**Original Article**

# Clinical Study of Risk Factors, Pattern of Clinical Presentation and Correlation with Imaging in Acute Stroke

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## ABSTRACT

**Background**: Stroke, a significant cause of mortality globally and particularly in India, has a reported prevalence of 471.58 per lakh population based on Indian studies. This study was initiated to understand the prevalent risk factors and common patterns of clinical presentation in stroke cases.

**Aims and Objectives**: The study seeks to identify the most frequent risk factors, determine the prevailing patterns of clinical presentation, and correlate the clinically identified stroke type with the imaging modality at VIMS, Ballari.

**Materials and Methods**: A Descriptive Observational Study was conducted at VIMS, Ballari, encompassing a sample size of 110 cases. Patients meeting the inclusion criteria were evaluated based on a proforma explicitly designed for the study.

**Results**: Our study population of 110 cases revealed that the incidence of stroke increases with age and is more prevalent in males. Cerebral ischemia was more common than hemorrhage. Hypertension emerged as the most significant risk factor for stroke, followed by dyslipidemia and smoking. Hemiplegia was the most common clinical manifestation, trailed by speech abnormality and facial palsy. Parietal lobe was predominantly affected in ischemic stroke and thalamus in hemorrhagic stroke. Ischemia was the most common stroke type, and anterior circulation was the frequently affected vascular territory clinically, correlating with the chosen imaging modality.

**Conclusion**: The study concluded that stroke incidence peaks between 51 to 60 years of age, with males being more susceptible. Ischemia is the most prevalent stroke type, and hypertension is the leading risk factor. Hemiplegia is the foremost clinical presentation. In ischemic stroke, the parietal lobe is commonly affected, and the thalamus is the primary region impacted in hemorrhagic stroke. Anterior circulation is the predominant vascular territory affected overall.

**Key Words**: *Stroke, age, risk factor, hypertension, age, ischemia, hemorrhage*

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## INTRODUCTION

Stroke is a devastating and disabling cerebrovascular disease with significant amount of residual deficit leading on to economic loss [1]. It has been defined as a rapidly developing signs of focal (or global) disturbance of cerebral function with symptoms lasting for ≥24 hours, or leading to death with no apparent cause other than vascular origin. It is a collection of clinical syndromes resulting from cerebral ischemia to intracranial hemorrhage. In the west, it is the 3rd most common cause of morbidity and mortality [2]. Some of the recent studies have elucidated the stroke pattern to considerable extent in our country with a prevalence rate 471.58/100000 population [3]. Recent study identified that 7% of medical and 45% of neurological admissions were due to stroke with a fatality rate of 9% at hospital discharge and 20% at 28 days [4]. Hypertension, alcoholism, smoking and dyslipidemia are commonest cause of stroke among them [3] and smoking, alcoholism, increased BMI, diabetes and hypertension are significantly associated with strokes among young people. Ischemic strokes account for 50%-85% of all strokes worldwide [5]. Hemorrhagic strokes are due to subarachnoid hemorrhage or intracerebral hemorrhage, they account for 1%-7% and 7%-27% respectively of all strokes worldwide [4]. The Indian national commission on macro economics and health estimated that the number of strokes will increase from 1081480 in 2000 to 1667372 in 2015 [6]. The global burden of disease study projects that total deaths from stroke in India will surpass established market economies by year 2020 [7]. Hence the study was done in our set up to study risk factors, clinical profile and imaging correlation of acute stroke.

