

The National Institute of Health Stroke Scale Score and Outcome in Acute Ischemic Stroke

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Abstract

Introduction: Stroke is a focal neurological deficit of sudden onset which lasts for more than 24 hours and has a vascular cause. Various prognostic indices derived from clinical features or patient characteristics and ancillary tests have been used to predict the prognosis of patients with acute ischemic stroke. The aim of this study was to find out the significance of the National Institute of Health Stroke Scale (NIHSS) score on admission in predicting the prognosis of patients with acute ischemic stroke.

Method: This is a prospective observational study done in a tertiary care hospital with two hundred patients with acute ischemic stroke

Result: The mean NIHSS score in patients with better outcome was 4.6 ($\pm$ 2.2) and the mean NIHSS score in patients with poor outcome was 14.16 ($\pm$ 7.96). The difference was statistically significant ($p=0.000$).

Conclusion: The baseline neurological status as measured by the National Institute of Health Stroke Scale score predicts the functional status at one month after acute ischemic stroke.

Key words: Ischemic stroke, baseline NIHSS score.

Introduction

The World Health Organization defines stroke as “rapidly developing clinical symptoms and/or signs of focal, and at times global, loss of cerebral function, with symptoms lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin.”¹ Of all strokes, 87% are ischemic and 10% are intracerebral hemorrhagic strokes, whereas 3% are subarachnoid hemorrhage strokes.² The American Heart Association and American Stroke Association (AHA/ASA) in 2009 gave a tissue based definition of ischemic stroke by defining ischemic stroke as infarction of central nervous system tissue irrespective of the duration of symptoms.³ This distinction is important to distinguish transient ischemic attacks from ischemic strokes, which also have therapeutic implications.

According to a WHO database, 15 million people worldwide suffer a stroke every year.⁴ Of these, 5 million die (3 million

women and 2 million men) and another 5 million are left permanently disabled. Stroke is the third most common cause of death in developed countries, exceeded only by coronary artery disease and cancer.⁴

Stroke is a leading cause of disability with devastating consequences. The rehabilitation of patients with stroke makes necessary the expenditure of considerable resources for a long duration. As a result, identifying factors that predict functional recovery after stroke has been the subject of much research. Various prognostic indices derived from clinical features or patient characteristics and ancillary tests have been used to predict survival, discharge disposition, length of hospital stay, functional, and neurological status. One of the factors most widely accepted as prognostically helpful with class I level of evidence is baseline neurological status as measured by the National Institute of Health Stroke Scale (NIHSS).⁵



Objective

- To find out the significance of the National Institute of Health Stroke Scale score on admission in predicting the prognosis of patients with acute ischemic stroke.

Outcome of Stroke

The Centers for Disease Control and Prevention estimates that on average, every 4 minutes, someone dies of a stroke.⁶ After an acute stroke, most functional recovery occurs within the first 2 months.⁷ Some studies have shown that there is less functional recovery at 4 to 5 months post-stroke and after 6 months little further functional recovery can be expected.⁸

In the Framingham study on the influence of gender and age on disability following ischemic stroke, among ischemic stroke survivors who were ≥ 65 years of age, the following disabilities were observed at 6 months after stroke:⁹

- 50% had some hemiparesis
- 30% were unable to walk without some assistance
- 46% had cognitive deficits
- 35% had depressive symptoms
- 19% had aphasia
- 26% were dependent in activities of daily living
- 26% were institutionalized in a nursing home.

The most frequently used scale to assess outcome is the modified Rankin scale (MRS).⁵ It measures functional independence on a seven grade scale.¹⁰ Functionally dependent is defined as the MRS score of 3, 4, or 5.¹¹

NIHSS Score

The National Institutes of Health Stroke Scale is a neurologic severity scale that is one of the most widely and commonly used stroke severity scoring scale. The NIHSS is considered to be valid, reliable, and reproducible; and it is one of the most commonly used scoring scales in many clinical trials dealing with medical therapy for acute stroke.¹²⁻¹⁴

The scale consists of eleven clinical items adding up to a total score of 0 to 42. The complete scale has been kept in the appendix for reference. The baseline neurological status is classified as follows:¹⁵

