

## Research Article

# A study of association between the national institute of health stroke scale score and arteriographic findings in acute ischaemic stroke

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## ABSTRACT

**Background:** In an ischaemic stroke, a strong correlation exists between the stroke severity and the level of arterial occlusion. Patients with major or proximal artery occlusion tend to have worst clinical picture and poor outcomes; and they are most benefited by revascularization interventions. These patients can be identified early before angiography by clinical scoring methods like National Institute of Health Stroke Scale (NIHSS) score. The NIHSS score (range 0-42) is a 15 item neurological examination stroke scale used to evaluate the effects of acute cerebral infarction on levels of consciousness, visual field loss, extra ocular movements, motor strength, ataxia, sensory loss, language, dysarthria and neglect.

**Methods:** A prospective study of 50 patients, who were admitted to the hospital with an acute ischaemic stroke within 12 hours of onset, was carried out to evaluate the relationship of NIHSS score and MR angiographic (MRA) findings.

**Results:** We found that majority of patients (38%) belonged to 6<sup>th</sup> decade with mean age of 59 years. Out of various risk factors, hypertension (64%) and smoking (48%) were most prevalent. Highest numbers of patients (40%) were in NIHSS score group 07 to 15. Out of 50 patients, 29 (58%) patients showed visible arterial occlusion on MRA. Median NIHSS score was 16 in occlusion group and 6 in non-occlusion group ( $p < 0.01$ ). In the same way, median NIHSS score in central occlusion group (20) was higher than distal occlusion group (11) ( $p < 0.01$ ). At NIHSS score 10, sensitivity and specificity to detect arterial occlusion in MRA was 86%. Positive predictive value (PPV) for arterial occlusion at  $>10$  NIHSS score was 89% and PPV for detecting central occlusion at  $>12$  NIHSS score was 87%.

**Conclusions:** In summary, a significant association was found between the NIHSS score and the presence and the location of a vessel occlusion in acute ischaemic stroke. In this era of reperfusion therapy where time is the most critical element, simple bedside score like NIHSS can greatly help in selecting patients requiring urgent treatment and improve patient disease outcome.

**Keywords:** NIHSS score, Acute ischaemic stroke

## INTRODUCTION

Cerebrovascular diseases include some of the most common devastating disorders: ischaemic stroke, haemorrhagic stroke and cerebrovascular anomalies such as intracranial aneurysms and arteriovenous malformations.<sup>1</sup>

“A stroke is defined as rapidly developing clinical signs of focal or global neurological disturbances of cerebral function with symptoms lasting 24 hours or longer or leading to death that is attributable to local vascular cause.”<sup>2</sup>

Cerebrovascular diseases are one of the three leading cause of death in world along with cancer and heart disease. A stroke is the most common cause of disability in adults. The average incident of strokes is about 2:1000 population. The economic and psychological cost of a stroke is tremendous. Developing countries like India have been also burdened with cerebrovascular diseases.<sup>1</sup>

In an ischaemic stroke, there is a strong correlation between the stroke severity and the level of arterial occlusion. Patients with major or proximal artery occlusion tend to have the worst clinical picture and poor outcomes; and are most benefited by revascularization interventions (i.e. thrombolysis and mechanical recanalization). These patients can be identified in advance before angiography by clinical scoring methods like National Institute of Health Stroke Scale (NIHSS) score.

## METHODS

A prospective study of 50 patients who were admitted to the general ward and the emergency ward of our institution with an acute ischaemic stroke within 12 hours of onset during 2013 to 2015 was carried out to evaluate the relationship between the NIHSS score and the MR angiographic (MRA) findings. The patients presented with haemorrhagic strokes (after brain NCCT Scan) and transient ischaemic attacks were excluded.

The NIHSS score is a 15 - item neurological examination stroke scale used to evaluate the effects of acute cerebral infarction on levels of consciousness, visual field loss, extra ocular movements, motor strength, ataxia, sensory loss, language, dysarthria and neglect. Each item are scored 0 to (up to) 5 grades with 0 as normal and total score ranging between 0 to 42.<sup>3</sup> The examination requires less than 10 minutes to be completed.

After obtaining informed written consent from the patients or their relatives, details of the patients with symptoms and signs of acute stroke syndrome were entered in a comprehensive proforma with two parts; the first part contained general details (demographic patient data, vascular risk factors, the time interval from the onset of symptoms to the time of admission to hospital and from the onset of symptoms to the time of angiography, along with short clinical history); the other part contained NIHSS score with eleven different clinical variables. After non-contrast CAT scan of brain was performed to rule out intracranial haemorrhage, only the patients with ischaemic strokes were enrolled for further study. Magnetic Resonance (MR) Angiography of brain was performed on all the enrolled patients within few hours of presentation. A permission of Institutional Ethical Committee for conducting the present study was not required as per the policies of the institute.

Statistical analysis was performed with SPSS 17.0 software package (SPSS Inc).

## RESULTS

### Age and sex distribution

**Table 1: Age distribution.**

Age group (years)	No. of patients (%)
<40	1 (2%)
40-50	9 (18%)
51-60	19 (38%)
61-70	12 (24 %)
>70	9 (18%)
Total	50 (100%)

The age of patients varies from 38 to 85. Majority of patients (38%) belonged to 6<sup>th</sup> decade with median age of 59 years. Out of 50 patients, 32 were male and 18 were female.

### Risk factors

**Table 2: Risk factors.**

Risk Factors	No. of patients (%)
Diabetes mellitus	16 (32%)
Hypertension	32 (64%)
Smoking	24 (48%)
Dyslipidemia	17 (34%)
H/o IHD or Stroke	7 (14%)

We have evaluated patients for important risk factors for stroke. Out of various risk factors, hypertension (64%) and smoking (48%) were the most prevalent factors in our study group.