## AIMS AND OBJECTIVES OF THE STUDY

- Identification of commonest risk factors for the stroke among the population
- Study the clinical pattern of presentation to the health care centre and correlation of clinical presentation of stroke with imaging modality (CT Brain)

## MATERIALS AND METHODS

Source of Data: The study was conducted in patients admitted in the VIMS hospital, Ballari

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Study design: Descriptive Observational Study
Study Area: VIJAYANAGARA INSTITUTE OF MEDICAL SCIENCES, BALLARI
Study population: ACUTE STROKE patients admitted in VIJAYANAGARA INSTITUTE OF MEDICAL SCIENCES, BALLARI
Sample Size: formula for sample size calculation:
(Source for formula: Source: Patrikar S. In Text book of Community Medicine.
1st Ed, 2009. Ed. Bhalwar R. Dept of Community Medicine. AFMC Pune. Publ.
WHO India Office, New Delhi)

**n= ( 〖Z1〗 ^2 {P(1-P))/d^2**

Variable considered for calculation of sample size: Mean operative time required for both type of surgeries is considered here for sample size calculation

P - Population P (any value<1) 0.68 [7]
1-α - Confidence level set by you 0.99
Z - Z value associated with confidence 2.58
d - Absolute precision (Value less than P)
0.17 n Minimum sample size 50
By using above formula and putting the values in it, minimum sample size came to 50.

**STUDY PERIOD:** The period of study from FEBRUARY 2021 TO AUGUST 2022

**INCLUSION CRITERIA:**
1) ALL cases of acute stroke admitted in VIMS, Ballari.
2) Age group >20years

**EXCLUSION CRITERIA**
1) Patients with traumatic brain injury cases.
2) Patients with neuro-infection.
3) Patients with neoplasm producing stroke.
4) Patients with stroke less than 20 years of age.
5) Patients with prior history of stroke
6) Stroke due to bleeding diathesis, vasculitis
7) Pure Subarachnoid hemorrhage
8) Patient not giving consent
9) Patient CT report normal

**METHODOLOGY**
- After obtaining approval and clearance from the institutional ethics committee, the patients fulfilling the inclusion criteria were enrolled for the study after obtaining formed consent.
- Demographic data, history, clinical examination and details of investigations were be recorded in the study proforma.

The history were collected by direct interview of the patient and patient relatives accompanying the patient. A thorough clinical examination was done in all the patients. Baseline investigations was done in all the patients.

**OUTCOMES**
Primary Outcome
1) To know the commonest risk factors leading to an acute stroke
2) To study the clinical presentation and make clinical diagnosis and correlate it with imaging report.

Secondary Outcome
1) Data of type of stroke distribution among particular age, gender, and risk factors.

**Statistical analysis:**
Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software.

Categorical data was represented in the form of Frequencies and proportions. **Chi-square test** was used as test of significance for qualitative data. **Fischer's exact test** was used as test of significance for qualitative data which does not fulfill the criteria for Chi-square test (2x2 tables only). **Yates correction** was applied wherever chi-square rules were not fulfilled (for 2x2 tables only).

**Normality of the continuous data**, was tested by Kolmogorov–Smirnov test and the Shapiro–Wilk test. Continuous data was represented as mean and standard deviation. **Independent t test** was used as test of significance to identify the mean difference between two quantitative variables. **Mann Whitney U test** was used as test of significance to identify the Median difference between two quantitative variables with Skewed distribution. **p value** (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

**Statistical software:** MS Excel**,** SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyze data. EPI Info (CDC Atlanta), Open Epi, Med calc and Medley's desktop were used to estimate sample size, odds ratio and reference management in the study.

## RESULTS

**Table 1: Age distribution of the study subjects**

|  | Mean | SD | Median | Minimum | Maximum |
|---|---|---|---|---|---|
| Age (in years) | 61.20 | 12.04 | 63.00 | 26.00 | 92.00 |

In the study, the age of the subjects ranged between 26 years and 92 years. The mean age of the subjects was 61.20 ± 12.04 years.

**Table 2: Distribution of the study subjects based on gender**

|  |  | Frequency (N) | Percentage (%) |
|---|---|---|---|
| Gender | Male | 65 | 59.1% |
|  | Female | 45 | 40.9% |

In the study, majority of the subjects were males (59.1%), and the remaining were females (40.9%).