- Normal/near normal examination (0)
- Minor stroke (1-4)
- Moderate stroke (5-14)
- Moderate/severe stroke (15-20)
- Severe stroke (>20)

Studies have established that the baseline NIHSS scores on admission are associated with chronic functional outcome.¹⁶ It is also associated with stroke severity at hospital disposition after stroke.¹⁷ The accuracy of the NIHSS in predicting outcome is almost unaffected by the timing of assessment in the first 9 days after stroke, and this makes this instrument more robust for determining patient prognosis.¹⁸

Methodology

The study is a prospective observational study done in general medical, neurology and high dependency wards of TU Teaching Hospital. Two hundred patients admitted with the diagnosis of acute ischemic stroke in different general medical and high dependency wards of TUTH were included in the study. Patients who developed ischemic stroke during admission for other reasons were also included in the study. The diagnosis of an acute ischemic stroke was done clinically and confirmed with computed tomography scan of the head. The baseline neurological status was calculated using the NIHSS score as soon as the patient arrived in the emergency department or got admitted. The patients were followed up after one month of onset of stroke in the medical outpatient department. Those patients who did not come for follow up were interviewed by means of phone calls. The functional independence was calculated by using the Modified Rankin Scale. The various demographic and clinical data were entered into the computer based statistical analysis software (SPSS-17). Descriptive as well as analytical computations were then done.

Results

The total number of patients included in the study was 200. The age range of the patients was from 18 to 92 years (Mean was 61.46 ± 16.3). Male patients numbered

108 (54%) and female patients numbered 92 (46%). The gender wise distribution of the patients is as shown in the figure (Fig. 1).



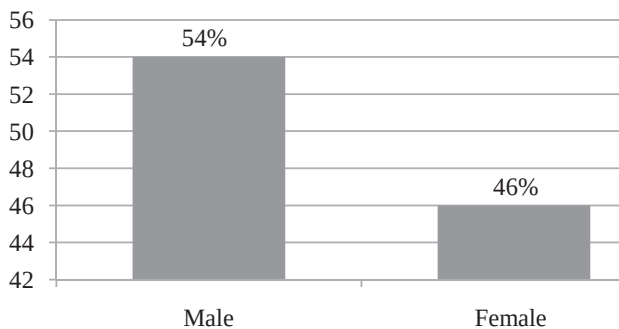


Figure 1 Gender distribution of the patients.

The frequencies and percentages of various comorbidities in the patients were as shown in the following table (Table 1).

Table 1 Comorbidities in the patients with ischemic stroke.

Comorbidities	Frequency	Percentage
Diabetes	29	14.5
Hypertension	85	42.5
Atrial Fibrillation	25	12.5
Heart Failure	3	1.5
Ischemic Heart Disease	7	3.5
Peripheral Vascular Disease	5	2.5
Valvular Heart Disease	17	8.5

The mean NIHSS score was 11.87 (± 8.1). The distribution of the NIHSS score among the patients is as shown in the following figure (Fig. 2)

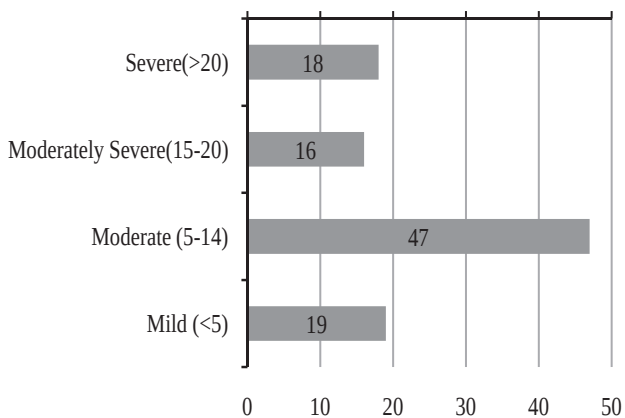


Figure 2 The NIHSS score of the patients.

