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# To compare NIHSS scoring system for outcome in anterior and posterior circulation stroke

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## ABSTRACT

**Background:** The arterial territory affected in the stroke significantly affects the prognosis and outcome. National institutes of health stroke scale (NIHSS) score widely used significantly differs between anterior and posterior circulation stroke. **Aims and Objectives:** The study aimed: (1) To compare the NIHSS score on day 0 and day 5 among anterior circulation and posterior circulation stroke patients. (2) To predict the grading of neurological deficit of the anterior and posterior circulation stroke based on NIHSS score. **Materials and Methods:** Data was collected among the patients having anterior or posterior circulation stroke after meticulous history taking and clinical examination, performing hematological investigations, computed tomography Brain and magnetic resonance imaging findings. **Results:** Ischemic stroke was more common in males than in females. Among the neurological deficit, weakness of upper limb and lower limb were most common in anterior circulation stroke and giddiness was the most common complaint in posterior circulation stroke. The NIHSS score was higher in anterior circulation stroke as compared to posterior circulation stroke on day 0 and also NIHSS score significantly decreased in the anterior stroke patients between day 0 and day 5 (paired T-test), when day 0 and day 5 were compared. **Conclusion:** From this study, we conclude that the NIHSS score significantly decreased in anterior circulation stroke between day 0 and day 5 whereas in posterior circulation stroke, the NIHSS scoring remained same or worsened. Hence, the prognosis is better in anterior circulation stroke as compared to posterior circulation stroke.

**Key words:** Stroke; Cerebrovascular; Acute ischemic

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## INTRODUCTION

Stroke is the second leading cause of death worldwide.[1] Stroke as described by the World Health Organization focuses on identifying the clinical signs of stroke, which manifest as focal or global disturbance of cerebral function, lasting more than 24 h or leading to death, with no apparent cause other than of vascular origin.[2]

Anterior circulation stroke refers to a type of stroke caused by a disruption of blood flow to the anterior (front) part of the brain. It typically involves the carotid arteries and their branches, including the anterior cerebral artery (ACA) and the middle cerebral artery (MCA).[3] The posterior circulation arteries primarily include the vertebral arteries in the neck, the intracranial vertebral arteries, the basilar artery, and the posterior cerebral arteries (PCA), along with their branches. Disruption of blood flow in these arteries can lead to ischemia (lack of oxygen and nutrients) in the posterior part of the brain, resulting in neurological deficits characteristic of posterior circulation strokes.[4]

The study aims to compare the severity and prognosis of anterior circulation stroke and posterior circulation stroke patients based on their national institutes of health stroke scale (NIHSS) scores. The NIHSS is a widely used tool for assessing the severity of stroke and predicting outcomes. Very few studies exist till date comparing these two types of strokes with respect to this mentioned scale. The idea of this study is to clinically compare these two types of

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stroke patients admitted in ESIC and postgraduate institute of medical science and research (PGIMSR) based on the NIHSS score on day 0 of admission and subsequent NIHSS score on day 5 of admission and prediction of prognosis based on the result of these scales.[5]

### Aims and objectives

Among the patients with anterior circulation stroke or posterior circulation stroke determined by clinical and radiological investigations.

1. To compare the NIHSS score on day 0 and day 5 among anterior circulation or posterior circulation stroke patients
2. To predict the grading of neurological deficit of the anterior or posterior circulation stroke based on NIHSS score.

## MATERIALS AND METHODS

### Source of data

All patients admitted with Anterior circulation and Posterior circulation stroke in Department General medicine in ESIC-MC and PGIMSR, Bengaluru. It was a prospective observational study from September 2022 to March 2024.

### Sample size

A study conducted by Rarhi et al., in India during January 2017–June 2018. The mean of NIHSS score on day 0 versus type of stroke was 13.98±5.03 in anterior circulation and in posterior circulation was 23.88±4.57. Based on that study at 95% confidence interval and power 80%, the estimated sample size was 33 per group. Therefore 34 patients in anterior circulation stroke and 33 patients in posterior circulation stroke were included.

### Inclusion criteria

1. Patient willing to give informed consent to participate in study
2. Patients of either gender aged between 18 years and 60 years
3. Patients with anterior and posterior circulation stroke.

### Exclusion criteria

1. Patients with hemorrhagic stroke as NIHSS is designed for ischemic strokes only
2. Patients with venous stroke secondary to dural sinus thrombosis as these strokes do not follow an arterial territory
3. Patients with a history of a previous stroke-since this would lead to underlying disability
4. Patients with underlying disability due to any cause because that would be a confounding factor
5. Patients with concomitant acute coronary syndrome since that would add in morbidity
6. Patients with watershed area infarcts - because not all of them follow a single vascular territory.