**Table 3: Characteristics of the subjects**

|  |  |  | Frequency (N) | Percentage (%) |
|---|---|---|---|---|
| Clinical presentation |  | Hemiparesis | 58 | 52.70% |
|  |  | Speech Involvement | 51 | 46.40% |
|  |  | Facial Palsy | 47 | 43.10% |
|  |  | Altered Sensorium | 30 | 27.27% |
|  |  | Convulsion | 9 | 8.20% |
|  |  | Gait instability | 24 | 21.80% |
|  |  | Headache | 5 | 4.54% |
|  |  | Giddiness | 12 | 10.90% |
|  |  | Visual Impairment | 7 | 6.40% |
| Risk Factors | Smoking | Yes | 27 | 24.50% |
|  |  | No | 83 | 75.50% |
|  | Tobacco Chewing | Yes | 2 | 1.80% |
|  |  | No | 108 | 98.20% |
|  | Alcohol Intake | Yes | 18 | 16.40% |
|  |  | No | 92 | 83.60% |
| Comorbidities | Hypertension | Yes | 83 | 75.50% |
|  |  | No | 27 | 24.50% |
|  | Diabetes | Yes | 21 | 19.10% |
|  |  | No | 89 | 80.90% |
|  | Dyslipidaemia | Yes | 53 | 48.20% |
|  |  | No | 57 | 51.80% |
|  | Rheumatic Heart Disease | Yes | 2 | 1.80% |
|  |  | No | 108 | 98.20% |
|  | Atrial Fibrillation | Yes | 4 | 3.60% |
|  |  | No | 106 | 96.40% |
|  | Coronary Artery Disease | Yes | 4 | 3.60% |
|  |  | No | 106 | 96.40% |
| NCCT (Topographic Area) |  | Basal Ganglia | 18 | 16.20% |
|  |  | Brainstem | 2 | 1.80% |
|  |  | Pons | 0 | 0.00% |
|  |  | Cerebellum | 5 | 4.50% |
|  |  | External Capsule | 1 | 0.90% |
|  |  | Frontal Lobe | 8 | 7.20% |
|  |  | Internal Capsule | 12 | 10.90% |

| | | | |
|---|---|---|---|
| | Medulla | 1 | 0.90% |
| | Occipital Lobe | 5 | 4.50% |
| | Paraventricular | 4 | 3.60% |
| | Parietal Lobe | 28 | 25.20% |
| | Temporal Lobe | 6 | 5.40% |
| | Thalamus | 15 | 13.50% |
| | Ventricular | 5 | 4.50% |
| **Type of Stroke** | Ischemic | 59 | 53.60% |
| | Hemorrhagic | 51 | 46.40% |

The study revealed hemiparesis as the most prevalent clinical presentation among the participants, with an occurrence rate of 52.7%. The subsequent frequently noted symptoms were speech impairment (46.4%) and facial palsy (43.1%). Approximately one-fourth of the participants (24.5%) were identified as smokers, while only a negligible number reported chewing tobacco. Notably, 16.4% of the subjects were classified as alcoholics.

A significant portion of the study population was diagnosed with hypertension (75.5%), making it the most common co-existing condition. Dyslipidemia and diabetes mellitus followed, affecting 48.2% and 19.1% of the subjects, respectively. To ascertain the brain areas affected by stroke, non-contrast CT scans were employed. The findings revealed that the parietal lobe was the most frequently affected area (25.5%), followed by the basal ganglia (16.4%) and the thalamus (13.6%).

When categorized by stroke type, the majority of the subjects had experienced an ischemic stroke (53.6%), while the remaining participants were diagnosed with a hemorrhagic stroke (46.4%). The study observed a higher incidence of both ischemic (64.41%) and hemorrhagic (52.96%) strokes in male participants. Nevertheless, there was no significant correlation found between the stroke type and the subject's gender.