The functional outcome of the patients at one month was measured with the Modified Rankin Scale (MRS). The mean MRS score was 3.58 (± 1.5). The distribution of the Modified Rankin Scale scores among the patients is as shown in the following figure (Fig. 3)

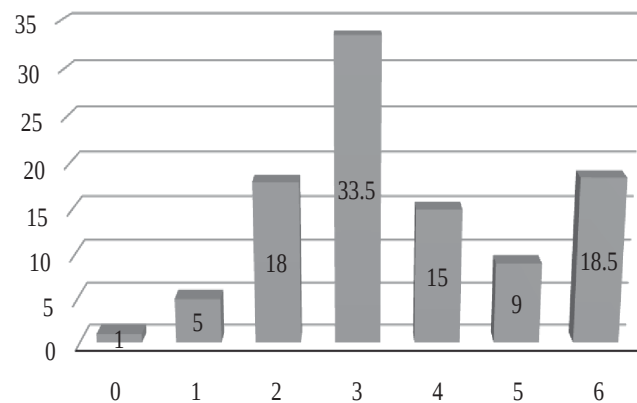


Figure 3 The Modified Rankin Scale scores of the patients.

The result of the statistical significances of the impact of NIHSS on outcomes of patients at one month based on the MRS score are shown in the following table (Table 2).

Table 2 Statistical significance of impact of NIHSS on outcome.

	Good Outcome	Bad Outcome	p-Value (t-test)
Mean NIHSS	4.6 $\pm$ 2.2	14.16 $\pm$ 7.96	0.000

The statistical significance of the categories of stroke severities based on NIHSS scores are as shown in the following table (Table 3).

Table 3 Statistical significance of NIHSS sub-divisions on outcome.

Stroke Severity (NIHSS Scores)	Good Outcome	Bad Outcome	p-value (Chi-square test)
Mild (<5)	25	13	0.000
Moderate (5-14)	23	71	
Moderately Severe (15-20)	0	32	
Severe (>20)	0	36	

Discussion

The mean NIHSS score was 11.87 in this study. This score indicates moderate stroke severity at stroke onset.¹⁵ Mild stroke severity (NIHSS less than 5) was present in 19% of the patients, moderate stroke severity (NIHSS 5-14) was present in majority (47%) of the patients, moderately severe stroke severity (NIHSS 15-20) was present in 16% of the patients and severe stroke severity (NIHSS more than 20) was present in 18% of the patients (Fig. 2).

The mean MRS score at one month post discharge was 3.58, which means that the patients are dependent to the caregiver in such a way that they are in between requiring some help but able to walk without assistance and unable to walk without assistance and unable to attend to own bodily needs without assistance. The majority of patients had the MRS score of 3 (33.5%) (Fig. 3). This score includes patients who require some help with their activities but able to walk without any assistance. Fully independent patients (MRS 0-2) and fully dependent patients (MRS 4 and 5) both amounted to 24% each (Fig. 3). Thirty seven patients (18.5%, MRS score 6) died within one month of onset of stroke. It can be seen in Table 2 that the mean NIHSS score is strongly associated with functional outcome based on MRS scoring at one month. In addition, it can be seen in table 3 that none of the patients with moderately severe and severe strokes according to the NIHSS score had good outcome. This table also shows that the less the NIHSS score, the better the outcome and the associations are strongly statistically significant.

In the trial of ORG 10172 in acute ischemic stroke, a score of more than or equal to 16 forecasted a high probability of death or severe disability and the score below 6 forecasted good recovery.¹⁶ In our study, the mean NIHSS score associated with good outcome is 4.6 and that associated with bad outcome is 14.16. The figures are almost similar and do serve as cutoff points to predict the prognosis as the chances of becoming dependent or independent were statistically significant (Table 2).

Although the NIHSS is the most widely used scoring system in patients with stroke and is highly predictive of chronic outcome, it has a potential weakness with respect to uneven scoring of lesion-specific neurologic deficits. The scale is highly weighted toward anterior circulation deficits, including cortical signs and motor function, while posterior circulation deficits, including cranial nerve signs and ataxia, receive fewer points.¹⁹ Thus, NIHSS may not appropriately evaluate the spectrum of posterior circulation-related signs.

Conclusion

It can be concluded from this study that the baseline neurological status as measured by the National Institute of Health Stroke Scale score predicts the functional status at one month after acute ischemic stroke. The higher the NIHSS score, the likelihood of becoming functionally dependent is also higher and the association is also statistically significant.

