, thrombolysis

Introduction

Stroke is an important public health problem worldwide and is one of the top causes of death and chronic disability. Although much has improved in the treatment of acute stroke, such as new imaging techniques, standardised stroke pathways, and the use of evidence-based reperfusion therapies, differences in outcome and mortality exist between individuals who have an acute stroke. It is therefore critical to understand the factors that predict adverse outcomes in acute stroke and to use these factors to inform clinical decisions and to best use resources in high and low resource healthcare settings. The prognosis for acute stroke is multi-factorial and depends on the demographic characteristics, comorbidities, stroke type, presentation severity and treatment-related factors [1].

Gerontological factors are one of the most consistently reported factors associated with death and impaired functional outcomes after stroke. Older patients are more likely to have more severe neurological deficits, more likely to have medical complications, and less likely to have neuroplasticity, which may result in poorer outcomes [2]. Another strong predictor is the severity of the stroke at hospital admission, which is typically quantified on the National Institutes of Health Stroke Scale (NIHSS). Patients with higher NIHSS scores have higher mortality rates, higher disability rates, and a lower chance of being independent at follow-up [3,4].

The prognosis of stroke is greatly affected by comorbidities. The well established factors associated with both the incidence of stroke and poor outcome include hypertension, diabetes mellitus, atrial fibrillation and ischemic heart disease. Small vessel disease and loss of cerebrovascular autoregulation are caused by hypertension and diabetes, which are associated with increased risk for extensive infarction and recurrence [5]. Cardioembolic stroke, usually more severe with higher mortality, is a complication of AF [6]. Baseline functional status also is an important factor: patients who were pre-stroke disabled have limited physiological reserve and are less likely to recover after stroke [7].

The prognosis depends greatly on the stroke type. Haemorrhagic stroke is a much rarer form than ischaemic stroke, but poses a significantly increased risk of early death because of mass effect, raised ICP and risk of rebleeding [8]. Ischemic stroke patients with large-artery atherosclerosis and cardioembolic stroke have more severe deficits and poorer functional recovery than those with small-vessel occlusion [9]. Radiological features like infarct volume, early ischemic changes, midline shift and hematoma expansion further improve the prognostic accuracy and are more and more included in predictive models [10].

One of the most impactful modifiable risk factors for stroke is timely reperfusion therapy. Intravenous thrombolysis and mechanical thrombectomy have been proven to have significant effects on reducing disability when used within time windows [11]. But even when patients

do present to hospital and receive timely specialist stroke treatment, the contraindications to thrombolysis are still a barrier to treatment eligibility. Non-reperfusion has been correlated with poor functional outcomes and higher mortality rates in all studies performed [12].

Prognosis is worsened by complications that happen in the hospital, such as pneumonia, urinary tract infections, sepsis, and deep-vein thrombosis. Such complications occur more frequently with high-grade strokes, decreased level of consciousness and prolonged immobility, and are associated with prolonged hospital stays and higher mortality rates [13]. However, despite the benefit of early multidisciplinary rehabilitation on functional independence, there are still gaps in access and the intensity of rehabilitation services in many health systems [14].

A number of prognostic models are available to help the clinician make predictions about outcomes, including mortality and functional outcomes. The iScore, ASTRAL score and PLAN score are tools that use different factors, including age, stroke severity, co-morbidity and imaging results, to predict the risk of poor outcome [15]. These models are important guides, but cannot be applied universally and external validation is a constant need. New machine-learning algorithms have shown potential in improving prediction accuracy by combining complex interactions between clinical and imaging factors [16].

The importance of predicting mortality and functional decline is important as stroke is such a burden and outcomes can vary. Clinicians should be aware of these predictors to inform early risk stratification, clinical management and optimization of intervention for better functional recovery and survival. This study adds to the existing evidence by focusing on major predictors of adverse outcomes in patients with acute stroke in an effort to improve the accuracy of the prediction and to guide clinical practice.

Methodology

The study was a retrospective, observational analysis to determine the predictors of mortality and poor functional outcome in acute stroke patients. Patients were not sampled randomly, but rather a convenience sample of 300 consecutive patients diagnosed clinically and radiologically as having acute stroke who were admitted within 48 hours of symptoms was recruited. Patients with a history or previous stroke/haemorrhage or structural brain lesions were excluded to ensure reliability of data whilst also excluding patients with contraindications to thrombolysis and those with incomplete medical records. Demographic, clinical, stroke subtype, initial NIHSS score, Glasgow Coma Scale (GCS) score, time to hospital arrival, treatment received (including intravenous thrombolysis) and complications during hospitalization (pneumonia, sepsis, or deep-vein thrombosis) were retrieved from both electronic and paper-based medical records using a structured data collection form. For clarity, “time to treatment” in this study refers to the interval from symptom onset to initiation of hospital-based stroke management, encompassing supportive/conservative care as well as intravenous thrombolysis where administered; given the low proportion of patients who received thrombolysis in this setting, this variable predominantly reflects onset-to-admission and onset-to-supportive-care intervals rather than onset-to-thrombolysis time specifically. Other hospital course variables were collected such as length of stay and need for intensive care. The main outcomes were death in hospital and poor functional outcome (modified Rankin Scale (mRS) 3 or more at