**Table4: Comparison of subject characteristics with respect to type of stroke**

| | | | TYPE OF STROKE | | | | p-value [#] |
|---|---|---|---|---|---|---|---|
| | | | ISCHEMIC | | HEMORRHAGIC | | |
| | | | N | % | N | % | |
| **Clinical Presentation** | **Hemiparesis** | Yes | 46 | 78.00% | 12 | 23.50% | <0.001* |
| | | No | 13 | 22.00% | 39 | 76.50% | |
| | **Speech Involvement** | Yes | 44 | 74.60% | 7 | 13.70% | <0.001* |
| | | No | 15 | 25.40% | 44 | 86.30% | |
| | **Facial Palsy** | Yes | 46 | 78.00% | 1 | 2.00% | <0.001* |
| | | No | 13 | 22.00% | 49 | 98.00% | |
| | **Altered Sensorium** | Yes | 14 | 23.72% | 16 | 31.37% | 0.751 |
| | | No | 45 | 76.28% | 35 | 68.63% | |
| | **Convulsion** | Yes | 0 | 0.00% | 9 | 17.60% | <0.001* |
| | | No | 59 | 100.00% | 42 | 82.40% | |
| | **Gait instability** | Yes | 14 | 23.70% | 10 | 19.60% | 0.602 |
| | | No | 45 | 76.30% | 41 | 80.40% | |
| | **Headache** | Yes | 0 | 0.00% | 6 | 11.76% | 0.106 |
| | | No | 59 | 100.00% | 45 | 88.24% | |
| | **Giddiness** | Yes | 9 | 15.25% | 3 | 5.88% | 0.8029* |
| | | No | 50 | 84.75% | 4 | 94.12% | |
| | **Visual Impairment** | Yes | 6 | 10.16% | 1 | 1.96% | 0.011* |
| | | No | 53 | 89.83% | 50 | 98.04% | |
| **Risk Factors** | **Smoking** | Yes | 27 | 45.80% | 0 | 0.00% | <0.001* |
| | | No | 32 | 54.20% | 51 | 100.00% | |
| | **Tobacco Chewing** | Yes | 2 | 3.40% | 0 | 0.00% | 0.185 |
| | | No | 57 | 96.60% | 51 | 100.00% | |
| | **Alcohol Intake** | Yes | 15 | 25.40% | 3 | 5.90% | 0.006* |
| | | No | 44 | 74.60% | 48 | 94.10% | |
| **Co-Morbidities** | **Hypertension** | Yes | 59 | 100.00% | 24 | 47.10% | <0.001* |
| | | No | 0 | 0.00% | 27 | 52.90% | |
| | **Diabetes** | Yes | 0 | 0.00% | 21 | 41.20% | <0.001* |
| | | No | 59 | 100.00% | 30 | 58.80% | |
| | **Dyslipidemia** | Yes | 42 | 71.20% | 11 | 21.60% | <0.001* |
| | | No | 17 | 28.80% | 40 | 78.40% | |
| | **RHD** | Yes | 0 | 0.00% | 2 | 3.90% | 0.125 |

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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | No | 59 | 100.00% | 49 | 96.10% | |
| | AF | Yes | 0 | 0.00% | 4 | 7.80% | 0.028* |
| | | No | 59 | 100.00% | 47 | 92.20% | |
| | CAD | Yes | 0 | 0.00% | 4 | 7.80% | 0.028* |
| | | No | 59 | 100.00% | 47 | 92.20% | |
| NCCT (Topographic Area) | Basal Ganglia | | 7 | 11.87% | 11 | 21.56% | <0.001* |
| | Brainstem | | 0 | 0.00% | 2 | 3.92% | |
| | Pons | | 0 | 0.00% | 0 | 0.00% | |
| | Cerebellum | | 4 | 6.78% | 1 | 1.96% | |
| | External Capsule | | 0 | 0.00% | 1 | 1.96% | |
| | Frontal Lobe | | 8 | 13.56% | 0 | 0.00% | |
| | Internal Capsule | | 6 | 10.17% | 6 | 11.76% | |
| | Medulla | | 1 | 1.70% | 0 | 0.00% | |
| | Occipital Lobe | | 5 | 8.50% | 0 | 0.00% | |
| | Paraventricular | | 1 | 1.70% | 3 | 5.88% | |
| | Parietal Lobe | | 22 | 37.30% | 6 | 11.76% | |
| | Temporal Lobe | | 5 | 8.50% | 1 | 1.96% | |
| | Thalamus | | 0 | 0.00% | 15 | 29.40% | |
| | Ventricular | | 0 | 0.00% | 5 | 9.80% | |

The study demonstrated that among individuals diagnosed with stroke, hemiparesis, speech involvement, and facial palsy were more prevalent in cases of ischemic stroke (78.0%, 74.6%, and 78.0% respectively) compared to hemorrhagic stroke (23.5%, 13.7%, and 2.0% respectively). These observations were found to have a statistically significant difference, suggesting a higher association of these symptoms with ischemic stroke.

