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STUDY OF STROKE SEVERITY (NIHSS SCORE) AND SHORT-TERM OUTCOME- A TERTIARY CARE CENTER EXPERIENCE

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Abstract

Background: Stroke remains a leading cause of mortality and long-term disability worldwide. The National Institutes of Health Stroke Scale (NIHSS) is widely used to quantify neurological impairment at presentation, yet its prognostic value in real-world clinical settings requires ongoing validation. This study aimed to evaluate the relationship between admission NIHSS scores and short-term outcomes, including in-hospital mortality, length of stay, and 30-day functional status.

Methods: A prospective observational study was conducted over 6 months in the Department of Neurology/Medicine of a tertiary care teaching hospital. Two hundred consecutive patients with acute stroke (ischemic or hemorrhagic) presenting within 7 days of symptom onset were enrolled. Baseline NIHSS scores were recorded at admission and categorized as mild (0–5), moderate (6–14), or severe (≥15). Primary outcomes included in-hospital mortality, complications, length of stay, and 30-day functional outcome assessed by the modified Rankin Scale (mRS). Logistic regression analysis identified independent predictors of unfavorable outcome (mRS 3–6).

Results: The mean age was 61.8±12.4 years with 62% male predominance. Hypertension (71%) and diabetes mellitus (39%) were the most prevalent risk factors. Ischemic stroke accounted for 76% of cases. The mean baseline NIHSS score was 9.1±5.8. In-hospital mortality increased progressively from 2.9% in mild strokes to 39.1% in severe strokes. At 30 days, favorable functional outcome (mRS 0–2) was achieved in 79.4% of mild, 46.5% of moderate, and only 13.0% of severe stroke patients. Multivariate analysis revealed that each one-point increase in baseline NIHSS independently raised the odds of unfavorable 30-day outcome by 15% (adjusted OR 1.15, 95% CI 1.08–1.23, $p<0.001$). Hemorrhagic stroke (adjusted OR 2.05, 95% CI 1.02–4.10, $p=0.044$) and advancing age (adjusted OR 1.28 per decade, 95% CI 1.06–1.55, $p=0.009$) were also independent predictors of poor outcome.

Conclusion: Baseline NIHSS score is a powerful, independent predictor of both acute in-hospital outcomes and 30-day functional recovery following stroke. A clear dose-response relationship exists between initial stroke severity and mortality, with each one-point NIHSS increase conferring 15% higher odds of unfavorable outcome. These findings support the systematic use of NIHSS for clinical triaging, resource allocation, prognostication, and family counseling. The high prevalence of delayed hospital presentation (only 27% within 3 hours) underscores the urgent need for enhanced public awareness and primary prevention strategies.

Keywords: *Stroke; National Institutes of Health Stroke Scale; NIHSS; prognosis; modified Rankin Scale; functional outcome*

Introduction

Stroke remains one of the leading causes of mortality and long-term disability worldwide, imposing a significant socioeconomic burden on healthcare systems. It is characterized by the sudden onset of neurological deficits resulting from focal vascular injury to the central nervous system, including ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage [1]. While medical advancements have improved acute management, the ability to accurately predict short-term outcomes remains a cornerstone of effective clinical practice. Among the various tools available to clinicians, the National Institutes of Health Stroke Scale (NIHSS) has emerged as a gold standard for quantifying neurological impairment at the time of presentation [2].The NIHSS is a systematic assessment tool that provides a quantitative measure of stroke-related neurological deficits. Originally designed as a research tool, it is now widely utilized in clinical settings to determine the appropriate course of treatment, such as the administration of intravenous thrombolysis or mechanical thrombectomy [3]. The scale evaluates several domains, including level of consciousness, visual fields, motor function, sensory loss, and language. Scores range from 0 to 42, where higher scores indicate greater neurological impairment [2, 4]. Previous research by Adams et al. demonstrated that baseline NIHSS scores are highly predictive of the volume of infarction and the likelihood of functional recovery, with lower scores generally correlating with higher rates of independence at discharge [4].Despite its utility, the progression of a stroke is influenced by a complex interplay of demographic factors and comorbid conditions. Advanced age is consistently identified as a non-modifiable risk factor that exacerbates stroke severity and complicates recovery [1]. Additionally, the presence of vascular risk factors—such as hypertension, diabetes mellitus, and atrial fibrillation—not only increases the risk of the initial event but also influences the risk of secondary complications and in-hospital mortality [5]. Kelly et al. highlighted that the management of these comorbidities in the acute phase is critical, as they can significantly alter the trajectory of short-term outcomes regardless of the initial NIHSS score [1].The Modified Rankin Scale (mRS) is frequently used in conjunction with the NIHSS to assess functional outcomes, typically at 30 or 90 days. While the NIHSS measures "impairment," the mRS measures "disability" or the impact of the stroke on daily life [6]. Understanding the correlation between these two scales is essential for setting realistic expectations for patients and their families. Wouters et al. observed that while early neurological improvement can occur, the initial NIHSS remains the strongest independent predictor of the 30-day mRS score [5].This study aims to evaluate the relationship between admission NIHSS scores and short-term outcomes, including in-hospital mortality, length of stay, and 30-day functional status. By analyzing a cohort of 200 patients, this research seeks to validate the prognostic value of stroke severity scales in a real-world clinical setting, emphasizing the importance of rapid assessment and the management of associated risk factors to improve patient survival and quality of life.

