

**A Study Among Ischemic Stroke Patients To Predict 30 Day Functional Outcome Using National Institute Of Health Stroke Scale And Barthel Index In A Tertiary Health Care Centre**

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**Abstract**

**Background:** NIHSS is a well validated tool to evaluate the initial severity of acute ischemic stroke. It has mortality prediction value, but 30-day mortality risk is not well studied before.

**Aims & Objective:** To find out the relation of admission day NIHS score; its progression and 30-day functional outcome in ischemic stroke patients, outcome being measured by Barthel index.

**Methods:** 100 patients with acute ischemic stroke were included in the study. Vitals recorded. Routine investigations & brain imaging done. NIHSS was performed on presentation and at 30 days, outcome measured by Barthel index. Presence of comorbidities was obtained by questionnaire.

**Results:** Most patients fall under age group of 61-70 yrs. 61% were males, 39 % were females; 88% had ACS while 12% had PCS. Risk factors like Dyslipidemia and Hypertension had an association with poor outcome. The overall 30-day mortality was 16%. The average NIHSS

score in expired patients was around 12.52. where as in patients with no or mild significant disability was 21.44. The mean NIHSS presenting score was significantly elevated in mortality group compared to alive group (42% higher) ( $p < 0.0001$ ). It showed significantly increased incidence in death as it rises through its class intervals. The mean score of NIHSS at presentation increased in comparison to decrease in the score of Barthel index at 30 days. ( $p < 0.0001$ ). Stroke subtypes by CT demonstrated a more worsening in patients with large to moderate cortical and subcortical infarcts, than in patients with lacunar and small subcortical infarcts or normal scans ( $p < 0.05$ ). Significant negative correlation exists between incidence rates of comorbidities like diabetes, hypertension and dyslipidemia when compared with barthel index at 30 days. ( $p < 0.0113$ ).

**Conclusion:** NIHSS is a good predictor of 30-day functional outcome in patients with acute ischemic stroke.

**Keywords:** National Institute of Health Stroke scale, Barthel index, ischemic stroke

## Introduction

Stroke ranks second in causing death worldwide after heart disease<sup>1</sup>. As per WHO, 15 million people suffer stroke every year and it causes 6.2 million deaths every year. Many of them are told to be silent, that is deficits are subtle. As per an article from Framingham study suggests that 1/10 individuals, stroke free and living in community have silent stroke and the mean age for it being, 62+/-9. As per WHO, stroke is the leading cause of death for people above the age of 60 yrs, fifth leading cause in people aged 15-59 issue. The Lancet 28 Nov 2009, stroke is second only to dementia as leading cause of mortality. The case fatality rates are also highly variable, with the highest being 42% in Kolkata. The first study was in Vellore, Tamil Nadu, South India, undertaken during the late 1960s and early 1970s covering 258,576 people in and around Vellore.

The second study happened to be at Rohtak, Haryana, North India (1971-1974). As per the India stroke factsheet which was updated in 2012, the estimated age adjusted prevalence rate for stroke is ranging between 84/100,000 and 262/100,000 in rural and between 334/100,000 and 424/100,000 in urban areas<sup>2,3</sup>. The incidence rate is 119-145/100000 as per recent population based studies. According to the 'WHO-STEPS Stroke protocol' population-based stroke epidemiology 4 studies were conducted during the first decade of the 21st century - in Mumbai<sup>4</sup>, Trivandrum<sup>5</sup>, Kolkata<sup>6</sup> and Bangalore<sup>7</sup> areas. From as per these studies, it has been estimated that hypertension causes 54% of stroke in low-income and middle-income countries, which is followed by hypercholesterolemia (15%) & tobacco smoking (12%)<sup>8</sup>. The brain is supplied by branches of Internal carotid disease and Vertebral arteries<sup>9</sup> Each Internal carotid artery divides into Anterior cerebral and Middle cerebral

arteries. The 2 vertebral arteries ascend on anterior aspect of medulla and joins to form basilar artery. It bifurcates into 2 posterior cerebral arteries<sup>10</sup>. The internal carotid & vertebrobasilar systems are connected by the posterior communicating arteries. The two anterior cerebral arteries are joined by anterior communicating artery. All this anastomosis finally give rise to *circulus arteriosus* (circle of willis). In addition to this there are arteries, anterior choroidal artery of Heubner which are branches of internal carotid artery<sup>11</sup>. The branches of Vertebral arteries are Posterior inferior cerebellar, anterior inferior cerebellar and superior cerebellar artery. Stroke or Cerebrovascular accident by definition is an abrupt onset of a neurological deficit that is attributable to a focal vascular cause. Stroke is purely diagnosed clinically and lab studies including brain imaging are just to support the diagnosis. About 80% of all cerebrovascular accidents are ischemic strokes<sup>12, 13</sup>. Stroke is ranking second in causing death worldwide after heart disease. To characterize the outcome possibilities and plan for discharge, we require a stroke scale that can ascertain the precise nature of stroke related disabilities and to characterize severity. A good stroke scale can identify the complete neurological impairments and is quantified adequately, so that patients progress can be monitored objectively.