Altered sensorium was present in both types of strokes with no significant difference (23.72% in ischemic, 31.37% in hemorrhagic), while convulsion was notably present only in hemorrhagic stroke cases (17.6%). Gait instability was relatively equally present in both stroke types (23.7% in ischemic, 19.6% in hemorrhagic). The study noted headache more prominently in hemorrhagic stroke (11.67%), while giddiness was more frequently associated with ischemic stroke (15.25% compared to 5.88% in hemorrhagic stroke). Visual impairment was more often present in ischemic stroke subjects (10.16% compared to 1.96% in hemorrhagic stroke).

In terms of lifestyle and co-morbidities, the study found a higher association of smoking (45.8%) and alcohol consumption (25.4%) with ischemic stroke, both findings being statistically significant. However, tobacco chewing had no significant difference between the two types of stroke.

All the subjects with ischemic stroke had hypertension, suggesting a higher association with this type of stroke, while diabetes mellitus was more commonly associated with hemorrhagic stroke (41.2%). Dyslipidemia was more common in ischemic stroke (71.2% compared to 21.6% in hemorrhagic stroke).

Rheumatic heart disease and atrial fibrillation showed no significant association with ischemic stroke but were present in hemorrhagic stroke subjects. Coronary artery disease also showed a higher association with hemorrhagic stroke.

In terms of affected brain areas, the parietal lobe was the most commonly involved in ischemic stroke (35.6%), while the thalamus was most commonly involved in hemorrhagic stroke (29.4%). These observations were statistically significant, reflecting a distinct pattern of brain areas affected by the different types of stroke.

**Table5: Area of lesion based on clinical and NCCT Brain diagnosis**

| | | Clinical diagnosis | | NCCT Brain - Topographic area | |
|---|---|---|---|---|---|
| | | Count | % | Count | % |
| Area of lesion | Basal Ganglia | 16 | 14.5% | 18 | 16.4% |
| | Brainstem | 11 | 10.0% | 2 | 1.8% |
| | Cerebellum | 10 | 9.0% | 5 | 4.5% |
| | Frontal Lobe | 7 | 6.4% | 8 | 7.3% |
| | Internal Capsule | 12 | 10.9% | 12 | 10.9% |
| | Paraventricular | 0 | 0.0% | 4 | 3.6% |
| | Parietal Lobe | 32 | 29.1% | 28 | 25.5% |
| | Temporal Lobe | 3 | 2.7% | 6 | 5.5% |
| | Thalamic | 9 | 8.2% | 15 | 13.6% |
| | Ventricular | 5 | 4.5% | 5 | 4.5% |
| | Caudate | 2 | 1.8% | 0 | 0% |

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| | | | | | |
|---|---|---|---|---|---|
| | Cerebellar | 5 | 4.5% | 0 | 0% |
| | External Capsule | 0 | 0% | 1 | 0.9% |
| | Pons | 0 | 0% | 0 | 0.0% |
| | Medulla | 0 | 0% | 1 | 0.9% |
| | Occipital Lobe | 0 | 0% | 5 | 4.5% |

χ 2 =464.481, p <0.001* [Chi-square test]

On Clinical diagnosis, most common area of lesion involved was Parietal Lobe (29.1%) and in NCCT brain most common area of lesions involved was Parietal Lobe (25.5%). There was significant association between clinical diagnosis and NCCT brain diagnosis with respect to area of lesion involvement.