Materials and Methods

Study design and setting

This was a hospital-based prospective observational study conducted in the Department of Neurology/Medicine of a tertiary care teaching hospital. Consecutive patients presenting with acute stroke and fulfilling the eligibility criteria were enrolled over a study period of 6 months.

Study population

A total of 200 patients with acute stroke were included in the study. Patients were recruited from the emergency department and inpatient wards.

Inclusion criteria

- Age ≥18 years.

- Clinical diagnosis of acute stroke (ischemic or hemorrhagic) with sudden onset focal neurological deficit.
- Presentation within 7 days of symptom onset.
- Neuroimaging (CT/MRI brain) consistent with stroke.
- Willingness to provide informed consent and comply with follow-up.

Exclusion criteria

- Transient ischemic attack (neurological deficit resolving within 24 hours).
- Stroke mimics (e.g., hypoglycemia, seizure with post-ictal deficits, space-occupying lesions, CNS infections).
- Previous history of significant disability (modified Rankin Scale >2) prior to index stroke.
- Patients with concomitant severe systemic illness with expected survival <30 days (e.g., terminal malignancy, end-stage organ failure).
- Incomplete baseline data or refusal of consent.

Data collection

All eligible patients underwent detailed clinical evaluation at admission using a predesigned, pretested structured proforma. The following information was recorded:

- Demographic details: age, sex, residence, socioeconomic status.
- Vascular risk factors: hypertension, diabetes mellitus, dyslipidemia, smoking, alcohol use, prior stroke or TIA, ischemic heart disease, atrial fibrillation, valvular heart disease, and other comorbidities.
- Clinical characteristics: time from symptom onset to hospital arrival, presenting symptoms, blood pressure, Glasgow Coma Scale, and systemic examination findings.
- Stroke subtype: ischemic or hemorrhagic stroke based on clinical evaluation and neuroimaging.

Stroke severity at admission was assessed using the National Institutes of Health Stroke Scale (NIHSS). The NIHSS was administered by trained residents/neurologists as per standard guidelines, and the total score was documented at the time of first assessment. For descriptive analysis, patients were categorized into severity groups (mild, moderate, and severe stroke) based on predefined NIHSS score ranges (e.g., ≤5, 6–14, ≥15).

Investigations

All patients underwent routine baseline investigations including: complete blood count, fasting and post-prandial blood glucose, renal and liver function tests, lipid profile, coagulation profile, and electrocardiogram. Chest radiograph and echocardiography were performed when clinically indicated. Neuroimaging with non-contrast CT brain was done in all cases at admission or as early as feasible; MRI brain with or without MR angiography was performed when available and indicated. Additional investigations (carotid Doppler, CT angiography, etc.) were obtained as per treating physician's discretion and resource availability.

Treatment

Patients received standard stroke care according to current institutional protocols and national/international guidelines. This included acute management (intravenous thrombolysis or endovascular therapy for eligible ischemic stroke patients where available, antiplatelet or anticoagulant therapy as indicated, control of blood pressure and blood glucose, management of raised intracranial pressure) and supportive care (airway and nutritional support, prevention of complications, early mobilization, and initiation of physiotherapy and rehabilitation). Treatment decisions were taken independently by the treating team and were not influenced by study participation.

