



Original Research Article

Prevalence of atrial fibrillation and etiological classification of ischemic stroke: A cross-sectional retrospective study in a tertiary care hospital

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Abstract

Background: Stroke is a major cause of morbidity and mortality worldwide, with ischemic strokes accounting for approximately 85% of all strokes. Atrial fibrillation (AF), a common cardiac arrhythmia characterized by rapid and irregular electrical activity in the atria, leading to uncoordinated contraction of the atrial muscle, is considerably a crucial risk factor for ischemic stroke, as it increases the risk of stroke by five-fold. The study aimed to assess the prevalence of atrial fibrillation among ischemic stroke patients at a tertiary care hospital in Kerala, India.

Materials and Methods: This retrospective cross-sectional study was conducted at a tertiary care hospital in South India from 2021 to 2022. A total of 264 ischemic stroke patients aged ≥ 18 years were included, with exclusions for patients with possible functional weakness. Diagnostic tests, including 12-lead electrocardiography (ECG), Holter monitoring (24-72 hours), echocardiography, and imaging (MRA/CTA), were reviewed to detect AF and determine stroke aetiology based on the TOAST classification.

Results: The overall prevalence of AF among ischemic stroke patients was 4.9%. With respect to TOAST classification, Cardioembolism was found in 2.7% of the subjects, Large artery atherosclerosis in 33%, Small artery disease in 11.4%, Other determined causes in 1.1%, and Undetermined cause in 51.9%. By excluding 'Not completely evaluated' cases, corrected proportion of each diagnosis in TOAST classification showed Cardioembolism to be 4.1%, Large artery atherosclerosis 51.5%, Small artery disease 17.7%, Other determined causes 1.8% and Undetermined causes to constitute 24.9%.

Conclusion: The prevalence of atrial fibrillation in ischemic stroke patients was found to be lower in our study compared to other studies probably due to the fewer amount of Holter done in these cases. This was due to multiple reasons such as financial reasons and high case load, emphasizing the need for systematic AF screening using the same. Improved detection and early management of AF in stroke patients could enhance outcomes, underlining the importance of comprehensive diagnostic workups for stroke care in developing nations like India.

Keywords: Toast, AF, Ischemic stroke, Cardioembolism

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1. Introduction

Stroke is defined as a sudden onset of neurologic deficit from a vascular mechanism out of which roughly 85% are ischaemic and 15% are primary haemorrhages (subarachnoid and intraparenchymal).¹ It ranks third in the leading causes of death worldwide accounting for 10% of the total deaths.²

Aetiology of stroke assessed here is referred from the Trial of ORG 10172 in Acute Stroke Treatment (TOAST).³ With regard to this aetiology, a hospital based study conducted in Hyderabad stipulated that 41% of stroke cases were due to large artery atherosclerosis, 10% due to cardioembolic causes, 18% small vessel occlusion, 4% due to

other determined causes (dissection, fibromuscular dysplasia, migraine) and 27% cases due to unknown aetiology.⁴

Atrial fibrillation-related strokes have been linked to about 60% increased risk of death and 50% increased possibility of disability at 3 months compared with strokes due to other causes.⁵ Atrial fibrillation, which is commonly confronted in patients with ischaemic stroke, bestows a 5-fold increased risk of ischaemic stroke.⁶

2. Materials and Methods

Aim of the study was to study the prevalence of atrial fibrillation in a population of ischemic stroke patients. This hospital-based retrospective cross-sectional study was conducted for a period of 1 year (2021-2022) at a tertiary

