

## Relationship between Left Atrial Enlargement and Ischemic Stroke in patients attending a tertiary care hospital in South India

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### Abstract

**Introduction:** Cerebrovascular accident is the leading cause of death worldwide and it is recognized that identification and treatment of stroke risk factors has the largest impact on morbidity and mortality. Left atrial enlargement is associated with stagnation of blood in left atrium which can result in thrombus formation, and it also serves as a marker for structural heart disease and systemic hypertension. Thus, this study has been done to determine the relationship between left atrial enlargement and ischemic stroke.

**Methodology:** A Prospective case control study conducted at the General Medicine OPD in Chettinad hospital and research institute. Our duration was from July 2019 and August 2020. 98 cases with ischemic stroke and 98 controls with risk factors for ischemic stroke were included in the study. Cases and controls were matched based on age, gender, and risk factors for ischemic stroke. Left atrial enlargement was measured using 2-dimensional transthoracic echocardiography. Left atrial diameter was compared between cases and controls.

**Results:** A total of 98 cases and 98 controls was included in final analysis, mean age was  $58.42 \pm 9.67$  and  $59.14 \pm 9.55$  among cases and controls respectively. There were 76 cases and 28 controls had left atrial enlargement, among which 61 cases had moderate to severe enlargement and 12 controls had moderate to severe enlargement. Left atrial diameter of  $>4.25$ cms in patients with hypertension and dyslipidaemia can be considered as a predictor of stroke with a diagnostic accuracy of 78% and 78.13 % respectively. Left atrial diameter  $>3.9$ cms and  $>4.25$ cms among patients with coronary artery disease and atrial fibrillation can be considered as a predictor of ischemic stroke with a diagnostic accuracy of 82.76% and 74.19% respectively. Left atrial diameter  $>4.25$ cms among patients with diabetes mellitus can be considered as a predictor for ischemic stroke with a diagnostic accuracy of 51.75%.

**Conclusion:** Left atrial enlargement can be considered as an independent predictor for ischemic stroke and this association was found to be significant in patients with coronary artery disease, systemic hypertension, atrial fibrillation, and dyslipidaemia. Left atrial size  $>4.25$ cms was determined as a Cut off value to predict ischemic stroke with a sensitivity of 69.4% and specificity of 83.7%.

**Keywords:** Ischaemic stroke, Left atrial enlargement, Tertiary care, Dyslipidaemia

## Introduction

A cerebrovascular accident is defined as an acute onset of a neurological deficit which may be attributed to a focal vascular cause<sup>1</sup>. According to world health organization, cerebrovascular accident is 2nd most common cause of death and third common cause of disability<sup>2</sup>. Traditionally stroke has been an important cause of mortality and morbidity in high income group and well-developed countries, but recent studies have concluded that there is around 42% reduction in incidence of stroke in developed countries.

This reduction has been predominantly attributed to control and prevention of modifiable risk factors. In recent years there has been an alarming increase in of stroke cases in developing world and this has been due to poor control of modifiable risk factors<sup>2,8</sup>. Left atrium plays an important role in cardiac cycle, during cardiac systole blood gets accumulated in left atrium and regulates filling of the left ventricle at the time of cardiac diastole<sup>3</sup>. Disease processes which can result in left ventricular diastolic abnormalities or diseases involving the mitral valves can result in elevated left atrial pressure<sup>4</sup>. If there is sustained elevation of left atrial pressure for a longer duration this can cause left atrial enlargement and remodeling<sup>5</sup>.

Multiple theories are suggested to describe the relationship between left atrial enlargement and cardiovascular morbidity. Rise in intra atrial pressure is associated with increase in left atrial size. As the left atrial size increases it leads to stagnation of blood which can lead to thrombus formation<sup>6,7</sup>. Flow velocity across the left atrial appendage reduces with an increasing left atrial pressure, which can predispose to thrombus formation. Atrial fibrillation is prone to develop in patients with an enlarged left atrium which can result in embolic stroke<sup>8</sup>. Left atrial enlargement can serve as a marker for systemic hypertension, structural heart disease and elevated left ventricular mass and these factors are found to be associated with an elevated risk of cerebrovascular accident and mortality<sup>6</sup>. Present study aims in determining the relationship between left atrial enlargement and ischemic stroke.