## NIH Stroke Scale

The National Institute of Health Stroke scale is a validated tool used in quantifying stroke impairment. The relation of NIHSS Score to 30-day mortality (short term) have not been studied well, though we have some studies which has studied long term mortality. To assess stroke outcomes, the Barthel Index is one of the scale used widely. The purpose of this study is to assess the relation of admission NIHSS to 30-day mortality and also to assess functional

outcome in survivors which can be measured by Barthel index.

**Materials And Method**

It's a unicentric prospective observational study conducted for 8 months in the tertiary health care centre with the sample size of 100 newly diagnosed stroke patients. The 30-day mortality rate by NIHSS in previous studies (AHA Study) was 13.6%. Assuming that the power of the analysis is 80. Identifiable time of onset, stable deficit lasting longer than one hour without rapid improvement and ability to obtain informed consent were included in this study. Patients with haemorrhagic stroke, Prior neurological deficits that obscure the ability to follow, neurological examination from most recent infarct and thrombolytic therapy were excluded

**Methodology**

All patients presenting to emergency room of tertiary care centre with the diagnosis of acute stroke; with any level of sustained focal deficits with CT brain showing compatible hypo density lesion or normal study were

**Results**

**Table: Age distribution**

Age Groups	Alive	%	Dead	%	Overall	%
≤ 50 years	10	11.90	2	12.50	12	12.00
51-60 years	32	38.10	3	18.75	35	35.00
61-70 years	36	42.86	7	43.75	43	43.00
71-80 years	6	7.14	4	25.00	10	10.00
Total	84	100.00	16	100.00	100	100.00

Among ischemic stroke patients, majority of the alive group patients belonged to 61-70 years' age class interval (n=36, 42.86%) with a mean age of 59.81 years. In the dead group patients, majority belonged to 61-70 years'

admitted to medicine ward/ICU. Vitals like Blood pressure, Pulse rate, Respiratory rate, Temperature, SaO2 measured. Routine blood investigations done at the time of admission. All the patients were treated as per institutions stroke pathway throughout hospital stay. The NIHSS was performed on presentation and at 30 days. Total scoring done summing up the individual item score.

**Data Analysis**

Descriptive statistics was done for all data and were reported in terms of mean values and percentages. Suitable statistical tests of comparison were done. Continuous variables were analysed with the unpaired t-test and ANOVA. Categorical variables were analysed with the Chi-Square Test and Fisher Exact Test. Statistical significance was taken as P < 0.05. The data was analysed using SPSS version 16 and Microsoft Excel 2007.

age class interval (n=7, 43.75%) with a mean age of 64.06 years. The association between the study groups and age distribution is considered to be not statistically significant since p > 0.05 as per unpaired t test.

**Table 2: Types of CVA patients observed**

Type of CVA	Alive	%	Dead	%	Overall	%
Anterior Circulation Stroke	73	86.90	15	93.75	88	88.00
Posterior Circulation Stroke	11	13.10	1	6.25	12	12.00
Total	84	100.00	16	100.00	100	100.00
P value Fishers Exact Test				0.6645		

In the study patients, majority had anterior circulation stroke as CVA type in alive group (n=73, 86.90%) and same in dead group patients (n=15, 93.75%). The

association between the study groups and type of CVA status is considered to be not statistically significant since  $p > 0.05$  as per fisher's exact test.

**Table 3: NIH Stroke Scale - Presenting Score**

NIH Stroke Scale - Presenting Score	Alive	%	Dead	%	Overall	%
1 to 4	12	14.29	0	0.00	12	12.00
5 to 15	48	57.14	4	25.00	52	52.00
16 to 21	15	17.86	3	18.75	18	18.00
22 to 42	9	10.71	9	56.25	18	18.00
Total	84	100.00	16	100.00	100	100.00

NIH Stroke Scale - Presenting Score Distribution	Alive	Dead	Overall
Mean	12.52	21.44	13.95
SD	6.84	8.25	7.77
P value Unpaired T Test			<0.0001

Among ischemic stroke patients, majority in alive group had NIHSS presenting score between 5 to 15 (n=48, 57.14%) with a mean score of 12.52 and majority in dead group had NIHSS presenting score between 22 to 42

(n=9, 56.25%) with a mean score of 21.44. The association between the study groups and NIHSS presenting score is considered to be statistically significant since  $p < 0.05$  as per unpaired t test.