Outcome assessment and follow-up

Short-term outcome was evaluated at discharge and at 30 days from the index stroke. In-hospital outcome parameters included:

- Survival status (alive/dead).
- Length of hospital stay.
- Presence of major in-hospital complications (e.g., aspiration pneumonia, sepsis, deep vein thrombosis, pulmonary embolism, recurrent stroke).

Functional outcome at 30 days was assessed using the modified Rankin Scale (mRS). For patients who had been discharged before 30 days, outcome was obtained through scheduled outpatient visits or telephonic interview with the patient or primary caregiver. For analysis, functional outcome was categorized as favorable (mRS 0–2) or unfavorable (mRS 3–6).

Sample size

A total of 200 consecutive eligible patients were included during the 6-month study period. The sample size was determined based on feasibility, expected admission load of stroke patients, and the requirement to obtain adequate representation across NIHSS severity categories for meaningful statistical analysis.

Statistical analysis

Data were entered into a spreadsheet and analyzed using appropriate statistical software. Continuous variables were expressed as mean ± standard deviation or median (interquartile range) depending on distribution, and categorical variables as frequencies and percentages.

Results- Among the 200 patients included in the study, the mean age was approximately 62 years with male predominance, and most had at least one vascular risk factor such as hypertension or diabetes, with ischemic stroke constituting nearly three-fourths of all events (Table 1). Mild, moderate, and severe strokes (NIHSS 0–5, 6–14, ≥15) accounted for about one-third, two-fifths, and one-quarter of the cohort, respectively, with an overall mean NIHSS score around 9 (Table 2). In-hospital mortality and complications increased progressively with higher baseline NIHSS, with severe strokes showing the longest median hospital stay, highest complication rate, and almost two-fifths in-hospital deaths compared to minimal mortality in the mild group (Table 3). At 30 days, favorable functional outcome (mRS 0–2) was seen in about four-fifths of patients with mild stroke but fell to roughly half in moderate and just over one-tenth in severe strokes, while mortality at 30 days was highest in the severe group (Table 4). Logistic regression showed that each one-point increase in baseline NIHSS independently increased the odds of an unfavorable 30-day outcome, even after adjustment for age, vascular risk factors, and stroke subtype, and hemorrhagic stroke also emerged as an independent predictor of poor short-term outcome (Table 5)

Table 1. Baseline demographic and clinical characteristics of stroke patients (n = 200)

Variable	Category	n (%)
Age (years)	Mean ± SD	61.8 ± 12.4
Age group (years)	18–39	18 (9.0)
	40–59	72 (36.0)
	60–79	86 (43.0)
	≥80	24 (12.0)
Sex	Male	124 (62.0)
	Female	76 (38.0)
Residence	Urban	118 (59.0)
	Rural	82 (41.0)
Hypertension	Present	142 (71.0)
Diabetes mellitus	Present	78 (39.0)
Dyslipidemia	Present	64 (32.0)

Current smoker	Yes	58 (29.0)
Alcohol use	Yes	46 (23.0)
Prior stroke/TIA	Yes	32 (16.0)
Atrial fibrillation	Yes	26 (13.0)
Time from symptom onset to arrival	≤3 hours	54 (27.0)
	>3–6 hours	62 (31.0)
	>6–24 hours	52 (26.0)
	>24 hours	32 (16.0)
Stroke subtype	Ischemic	152 (76.0)
	Hemorrhagic	48 (24.0)

Table 2. Distribution of baseline NIHSS scores and stroke severity (n = 200)

NIHSS category (at admission)	NIHSS range	n (%)	Mean NIHSS ± SD
Mild	0–5	68 (34.0)	3.4 ± 1.2
Moderate	6–14	86 (43.0)	9.2 ± 2.3
Severe	≥15	46 (23.0)	18.7 ± 3.1
Total		200 (100)	9.1 ± 5.8

Table 3. Short-term in-hospital outcome according to baseline NIHSS category (n = 200)