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healthcare centre in Kerala. Participants selected were ischemic stroke patients presenting to the Neurology department who had a history of ischemic stroke with age \geq 18 years. Patients with possible functional weakness were excluded from the study. The study was done on 264 patients. Institutional Review Board and Ethics Committee approval and permission for conductance of the study was obtained. As the investigator did not encounter the patient and the study involved only review of hospital records, a waiver of consent was obtained from the institutional ethics committee. All data was stored and managed anonymously by the investigator and authorized personnel. The TOAST classification was used to classify stroke patients based on the etiological factors. Twelve lead Electrocardiography (ECG), Holter monitoring (24hr and 72hr), 2D Echo test, Magnetic Resonance Angiography (MRA)/ Computed Tomography Angiography (CTA)/Carotid Doppler were done in the patients to assess the prevalence of atrial fibrillation and to rule out other causes. Carotid Doppler was done in all the cases except those who already underwent CT Angiography procedure.

Toast classification

1. Large artery atherosclerosis
2. Small vessel disease
3. Cardioembolism
4. Other determined causes
5. Undetermined cause

2.1. Statistical analysis

All the categorical variables were summarized using frequency and percentage. Quantitative variables were summarized using mean and SD if data followed normality assumption else using Median and IQR [Q 1, Q 3]. Kolmogorov-Smirnov test and Shapiro test were used to check the normality of the data. The entire analysis was performed using SPSS and EZR software.

3. Results

The total number of subjects included in the study was 264, out of which 61.74% were males (n =163) and 38.2% were females (n = 101). Mean age of the study was 65 years while mean age for males was 66 years and that of females was 64 years.

With respect to percentage of existing comorbidities, Systemic hypertension was found in 67.8% (n=179), Diabetes Mellitus in 56.4% of the subjects (n=149), and Dyslipidaemia in 49.2% of the subjects (n=130). Other comorbidities like bronchial asthma, renal disease, liver disease were found in 26.1% of the subjects (n=69). (**Table 1** Percentages of Diabetes mellitus, hypertension, dyslipidaemia and other comorbidities)

Prevalence of atrial fibrillation was found to be 4.9% (n=13). Percentage of cases in which ECG showed positive

for atrial fibrillation was 3%(n=8). Holter monitoring was done in 56.4% subjects(n=149)(**Figure 1** Percentage of Holter monitoring done) out of which one was done through 3-day Web Cardio monitoring and the remaining 148 were done through 24 hour Holter monitoring producing positive results in only 1.8% (n=5)(**Figure 2** Percentage of Holter positive cases)(**Table 2** Holter monitoring results), while echocardiography was done in 253 subjects out of which 0.8% (n=2) showed presence of clot.

With respect to proportion based on TOAST classification, Cardioembolism was found in 2.7% of the subjects (n=7), Large artery atherosclerosis in 33% (n=87), Small artery disease in 11.4%(n=30), Other determined causes in 1.1%(n=3), and Undetermined cause in 51.9% of the subjects (n=137).(**Table 3** Percentage of each diagnosis in TOAST -uncorrected)

Those with undetermined causes were further subclassified, of which 'Dual aetiology' was identified in 5.1% of the subjects (n=7), 'ESUS' (embolic stroke of undetermined source) in 17.5% (n=24), 'No cause after complete evaluation' in 8%(n=11) and 'Not completely evaluated' in 69.3% of the subjects(n=95). (**Table 4** Percentage of each diagnosis in undetermined causes)(**Figure 3** Percentage of diagnoses under undetermined causes).

We did an additional analysis by excluding 'Not completely evaluated' cases, following which the corrected proportion of each diagnosis in TOAST classification showed Cardioembolism 4.1%(n=7) , Large artery atherosclerosis 51.5%(n=87), Small artery disease 17.7%(n=30), Other determined causes 1.8%(n=3)and Undetermined causes to constitute 24.9%(n=42) (**Table 5** Percentage of each diagnosis in TOAST -corrected)(**Figure 4** Corrected percentage of diagnoses under TOAST classification).