### Study protocol

Patients admitted with focal neurological deficit were assessed.

A standard proforma was used to record detailed history of present complaints, past history including tuberculosis, hypertension, Ischemic heart disease, heart failure, dilated cardiomyopathies, dyslipidemia, previous stroke, chronic kidney disease, and endocrine problems.

Detailed clinical examination including the neurological deficits of patient assessed and recorded. The examination findings, which assess any underlying diseases contributing to the stroke, were also evaluated. All anterior circulation and posterior circulation infarct patients received standard medical therapy. NIHSS score was calculated on day 0 and day 5 of admission.

### Statistical analysis

All the quantitative variables such as age of the patient, height, and weight will be presented using descriptive statistics (mean±SD). Qualitative/categorical variable such as gender, incidence of sore throat will be analyzed using frequency and percentage. To compare between two groups T test and Mann–Whitney test will be used. All the data collected will be entered and compared using Microsoft excel. The data will be analyzed using statistical software- EPI INFO 7.0

## RESULTS

1. Demographic distribution regarding age, sex, co morbidities, anthropometric measurements were illustrated in Table 1 and P value was found not significant in both anterior and posterior circulation stroke.
2. In anterior circulation stroke , 16 patients had hypertension. In posterior circulation stroke, 18 patients had hypertension. Association of hypertension and type of stroke was not statistically different. (P = 0.54).
3. In anterior circulation , 8 patients had diabetes mellitus. In posterior circulation, 12 patients had hypertension. Association of diabetes and type of stroke was not statistically different. (P = 0.25).
4. Most common symptoms in anterior circulation was upper limb and lower limb weakness (Figure 1 and Table 2) and in posterior circulation was giddiness (Figure 2 and Table 3).
5. Most common CT brain findings in anterior circulation stroke was MCA territory infarct and in posterior circulation stroke was normal ( Table 4). Most common MRI brain findings in anterior circulation stroke was MCA territory infarct and in posterior circulation stroke was cerebellar infarct (Table 5 ).

**Table 1: Demographic distribution among anterior and posterior stroke**

| Variable of observation | Anterior stroke (n=34) | Posterior stroke (n=33) | P-value |
|---|---|---|---|
| Age in years (Mean±SD) | 55.88±12.5 | 56.27±12.22 | 0.89 on unpaired T-test (Not significant) |
| Gender distribution | | | |
| Male (n) | 28 | 27 | 0.95 on Chi-square (Not Significant) |
| Female (n) | 6 | 6 | |
| Distribution of comorbidities | | | |
| No comorbidities associated (n) | 11 | 10 | 0.85 on Chi-square (Not significant) |
| Hypertension (n) | 16 | 18 | 0.54 on Chi-square (Not significant) |
| Type 2 diabetes mellitus (n) | 8 | 12 | 0.25 on Chi-square (Not significant) |
| Chronic obstructive pulmonary disease (n) | 1 | 1 | 1 on Chi-square (Not significant) |
| Others (Pancreatitis/Chronic liver disease/seizure disorder/ischemic heart disease) (n) | 2 | 2 | 1 on Chi-square (Not significant) |
| Anthropometric evaluation | | | |
| Height in meters (Mean±SD) | 163.79±8.91 | 160.88±6.98 | 0.14 on unpaired T-test (Not significant) |
| Weight in kg (Mean±SD) | 64.88±8.65 | 63.73±6.25 | 0.53 on unpaired T-test (Not significant) |
| Body mass index in kg/m$^2$ (Mean±SD) | 24.24±2.9 | 24.68±2.6 | 0.53 on unpaired T-test (Not significant) |

**Table 2: Distribution of chief complaints in anterior stroke**

| Anterior stroke (n=34) | Frequency | Percentage |
|---|---|---|
| Weakness of upper and/or lower limbs | 26 | 76.47059 |
| Deviation of angle of mouth | 4 | 11.76471 |
| Slurred speech | 3 | 8.823529 |
| Altered sensorium | 1 | 2.941176 |

**Table 3: Distribution of chief complaints in posterior stroke**

| Posterior stroke (n=33) | Frequency | Percentage |
|---|---|---|
| Giddiness | 24 | 72.72727 |
| Blurring of vision | 7 | 21.21212 |
| Slurred speech | 5 | 15.15152 |
| Weakness of limbs | 4 | 12.12121 |
| Tinnitus | 3 | 9.090909 |
| Headache | 3 | 9.090909 |
| Loss of consciousness | 2 | 6.060606 |
| Difficulty in swallowing | 2 | 6.060606 |
| Vomiting | 1 | 3.030303 |

