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A Study On The Correlation Between Stroke Severity Scores And Functional Outcomes In Patients With Cerebellar Stroke

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Abstract

Background

Cerebellar stroke, a subtype of posterior circulation stroke, often presents with subtle clinical features and may be underestimated by conventional stroke severity scales such as the National Institutes of Health Stroke Scale (NIHSS). Understanding the relationship between stroke severity and functional outcomes is essential for prognostication and management.

Aim

To evaluate the correlation between stroke severity scores and functional outcomes in patients with cerebellar stroke.

Materials and Methods

This hospital-based prospective observational study included 50 patients aged ≥18 years with radiologically confirmed cerebellar stroke. Stroke severity was assessed at admission using the NIHSS. Functional outcome was evaluated at 3 months using the Modified Rankin Scale (mRS). Correlation between NIHSS and mRS was assessed using Spearman correlation, and association between severity categories and outcomes was analyzed using the Chi-square test. A p-value <0.05 was considered statistically significant.

Results

The mean age of the study population was 63.8 ± 10.9 years, with a male predominance (60%). Moderate stroke severity was observed in 52% of patients. At 3 months, 60% achieved favourable outcomes (mRS 0–2). A strong positive correlation was found between NIHSS and mRS scores ($r = 0.66$, $p < 0.001$). A statistically significant association was observed between stroke severity and functional outcome ($p < 0.001$), with severe strokes showing higher rates of unfavourable outcomes.

Conclusion

Stroke severity at admission is a significant predictor of functional outcome in cerebellar stroke patients. NIHSS remains a valuable tool for early prognostication and guiding clinical management.

Keywords: Cerebellar stroke, NIHSS, Modified Rankin Scale, Stroke severity, Functional outcome

Introduction

Stroke is a leading cause of mortality and long-term disability worldwide, with an increasing global burden over the past decades. Recent estimates suggest that more than 12 million new stroke cases occur annually, reflecting a significant rise due to aging populations and changing risk factor profiles[1]. Ischemic strokes account for the majority of cases, with posterior circulation strokes, including cerebellar infarctions,

comprising approximately 20% of all strokes. Although cerebellar strokes are less common compared to anterior circulation strokes, they are clinically important due to their potential for rapid neurological deterioration, brainstem compression, and life-threatening complications[2].

Cerebellar stroke presents with distinct clinical features such as ataxia, vertigo, dysarthria, and imbalance, which are often subtle and easily overlooked, leading to delayed diagnosis and management. Unlike cortical strokes, traditional stroke severity assessment tools such as the National Institutes of Health Stroke Scale (NIHSS) may underestimate the severity of cerebellar involvement due to their limited emphasis on posterior circulation signs[3]. Studies have shown that patients with cerebellar stroke may have low NIHSS scores despite significant neurological impairment, highlighting a critical limitation in routine clinical assessment[4].

Stroke severity scoring systems play a pivotal role in the early evaluation, prognostication, and management of stroke patients. Among these, the NIHSS is the most widely used and validated tool, providing a standardized assessment of neurological deficits. It has been demonstrated that higher baseline NIHSS scores are strongly associated with poorer functional outcomes and increased mortality in acute ischemic stroke patients[5]. However, its predictive accuracy varies depending on stroke location, with posterior circulation strokes showing weaker correlation compared to anterior circulation strokes[6]. Functional outcome assessment is equally important in stroke research and clinical practice. The modified Rankin Scale (mRS) is commonly used to evaluate the degree of disability and functional independence following stroke. The correlation between initial stroke severity scores and functional outcomes forms the basis for predicting prognosis, guiding treatment decisions, and planning rehabilitation strategies[5]. In cerebellar stroke specifically, emerging evidence suggests that alternative scoring systems, including cerebellar-specific grading scales, may provide better prognostic accuracy compared to conventional tools[7]. In the Indian context, stroke incidence has shown a rising trend, with studies reporting a prevalence ranging from 84 to 262 per 100,000 population, significantly contributing to the national burden of non-communicable diseases. Limited awareness, delayed hospital presentation, and variability in access to stroke care further complicate outcomes in developing countries like India. Despite this, there is a paucity of focused research evaluating the correlation between stroke severity scores and functional outcomes specifically in cerebellar stroke patients within the Indian population.

Given these gaps, the present study aims to evaluate the correlation between stroke severity scores and functional outcomes in patients with cerebellar stroke, thereby contributing to improved prognostic assessment and clinical decision-making in this unique subgroup of stroke patients.

Aim

To evaluate the correlation between stroke severity scores and functional outcomes in patients with cerebellar stroke.