On analysing the diagnosis in each age group, Cardioembolism was most prevalent in the 70-80 age group, Large artery atherosclerosis in the 70-80 age group, Small artery disease in 60-70 age group, other determined causes equally prevalent in the 40-50, 60-70 and 70-80 age groups, and undetermined causes in the 60-70 age group. Atrial fibrillation was found to be the most prevalent in the 70-80 age group (69.2% of AF positive cases).

On evaluating the association of comorbidities with each diagnosis, systemic hypertension was highly associated with large artery atherosclerosis (2.61 times higher than those who do not have hypertension), Diabetes Mellitus and hypertension was most associated with small artery disease, Diabetes mellitus was more associated with undetermined causes (2.1 times higher than those without DM). However, regression analysis could not be performed for cardioembolism and other determined causes as their percentage of occurrence in the population was low.

On analysis of the association between comorbidities and AF positive cases, Diabetes Mellitus alone was most associated with AF followed by combination of Diabetes Mellitus and Systemic Hypertension.

Table 1: Percentages of diabetes mellitus, hypertension, dyslipidaemia and others

| Comorbidities | | Count | Percentage |
|-----------------------|-----|-------|------------|
| Diabetes mellitus | No | 115 | 43.6% |
| | Yes | 149 | 56.4% |
| Systemic hypertension | No | 85 | 32.2% |
| | Yes | 179 | 67.8% |
| Dyslipidaemia | No | 134 | 50.8% |
| | Yes | 130 | 49.2% |
| Others | No | 195 | 73.9% |
| | Yes | 69 | 26.1% |

Table 2: Holter monitoring results

| | |
|-----------------|-------------|
| Holter positive | 1.8% (5) |
| Holter negative | 54.5% (144) |
| Holter not done | 43.6% (115) |

Table 3: Percentage of each diagnosis in TOAST (uncorrected)

| Diagnosis | Frequency | Percent |
|------------------------------|-----------|---------|
| Cardioembolism | 7 | 2.7 |
| Large artery atherosclerosis | 87 | 33.0 |
| Other determined causes | 3 | 1.1 |
| Small vessel disease | 30 | 11.4 |
| Undetermined | 137 | 51.9 |
| Total | 264 | 100.0 |

Table 4: Percentage of each diagnosis in undetermined causes

| If undetermined | Frequency | Percent |
|------------------------------------|-----------|---------|
| Dual aetiology | 7 | 5.1 |
| ESUS | 24 | 17.5 |
| No cause after complete evaluation | 11 | 8.0 |
| Not completely evaluated | 95 | 69.3 |
| Total | 137 | 100.0 |

Table 5: Percentage of each diagnosis in TOAST (corrected)

| Diagnosis | Frequency | Percent |
|------------------------------|-----------|---------|
| Cardioembolism | 7 | 4.1 |
| Large artery atherosclerosis | 87 | 51.5 |
| Other determined causes | 3 | 1.8 |
| Small vessel disease | 30 | 17.7 |
| Undetermined | 42 | 24.9 |
| Total | 169 | 100.0 |

