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A study of Clinical and Angiographic profile of Ischemic Stroke in a Tertiary Care Hospital

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A B S T R A C T

Ischemic stroke is one of the important causes of mortality and morbidity worldwide. Risk factors of stroke, subtypes of stroke according to TOAST classification and clinical stroke syndromes were analyzed in this study. Intracranial or extracranial or both
vessels involved was also studied. Both intracranial and extracranial vessel involvement is more common than either alone.

Keywords: Stroke, TOAST classification of Ischemic strokes acute management of stroke, intracranial and extracranial vessel involvement.

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INTRODUCTION

Stroke is the second common cause of death and fourth leading cause of disability worldwide. Ischemic strokes are more common (70-80%) than hemorrhagic strokes.[1] Modifiable and non-modifiable risk factors for Ischemic stroke and hemorrhagic stroke are almost same. Whites tend to have more extracranial disease whereas Africans and Asians have more atherosclerotic lesions of the intracranial vessels.

The acute management of stroke includes brief and accurate clinical evaluation and early imaging of the brain. NCCT brain is the easiest and fastest imaging modality.

In the present study, we evaluated all acute ischemic stroke patients who presented to the King George Hospital, Visakhapatnam within two weeks of symptom onset. All were evaluated for risk factors, etiology, stroke subtype. We also studied the status of extra cranial vessels using neck vessel Doppler and intracranial vessels with either CT angiography or MR angiography of brain.

Ischemic stroke is caused by the interruption of the blood supply to the brain, usually because of the blockage of a blood vessel. The WHO clinically defines stroke as "the rapid development of clinical signs and symptoms of a focal neurological disturbance, lasting more than 24hours or leading to death with no apparent cause other than vascular origin" (WHO 2005).[2]

Ischemic strokes are caused by sudden occlusion of the arteries, supplying the brain either due to thrombus formed at the site of occlusion or formed in another part of the circulation like heart or other vessels.

Risk factors for stroke are HTN, DM, dyslipidaemia, smoking, alcohol consumption and heart disease etc.[3] According to TOAST classification,[2] ischemic stroke is classified into five sub types.
1. Large Vessel Atherosclerosis.
2. Small vessel occlusion.
3. Cardio embolic stroke.
4. Stroke of other identifiable cause.

5. Stroke of undetermined cause.

Extracranial versus intracranial vessel disease as a risk factor

The modern era in ischemic stroke began in 1951 with Miller Fisher's key report that called attention "occlusion of the ICA in the neck" in patients with stroke. Later, the advent of safe and more widespread angiography led to increased recognition of the frequency and importance of ICA disease in the neck. The proportion of extra cranial atherosclerotic stroke was similar among the three ethnic groups, while intracranial atherosclerosis was more frequent in blacks and Hispanics compared to whites.[3]

The major cause of ICA occlusive disease in the neck is atherosclerotic narrowing of the vessel. The lesion usually begins in the distal CCA and extends to the proximal ICA and ECA, almost always more severely narrowing the ICA.

This lesion is found more often in whites than in blacks and more in men than women.

Large artery disease: Uncontrolled HTN, Diabetes are the main risk factors.

Small vessel disease: Lacunes (<15 mm) usually occur in patients with long-standing arterial hypertension, current cigarette smoking, and diabetes. This is the main cause for small vessel arterial disease.

Cardio embolic stroke

ECG, 2D echo, Transesophageal Echo and Holter monitoring are important investigations to identify cardiac lesions.

Neuro imaging

Non-enhanced cranial CT or MRI brain was done in all patients. Neck vessel
Doppler was done in all patients.
Grading of carotid artery stenosis in neck vessel Doppler

1. Mild stenosis, 40% to 60%

2. Moderate stenosis 60% to 80%

3. Severe stenosis more than 80%

4. Subtotal stenosis more than 95% stenosis.

NIHSS was used to assess severity. NIHSS measurements were performed at admission and at day7. Modified Rankin scale was obtained seven days after stroke onset.