### Time interval

**Table 3: Time interval.**

Time interval	Range (minutes)	Average with standard deviation (minutes)
From onset of stroke to presentation	30 - 720	320±202
From the onset of stroke to MR angiography	300 - 1200	680±242

The time interval from the onset of symptom to the admission to hospital depended upon the awareness of the patient, availability of transportation facility, referral system, etc., while the time interval for MRI depended upon the availability of MRI instrumentation and the financial condition of the patient for performance of the test.

**NIHSS score distributions****Table 4: NIHSS Score distribution.**

NIHSS Score	No. of patients (%)
0 to 06	14 (28)
07 to 15	20 (40%)
16 or more	16 (32%)

The highest number of patients (20) was seen in 07 to 15 NIHSS score group. The median NIHSS score in our patients was 11.

**Magnetic resonance angiography findings****Table 5: Magnetic resonance angiography findings.**

	Artery involved on MR angiography	No. of patients (%)
Central occlusion	Basilar artery	3 (6%)
	Internal carotid artery	4 (8%)
	Middle cerebral artery – M1	9 (18%)
Distal occlusion	Middle cerebral artery – M2	12 (24%)
	Anterior cerebral artery	1 (2%)
	Posterior cerebral artery	0
No occlusion		21 (42%)
Total		50 (100%)

On MR Angiography, 42% of patients had no visible arterial occlusion. Occlusion group was further subdivided into 6 subgroups:

- Basilar artery, Internal carotid artery (ICA) and Middle cerebral artery (MCA – M1) was included in central occlusion group (32%).
- MCA - M2, Anterior cerebral artery (ACA), and Posterior cerebral artery (PCA) were considered in distal occlusion group (26%).

As Table 5 shows highest number of patients were with MCA-M2 occlusion (24%) and there was no patient with PCA occlusion in our study.

**Table 6: NIHSS score with MR angiography findings.**

NIHSS Score	No. of patients	No. of patients with arterial occlusion	Percentage of patients with arterial occlusion
0 to 5	9	1	11.1 %
6 to 10	15	5	33.3%
11 to 15	10	8	80%
16 to 20	8	7	87.5%
> 20	8	8	100%

Table 6 shows percentage of patients with visible arterial occlusion in specific NIHSS group. The percentage of patients with visible arterial occlusion increases with NIHSS score.

**Table 7: Distribution of NIHSS scores in occlusion and non-occlusion group.**

NIHSS Score	Occlusion group	No occlusion group
Highest value	33	17
Lowest value	4	2
Median	16	6

Table 7 shows distribution of NIHSS Score in occlusion and non-occlusion group by range and median. The median NIHSS score was higher (16) in occlusion group than the Non-occlusion group (6) ( $p < 0.01$ ).

**Table 8: Distribution of NIHSS scores in central and distal occlusion group.**

NIHSS Score	Central occlusion	Distal occlusion
Highest value	33	16
Lowest value	13	4
Median	20	11

In the same way, the patients with central occlusion group had higher median NIHSS score (20) as compared to the distal occlusion group (11) ( $p < 0.01$ ).

**Sensitivity and specificity**

At NIHSS score 10, sensitivity and specificity to detect arterial occlusion in MRA was 86%.

At NIHSS score >10, Positive predictive value (PPV) to detect arterial occlusion on MRA was 89%; and at NIHSS score >12, PPV to detect central occlusion was found to be 87%.

**DISCUSSION**

The potential value of the baseline NIHSS score in identifying those stroke patients who are likely to progress has been established.<sup>4</sup> A direct relation between the baseline NIHSS score and likelihood of the presence of a clot on initial arteriography has also been demonstrated. Our data shows that MRA findings are also well correlated with the baseline NIHSS Score. Significant association was found between NIHSS score and the presence and the location of arterial occlusion in an acute ischaemic stroke. With NIHSS score  $\geq 10$ , a vessel occlusion can be predicted on MR Angiography; and with a score  $\geq 12$ , its location can be predicated to be central.

Based on the National Institute of Neurological Disorders and Stroke (NINDS) rtPA stroke study and subsequent European Cooperative Acute Stroke Study (ECASS) III trial, rtPA is approved for use in 0-3 hour window in United State and for 0-4.5 hour window in Europe and Canada.<sup>5</sup> In this era of reperfusion therapy, where time is the most critical element, simple bedside score like NIHSS scale can greatly help in selecting patients requiring urgent treatment and thus, in improving the disease outcome.

The results of the present study will help the clinician to select such patients, but NIHSS does not substitute for vascular imaging. However, the demonstration of an arterial occlusion is not mandatory, if the patient qualifies with NINDS tPA trial criteria.

It is also clear that the presence of a cerebral arterial occlusion alone may be insufficient to predict ischaemic lesion enlargement in individual patients. The location of the vessel occlusion and the role of collaterals are crucial for neurological outcome of stroke patients with a persistent cerebral arterial occlusion. However, this collateral circulation cannot be adequately assessed by MRA only.

## CONCLUSION

Above discussion is suggestive of strong relationship between the baseline NIHSS score and the MR angiographic findings with limited number of patients. But our study had some limitations. To have a better estimation of the number of acute stroke patients with occlusion on MRA, we should have performed the MRI and clinical evaluation of each patient immediately on admission. However, this study was conducted at a government hospital that serves the economically weaker section of the society; and due to the limited availability

of the MRI instrumentation and economic constraints of the patients, the mean time from the onset of stroke to the performance of MRI was approximately 11 hours. Hence, there is a time lag between the onset of stroke, clinical evaluation and MRA. For all these reasons, the rate of cerebral arterial occlusion is probably underestimated in our study.

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