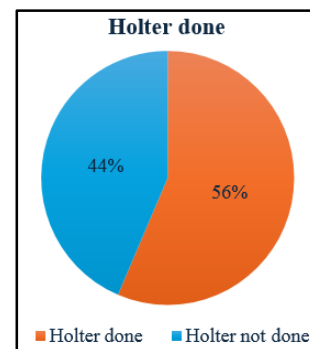


Figure 1: Percentage of Holter done

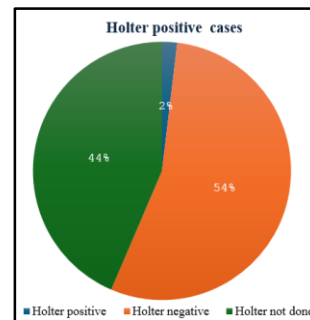


Figure 2: Percentage of Holter positive

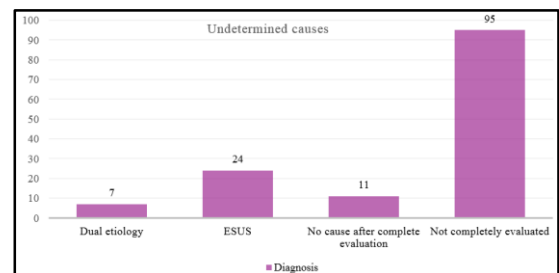


Figure 3: Undetermined causes

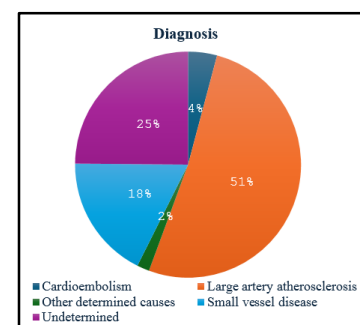


Figure 4: Diagnosis

4. Discussion

A study conducted in Hyderabad by Manorenj S et al.⁷ classified ischemic stroke patients according to TOAST classification concluding that 46.4% of total patients came under Large artery atherosclerosis, 32.4% was due to small vessel occlusion, 15.4% due to cardioembolic aetiology, 4.7% was due to undetermined causes and 1.1% of the patients belonged to other determined causes. Compared to this, our study also found majority of cases due to large artery

atherosclerosis (33%), 11.4% were due to small vessel occlusion, 2.7% due to cardioembolic causes and 1.1% belonging to other determined aetiology. Research reports conducted by Dalal et al.⁸ from northern, western and southern counterparts of India showed that in ischemic stroke patients, 41% was due Large artery stroke aetiology, 18% due to small vessel aetiology, 10% were cardioembolic, 10% due to other determined causes, and 20% under undetermined causes.

A research study conducted in Pune by Raju et al.⁹ concluded that the most prevalent cause of stroke was undetermined aetiology accounting for up to 32% followed by 30% constituted by large artery atherosclerosis and 11% by cardioembolism. These reports were found to be similar to our study that showed undetermined aetiology to be the leading factor(51.9%), followed by large artery atherosclerosis (33%), small artery occlusion (11.4%), cardioembolism (2.7%) and other determined causes (1.1%).

In a study conducted from 2005-2010 by Deepa et al.¹⁰ in North India among ischemic stroke patients, 83.4% constituted male patients compared to 61.7% in our study. The most common aetiology of stroke was undetermined (57%), followed by other determined causes (17.3%). Under the category of undetermined aetiology, incomplete evaluation was the most frequent factor which was found to be similar to our study that revealed 51.9% under undetermined causes (in which inadequate evaluation constituted up to 69.3%) and 1.1% under other determined aetiology.

Indian population has a substantial proportion of atherosclerotic risk factors (as suggested in our study as 67.8% had hypertension and diabetes in 56.4% and dyslipidaemia in 49.2%) and follows a sedentary lifestyle thus justifying Large artery atherosclerosis to be the most common aetiology for ischemic stroke. In another study conducted by Goel et al.¹¹ reports revealed 246 patients suffering from ischemic stroke out of which 69.5% were males and 30.5% were females which is comparable to our study in which 61.7% constituted males and 38.3% females. AF was found to be prevalent in 25.2% of the patients through 24 hour Holter monitoring or conventional ECG findings in that study when compared to our study that had only 4.9%.

A substantial number of cases were attributed to undetermined aetiology (51.9%) as we had a considerable figure of cases who were not completely evaluated (69.3% among undetermined cases), which stresses the importance and need for completion of evaluation for etiological causes of stroke. Fewer number of cardioembolic causes in our study was due to the smaller number of Holter monitoring in our study population (56.4%) out of which only 1 had underwent 3 day Holter. This in turn suggests the importance of executing prolonged Holter of at least 3 days.