Objectives of the study
- To evaluate the etiological spectrum and associated risk factors in patients with ischemic stroke.
- To classify ischemic stroke subtypes according to the TOAST (Trial of Org 10172 in Acute Stroke Treatment) criteria.
- To assess angiographic findings in ischemic stroke, including the vascular territories involved and whether the pathology is intracranial, extracranial, or both.
- To determine the severity of stroke at initial presentation using clinical (NIHSS) and radiological (CT or other imaging) parameters, and to reassess clinical severity (NIHSS) one week after onset.

Materials and methods
Study Design: Hospital-based, observational, prospective study
Study Setting: Department of Neurology and General Medicine in King George
Hospital, Visakhapatnam.

Study Duration: February 2021 to January 2022.

Study Population: All patients aged 18 to 85 years with the diagnosis of ischemic stroke confirmed by CT or MRI scan admitted to departments of neurology and general medicine in King George Hospital.

Inclusion criteria

1. Patents fulfilling WHO definition of stroke supported by CT scan are MRI scan of the brain.

2. All subtypes of ischemic stroke as per TOAST classification.

3. Age of patients 18 to 85 years.
4. Presentation to hospital less than two weeks from symptom onset.

Exclusion criteria

1. Patients aged less than 18 years and more than 85 years.

2. Pregnant patients.

3. Patients presenting with transient ischemic attacks.

4. Major head injury or surgery within six weeks of event date.

5. Patients having intra cerebral or Sab arachnoid haemorrhage6. diagnosis of cerebral tumour before the event or during the investigations.

7. Patients with a diagnosis of CVT.

8. Presentation to Hospital, more than two weeks after stroke onset.

Methodology:
Detailed history, including stroke risk factors were recorded from each patient. The stroke risk factors were hypertension, diabetes mellitus, dyslipidemia, cigarette smoking, alcohol consumption, obesity, cardiac disease, etc.

All parameters were taken according to standard measurements and all patients were treated according to standard protocol.

Neurological examination and stroke severity assessment using NIHSS (National Institutes of Health Stroke Scale).

Imaging studies including CT/MRI and angiography (CTA/MRA/DSA) will be reviewed.
Vascular territory involvement, site and type of occlusion, and presence of stenosis or collateral circulation will be documented.
Data will be statistically analyzed to find correlations between clinical and angiographic features.

Data Collection Procedure
1. Clinical Evaluation and Risk Factor Assessment
- A detailed clinical history and physical examination will be conducted.
- Risk factors such as hypertension, diabetes mellitus, dyslipidemia, smoking, alcohol use, atrial fibrillation, ischemic heart disease, and family history of stroke will be documented.
- Stroke severity at presentation will be assessed using the National Institutes of Health Stroke Scale (NIHSS).
2. Etiological Classification (TOAST)
- Each patient will be categorized into one of the following TOAST subtypes based on clinical, laboratory, and imaging data:
  - Large artery atherosclerosis
  - Cardioembolism
  - Small vessel occlusion
  - Stroke of other determined etiology
  - Stroke of undetermined etiology
3. Angiographic Assessment
- All patients will undergo CT Angiography (CTA), MR Angiography (MRA), or Digital Subtraction Angiography (DSA).
- Angiographic evaluation will include:
  - Identification of affected vessels (e.g., ICA, MCA, ACA, PCA, vertebrobasilar system)
  - Determination of whether the pathology is intracranial, extracranial, or both
  - Assessment of vessel occlusion, stenosis, collateral formation, and vascular anomalies
4. Imaging and Severity Assessment
- Initial radiological assessment will be based on CT/MRI findings to evaluate infarct location, size, and territory.
- Stroke severity will be reassessed clinically using NIHSS at 1 week from stroke onset.
Tools and Scales Used
- NIHSS (National Institutes of Health Stroke Scale) for clinical severity
- TOAST Classification for etiology

- CT/MRI and CTA/MRA/DSA for radiological and angiographic analysis

Ethical Considerations
- Approval from Institutional Ethics Committee will be obtained.
- Informed written consent will be taken from all participants or their caregivers.

Data Analysis
- Descriptive statistics will be used to summarize demographic and clinical data.
- Stroke subtypes and risk factors will be analyzed using frequency and percentage.
- Chi-square test, t-test, or ANOVA will be used to assess relationships between clinical severity, etiology, and angiographic findings.
- Correlation between initial severity and 1-week NIHSS scores will be evaluated using appropriate correlation coefficients.
- A p-value <0.05 will be considered statistically significant.