Conflict of interest: None declared.

References

1. Hatano S. Experience from a multicentre stroke register: a preliminary report. *Bull World Health Org.* 1976; 54: 553
2. Go AS, Mozaffarian D, Roger VL, Benjamin EJ, Berry JD, Borden WB, et al. Heart disease and stroke statistics—2013 update: a report from the American Heart Association. *Circulation.* 2013; 127: e6-e245.
3. Easton JD, Saver JL, Albers GW, Albers MJ, Chaturvedi S, Feldmann E, et al. Definition and evaluation of transient ischemic attack: a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association Stroke Council; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular Radiology and Intervention; Council on Cardiovascular Nursing; and the Interdisciplinary Council on Peripheral Vascular Disease. *Stroke.* 2009; 40(6): 2276.
4. Mackay J, Mensah GA. The atlas of heart disease and stroke. Brighton: Myriad Edition Limited; 2004. p. 50-53.
5. Veerbeek JM, Kwakkel G, van Wagen EEH, Ket JCF, Heymans MW. Early prediction of activities of daily living after stroke: a systematic review. *Stroke.* 2011; 42: 1482-8.
6. Centers for Disease Control and Prevention. Underlying cause-of-death 1999-2009. Compressed Mortality File 1999-2009. 2012; 20: 20.
7. Andrews K, Brocklehurst JC, Richards B, Laycock PJ. The rate of recovery from stroke and its measurement. *Int J Rehabil Res.* 1981; 3: 155-61.
8. Skilbeck CE, Wade DT, Langton Hewer R, Wood VA. Recovery after stroke. *J NeurolNeurosurg Psychiatry.* 1983; 46: 5-8.
9. Kelly-Hayes M, Beiser A, Kase CS, Scaramucci A, D'Agostino RB, Wolf PA. The influence of gender



- and age on disability following ischemic stroke: the Framingham study. *J Stroke Cerebrovasc Dis.* 2003; 12: 119–126.
10. RANKIN J. Cerebral vascular accidents in patients over the age of 60. II. Prognosis. *Scott Med J.* 1957; 2(5): 200.
 11. Bamford J, Sandercock P, Dennis M, Burn J, Warlow C. A prospective study of acute cerebrovascular disease in the community: the Oxfordshire Community Stroke Project—1981-1986. *J NeurolNeurosurg Psychiatry.* 1990; 53: 16-22.
 12. Brott T, Adams Jr. HP, Olinger CP, Marler JR, Barsan WG, Biller J, et al. Measurements of acute cerebral infarction: a clinical examination scale. *Stroke.* 1989; 20: 864–870.
 13. Goldstein LB, Bertels C, Davis JN. Interrater reliability of the NIH Stroke Scale. *Arch Neurol.* 1989; 46: 660–662.
 14. Lyden P, Brott T, Tilley B, Welch KM, Mascha EJ, Levine S, et al. Improved reliability of the NIH Stroke Scale using video training. NINDS TPA Stroke Study Group. *Stroke.* 1994; 25: 2220–2226.
 15. Mack W, Dusick JR, Martin N, Gonzalez N. Principles of endovascular therapy. In: Daroff RB, Fenichel GM, Jankovich J, Mazziotta JC, editors. *Bradley's neurology in clinical practice.* 6th ed. Philadelphia: Elsevier Saunders; 2012. p. 828-852.
 16. Adams Jr. HP, 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: 126-131.
 17. Schlegel D, Kolb SJ, Luciano JM, Tovar JM, Cucchiara BL, Liebeskind DS, et al. Utility of the NIH Stroke Scale as a predictor of hospital disposition. *Stroke.* 2003; 34: 134–137.
 18. Kwakkel G, Veerbeek JM, vanWegen EE, Nijland R, Harmeling-vanderWel BC, Dippel DW, et al. Predictive value of the NIHSS for ADL outcome after ischemic hemispheric stroke: does timing of early assessment matter? *J Neurol Sci.* 2010; 294: 57–61.
 19. Kasner SE. Clinical interpretation and use of stroke scales. *Lancet Neurol* 2006; 5: 603–612.

