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Study to estimate the NIHS score and volume of stroke in predicting 30-day mortality in acute ischemic stroke patients

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ABSTRACT

Background. Stroke is defined as a sudden onset of a neurological deficit attributed to a focal vascular cause. It is one of the leading causes of mortality and morbidity all over the world. The present study aimed to estimate the NIHS score and volume of stroke in predicting 30-day mortality in acute ischemic stroke patients.

Material and methods. The present study was a prospective cross-sectional study conducted in 100 patients above 18 years old, of either gender, with symptoms of stroke for less than 24 hours, diagnosis of acute ischemic stroke based on history, physical examination, CT scan and/or diffusion weighted MRI scan performed during the first 24 hours.

Results. In the present study, the mean age was 57.4±13.36 years. The volume of stroke on 1st day was 40. 75 ± 38.51, and on 30th day it was reduced to 31.94±33.20 which was statistically significant. NIHSS (National Institutes of Health Stroke Scale) score on day 1 was 9.70±5.22, and on day 30 it was 7.77±5.25, with a statistically significant difference (p=0.000). At the end of the 30 days, 10% mortality was observed. NIHSS score and volume of stroke were significantly associated with the 30-day outcome.

Conclusion. In conclusion, integrating NIHSS scoring and stroke volume assessment into routine clinical practice enhances predictive accuracy for 30-day mortality in acute ischemic stroke patients. These findings advocate for early intervention strategies aimed at reducing stroke volume and improving neurological outcomes. Further research is recommended to validate these findings across diverse populations and settings, potentially refining acute stroke management protocol.

Keywords: stroke, NIHSS, volume of stroke, MRI brain, acute ischemic stroke

INTRODUCTION

The abrupt onset of a neurological loss resulting from a focal vascular source is referred to as a stroke [1]. Across the globe, it is one of the main causes of both mortality and morbidity. There are two types of strokes: ischemic and hemorrhagic. 15% of strokes are hemorrhagic, while 85% of all strokes are ischemic [2]. There are several risk factors for stroke that are discussed, including high blood pressure, a history of stroke or transient ischemic attack, high cholesterol, heart disease, diabetes, and sickle cell disease. Stroke was also linked to lifestyle-related factors such as smoking, drinking too much alcohol, obesity, poor diet, and lack of physical activity [3]. The Glasgow Coma Scale (GCS), Canadian Neurological Scale (CNS), and National Institute of Health Stroke Scale (NIHSS) are used to evaluate the prognosis of acute ischemic stroke. Because of its rigorous design and simplicity, NIHSS is widely acknowledged [4]. It has been shown to be a highly accurate predictor of patient outcomes, evaluating patients based on eleven distinct characteristics. One important factor influencing prognosis in acute stroke patients is the quantity of brain tissue that has had reversible damage at the time of presentation. A worse prognosis and spontaneous hemor-

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rhagic change are often linked to larger infarcts in ischemic stroke [5]. The purpose of the current study was to estimate the NIHS score and stroke volume in order to predict the 30-day death rate for patients with acute ischemic stroke.

MATERIAL AND METHODS

This prospective cross-sectional study was carried out at Saveetha Medical College and Hospital's general medicine department in Chennai, India. The two-year study period ran from January 2021 until December 2022. It was approved by the institutional ethical committee to conduct the study. Patients who meet the following criteria were included in the study: they must be over the age of 18, male or female, have symptoms of a stroke within 24 hours, have been diagnosed with acute ischemic stroke based on history, physical examination, CT scan, or diffusion weighted MRI scan completed within the first 24 hours, and were willing to participate in the study.

Exclusion criteria: Intracerebral mass, subdural hematoma, and cerebral hemorrhage diagnosed by CT scan. Individuals that exhibit hemodynamic instability and are unsuitable for MRI testing for a variety of reasons Individuals with a prior history of stroke were known to have hematological problems that impact red blood cells and platelets. Individuals unwilling to provide written informed consent.

Patients were informed about the study in their native tongue. The stroke patient's family gave their signed, informed consent. Patient information was documented, including demographics, medical history, co-morbidities, drug and alcohol use, alcohol intake, smoking and nicotine use, trauma, and previous history of TIA or stroke. All patients underwent a thorough clinical examination upon admission to assess neurological impairment, vital statistics, and Glasgow Coma Scale scores.

All patients had routine tests, including full hemogram, ESR, BT, CT, PT, aPTT, platelet count, routine and microscopic urine examination, serum creatinine, eGFR, serum electrolytes, LFT, lipid profile, CT scan/MRI head, ECG, and chest X-ray. Whenever necessary, additional tests were carried out, including connective tissue workups and echocardiograms.

Every patient got the usual care. The assessment of stroke patients' outcome was based on their mortality rate 30 days following the stroke occurrence. Follow-up continued for three months. Day 1 and Day 30 NIHSS scores and the volume of stroke (based on MRI) were computed.