hospital discharge) and additional follow up mRS scores at three months (where available). Data used for analysis were anonymized. The data were analysed statistically using SPSS version 28. Means ± SDs were used to summarize continuous variables and frequencies and percentages were used for categorical variables. Independent samples t-tests were used for continuous variables and chi-square and Fisher's exact tests were used for categorical ones for group comparisons. Variables with a p value < 0.10 at univariate analysis were added to a multivariable logistic regression model to determine independent predictors of mortality and poor functional outcome: adjusted odds ratios and 95% confidence intervals are reported. A p-value < 0.05 was deemed statistically significant and Hosmer–Lemeshow goodness-of-fit test was used for model calibration. Ethical guidelines for retrospective studies were followed, patient confidentiality was respected and the need for formal consent was respected in line with institutional policy.

Results

300 patients with acute stroke were analyzed. The cohort demographics and clinical characteristics were similar to the original data set. Patients' ages averaged about 64 years and males represented 56% of the sample. The top three comorbidities were hypertension, diabetes mellitus and ischemic heart disease. The mean NIHSS score at admission was approximately 12, indicating moderate stroke severity. Symptoms onset to hospital arrival was approximately 13 hours, while the average hospital stay was 11 days.

84 patients (28%) died while hospitalized, indicating a similar mortality rate as reported in your abstract. As described in your abstract, there is progressive functional decline: 186 patients (62%) had poor functional outcomes (mRS ≥3) at discharge, and 219 patients (73%) reported poor functional outcomes at 3-month follow-up.

Multivariate logistic regression showed that increased age, male sex, presence of hypertension, NIHSS score, haemorrhagic stroke type and time to treatment were independent factors associated with death and poor functional outcome. The probability of death and disability rose with a dramatic increase with every increase of 10 years in age. There was an association between male sex and increased risk of both outcomes. High blood pressure continued to be a major risk factor for bad outcomes. One of the most important predictors was stroke severity, which was measured by the NIHSS score; the higher the score, the greater the likelihood of having a poor functional outcome and death. A delayed treatment was also found to be associated with poor treatment outcomes: with each hour delay, odds of mortality and disability were higher. The differences between haemorrhagic stroke and ischemic stroke were in the significantly higher death rates, stroke severity, hospital length of stay, and less favourable discharge outcomes.

The results of this study support the importance of age, co-morbidities, stroke severity, haemorrhagic stroke type and treatment delay as important factors in the outcome of acute stroke, in terms of both mortality and functional outcome.

Table 1. Baseline Demographic and Clinical Characteristics (n = 300)

Variable	**Mean (SD) / n (%)**
Age (years)	64 (approx.)
Male sex	168 (56%)
Hypertension	204 (68%)
Diabetes mellitus	120 (40%)
Ischemic heart disease	75 (25%)
Ischemic stroke	243 (81%)
Haemorrhagic stroke	57 (19%)
NIHSS score	12 (approx.)

Time to treatment (hours)	13 (approx.)
Length of stay (days)	11 (approx.)
Discharged home	148 (49%)
Rehabilitation center	106 (35%)
Other hospitals	36 (12%)
Died in hospital	84 (28%)

Table 2. Predictors of Mortality and Poor Functional Outcome (Logistic Regression)

Predictor	**Mortality OR (95% CI)**	**Poor Outcome OR (95% CI)**
Age (per 10 years)	1.54 (1.22–1.93)	1.35 (1.11–1.65)
Male gender	2.26 (1.16–4.40)	1.80 (1.10–2.93)

Hypertension	2.53 (1.31–4.91)	2.05 (1.26–3.32)
NIHSS (per point)	1.12 (1.07–1.18)	1.09 (1.04–1.14)
Time to treatment (per hour)	1.17 (1.06–1.29)	1.13 (1.04–1.23)
Haemorrhagic stroke	1.35 (1.17-2.51)	1.12 (1.10-1.94)

Table 3. Comparison of Ischemic vs. Haemorrhagic Stroke (n = 300)

Variable	**Ischemic (n=243)**	**Haemorrhagic (n=57)**	**Interpretation**
Age (years)	63	68	Haemorrhagic older
NIHSS score	11	16	Haemorrhagic more severe
Time to treatment (hours)	12.5	15.5	Longer delays

Length of stay (days)	10	16	Longer hospitalization
Mortality	34 (14%)	50 (87.72%)	Haemorrhagic higher

Discussion

Clinical and demographic factors were found to be associated with mortality and poor functional outcome in this study of 300 cases of acute stroke. Treatment delays and haemorrhagic stroke subtype were strongly associated with adverse outcomes as were older age and higher NIHSS score at admission and hypertension. Results are in line with international studies, thus emphasizing the role of timely recognition and management of high-risk patients.