Outcome variable	Mild (0–5) n=68	Moderate (6–14) n=86	Severe (≥15) n=46	Total n=200
In-hospital mortality	2 (2.9)	10 (11.6)	18 (39.1)	30 (15.0)
Discharged alive	66 (97.1)	76 (88.4)	28 (60.9)	170 (85.0)
Median length of stay (days)	6 (IQR 4–8)	8 (IQR 6–11)	10 (IQR 7–14)	8 (IQR 5–11)
Any in-hospital complication*	10 (14.7)	26 (30.2)	28 (60.9)	64 (32.0)

Table 4. Thirty-day functional outcome (mRS) by baseline NIHSS category (n = 200)

Outcome at 30 days	Mild (0–5) n=68	Moderate (6–14) n=86	Severe (≥15) n=46	Total n=200
Favorable outcome (mRS 0–2)	54 (79.4)	40 (46.5)	6 (13.0)	100 (50.0)
Unfavorable (mRS 3–5)	12 (17.6)	34 (39.5)	20 (43.5)	66 (33.0)
Death (mRS 6)	2 (2.9)	12 (14.0)	20 (43.5)	34 (17.0)

Table 5. Logistic regression: association of baseline NIHSS with unfavorable 30-day outcome (mRS 3–6)

Predictor variable	Category / unit	Crude OR (95% CI)	Adjusted OR* (95% CI)	p value
NIHSS score (per 1-point ↑)	Continuous	1.18 (1.11–1.25)	1.15 (1.08–1.23)	<0.001
Age (per 10-year ↑)	Continuous	1.32 (1.10–1.58)	1.28 (1.06–1.55)	0.009
Hypertension	Yes vs no	1.40 (0.80–2.44)	1.22 (0.68–2.20)	0.50
Diabetes mellitus	Yes vs no	1.62 (0.94–2.80)	1.48 (0.84–2.61)	0.17
Stroke subtype	Hemorrhagic vs ischemic	2.30 (1.20–4.41)	2.05 (1.02–4.10)	0.044

Discussion

Demographic Profile and Risk Factor Prevalence

The study cohort ($n = 200$) was characterized by a mean age of approximately 62 years with a notable male predominance (62%), aligning with established global trends in stroke epidemiology. A significant majority of patients presented with at least one major vascular risk factor, most notably hypertension (71%) and diabetes mellitus (39%). These results are consistent with large-scale German nationwide data reported by Kelly et al., where hypertension was the most prevalent comorbidity, affecting approximately 74.4% of acute stroke patients [1]. The high prevalence of these comorbidities underscores their critical role as primary drivers of stroke in this population. Furthermore, ischemic stroke was the dominant subtype, accounting for 76% of cases, mirroring global observations that ischemic events constitute the vast majority of stroke hospitalizations [1, 7].

Stroke Severity and Initial Presentation

The distribution of stroke severity at admission, measured by the NIHSS score, reveals a relatively balanced cohort, with moderate strokes (43%) being the most frequent, followed by mild (34%) and severe (23%) cases. The mean NIHSS score of 9.1 suggests a population with moderate neurological deficits upon arrival. Notably, only 27% of patients reached the hospital within the "golden window" of 3 hours. This delay is a common clinical challenge; for instance, Olavarría et al. noted that the validity of NIHSS in predicting vessel occlusion is highly time-dependent, decreasing significantly as the time from symptom onset to clinical evaluation increases [3]. This indicates a potential need for improved public awareness regarding stroke symptoms and the urgency of medical intervention to optimize treatment windows.

Impact of Severity on In-Hospital Outcomes

A clear, direct correlation was observed between baseline NIHSS and in-hospital morbidity and mortality. Patients with severe strokes (NIHSS≥ 15) faced a starkly higher in-hospital mortality rate of 39.1% compared to a negligible 2.9% in the mild group. This trend extended to complications and healthcare utilization; severe stroke patients experienced nearly four times the complication rate of mild cases and required longer hospital stays (median of 10 days vs. 6 days). These findings highlight the prognostic value of the NIHSS score in predicting not just clinical decline, but also the complexity of inpatient care, a relationship also emphasized by Sussman et al. regarding the increased risk of hemorrhagic transformation and neurological deterioration in more severe baseline presentations [8].