SPSS 23.0 was used for data analysis after Microsoft Excel was used for data collection and compilation. For the continuous variables, frequency, percentage, means, and standard deviations (SD) were computed; for the categorical variables, ratios and proportions were computed. The chi-square test or the Fisher exact test, if appropriate, were used to evaluate the differences in proportions between the qualitative variables. A P-value of less than 0.5 was deemed statistically noteworthy.

RESULTS

In present study, mean age was 57.4±13.36 with the minimum age of 24 years and maximum of 83 years. Majority patients were between 41-60 years of age (44%), followed by above 60 years age (42%). 55% of our subjects were males in our study. The most common co-morbidities were diabetes mellitus (46%), followed by hypertension (27%), sustained hypertension (21%) & chronic kidney diseases (6%) (Table 1). The volume of stroke on 1st day was 40.75±38.51 and on 30th day it reduced to 31.94±33.20 which was statistically significant. NIHSS (National Institutes of Health Stroke Scale) score on day 1 was 9.70±5.22 and on day 30 the score was 7.77±5.25, difference was statistically significant (p=0.000) (Table 2).

Severity of stroke based on NIHSS score on 1st day of acute ischemic stroke patients was 3.50±1.75, moderate category score was 29.46±8.417, moderate to severe stroke was 81.56±14.48 and severe stroke category was 161.20±38.51. Intergroup comparison by

TABLE 1. General characteristics and prevalence of various co-morbidities

Characteristics	No. of patients	Percentage (%)
Age groups (in years)		
20-40	14	14
41-60	44	44
>60	42	42
Mean age (mean ± SD)	57.4±13.36	
Gender		
Male	55	55
Female	45	45
Co-morbidities		
Type 2 diabetes mellitus	46	46
Hypertension	27	27
Sustained hypertension	21	21
Chronic kidney diseases	06	06

TABLE 2. Comparison of 1st day and 30th day parameters

Parameter	on 1st day	on 30th day	Mean difference	t-value	p value
Volume of stroke	40.75±38.51	31.9±33.20	8.818	5.200	0.000***
NIHSS Score	9.70±5.22	7.77±5.25	1.93	8.36	0.000***

TABLE 3. Comparison of volume of stroke in severity of stroke on 1st day and on 30th day

Severity of stroke based on NIHSS Score (N)	Volume of stroke on 1st day	F- Value	p-value	Intergroup comparison by post Hoctukey test
Minor stroke (20)	3.50±1.75	570.42	0.000***	1-2–0.000***
Moderate stroke (56)	29.46±8.417			1-3–0.000***
Moderate–severe stroke (19)	81.56±14.48			1-4–0.000***
Severe stroke (05)	161.20±38.51			2-3–0.000***
				2-4–0.000***
				3-4–0.000***
Severity of stroke based on NIHSS score (N)	Volume of stroke on 30th day	F- Value	p-value	Intergroup comparison by post Hoctukey test
Minor stroke (20)	3.47±2.07	414.126	0.000***	1-2–0.000***
Moderate stroke (56)	31.79±11.18			1-3–0.000***
Moderate–severe stroke (19)	80.43±9.93			1-4–0.000***
Severe stroke (05)	160.40±6.150			2-3–0.000***
				2-4–0.000***
				3-4–0.000***

TABLE 4. Comparison of grade of stroke severity between 1st day and 30th day

Stroke severity on 1st day	Stroke severity on 30th day				Total
	Minor stroke N (%)	Moderate stroke N (%)	Moderate–severe stroke N (%)	Severe strokeN (%)	
Minor stroke	20 (20)	0	0	0	20 (20)
Moderate stroke	12 (12)	44 (44)	0	0	56 (56)
Moderate–severe stroke	0	10 (10)	09 (09)	0	19 (19)
Severe stroke	0	0	02 (02)	03 (03)	05 (05)
Total	32(32)	54 (54)	11 (11)	03 (03)	100 (100)
Fisher Exact Test: -X2value=100.523, p–Value=0.000***					

TABLE 5. Comparison of parameters among survivor and death patients

Parameter	Survivor patients N=90		Death Patients N=10	
	Parameter at 1st day Mean±SD	Parameter at 30th day Mean±SD	Parameter at 1st day Mean±SD	Parameter at 30th day Mean±SD
NIHSS score	8.28±3.90	6.44±3.92	19.80±1.75	19.20±2.04
	tvalue:8.727; pvalue: 0.000***		tvalue:2.714; pvalue:0.024**	
Volume of stroke	32.19±25.27	25.28±21.95	132.16±34.61	100.13±50.67
	tvalue:4.724; pvalue: 0.000***		tvalue:2.855; pvalue:0.02**	

p<0.05-p<0.001-statistically significant, ns-not significant*

post Hocktuckey test showed statistical results in between all groups (Table 3). NIHSS score on the 30th day of acute ischemic stroke patients, in minor stroke category was 3.47±2.07, 31.79±11.18 was score of moderate categories, score in moderate to severe category was 80.43±9.93 and score in severe category was 160.40±6.150. The intergroup comparison was highly statistically significant (p=0.000) (Table 3).