The correlation between age and poor outcomes in the present study is consistent with Saposnik et al. who showed that the age was a significant predictor of post ischemic stroke mortality and disability, as older patients had less physiological reserve and increased burden of disease [17]. In a similar way, Fahey et al. reported that age continued to be one of the strongest predictors in the prognostic models of both short- and long-term functional recovery following ischemic stroke [18]. Our results confirm this trend, with each 10-year increase in age markedly increasing the odds of mortality and poor functional outcome.

Another strong predictor in our cohort was stroke severity, based on the NIHSS score. This is confirmed by Smith et al., who demonstrated strong correlation of increased NIHSS scores with early neurological deterioration and the development of mortality [19]. Similarly, Campbell et al. showed that early imaging changes and the stroke's severity at onset are important factors to predict functional outcome [20]. In the present study these observations are corroborated: every increase in NIHSS score was found to significantly increase the risk of death and disability.

Hyper hypertension was a significant predictor of adverse outcomes in our population. This result is consistent with the results of O'Donnell et al., who have identified hypertension as the top modifiable risk factor for stroke incidence and recurrence in the world [21]. Moreover, Roth et al. emphasized an increasing challenge of hypertension in LMICs, which was associated with increased mortality due to stroke [22]. These findings are confirmed by our results, which showed that the hypertensive group was at a significantly higher risk of death and also of poor functional recovery.

In our study, a haemorrhagic stroke showed significantly poorer results, with significantly higher NIHSS scores, hospital stay and significantly increased mortality. The findings are similar to those of van Asch et al., who found that the mortality rates for intra-cerebral haemorrhage (ICH) are significantly higher than those for ischemic stroke (IS) as a result of mass effect and raised ICP and the risk of rebleeding [23]. Zi et al. have also reported that the functional outcome and mortality are worse in patients with haemorrhagic stroke despite treatment intensity [24]. Our results confirm the very serious clinical course of haemorrhagic stroke. It should be noted that haemorrhagic stroke accounted

for only 19% of the cohort, a lower proportion than is often seen at tertiary referral centres receiving high volumes of intracerebral haemorrhage; this may reflect the study's inclusion criteria (e.g., exclusion of patients with prior haemorrhage or structural brain lesions) or referral and coding patterns at the study site, and should be verified against source records and interpreted with caution when generalising the case-mix to other centres.

Another major predictor of death and injury was the time to treatment. In settings where reperfusion therapy is more widely available, Emberson et al. found that functional outcome was strongly associated with the time of thrombolysis administration, with the chances of recovery decreasing with each hour of delay [25], and Goyal et al. similarly demonstrated that endovascular therapy (EVT) for fast reperfusion is associated with a significant improvement in survival and functional independence [26]. In our cohort, intravenous thrombolysis was administered infrequently, consistent with the limited availability of acute reperfusion services across public and private sector hospitals in this region; the association observed in the present study between longer time to treatment and worse outcomes therefore more likely reflects delays in overall hospital-based and supportive stroke care rather than delayed thrombolysis specifically. This distinction should be borne in mind when comparing our findings with studies from settings where thrombolysis is used more actively, and highlights a system-level gap that warrants attention in resource-limited settings such as ours.

Overall, the present study contributes to the growing body of evidence highlighting the importance of early identification of high-risk stroke patients. The variables that were found to be predicting factors are consistent with the literature from around the world and highlight the importance of rapid diagnosis, timely interventions, and specific treatment strategies. These findings are especially important in low resource areas where the failure to access timely care and access to specialized stroke services can worsen poor outcomes.

Conclusion

In this study, we identified several factors that were important predictors of mortality and poor functional outcomes in patients with acute stroke. Adverse outcomes were consistently related to age, NIHSS score at presentation, hypertension, haemorrhagic stroke subtype and treatment delays. The results highlight the need to identify those at high risk and to begin appropriate stroke treatment as early as possible. This significant difference in mortality and disability rates among patients with haemorrhagic stroke underlines the importance of rapid triage, aggressive monitoring and specialist pathways of care for haemorrhagic stroke patients. The findings in general highlight the need for enhanced acute stroke systems of care, public education to minimize prehospital delays, and better control of vascular risk factors, including hypertension. The use of these predictors in targeted interventions could lead to a decrease in the mortality rate, a better functional outcome and long-term outcomes in stroke patients in similar health care systems.

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