RESEARCH ARTICLE

Predictors of seizures in patients with stroke in a tertiary care setup

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Abstract

Objective: To determine clinical and imaging predictors of post-stroke seizures among adult patients admitted with stroke.

Method: The prospective, observational study was conducted from April 2023 to March 2024 at Aga Khan University Hospital, Karachi, and comprised patients aged 18-85 years who were admitted with a diagnosis of stroke. Demographic variables, comorbid conditions, stroke characteristics, and neurological severity scores, as assessed with Glasgow Coma Scale and National Institutes of Health Stroke Scale, were recorded. The relationship between these factors and post-stroke seizures was explored. Data was analysed using SPSS 24.

Results: Of the 111 patients with mean age 63±16 years, 68(61.3%) were male. Post-stroke seizures were observed in 38(34.2%) of the participants. Stroke location (p=0.043), Glasgow Coma Scale score <12 (p<0.001), and National Institutes of Health Stroke Scale score (p<0.001) were significantly associated with seizure occurrence. Mortality and prolonged hospital stays were also higher among patients who developed seizures (p<0.05). No significant association were found for seizure occurrence with demographic factors, comorbidities and prior stroke history (p>0.05).

Conclusion: Stroke severity and brain region involvement, particularly temporal lobe lesions, were found to be significant predictors of post-stroke seizures.

Keywords: Seizures, Stroke, Temporal lobe, Consciousness disorders, Glasgow Coma Scale. (JPMA 76: 1317; 2026)

DOI: https://doi.org/10.47391/JPMA.30677

Introduction

Haemorrhagic stroke is particularly associated with acute symptomatic seizures even though both ischaemic and haemorrhagic strokes can precipitate seizure activity.[1] Early seizures typically occur within seven days of stroke, and are considered acute symptomatic seizures.[2] Any seizure occurring after that is termed a late seizure. Seizures that occur following a stroke in patients with no prior history of epilepsy are called post-stroke seizures.[3] Acute symptomatic seizures, defined as a single seizure or recurrent seizures occurring within seven days of stroke onset are not considered epilepsy, as the risk of subsequent unprovoked seizures after an acute seizure is approximately 30%.[4] Prior studies have reported that 3% to 16% of patients with acute stroke develop symptomatic seizures.[5]

Seizures may be provoked or unprovoked. Provoked seizures, also referred to as acute symptomatic seizures, commonly occur within seven days after stroke.[6,7] Post-stroke seizures may exacerbate brain injury by increasing metabolic stress and promoting apoptosis, thereby potentially contributing to larger infarct sizes and poorer outcomes.[8] Seizure risk after stroke has been studied in both ischaemic and haemorrhagic cases, with pharmaco-resistance and thrombolysis being key considerations in post-stroke epilepsy and early seizure development, respectively.[9,10] Identified predictors of post-stroke epilepsy include severe stroke, cortical involvement, haemorrhagic stroke subtype, and younger age.[11]

Although seizure incidence post-stroke is relatively low, early-onset seizures still occur, and are associated with poorer outcomes, including increased disability, prolonged hospitalisation, and reduced quality of life (QOL). In many cases, the underlying mechanisms remain unclear.[12,13]

While it remains difficult to predict which patients will develop post-stroke seizures, but several risk factors have been identified. For example, haemorrhagic strokes have a higher risk (8.4%) compared to ischaemic strokes (2.4%).[14] Cortical injury also increases the likelihood, and even lacunar strokes, though less cortical in nature, are associated with seizures in about 11% of cases.[15]

Regarding management, no definitive treatment protocol exists. Treatment decisions are often based on patient history, risk factors and stroke location. While antiepileptic drugs are commonly used for post-stroke seizures, evidence supporting their efficacy remains limited. Approximately 35% of patients with early post-stroke seizures may progress to epilepsy within nine months.[15] This progression is thought to result from persistent cortical injury, gliosis and the formation of epileptogenic foci

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Submission completed: 21-04-2025 **1st Revision received:** 08-07-2025

Acceptance: 06-05-2026 **Last Revision received:** 05-05-2026

following structural neuronal damage caused by stroke.

The current study was planned to determine the predictive factors for seizure development in patients admitted with stroke and related clinical outcomes.

Patients and Methods

The prospective, observational study was conducted from April 2023 to March 2024 at Aga Khan University Hospital, Karachi, and comprised patients diagnosed with stroke. Approval was obtained from the institutional ethics review committee, and written informed consent was obtained from all the participants or their legal guardians prior to enrolment.

Those included were all patients aged 18-85 years admitted with a confirmed diagnosis of stroke (ischaemic or haemorrhagic) based on clinical assessment and neuroimaging. Those excluded were patients with a prior diagnosis of epilepsy, those with incomplete medical records, and those with metabolic derangements not corrected during the acute phase.