The volume of stroke in mild, moderate, moderate to severe and severe stroke category on day 1 was 3.50±1.75, 29.46±8.417, 81.56±14.48 and 161.20±38.51 respectively. The volume of stroke in mild, moderate, moderate to severe and severe stroke category on day 30 was 3.47±2.07, 31.79±11.18, 80.43±9.93 and 160.40 ± 6.150 respectively. Except in moderate category all other category had decrease in the volume of stroke on day 30 compared to day 1. Though the results are not significant in all categories except moderate, the volume of stroke was reduced on day 30.

NIHSS score decreased on day 30 in moderate and moderate to severe category and the score is increased slightly in mild and severe category. This shows that the overall severity of our subjects was greatly reduced and it was statistically significant (p=0.000) (Table 4).

At end of the 30 days, 10 % mortality was observed in present study. NIHSS score & volume of stroke were significantly associated with 30 days outcome (Table 5).

DISCUSSION

In our study, we have observed that the mean infarct volume of stroke on 1st day was 40.75±38.51 and on 30th day it reduced to 31.94±33.20 which was statistically highly significant (p=0.000). Infarct volume is one of the important predictors of mortality in acute ischemic stroke. Reduction in infarct volume

has been encouraged as a substitute outcome measure for human stroke clinical trials. Past studies have shown correlations between subacute CT lesion size and clinical scales such as NIHSS, Rankin Disability Scale, Oxford Disability Scale and aphasia severity scale [6]. Within the mild, moderate, moderate to severe, and severe stroke categories in our study, the volume of strokes on day 1 was 3.50±1.75, 29.46±8.417, 81.56±14.48, and 161.20±38.51, respectively. On day 30, the number of stroke cases in the mild, moderate, moderate to severe, and severe stroke categories was 3.47±2.07, 31.79±11.18, 80.43±9.93, and 160.40±6.150, in that order. On day 30, there was a significant decrease in the volume of stroke in all categories except moderate. There was a substantial statistical difference between the groups (p=0.000).We have seen a strong correlation between our individuals' NIHSS scores and the amount of stroke. Given the relationship between CT infarct volume and accepted clinical outcome indicators, CT volume may be used as a prognostic indicator to estimate 30-day mortality in cases of acute ischemic stroke. Although the NIH Stroke Scale (NIHSS) was initially intended for prospective scoring, it is now utilized to determine the severity of a stroke retrospectively [7,8]. Baseline NIHSS scores that are highly correlated with lesion volume show a strong likelihood of mortality for scores greater than 16, and a strong likelihood of a good recovery for scores less than 6 [9].

The NIHSS score was 9.70±5.22 on day 1 and 7.77±5.25 on day 30. At p=0.000, this is statistically significant. Patients with acute ischemic stroke can be accurately predicted by having elevated NIHSS scores. According to our analysis, 3 of them fell into the category of severe stroke after 30 days, 2 had passed away, 2 had complications from an acute ischemic stroke, meaning that 66.7% of patients in the severe group, as defined by the NIHSS, were at danger of dying. In our investigation, we found a strong correlation between the volume of stroke and NIHSS. Significant correlation was found at the 0.01 (2-tailed) level. The development of stroke and its effects may be prevented by early diagnosis, treatment, including lifestyle change, and prevention of diabetes. Many clinical and medical factors, including age, comorbid conditions, sex, the size and severity of the infarct, the etiology and location of the stroke, the amount of time that passes between the stroke's onset and hospitalization, and the type of medical care provided, such as stroke unit, stroke team, and stroke pathway, all affect the prognosis for functional recovery following a stroke [10]. This is a significant challenge for medical professionals dealing with the epidemic of both diabetes and stroke. Future research should evaluate the precise reasons for the poor result and whether a more aggressive treatment strategy will enhance the prognosis of these patients.

CONCLUSION

The strong correlation observed between stroke volume measured by MRI and NIHSS scoring in predicting 30-day mortality in acute ischemic stroke patients underscores the importance of these factors in clinical prognosis. This finding suggests that integrating both stroke volume assessment and NIHSS scoring into routine evaluation protocols could significantly enhance predictive accuracy and ultimately improve patient outcomes. The significant reduction in stroke volume from the first day to the 30th day highlights the potential efficacy of interventions aimed at minimizing infarct size, thereby potentially mitigating the risk of mortality. This reduction in stroke volume aligns with previous research suggesting that smaller infarct volumes are associated with better clinical outcomes. Furthermore, the observed decrease in NIHSS scores over the 30-day period indicates an overall improvement in the neurological status of the patients. This improvement, coupled with the decrease in stroke volume, suggests positive responses to treatment and underscores the importance of timely and appropriate medical interventions in acute ischemic stroke management. Overall, our findings emphasize the critical role of stroke volume assessment and NIHSS scoring in predicting short-term mortality outcomes in acute ischemic stroke patients. Incorporating these measures into clinical practice can facilitate more informed decision-making, optimize treatment strategies, and ultimately improve patient care and outcomes. Further research is warranted to validate these findings across diverse patient populations and healthcare settings and to explore additional factors that may influence mortality risk in acute ischemic stroke.

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