Objectives

1. To assess stroke severity in patients with cerebellar stroke using standardized stroke severity scoring systems (e.g., NIHSS).
2. To evaluate functional outcomes in these patients using validated outcome measures (e.g., modified Rankin Scale) and determine their correlation with initial stroke severity scores.

Materials And Methods

Study design

This will be a hospital-based prospective observational study conducted in patients diagnosed with cerebellar stroke.

Study population

All eligible patients admitted with a diagnosis of cerebellar stroke during the study period will be screened for inclusion in the study.

Sample size

The sample size for the present study was fixed at 50 patients. Fifty consecutive eligible patients with cerebellar stroke were enrolled during the study period. This sample size was considered adequate for a prospective observational study to evaluate the correlation between stroke severity scores and functional outcomes

Sampling method

Volume 9, Issue 3; May-June 2026; Page No 51-58
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A simple random sampling method was used. All patients fulfilling the inclusion criteria during the study period will be included until the required sample size is achieved.

Selection criteria

Inclusion criteria

1. Patients aged 18 years and above.
2. Patients with acute cerebellar stroke, confirmed by CT brain and/or MRI brain.
3. Patients presenting within the defined study period and willing to participate in the study.
4. Patients or legally acceptable representatives giving written informed consent.

Exclusion criteria

1. Patients with mixed stroke involving both cerebellum and extensive supratentorial areas, where cerebellar stroke cannot be assessed separately.
2. Patients with subarachnoid hemorrhage, traumatic intracranial bleed, or stroke mimics.
3. Patients with pre-existing severe neurological illness causing significant disability, such as advanced dementia, Parkinsonism, old major stroke with residual disability, or cerebellar degenerative disorders.
4. Patients with severe systemic illness or terminal disease likely to independently affect functional outcome.
5. Patients who are lost to follow-up or unable to complete outcome assessment.

Study procedure

All patients admitted with symptoms suggestive of posterior circulation stroke, such as vertigo, vomiting, gait instability, dysarthria, ataxia, headache, nystagmus, or altered sensorium, will be evaluated clinically and radiologically. After confirmation of cerebellar stroke and fulfilment of eligibility criteria, patients will be enrolled into the study after obtaining written informed consent.

A detailed history will be obtained from the patient or relatives, including age, sex, presenting complaints, time of onset of symptoms, vascular risk factors, past history of hypertension, diabetes mellitus, dyslipidaemia, smoking, alcohol use, previous stroke, ischemic heart disease, and treatment history. A complete general physical examination and detailed neurological examination will be performed in all patients.

Stroke severity at admission will be assessed using a standardized stroke severity score, preferably the National Institutes of Health Stroke Scale (NIHSS). Since cerebellar stroke may present with posterior circulation features not completely represented in NIHSS, the severity assessment will be interpreted carefully in relation to clinical and radiological findings. Radiological confirmation of cerebellar stroke will be done by non-contrast CT brain and/or MRI brain, depending on availability and clinical indication. Imaging details such as side of cerebellar involvement, vascular territory involved, presence of edema, hydrocephalus, brainstem compression, and associated infarction or hemorrhage will be noted.

Baseline clinical and demographic variables will be recorded in a structured proforma. These may include:

1. Age
2. Sex
3. Type of stroke (ischemic/hemorrhagic)
4. Time to presentation
5. Risk factors and comorbidities
6. Admission vital parameters
7. NIHSS score at admission
8. Glasgow Coma Scale, wherever applicable
9. Radiological findings
10. Need for ICU care, neurosurgical intervention, or decompression, if any

All patients will receive treatment as per standard institutional stroke management protocol. The study is observational in nature, and no additional intervention will be administered solely for research purposes.

Outcome assessment

Functional outcome will be assessed using the Modified Rankin Scale (mRS).

Outcome assessment may be done at:

1. At discharge, and/or
2. At 3 months follow-up after stroke

The functional outcome will be graded on the mRS scale from **0 to 6**, where:

1. 0 = No symptoms

Volume 9, Issue 3; May-June 2026; Page No 51-58

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2. 1 = No significant disability
3. 2 = Slight disability
4. 3 = Moderate disability
5. 4 = Moderately severe disability
6. 5 = Severe disability
7. 6 = Death

For analysis, outcome may also be categorized as:

1. **Favourable outcome**: mRS 0–2
2. **Unfavourable outcome**: mRS 3–6

The primary purpose of the study will be to determine the relationship between the initial stroke severity score and later functional outcome.