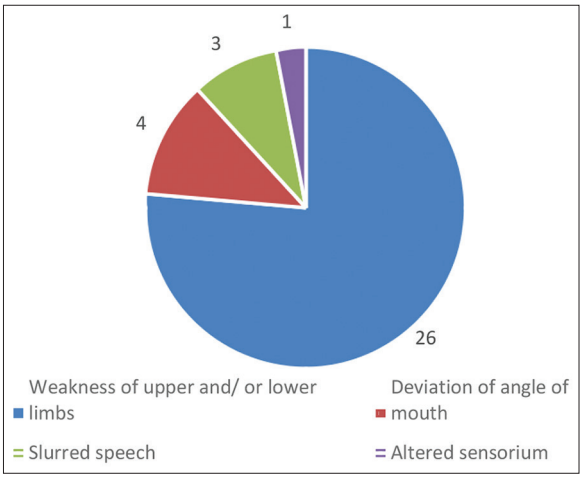


**Figure 1:** Distribution of cheif complaints in anterior stroke (n=34)

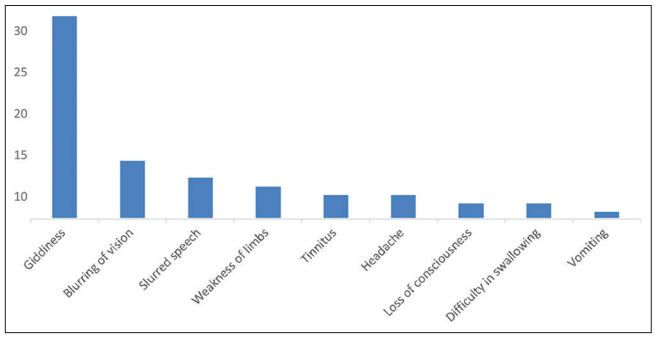


**Figure 2:** Distribution of cheif complaints in posterior stroke (n=33)

6. NIHSS score significantly decreased in anterior stroke patients between day 0 and day 5 which is statistically significant (P< 0.00001)compared to posterior circulation stroke (Table 6)

## DISCUSSION

Stroke is the most the most common neurologic emergency encountered. During the period of present study, patients admitted with stroke were subdivided into anterior and posterior circulation stroke and NIHSS scoring was done on day 0 and day 5 of admission and further classified into mild, moderate, and severe stroke based on their NIHSS score. There were 55 males and 12 females with the ratio of 4.5:1. Stroke was found to be more common in males. This is also similar to the study by Wyller which also showed increased incidence of stroke among males as compared to females.[6,7]

In the present study, stroke was more commonly seen in patients in the age group of 51–60 years than in younger patients. The ratio between numbers of patients above 50 years in comparison of below 50 years is 2.04:1 showing elderly patients are more prone for stroke. The mean age in

**Table 4: CT findings**

| Anterior stroke (n=34) | | Posterior stroke (n=33) | |
|---|---|---|---|
| **Findings** | **Frequency** | **Findings** | **Frequency** |
| MCA territory infarct | 21 | Normal | 22 |
| Internal capsule infarct | 2 | Hemipons with cerebellar infarct | 3 |
| Normal | 2 | Cerebellar infarct | 3 |
| Parietal lobe infarct | 1 | Parieto-occipital lobe infarct | 3 |
| Parietal lobe and frontal lobe infarct | 1 | Hemipons infarct | 1 |
| Caudate lobe infarct | 1 | Thalamic infarct | 1 |
| Caudate with lentiform nucleus infarct | 1 | | |
| Lentiform nucleus infarct | 1 | | |
| Frontal lobe infarct | 1 | | |
| Centrum semi-ovale infarct | 1 | | |
| Cortical infarct | 1 | | |
| Temporo-parietal cortical and sub-cortical infarct | 1 | | |

MCA: Middle cerebral artery, CT: Computed tomography

**Table 5: MRI findings**

| Anterior stroke (N=34) | | Posterior stroke (N=33) | |
|---|---|---|---|
| **Findings** | **Frequency** | **Findings** | **Frequency** |
| MCA territory infarct | 18 | Cerebellar infarct | 12 |
| Lentiform nucleus | 2 | Hemipons infarct | 2 |
| Cortical infarct | 1 | Hemipons with cerebellar infarct | 3 |
| Centrum semi-ovale infarct | 1 | Occipital lobe infarct | 3 |
| Caudate infarct | 1 | Medullary tract infarct | 1 |
| Multiple infarcts in various regions | 2 | Thalamus infarct | 2 |
| Caudate and lentiform nucleus infarct | 1 | Parieto-occipital lobe infarct | 4 |
| Fronto-parietal lobe infarct | 2 | Mid-brain infarct | 2 |
| Globus pallidus and thalamus infarct | 1 | PICA territory infarct | 1 |
| Parietal lobe infarct | 1 | Multiple infarcts at various sites | 3 |
| Internal capsule lacunar infarct | 1 | | |
| Anterior periventricular region infarct | 1 | | |
| MCA territory infarct with cerebral oedema | 1 | | |
| Temporo-parietal with cortical infarct | 1 | | |