Against this background, the objectives of the present study were to assess the left atrial diameter in patients with ischemic stroke; and to compare the left atrial diameter of patients with ischemic stroke with age/gender/risk factors matched non stroke patients.

## Material and Methods

A prospective case control study conducted at the General Medicine OPD in Chettinad hospital and research institute. Our duration was from July 2019 and august 2020. 98 cases with ischemic stroke and 98 controls with risk factors for ischemic stroke were included in the study. Cases and controls were matched based on age, gender, and risk factors for ischemic stroke. Left atrial enlargement was measured using 2-dimensional transthoracic echocardiography. Left atrial diameter was compared between cases and controls.

Inclusion criteria:

- All patients who are newly diagnosed with recently diagnosed ischemic stroke (onset less than 14 days) which are confirmed with computed tomography brain or magnetic resonance imaging of brain.
- Age group of above 18yrs.

Exclusion criteria:

- Patients with haemorrhagic stroke.
- Patients with history of other neurological disorders (stroke mimics including primary cerebral tumours, cerebral abscess, demyelination, metastatic cerebral tumours).
- Patients with H/O thrombophilia.

**Case group:** Patients with ischemic stroke attending Chettinad hospital and research institute.

**Control group:** Age and Gender matched individuals with risk factors for stroke.

## Results

**Table 1: Socio-demographic profile of the study participants**

Category	Cases (N=98)		Controls (N=98)	
	N	%	N	%
<b>Age group</b>				
41-50	24	24.5	22	22.4
51-60	35	35.7	34	34.7
61-70	30	30.6	29	29.6
>71	9	9.2	13	13.3
<b>Gender</b>	<b>N</b>	<b>%</b>	<b>N</b>	<b>%</b>
Female	21	21.4	27	27.6
Male	77	78.6	71	72.4

The mean age of the study participants in cases and controls were  $58.42 \pm 9.67$  and  $59.14 \pm 9.55$  respectively. Majority of the study participants in both the groups were males.

**Table 2: Distribution of study participants according to prevalence of left atrial enlargement and its severity**

Left atrial enlargement	Cases (N=98)		Controls (N=98)		P value*
	N	%	N	%	
Yes	72	73.5	28	28.6	0.0001
No	26	26.5	70	71.4	
<b>Severity of LAE</b>					
Normal	26	26.5	71	72.4	0.0001
Mild	11	11.2	15	15.3	
Moderate	38	38.8	9	9.2	
Severe	23	23.5	3	3.1	

\*Chi-squared test applied

Among the study participants 73.5% of cases and 28.6% of controls had left atrial enlargement. Total 38.8% of the cases and 9.2% of the controls had moderate left atrial enlargement and 23.5% and 3.1% of the cases and controls respectively had severe left atrial enlargement.

**Table 3: Association between the left atrial diameter with general profile and comorbidities of the study participants**

Variable	Cases		Controls		P-value*
	Mean	SD	Mean	SD	
<b>Age (years)</b>					<0.0001
41-50	4.27	0.71	3.61	0.32	
51-60	4.27	0.69	3.59	0.43	
61-70	4.80	0.74	3.92	0.55	

>71	4.74	0.67	4.02	0.59	
<b>Gender</b>					
Female	4.20	0.66	3.64	0.44	<0.0001
Male	4.55	0.75	3.79	0.51	
<b>Hypertension</b>					
No	4.12	0.70	3.58	0.37	<0.0001
Yes	4.58	0.73	3.81	0.52	
<b>Diabetes</b>					
No	4.50	0.71	3.78	0.50	<0.0001
Yes	4.45	0.78	3.72	0.50	
<b>Dyslipidaemia</b>					
No	4.33	0.74	3.76	0.50	<0.0001
Yes	4.64	0.72	3.74	0.50	
<b>CHD</b>					
No	4.54	0.75	3.77	0.51	<0.0001
Yes	4.13	0.62	3.66	0.46	
<b>Atrial Fibrillation</b>					
No	4.42	0.76	3.73	0.48	<0.0001
Yes	4.65	0.69	3.90	0.60	

\*Independent t test applied.