**Table6: Vascular territory involved comparison between clinical and NCCT diagnosis**

| | | NCCT Vascular Territory | | | |
|---|---|---|---|---|---|
| | | Anterior circulation | | Posterior circulation | |
| | | Count | % | Count | % |
| Clinical Vascular territory | Anterior circulation | 68 | 90.7% | 16 | 45.69% |
| | Posterior circulation | 7 | 9.3% | 19 | 54.32% |

χ 2 =21.53, p <0.001* [Chi-square test]

In the study there was significant association between clinical and NCCT diagnosis with respect to vascular territory.

**Table7: Comparison of Type of stroke between Clinical and NCCT diagnosis**

| | | NCCT | | | |
|---|---|---|---|---|---|
| | | Hemorrhagic | | Ischemic | |
| | | Count | % | Count | % |
| Clinical | Hemorrhagic | 25 | 48.98% | 9 | 15.3% |
| | Ischemic | 26 | 51.02% | 50 | 84.7% |
| | Total | 51 | 100.0% | 59 | 100.0% |

χ 2 =17.64, df = 1, p <0.001* [Chi-square test]

In the study out of 51 subjects with Hemorrhagic on NCCT, 48.98% had Hemorrhagic as per clincial diagnosis and 51.02% were diagnosed as ischemic. Out of 59 subjects with Ischemic stroke on NCCT, 84.7% were diagnosed as ischemic clinically and 15.3% were diagnosed as Hemorrhagic clinically. There was significant association between clinical and NCCT diagnosis.

**DISCUSSION**

Our study's age distribution, which ranged from 18 to 98 years, with a mean age of 61.20±12.04 years, aligns with various research, including Maskey et al. [8] and Behera BP et al. [9]. Interestingly, the peak incidence of stroke was observed in the age group of 51-60 years (30.5% of total patients), resonating with results from Aiyar et al. [10] and Behara BP et al. [9]. The elevated incidence in those over 50 may be attributed to atherosclerosis, whereas lifestyle changes, sedentary habits, and increased stress levels might explain the incidence in the younger demographic [11].

The male-to-female ratio in our study was 1.44:1, mirroring Patne SV et al. [12] and others. We found a prevalence of ischemic stroke (53.6%) over hemorrhagic stroke (46.4%), closely correlating with Vandana et al. and Aiyer et al., among others. Stroke was more common in males, consistent with findings by Aiyer et al., Vaidya CV et al., and others.

Hypertension was identified as the predominant risk factor (75.5%) in our study, comparable to Behara BP et al. and Abdul Alhamanet al. [13]. In patients with ischemic stroke, all had hypertension, closely aligning with Behara BP et al. Meanwhile, 47.1% of hemorrhagic stroke patients had hypertension, closely matching Kaur et al. [14]. Dyslipidemia (48.92%) and smoking (24.5%) were other common risk factors, aligning with Behara BP et al. [9] and Shakya S et al. [15], respectively.

In clinical presentation, weakness (52.7%) was most common, followed by speech involvement (46.4%), UMN type facial palsy (43.1), and altered sensorium (27.27%). These results align with Behara BP et al. and Vaidya CV et al., among others.

Regarding radiographic sites, the most common site of hemorrhage was the thalamus (29.4%), as found in Eapenet al. [11] and Aiyer et al. [10]. The most common site of ischemic stroke was the parietal lobe (37.3%), correlating with Vaidya CV et al. and R P Eapen et al. The findings suggest a favoring of the middle cerebral artery territory, also confirmed by Devichandet al. [16].

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## CONCLUSION

In conclusion, our study found the highest incidence of stroke occurring in individuals aged between 51 to 60 years, with a marked predominance in males. Ischemic stroke emerged as the most common type both overall and among both genders, aligning with clinical observations and imaging results. In terms of risk factors, hypertension was found to be the most prevalent. The majority of patients presented with hemiplegia, which is a common symptom in stroke cases. When considering the location of stroke, the parietal lobe was the most frequently affected area in ischemic strokes, while the thalamus was primarily impacted in hemorrhagic strokes. In terms of vascular territories, anterior circulation was the most commonly affected in both types of stroke, again confirming the correlation between clinical presentation and imaging findings.

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