Long-Term Functional Recovery at 30 Days

The 30-day functional outcomes, measured by the Modified Rankin Scale (mRS), demonstrate that initial stroke severity is a powerful predictor of long-term disability. While nearly 80% of patients with mild strokes achieved a favorable outcome (mRS 0–2), this dropped precipitously to only 13% for those with severe strokes. By the one-month mark, mortality in the severe group reached 43.5%. This steep decline in recovery potential emphasizes that while the brain possesses plasticity, the initial volume of neurological insult remains a primary determinant of short-term independence. Wouters et al. similarly found that baseline NIHSS is a robust predictor of 90-day functional outcomes, with higher scores strongly associated with a decreased likelihood of achieving functional independence [5].

Independent Predictors of Poor Outcome

The multivariate logistic regression analysis confirms that baseline NIHSS is an independent predictor of unfavorable 30-day outcomes. Even after adjusting for age and comorbidities, every one-point increase in the NIHSS score raised the odds of a poor outcome by 15% (AOR = 1.15). Additionally, hemorrhagic stroke was associated with over double the odds (AOR = 2.05) of an unfavorable outcome compared to ischemic stroke. This aligns with findings from Girgenti et al., who observed that patients with intracerebral hemorrhage often present more severely and maintain

significantly worse functional scores over time compared to matched ischemic stroke patients [8]. Age also remained a significant factor, with the risk of disability increasing by 28% for every decade of life, reinforcing the multifactorial nature of stroke prognosis where physiological severity and stroke type remain the most robust indicators of recovery [5, 8].

Conclusion ;This study confirms that the baseline NIHSS score is a powerful, independent predictor of both acute in-hospital outcomes and 30-day functional recovery. A clear dose-response relationship was observed: as stroke severity increased, mortality rates rose from 2.9% in mild cases to 39.1% in severe ones. Furthermore, each one-point increase in NIHSS independently raised the odds of an unfavorable outcome by 15%, even when adjusting for age and stroke subtype. The high prevalence of hypertension (71%) and the fact that only 27% of patients arrived within the 3-hour "golden window" highlight urgent needs for better primary prevention and public awareness. While hemorrhagic strokes and advanced age significantly worsen prognosis, initial neurological deficit remains the most robust prognostic tool. These findings advocate for the systematic use of NIHSS to guide clinical triaging, resource allocation, and family counseling regarding recovery expectations.

References

1. Kelly DM, Feld J, Rothwell PM, Reinecke H, Koeppe J. Admission Rates, Time Trends, Risk Factors, and Outcomes of Ischemic and Hemorrhagic Stroke From German Nationwide Data. Neurology. 2022;99(22):e2439-e2451.
2. Lyden P. Using the National Institutes of Health Stroke Scale. Stroke. 2017;48(2):513-519.
3. Olavarría VV, Delgado I, Hoppe A, Brunser A, Cárcamo D, Díaz-Tapia V, et al. Validity of the NIHSS in predicting arterial occlusion in cerebral infarction is time-dependent. Neurology. 2011;76(1):62-68.
4. Adams HP Jr, Davis PH, Leira EC, Chang KC, Bendixen BH, Clarke WR, et al. Baseline NIH Stroke Scale score strongly predicts outcome after stroke: A report of the Trial of Org 10172 in Acute Stroke Treatment (TOAST). Neurology. 1999;53(1):126-131.
5. Wouters A, Nysten C, Thijs V, Lemmens R. Prediction of Outcome in Patients With Acute Ischemic Stroke Based on Initial Severity and Improvement in the First 24 h. Frontiers in Neurology. 2018;9:308.
6. Banks JL, Marotta CA. Outcomes validity and reliability of the modified Rankin scale: implications for stroke clinical trials: a literature review and synthesis. Stroke. 2007;38(3):1091-1096.
7. Mosenzon O, Cheng AY, Rabinstein AA, Sacco S. Diabetes and Stroke: What Are the Connections? J Stroke. 2023 Jan;25(1):26-38. doi: 10.5853/jos.2022.02306. Epub 2023 Jan 3. PMID: 36592968; PMCID: PMC9911852.
8. Sussman ES, Connolly ES Jr. Hemorrhagic Transformation: A Review of the Rate of Hemorrhage in the Major Clinical Trials of Acute Ischemic Stroke. Frontiers in Neurology. 2013;4:69.