According to the study conducted by Akanksha et al. in Ludhiana,¹² atrial fibrillation was seen in 10% of the patients being more common in the 60-70 age group while in the current study AF is seen in only 4.9% of the patients being prevalent among the 70-80 age groups. The occurrence of hypertension in AF positive patients was 87% compared to 75% in the current study while dyslipidaemia was 32% compared to 37.5% in the current study.

Atrial fibrillation was confirmed using standard ECG in 24.6% of the patients in a study conducted by Carmine Marini et al. in Italy¹³ compared to 3% of the patients in the current study. The above mentioned research report was a much larger study in terms of volume and in addition to this, the ethnical difference too explains the substantial disparity in prevalence when compared to our study.

Bhana et al.¹⁴ conducted a multicentric cohort study in India which revealed AF to be prevalent in 8% of the ischemic stroke patients while in comparison our study revealed 4.9%.

The study conducted in Turkey by M Karataş et al.¹⁵ showed AF prevalence of 20.1% compared to 4.9% in the current study. It also showed higher incidence of ischemic and valvular heart disease in those with atrial fibrillation and rate of recovery from stroke being slower than those without atrial fibrillation. Thus, identifying Atrial fibrillation is not only required for determining the aetiology but, it also has a role in predicting the recovery which again underlines the importance of doing a detailed evaluation in undetermined cases.

Since this was a retrospective study and guidelines do not recommend Transoesophageal ECHO to be routinely done, the investigation could not be practically carried out for all patients. However, it has been done for some of the patients especially the true undetermined cases and although it should have been carried out for all the undetermined cases, the logistical issues in the present hospital in which the study was conducted, did not allow for the same to be done for those cases.

Even though the ACHA guidelines underscore the recommendation of workup of stroke including Holter monitoring, a significant proportion of the stroke cases as shown in our research i.e. 43.6% of patients have not done the same whereas in those for whom Holter has been done i.e. 149 cases (59.4%), 5 cases (3.4%) were found to be positive for atrial fibrillation therefore signifying the paramount importance of doing this procedure and the importance of early detection and subsequent recovery through treatment. There are multiple reasons why Holter is not done in many of the patients. One of them is the non-availability of Holter facility in the neurology department and the difficulty of acquiring the same service under cardiology department as it is always in demand and the patients frequently face the hassle of getting suitable dates for the same. Another reason

is that majority of the patients that are admitted to the department come from underprivileged socioeconomic backgrounds due to which many of the patients are not willing for this supplementary investigation as they may face financial inconveniences in the future and end up paying only for the initial emergency investigations. Lack of compliance is also another factor to be considered as many patients come to the OP and dates are given to them for undergoing the procedure, however they do not inevitably follow up for the same. High patient load is also another reason for not taking up Holter as an investigation as it prolongs the hospital stay and increases waiting time of patients leading to their unwanted dissatisfaction. Prolonged Holter(>24hour) is done by a private company in our hospital which is again costlier and lacks insurance support however, this can yield to a better pick up rate than 24 hour Holter. If Holter monitoring had been executed for all patients, more cases with possible atrial fibrillation could be identified which would accordingly indicate a change in management pressing the need for aid of anticoagulation treatment for additional secondary prevention of stroke which is indisputably essential because stroke as a disease is known for its obstinate detrimental effect on the morbidity of the patient.

5. Conclusion

The most common etiological subtype was Large vessel disease, and the most common comorbidities associated were diabetes mellitus and systemic hypertension. In particular, large artery diseases are strongly associated with systemic hypertension. This implies the importance of aggressive measures to control CVD risk factors in the population as a part of primary prevention. The prevalence of atrial fibrillation in ischemic stroke patients was found to be lower in our study compared to other studies. However, this finding is after excluding 'Not completely evaluated' cases which if included would have made Undetermined aetiology the most common subtype. This stresses on the fact that Holter done was significantly less due to multiple factors, including financial reasons and high case load, emphasizing the need for systematic AF screening using the same. In addition, the amount of prolonged Holter done is lesser even in tertiary care setups. Doing a prolonged Holter may help in picking up more AF cases, and improved detection and early management of AF in stroke patients could enhance outcomes, underlining the importance of comprehensive diagnostic workups for stroke care in developing nations like India.