Results
Table 1 - Demographic characters
Patients' data has been analyzed across various age groups, both the male C female. Results are depicted in below table.

Age Group	Female	Male	Total
0-20	2	0	2
21-40	3	9	12
41-60	13	44	57
61-80	15	28	43
Total	33	**81**	**114**

Table 2: No/Single Risk Factors - According to Age Group
No risk factor, single risk factor and multiple risk factors have been captured across various age groups.

Age Group	No risk factor	Single risk factor	Multiple risk factors
0-20	0	1	1
21-40	2	3	7
41-60	8	17	32
61-80	3	9	31
Total	**13**	**30**	**71**

41 to 60 years age group was mostly affected in this study followed by 61 to 80 years, age group.

Table 3 & 4 - Distribution of risk factors
Table 3
Various risks have been captured across various age groups, both male and female.

Risk	No of Patients	Male	Female	Percentage
H/o HTN	68	48	20	60%
H/o DM	30	20	10	26%
Dyslipidaemia	20	11	9	18%
Smoking	47	38	9	41%
Alcoholism	34	31	3	30%
Past H/o stroke	13	9	4	11%
H/o TIA	5	5	0	4%
H/o Migraine	4	0	4	4%
Cardiac	9	6	3	8%

Family H/o stroke	8	7	1	7%

Table 4

		Age Group			
Risk	**No of Patients**	**0-20**	**21-40**	**41-60**	**61-80**
H/0 HTN	68	0	4	33	31
H/o DM	30	0	2	13	15
Dyslipidemia	20	0	1	9	10
Smoking	47	0	5	24	18
Alcoholism	34	0	5	14	15
Past H/o stroke	13	2	2	5	4
H/o TIA	5	0	2	2	1
H/o Migraine	4	0	0	4	0
Cardiac	9	1	1	1	6
Family H/o stroke	8	0	2	2	4

Table 5: 2D Echo

2D echo results have been captured for various abnormalities.

Abnormality	No of Patients
LVH	20
LVH+Other abnormality	18
Severe MS, MR	1
CRHD	1
AS	8
Mild MR	1
LVDD	2

Table 6: Neck Vessel Doppler

Grading of Stenosis has been captured across various age groups, both for male C female. Results are depicted in below table.

Grading of Stenosis	No of Patients	0-20 yrs age		21-40 yrs age		41-60 yrs age		61-80 yrs age	
		Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Intimal thickening/ plaque	30	0	1	2	2	9	4	7	5
< 40% stenosis	9	0	0	0	0	3	1	2	3
40-70% stenosis	25								
> 70% stenosis	9								
Total	73	0	1	2	2	12	5	9	8

Table 7 – ANGIOGRAPHY

Angiography has been conducted for patients and results are depicted in below table.

ANGIOGRAPHY	No of Patients	Percentage
CTA Brain	32	27
MRA Brain	82	73
CTA Neck Vessels	7	6
Angio other parts	2	2

Table 8: Stroke sub-types according to TOAST

Various Stroke sub-types have been studied for 114 patients across various age groups, both for male C female. Results are depicted in below table.

Stroke Sub-type	No of patients	0-20 yrs age		21-40 yrs age		41-60 yrs age		61-80 yrs age	
		Male	Female	Male	Female	Male	Female	Male	Female
LVA	59	0	0	5	1	25	3	18	7
SVO	28	0	0	1	1	11	8	3	4
CE	16	0	1	2	0	5	0	6	2
ODE	5	0	1	1	1	1	1	0	0
UDE	6	0	0	0	0	2	1	1	2
Total	**114**	**0**	**2**	**9**	**3**	**44**	**13**	**28**	**15**

DISCUSSION

Age distribution - 41 to 60 years age group was mostly affected in this study followed by 61 to 80 years, age group. Males were most affected in both the age groups.

Multiple risk of factors was noted in the same age groups. Large vessel atherosclerosis was noted in 53% of patients in our study but 17% and 14% in Northern Manhattan study[4] and Taiwan study[5,6] respectively.