The sample size was calculated using OpenEpi 3.01.[16] assuming a 25% prevalence of post-stroke seizures. While published studies report that 3% to 16% of patients with acute stroke develop seizures,[5] a slightly higher estimate was used to account for variation across stroke types, inclusion of both ischaemic and haemorrhagic strokes, and the likelihood of higher detection rates in a tertiary care hospital setting. This approach helped avoid under-estimating the required sample size and ensured adequate power to detect meaningful associations, with a 95% confidence level and 8% absolute precision, as per standard sample size determination methodology for estimating population proportions. The sample was raised using consecutive non-probability sampling technique.

Data was collected using a structured proforma, including demographic information (age, gender), comorbid conditions (hypertension [HTN], diabetes mellitus [DM], ischaemic heart disease [IHD], atrial fibrillation [AFib]), smoking history, previous stroke history, and clinical variables, such as type of stroke, and stroke severity assessed using the Glasgow Coma Scale (GCS)[17] and the National Institutes of Health Stroke Scale (NIHSS).[18] Imaging data (computed tomography and magnetic resonance imaging) were also recorded. Stroke size was obtained from radiology reports and recorded as the maximum lesion dimensions (length×width in millimetres) as measured on computed tomography (CT) or magnetic resonance imaging (MRI). Patients were monitored for seizure occurrence throughout their hospital admission. Seizure surveillance was conducted during the in-hospital period, and follow-up ended at discharge.

Data was analysed using SPSS 24. Quantitative variables, such as age and stroke size, were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. Chi-square test was used to assess associations between categorical variables. $P<0.05$ was considered statistically significant.

Results

Of the 111 patients with mean age 63±16 years, 68(61.3%) were male. Post-stroke seizures were observed in 38(34.2%) of the participants. Length of hospital stay (LOS) was prolonged in 22(19.8%) cases and there were 9(8.1%) deaths. The average stroke size was 61×35+/57×28mm (Table 1).

The comorbidity profile of the sample was noted in detail, with HTN being the most common 77(69.4%) and AFib being the least common 8(7.2%). Previous history of stroke was reported by 74(66.7%) patients, and smoking by 49(44.1%) (Table 2).

Most participants experienced ischaemic strokes 87(78.4%), while 24(21.6%) patients had haemorrhagic

Table-1: Baseline demographic and clinical characteristics of the participants (n=111).

Variables	Categories	n (%)
Gender	Male	68 (61.3)
	Female	43 (38.7)
Mean Age (years)		63±16
Prolonged Length of stay	Yes	22 (19.8)
	No	89 (80.2)
Mortality	Yes	9 (8.1)
	No	102 (91.9)
Mean Size of Stroke		61×35 ±57×28 mm

SD: Standard deviation.

Table-2: Baseline comorbid characteristics of the participants (n=111).

Variables	Categories	n (%)
Hypertension	Yes	77 (69.4)
	No	34 (30.6)
Diabetes	Yes	47 (42.3)
	No	64 (57.7)
Ischaemic Heart	Yes	24 (21.6)
Disease	No	87 (78.4)
Atrial Fibrillation	Yes	8 (7.2)
	No	103 (92.8)
Metabolic Abnormality		
Hyponatraemia	Yes	11 (9.9)
Hypocalcaemia	Yes	9 (8.1)
Hypoglycaemia	Yes	1 (0.9)
Previous history of stroke	Yes	74 (66.7)
	No	37 (33.3)
Smoking	Yes	49 (44.1)
	No	62 (55.9)

Table-3: Clinical characteristics of the patients.

Variable	Categories	n (%)
Type of stroke	Ischaemic	87 (78.4)
	Haemorrhagic	24 (21.6)
Site of stroke	Frontal	21 (18.9)
	Parietal	6 (5.4)
	Temporal	16 (14.4)
	Occipital	8 (7.2)
GCS level <12	Yes	38 (34.2)
	No	73 (65.8)
Type of Brain imaging	CT-Brain	53 (47.7)
	MRI-Brain	58 (52.3)
Post-Stroke Seizure	Yes	38 (34.2)
	No	73 (65.8)
NIHSS Score	Mild	35 (31.5)
	Moderate	46 (41.4)
	Severe	30 (27.0)

GCS: Glasgow Coma Scale, NIHSS: National Institutes of Health Stroke Scale.

Table-4: Association of demographic and comorbid variables with post-stroke seizures.