Study variables

Primary variable

- Stroke severity score at admission

Outcome variable

- Functional outcome measured by modified Rankin Scale

Other variables

1. Age
2. Sex
3. Type of cerebellar stroke
4. Time from symptom onset to hospital presentation
5. Vascular risk factors
6. Imaging characteristics
7. Need for intensive care
8. Length of hospital stay
9. In-hospital complications
10. Mortality

Data collection tool

Data will be collected using a predesigned, pretested structured case record proforma. Clinical details, examination findings, investigation results, stroke severity score, treatment details, and functional outcome scores will be recorded systematically.

Statistical analysis

The collected data will be entered into Microsoft Excel and analysed using SPSS software. Continuous variables were expressed as mean ± standard deviation or median with interquartile range, depending on the distribution of data, while categorical variables were presented as frequency and percentage. The correlation between stroke severity score (NIHSS) and functional outcome (mRS) was assessed using the Pearson correlation coefficient for normally distributed data and the Spearman rank correlation coefficient for non-normally distributed or ordinal data. Comparison between groups was performed using the Chi-square test or Fisher's exact test for categorical variables, and the independent t-test/ANOVA or Mann–Whitney U test/Kruskal–Wallis test for continuous variables based on data distribution. A p-value <0.05 was considered statistically significant.

Results

A total of 50 patients with cerebellar stroke were included in the study. Stroke severity was assessed using the NIHSS at admission, and functional outcome was evaluated using the Modified Rankin Scale (mRS) at 3 months.

Table 1: Baseline Demographic Characteristics (n = 50)

Variable	Frequency	Percentage (%)
Age (Mean ± SD)	63.8 ± 10.9 years	—
Male	30	60%
Female	20	40%
Hypertension	28	56%
Diabetes Mellitus	20	40%
Smoking	16	32%

Interpretation

Volume 9, Issue 3; May-June 2026; Page No 51-58
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The mean age of the study population was 63.8 years, indicating predominance in the elderly age group. There was a male predominance (60%), consistent with known stroke epidemiology. Hypertension (56%) and diabetes (40%) were the most common risk factors, reflecting typical cerebrovascular risk profiles.

Table 2: Distribution of Stroke Severity (NIHSS Score)

NIHSS Category	Frequency	Percentage (%)
Mild (0–4)	14	28%
Moderate (5–15)	26	52%
Severe (>15)	10	20%

Interpretation

The majority of patients (52%) had moderate stroke severity, followed by mild (28%) and severe (20%) categories. This indicates that cerebellar strokes commonly present with moderate neurological deficits, though a notable proportion present with severe involvement.

Table 3: Functional Outcome at 3 Months (mRS Score)

Outcome Category	Frequency	Percentage (%)
Favourable (mRS 0–2)	30	60%
Unfavourable (mRS 3–6)	20	40%

Interpretation

At 3 months follow-up, 60% of patients achieved favourable outcomes, while 40% had unfavourable outcomes. This suggests that although cerebellar stroke has a relatively good prognosis, a considerable proportion still develop significant disability.

Table 4: Correlation Between NIHSS Score and mRS Score

Variable	Correlation Coefficient (r)	p-value
NIHSS vs mRS	+0.66	<0.001

Interpretation

A strong positive correlation (r = 0.66) was observed between NIHSS score at admission and mRS score at 3 months, which was statistically highly significant (p <0.001). This indicates that higher stroke severity is strongly associated with poorer functional outcomes.

Table 5: Association Between Stroke Severity and Functional Outcome

NIHSS Category	Favourable Outcome (mRS 0–2)	Unfavourable Outcome (mRS 3–6)	p-value
Mild	13	1	<0.001
Moderate	15	11	
Severe	2	8	

Interpretation

A statistically significant association (p <0.001) was found between stroke severity and functional outcome. Patients with mild stroke had predominantly favourable outcomes (92.8%), whereas severe stroke patients showed higher unfavourable outcomes (80%).

Volume 9, Issue 3; May-June 2026; Page No 51-58
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This clearly demonstrates that increasing stroke severity leads to poorer prognosis.

Discussion

The present study evaluated the correlation between stroke severity scores and functional outcomes in patients with cerebellar stroke, with particular emphasis on the prognostic value of the NIHSS at admission. The findings demonstrated a strong positive correlation ($r = 0.66$, $p < 0.001$) between initial stroke severity and 3-month functional outcome, thereby supporting the primary objective of the study.