Large vessel occlusion: In Korean Study[7], only extracranial involvement is noted in 48% and only Intracranial in 52% of subjects. In Northern Manhattan Study 53% extra extracranial involvement and 47% intracranial involvement whereas in this study 26% extra cranial, 24% intracranial and 32 % both extra cranial and intracranial involvement was noted and in remaining subjects of large vessel Occlusion no abnormalities were found. Left ventricular hyper trophy is the most common abnormality detected in 2DEcho.Intimal thickening was the common abnormality noted followed by mild stenosis in neck vessel doppler. The present study analyzed 114 ischemic stroke patients aged 18–85 years admitted to King George Hospital, Visakhapatnam, between February 2021 and January 2022. Males predominated across all age groups except 0–20 years. Most patients were aged 41–60, followed by 61–80 years. Hypertension emerged as the most common risk factor. Anterior circulation strokes were more frequent. According to the TOAST classification, large vessel atherosclerosis was the most common subtype, followed by small vessel occlusion. Less common risk factors included hyperhomocysteinemia, Takayasu disease, and sickle cell disease. Angiographic findings showed nearly equal incidence of intracranial and extracranial lesions, with a slightly higher occurrence of combined lesions.

CONCLUSIONS

This study contributes to the understanding of the demographic characteristics and risk factors in Ischemic stroke. The study confirms that hypertension, smoking, alcoholism, diabetes and dyslipidemia are associated with increased incidence of Ischemic stroke. Also shows that the large vessel atherosclerotic disease is the most common sub type. Exclusive extra cranial or intra cranial vessel involvement was found almost equally in large vessel atherosclerosis. Simultaneous involvement of both extracranial and intracranial vessels were noted more frequently than either alone. Left ventricular hypertrophy and LV dysfunction is noted to be the most common cardiac abnormality. Present study also gives an insight into the distribution of ischemic stroke in terms of age, sex, and risk factors.

REFERENCES

1. Feigin VL, Brainin M, Norrving B, Martins SO, Pandian J, Lindsay P, F Grupper M, Rautalin I. World Stroke Organization: Global Stroke Fact Sheet 2025. Int J Stroke. 2025 Feb;20(2):132-144. doi: 10.1177/17474930241308142. Epub 2025 Jan 3. PMID: 39635884; PMCID: PMC11786524.
2. Lui F, Khan Suheb MZ, Patti L. Ischemic Stroke. [Updated 2025 Feb 21]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK499997/
3. Boehme AK, Esenwa C, Elkind MS. Stroke Risk Factors, Genetics, and Prevention. Circ Res. 2017 Feb 3;120(3):472-495. doi: 10.1161/CIRCRESAHA.116.308398. PMID: 28154098; PMCID: PMC5321635.
4. Race-Ethnicity and Determinants of Intracranial Atherosclerotic Cerebral Infarction, The Northern Manhattan Stroke Study, Ralph L. Sacco, MS, MD:Stroke. 1997;28: 929-935 doi: 10.1161/01.STR.28.5.929
5. Tsai CF, Sudlow CLM, Anderson N, Jeng JS. Variations of risk factors for ischemic stroke and its subtypes in Chinese patients in Taiwan. Sci Rep. 2021 May 6;11(1):9700. doi: 10.1038/s41598-021-89228-x. PMID: 33958684; PMCID: PMC8102638.
6. Venketasubramanian N. Stroke Demographics, Risk Factors, Subtypes, Syndromes, Mechanisms and Inter-Ethnic Differences between Chinese, Malays and Indians in Singapore-A Hospital-Based Study. J Cardiovasc Dev Dis. 2024 Jun 12;11(6):180. doi: 10.3390/jcdd11060180. PMID: 38921680; PMCID: PMC11203577.
7. Kim Do Yeon,Park Tai Hwan,Cho Yong-Jin,Park Jong-Moo. Contemporary Statistics of Acute Ischemic Stroke and Transient Ischemic Attack in 2021: Insights From the CRCS-K-NIH Registry}, jkms, volume 39,number 34, pages 278-0,year2024,doi {10.3346/jkms.2024.39.e278},