**Table 4: NIH Stroke Scale - 30th Day**

NIH Stroke Scale - 30th Day	Alive	%	Dead	%	Overall	%
1 to 4	17	20.24	16	100.00	33	33.00
5 to 15	43	51.19	0	0.00	43	43.00
16 to 21	17	20.24	0	0.00	17	17.00
22 to 42	7	8.33	0	0.00	7	7.00
Total	84	100.00	16	100.00	100	100.00

NIH Stroke Scale - 30th Day Distribution	Alive	Dead	Overall
Mean	10.85	0.00	9.11
SD	6.84	0.00	7.43
P value Unpaired T Test			<0.0001

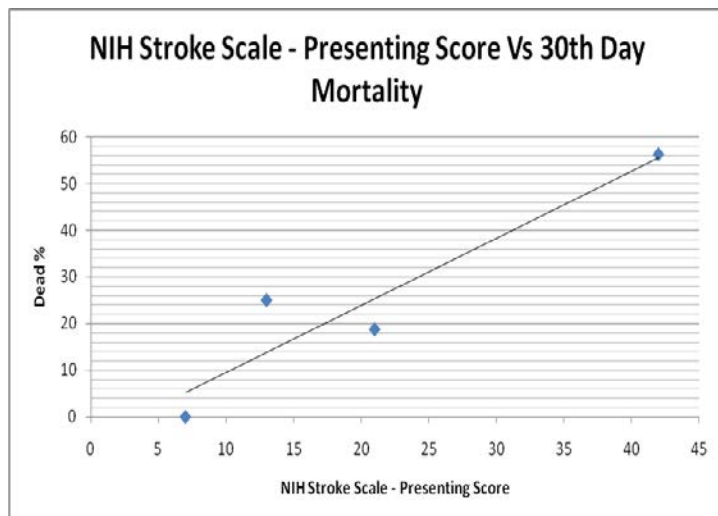
Among ischemic stroke patients, majority in alive group had NIHSS at 30 days' score between 5 to 15 (n=43, 51.19%) with a mean score of 10.85 and majority in dead group had NIHSS at 30 days' score of 0 (n=16, 100%)

with a mean score of 0.00. The association between the study groups and NIHSS at 30 days score is considered to be statistically significant since  $p < 0.05$  as per unpaired t test.

**Table 5: NIH Stroke Scale - Presenting Score Vs Cumulative Incidence of Death**

NIH Stroke Scale - Presenting Score	Cumulative Incidence of Death (%)
1 to 4	0
5 to 15	25
16 to 21	43.25
22 to 42	99.5

**Figure 1: NIH Stroke Scale - Presenting Score Vs 30th Day Mortality**



In our study the NIHSS at presentation score showed significantly increased incidence in death as it rises through its class intervals. Patients with 0 to 4 NIHSS at presentation score when compared to 5 to 15 NIHSS at presentation score has a 25% increased chance of dying as

a result of ischemic stroke. Similarly, the increased chance of dying jumps to 43.25% when NIHSS at presentation score is between 16 to 21 and to 99.5% when NIHSS at presentation score is between 22 to 42.

**Table 6: Barthel Index - 30th Day**

Barthel Index - 30th Day	Alive	%	Dead	%	Overall	%
≤ 50	11	13.10	16	100.00	27	27.00
51-70	47	55.95	0	0.00	47	47.00
71-100	26	30.95	0	0.00	26	26.00
Total	84	100.00	16	100.00	100	100.00

Barthel Index - 30th Day Distribution	Alive	Dead	Overall
Mean	65.00	0.00	54.60
SD	19.26	0.00	29.74
P value Unpaired T Test			<0.0001

**Table 7: Barthel Index - 30th Day Distribution Vs NIHSS**

Barthel Index - 30th Day Distribution Vs NIHSS	NIHSS Oth day		NIHSS ON 30 th Day	
	Mean	SD	Mean	SD
≤ 50	22.44	7.00	22.64	4.13
51-70	13.85	3.95	12.11	3.79
71-100	5.31	1.91	3.58	1.72
P value Single Factor ANOVA	< 0.0001		< 0.0001	

The enrolled subjects were then evaluated at presentation their functional outcome was assessed using Barthel index using NIHSS score. The subjects were followed-up and (BI) on the 30th day along with NIHSS score at 30 days.