The mean left atrial diameter was higher among those aged 61 to 70 years among the cases. Similarly, among the cases, male had higher mean left atrial diameter. The mean left atrial diameter was higher among the hypertensives and those with dyslipidaemia and atrial fibrillation in both the cases group and controls which is statistically shown by applying independent t test by comparing the relation between the two groups.

**Table 4: Cut-off values of LAD in participants with various co-morbidities**

Co-morbidities	LAD cut-off			
	>4.25cms		<4.25cms	
	Cases	Controls	Cases	Controls
<b>Hypertension</b>	54	11	22	63
<b>Diabetes</b>	30	9	16	44
<b>Atrial Fibrillation</b>	18	2	4	10
<b>Dyslipidaemia</b>	35	4	11	37
	>3.9cms		<3.9cms	
<b>Coronary Artery Disease</b>	9	2	6	14

## Discussion

In our study mean age of our cases was 58.42 and controls was 59.14, there was 24 cases and 22 controls between 41 to 50 years, 35 cases and 34 controls between 51 to 60 years, 30 cases 29 controls between 61 to 70 years and 9 cases and 13 controls above 70 years. The mean left atrial diameter was significantly higher in the cases in all above-mentioned age groups when compared with controls and the difference is statistically significant.

In another study conducted by Di Tullio et al observed a higher mean age group among stroke cases (68.8 years)<sup>9</sup>, mean age group among stroke patients was 75 years in observations made by Fatema et al<sup>10</sup>, these studies were done among western population.

Mean left atrial diameter was found to be higher in case group (4.58 cm) when compared with controls (3.81 cm) and it was statistically significant. Thus, the severity of the left atrial enlargement has a direct correlation with possibility of ischemic stroke. Shin et al studied left atrial enlargement in patients with ischemic stroke, they concluded that left atrial enlargement among hypertensive patients had a significant correlation with ischemic Stroke<sup>11</sup>.

In our study population mean left atrial enlargement in diabetic patients with stroke is 4.45 cm and in diabetic patients without stroke is 3.72 cm and this is statistically significant. Increased left atrial size in patients with diabetes mellitus has a positive relationship with ischemic stroke. This was similar to the findings observed by Bouzas-Mosquera et al<sup>12</sup>.

In our study group, left atrial enlargement in cases with dyslipidaemia has a positive relationship with ischemic stroke. Bouzas-Mosquera et al on analysing left atrial enlargement in patients with ischemic stroke also observe a similar relationship in patients with dyslipidaemia and ischemic stroke<sup>12</sup>.

In our study population, increased left atrial size in patients with coronary artery disease has a positive correlation with ischemic stroke. Bouzas Mosquera et al and Fatema et al made similar observations while shin et al observed that left atrial size does not have any significant relationship in patients with coronary artery disease and ischemic stroke<sup>10,12</sup>. In our study population left atrial chamber size in patients with atrial fibrillation has a significant positive relationship with ischemic stroke. This is supported by the observations made by shin et al, Fatema et al and Bouzas Mosquera et al<sup>10,11,12</sup>.

The present study is not without limitations. This was a single centre study with a limited population. A larger sample size is required to generalize the findings observed to general population. Further follow-up of the study population was not done. Effect of treating the risk factors of stroke and alteration in left atrial diameter need to be studied.

## Conclusion

Left atrial enlargement (left atrial anteroposterior diameter) was found to be an independent predictor of ischemic stroke. There was significant association between enlarged Left Atrial Diameter in patients with systemic hypertension, atrial fibrillation, dyslipidemia, coronary artery disease but not among diabetics. Left atrial anteroposterior diameter of greater than 4.25cms was determined as a cut-off value to predict ischemic stroke with a sensitivity of 69.4% and specificity of 83.7%.

**Conflicts of interest:** Nil

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