Variable	With Seizure (n=38), n (%)	Without Seizure (n=73), n (%)	*p*-value
Gender			0.839
Male	24 (63.2)	44 (60.3)	
Female	14 (36.8)	29 (39.7)	
Diabetes Mellitus			0.425
Yes	14 (36.8)	33 (45.2)	
No	24 (63.2)	40 (54.8)	
Hypertension			0.665
Yes	25 (65.8)	52 (71.2)	
No	13 (34.2)	21 (28.8)	
Ischaemic Heart Disease			0.338
Yes	6 (15.8)	18 (24.7)	
No	32 (84.2)	55 (75.3)	
Atrial Fibrillation			0.496
Yes	2 (5.3)	6 (8.2)	
No	36 (94.7)	67 (91.8)	
Smoking			0.841
Yes	16 (42.1)	33 (45.2)	
No	22 (57.9)	40 (54.8)	
Previous History of Stroke			0.672
Yes	24 (63.2)	50 (68.5)	
No	14 (36.8)	23 (31.5)	

Chi-square test applied for categorical comparisons.

strokes. Clinical characteristics as well as GCS and NIHSS scores were also noted (Table 3).

No significant associations were observed for seizure occurrence with gender, DM, HTN, IHD, AFib, smoking status and prior stroke history (Table 4).

Stroke location (p=0.043), GCS score <12 (p<0.001), and higher NIHSS score (p<0.001) were significantly associated with seizure occurrence. Mortality and prolonged hospital stays were also higher among patients who developed seizures (p<0.05) (Table 5).

Table-5: Association of post-stroke seizures with clinical and imaging characteristics.

Variable	With Seizure (n=38), n (%)	Without Seizure (n=73), n (%)	*p*-value
Type of stroke			0.809
Ischaemic	29 (76.3%)	58 (79.5%)	
Haemorrhagic	9 (23.7%)	15 (20.5%)	
Site of stroke			0.043
Frontal	2 (5.3%)	19 (26.0%)	
Parietal	0 (0.0%)	6 (8.2%)	
Temporal	7 (18.4%)	9 (12.3%)	
Occipital	2 (5.3%)	6 (8.2%)	
Brain Imaging			0.318
CT Brain	21 (55.3%)	32 (43.8%)	
MRI Brain	17 (44.7%)	41 (56.2%)	
Prolonged Length of stay			0.002
Yes	14 (36.8%)	8 (11.0%)	
No	24 (63.2%)	65 (89.0%)	
GCS<12			
Yes	33 (86.8%)	6 (8.2%)	<0.001
No	5 (13.2%)	67 (91.8%)	
NIHSS Score			<0.001
Mild	1 (2.6%)	34 (46.6%)	
Moderate	9 (23.7%)	37 (50.7%)	
Severe	28 (73.7%)	2 (2.7%)	
Mortality			<0.001
Yes	9 (23.7%)	0 (0.0%)	
No	29 (76.3%)	73 (100.0%)	

Chi-square test applied for categorical comparisons; MRI: Magnetic resonance imaging, CT: Computed tomography, GCS: Glasgow Coma Scale, NIHSS: National Institutes of Health Stroke Scale.

Discussion

In the current study, seizures occurred in 34.2% of the patients with stroke. No significant difference in age or gender was found between patients with and without post-stroke seizures, which was consistent with earlier findings.[14] Stroke severity was significantly associated with post-stroke seizures (p<0.001), which supports prior studies.[19] Comorbid conditions did not show a strong association with post-stroke seizures, and the finding aligned with previous studies,[2,14]

The current study did not find significant correlation between haemorrhagic stroke and seizure incidence. However, patients with post-stroke seizures had GCS score <12, which showed a strong association (p<0.001). This highlights impaired consciousness as a risk factor. Previous literature has also noted that severe neurological impairment, as indicated by low GCS scores, correlates with seizure risk in acute stroke populations.[19]

Zelano et al. noted that cortical strokes, especially those affecting the temporal lobe, are associated with increased seizure susceptibility due to disruption of excitatory-inhibitory neuronal balance.[3] The current findings support

this as well.

Seizures were significantly associated in the present study with increased mortality and prolonged LOS. This aligns with findings by Zelano et al.[3]

The current study provides valuable insight into seizure predictors in a clinically diverse population. However, it has limitations of a relatively small sample size and lack of long-term follow-up. Larger cohort studies with extended follow-up are needed to validate the findings and to explore additional factors, such as genetic predisposition and inflammatory markers. Also, future studies should explore long-term data to differentiate early and late seizures, as they may have different risk profiles.

Conclusion

Stroke severity and brain region involvement, particularly temporal lobe lesions, were found to be significant predictors of post-stroke seizures. Post-stroke seizures were also linked to prolonged LOS and higher mortality. However, demographic factors and comorbidities did not have significant associations with seizure occurrence.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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