6. Ethical No.

MOSC/IEC/719/2022.

7. Source of Funding

None.

8. Conflict of Interest

None.

References

1. Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL, Loscalzo J, editors. Harrison's Manual of Medicine. 20th edn. New York: McGraw Hill. 2019.
2. Global Health Estimates. The top 10 leading causes of death; World Health Organization. 2021.
3. The Publications Committee for the Trial of ORG 10172 in Acute Stroke Treatment (TOAST) Investigators. Low Molecular Weight Heparinoid, ORG 10172 (Danaparoid), and Outcome after Acute Ischemic Stroke: A Randomized Controlled Trial. *JAMA*. 1998;279(16):1265–72.
4. Kaul S, Sunitha P, Suvama A, Meena AK, Uma M, Reddy JM. Subtypes of Ischaemic Stroke in a Metropolitan City of South India. *Neurology India*. 2003;50(s1):S8–S14.
5. Lévy S, Novella P, Ricard P, Paganelli F. Paroxysmal Atrial fibrillation: a need for classification. *J Cardiovasc Electrophysiol*. 1995;6(1):69–74.
6. Tsang TS, Petty GW, Barnes ME, O'Fallon WM, Bailey KR, Wiebers DO et al. The prevalence of atrial fibrillation in incident stroke cases and matched population controls in Rochester, Minnesota: changes over three decades. *J Am Coll Cardiol*. 2003;42(1):93–100.
7. Manorenj S, Inturi S, Jyotsana B. Trial of ORG 10172 in acute stroke treatment classification and associated risk factors of ischemic stroke: a prospective study from a tertiary care center in South India. *Int J Res Med Sci*. 2016;4(11):5012–8.
8. Dalal PM. Burden of Stroke: Indian Perspective. *Int J Stroke*. 2006;1(3):164–6.
9. Reddy RH, Diggikar P, Mundada M, Oommen A, Pancholi T, Yammanuru B et al. A Comprehensive Study of Risk Factors, Etiology, and Infarction Patterns in Cerebrovascular Accidents at a Tertiary Care Hospital in India. *Cureus*. 2024;16(9):e68433..
10. Dash D, Bhashin A, Pandit AK, Tripathi M, Bhatia R, Prasad K et al. Risk factors and etiologies of ischemic strokes in young patients: a tertiary hospital study in north India. *J Stroke*. 2014;16(3):173–7.
11. Goel D, Gupta R, Keshri T, Rana S. Prevalence of atrial fibrillation in acute ischemic stroke patients: a hospital-based study from India. *Brain Circ*. 2020;6(1):19–25.
12. Akanksha WG, Paramdeep K, Gagandeep S, Rajinder B, Birinder SP, Monika S et al. Clinical features, risk factors, and short-term outcome of ischemic stroke, in patients with atrial fibrillation: data from a population-based study. *Ann Indian Acad Neurol*. 2017;20(3):289–93.
13. Marini C, De Santis F, Sacco S, Russo T, Olivieri L, Totaro R et al. Contribution of atrial fibrillation to incidence and outcome of ischemic stroke: results from a population-based study. *Stroke*. 2005;36(6):1115–9.
14. Bhana I, Ojha A, Pandey RK, Singh D, Chourasiya M. Prevalence of Atrial Fibrillation in Patients with Acute Ischemic Stroke: A Multicentric Cohort Study. *J Clin Diagn Res*. 2021;15(9):21–4.
15. Karataş M, Dilek A, Erkan H, Yavuz N, Sözü S, Akman N. Functional outcome in stroke patients with atrial fibrillation. *Arch Phys Med Rehabil*. 2000;81(8):1025–9.

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