MRI: Magnetic resonance imaging, MCA: Middle cerebral artery

**Table 6: NIHSS at 0$^{th}$ day and 5$^{th}$ day**

| Types of Stroke | NIHSS score at 0$^{th}$ day | NIHSS score at 5$^{th}$ day | P-value (Paired T-test)-within the group |
|---|---|---|---|
| Anterior stroke (n=34) | 8.5±4.15 | 6.74±3.4 | <0.00001* (Significant) |
| Posterior stroke (n=33) | 7.94±5.2 | 7.94±5.4 | >0.05 (Not significant) |
| P-value with unpaired T test (Between the group comparison) | 0.62 (Not significant at Day 0) | 0.27 (Not significant at Day 5) | |

*Highly statistically significant. NIHSS: National institutes of health stroke scale

the present study was 56.07 years which was comparable to other studies. The study done by, Thayabaranathan et al., also reported similar mean age at incidence of stroke.[7]

The various factors responsible for stroke in elderly are uncontrolled hypertension, type 2 diabetes milletus, atherosclerosis, dyslipidemia, coronary artery disease, drug non-compliance, and other concomitant illnesses. The study by Kissela et al., showed similar risk factors associated with increased incidence of stroke.[8] Based on the arterial territory involved, patients with ACA, MCA territory and PCA territory were classified into anterior and posterior circulation stroke respectively. The study consisted of 34 patients with anterior circulation stroke and 33 patients with posterior circulation stroke. While analyzing history, 76% patients among anterior circulation stroke had weakness of upper and or lower limbs. About 72% patients among posterior circulation stroke had giddiness as common complaint. In the study, differences between anterior and posterior circulation stroke in TOAST showed headache and vomiting as the predominant complaints unlike to our study.[9] There were no significant differences between the two groups with respect to age, race, or history of hypertension, diabetes, hypercholesterolemia, myocardial infarction, angina, atrial fibrillation, congestive heart failure, claudication, chronic lung disease. In the present study, the most common electrocardiogram finding in both

anterior and posterior circulation stroke was sinus rhythm and most common echocardiogram finding was concentric left ventricular hypertrophy. Further, the most common computed tomography (CT) finding in anterior circulation stroke was MCA territory infarct, infarct in internal capsule whereas in posterior circulation stroke showed normal CT findings in most of the cases. 52.9% patients among anterior circulation stroke showed MCA territory infarct in the Magnetic resonance imaging (MRI), whereas 36.3% of patients with posterior circulation stroke showed cerebellar infarct on MRI.

Patients in both groups were monitored in hospital and NIHSS score was applied on day 0 and day 5 of admission. There was association ($P<0.05$) between NIHSS score on day 0 and day 5 in anterior circulation group, stating there was significant improvement in the neurological deficit as compared to posterior circulation stroke. There was no association ($P>0.05$) between NIHSS score on day 0 and day 5 in posterior circulation group.

A number of studies have evaluated the differences in anterior and posterior circulation strokes in general, but there are very few relevant studies comparing NIHSS scoring between anterior and posterior circulation stroke in inpatients in medical wards. Understanding the differences is important to impart specific treatment tailored to the etiology as well as to counsel the patients regarding the prognosis of disease.

### Limitations of the study

Sample size is less and only NIHSS scale is used.

## CONCLUSION

Stroke is the most the most common neurologic emergency encountered. Most common gender affected is male population. Elderly population is most commonly prone to cerebral vascular accident. The various factors responsible for stroke in elderly are uncontrolled hypertension, type 2 diabetes mellitus, atherosclerosis, dyslipidemia, and coronary artery disease. The most common symptom in anterior circulation stroke was upper limb or lower limb weakness and in posterior circulation stroke giddiness. Anterior circulation strokes do better than posterior circulation strokes in hospital.

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**Authors Contribution:**
**AR-** Concept and design of the study; prepared first draft of manuscript, intrepreted the results; **MTR-** Reviewed the literature and manuscript preparation; **MTR-** Concept, coordination, review of literature and manuscript preparation; **SRN-** Statistically analysed and interpreted, preparation of manuscript and revision of the manuscript.

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