**Table 8: Barthel Index - 30th Day Distribution Vs Morbidities**

Barthel Index - 30th Day Distribution Vs Morbidities	Diabetes Mellitus	%	Hyper - tensio n	%	Dyslip - idemi a	%
	≤ 50	8	44.44	24	38.71	13
51-70	8	44.44	23	37.10	5	26.32
71-100	2	11.11	15	24.19	1	5.26
Total	18	100.00	62	100.00	19	100.00
P value	Fishers Exact Test			0.0113		

The enrolled subjects were then evaluated by matching (BI) on the 30th day along with incidence of their functional outcome as assessed using Barthel index comorbidities.

**Discussion**

We studied about 100 patients of acute ischemic stroke admitted in the hospital, admission NIHSS and the 30-day NIHSS measured, 30-day mortality was noted. Out of survived, functional outcome was measured using Barthel index, the results were analysed and discussed as follows. Out of 100 patients who presented with ischemic stroke, most of our subjects fall under age group of 61-70 yrs. 61% of patients were males, 39 % were females. 88% had ACS while 12% has PCS. Out of the risk factors studied,

Dyslipidaemia and Hypertension had a correlation on poor outcome. In our study the hypertension status between outcome groups was meaningfully statistically significant. The incidence of hypertension was significantly elevated in dead group compared to alive group by a percentage difference of 25.60 percentage points (29% higher). This difference is significant with a p-value of 0.0479 as per fisher’s exact test. The incidence of dyslipidaemia was significantly elevated in dead group compared to alive group by a percentage

difference of 29.46 percentage points (34% higher). This difference is significant with a p-value of 0.0118 as per fisher's exact test.

NIHSS scoring was done on the day of admission, within 24 hours of stroke onset. Majority of the patients i.e. comes under the category of moderate stroke i.e. NIHSS range from 5-15. The average NIHSS score in expired patients was around 12.52. where as in patients with outcome of no or mild significant disability, the average NIHSS was 21.44. The mean NIHSS presenting score was significantly elevated in dead group compared to alive group by a mean difference of 8.91 scoring points (42% higher). This difference is significant with a p-value of <0.0001 as per unpaired t test.

The overall 30-day mortality was 16% and 84% were alive. Out of the alive, outcome was assessed based on the functional independence score called Barthel. The average NIHSS scoring was higher in the mortality group (21.44) than those who survived (12.52). So there was a significant negative correlation between NIHSS score at presentation and barthel index at 30 days. This showed that as the mean score of NIHSS at presentation increased in comparison to decrease in the score of Barthel index at 30 days. Results showed that 82% of the change in Barthel Index score was attributable to change in NIHSS score. This relationship is statistically significant with a p value of <0.0001 as per single factor ANOVA test.

From our study, it is evident that there is graded near-linear relationship between the NIHSS and the 30-day mortality risk and it is also a better predictor of functional outcome.

Our study had few limitations. One was the small sample size. The other challenge which we had to overcome was to call the patient for follow up on 30 th day, which we have done. We still believe it as a valuable addition

because of the scope for NIHS score as a good measuring entity to prognose the stroke patient on day one itself, especially in the context of limited studies in those areas. Compared to previous studies, we have additionally assessed some important outcomes that may be predicted by NIHSS like health-related quality of life, disability, other clinical outcomes that may be of interest at 30 days.

### Conclusion

Ischemic stroke patients with higher NIHSS presenting score had 1.71 times higher chance of dying compared to ischemic stroke patients with lower NIHSS presenting score. The NIHSS score is a good predictor of patient's recovery after stroke. NIHSS score at presentation is strongly associated with functional outcome after 30 days' ischemic stroke. Thus this score of stroke severity is a very strong discriminator of mortality risk if evaluated as a continuous or even as a categorical risk determinate & hence can be easily identified as being at low, medium, and high risk for 30-day. It is reliable, valid and reproducible. The efficiency of the score to predict clinical improvement and progression of deficit in patients with acute cerebral ischemic infarct is a valuable treasure in future attempts to assess the effects of therapeutic interventions. If NIHS score at the time of admission proved to be a good marker of prognosis, it can be even used to adequately dispose patients which will even prevent the patients from extended hospitalization and also help in efficient use of resources. NIHSS can be even used to assess final outcome after Thrombolysis.

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