In the current study, the mean age was 63.8 ± 10.9 years, with a predominance of elderly patients. This observation is consistent with global stroke epidemiology, where advancing age is a major non-modifiable risk factor for stroke. Valery L. Feigin et al. have reported that the global burden of stroke is increasingly concentrated in older populations, reflecting demographic transitions and increased life expectancy[8]. Similarly, in the Indian context, studies such as those by Yogesh V. Kalkonde et al. have demonstrated a rising prevalence of stroke among older age groups, consistent with the findings of the present study[9]. The present study showed a male predominance (60%), which aligns with earlier epidemiological studies. Peter Appelros et al. reported that males are more commonly affected by stroke, possibly due to higher exposure to modifiable risk factors such as smoking and hypertension[10]. This trend was similarly observed in our study population, where smoking (32%) and hypertension (56%) were prevalent.

Hypertension and diabetes mellitus were identified as the most common risk factors in this study, present in 56% and 40% of patients, respectively. These findings are consistent with the landmark INTERSTROKE study conducted by Martin J. O'Donnell et al., which identified hypertension as the most significant modifiable risk factor for stroke worldwide[11]. Indian studies, including those by Jeyaraj Durai Pandian et al., have also emphasized the role of uncontrolled vascular risk factors in increasing stroke burden[12]. The findings of the present study further reinforce the importance of aggressive risk factor control in stroke prevention.

Regarding stroke severity, the majority of patients in this study had moderate NIHSS scores (52%), followed by mild (28%) and severe (20%) categories. This distribution is comparable to previous studies on posterior circulation strokes. Jong S. Kim et al. reported that cerebellar strokes often present with moderate neurological deficits but may carry a risk of rapid deterioration due to complications such as edema and brainstem compression[13]. However, it is important to note that the NIHSS has limitations in assessing posterior circulation strokes, as it underrepresents cerebellar signs such as ataxia and vertigo. In the present study, 60% of patients achieved favourable outcomes (mRS 0–2) at 3 months, while 40% had unfavourable outcomes, indicating that cerebellar stroke, although often associated with relatively good prognosis, can still result in significant disability. These findings are in agreement with previous studies. Orhan C. Singer et al. demonstrated that posterior circulation strokes can have variable outcomes depending on early diagnosis and management[14]. Similarly, studies by Hannes Neugebauer et al. have shown that complications such as space-occupying edema can significantly worsen prognosis in cerebellar infarction[15].

A key finding of the present study was the strong positive correlation ($r = 0.66$, $p < 0.001$) between NIHSS scores at admission and functional outcome at 3 months. This indicates that increasing stroke severity is associated with worsening functional outcomes. Similar findings were reported by Natalia S. Rost et al., who demonstrated that baseline NIHSS is a robust predictor of functional outcome and mortality in stroke patients[16]. Although their study primarily included anterior circulation strokes, the present study confirms that this relationship is also applicable to cerebellar stroke. Furthermore, the association analysis in the present study revealed that 92.8% of patients with mild stroke had favourable outcomes, whereas 80% of patients with severe stroke had unfavourable outcomes, with a statistically significant association ($p < 0.001$). These findings are consistent with earlier studies. Harold P. Adams Jr. et al. demonstrated that higher baseline NIHSS scores are strongly associated with poor functional outcomes and increased disability[17].

Despite these findings, it is important to recognize the limitations of NIHSS in cerebellar stroke. The scale does not adequately capture posterior circulation deficits, which may lead to underestimation of stroke severity. Studies by Liang Kwah et al. have

Volume 9, Issue 3; May-June 2026; Page No 51-58
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emphasized that NIHSS may underestimate the severity of posterior circulation strokes, thereby affecting prognostic accuracy[18]. This suggests the need for supplementary or cerebellar-specific scoring systems for better assessment.

Additionally, radiological factors such as lesion size, hydrocephalus, and brainstem compression, which were not quantitatively analyzed in the present study, may significantly influence outcomes. Studies by Erich Jüttler et al. have highlighted the role of timely neurosurgical intervention in improving outcomes in patients with space-occupying cerebellar infarction[19].

Overall, the findings of the present study are consistent with existing literature and confirm that stroke severity at presentation is a key determinant of functional outcome in cerebellar stroke, despite the inherent limitations of NIHSS. The study also underscores the importance of early assessment, prompt management, and risk factor control in improving patient outcomes.

Conclusion

The present study demonstrates a significant positive correlation between admission stroke severity (NIHSS) and functional outcome (mRS) in patients with cerebellar stroke. Higher NIHSS scores were associated with poorer outcomes at 3 months. The majority of patients with mild stroke achieved favourable recovery, whereas severe stroke cases showed increased disability. Despite its limitations in posterior circulation stroke, NIHSS remains a useful prognostic tool. Early assessment of stroke severity can aid in risk stratification, clinical decision-making, and improving patient outcomes.

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Volume 9, Issue 3; May-June 2026; Page No 51-58

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Volume 9, Issue 3; May-June 2026; Page No 51-58

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