

# A clinical study of acute ischemic stroke with special emphasis on cardiovascular manifestations, and their variations in presentation pattern among either sex

Imran-ul-Haq

Department of Cardiology, Southern Railway Headquarters Hospital, CHENNAI-600 023, INDIA.

Email: [drimranulhaqmd@yahoo.com](mailto:drimranulhaqmd@yahoo.com)

## Abstract

**Background:** Stroke is defined as a rapidly developing symptoms and/or signs with global loss of brain function, lasting for more than 24 hours, or leading to death, with no apparent cause other than vascular origin. A significant number of stroke patients have co-existent cardiac abnormalities. Hence this study was done to determine the cardiac abnormalities in patients of acute ischemic stroke, which would help in early recognition and treatment of the same. **Methods:** The present study was conducted in the 'Department of Cardiology', Southern Railway Headquarters Hospital, Chennai, on 50 patients diagnosed to have acute ischemic stroke during the period of January 2017 to June 2017. Data was collected by relevant history, clinical examination & investigations. **Results:** The mean age of the patients was 58, with the majority in the age group 51-70 years, with a male-female ratio of 7:3. Chest pain (12%), palpitations (2%), orthopnea (6%) were the main presenting cardiac symptoms. ECG abnormalities noted were T-wave inversion in 38%, ST segment depression/elevation in 20%, QTc prolongation in 8%, AF in 6%. Left ventricular dysfunction was the most common 2D echo abnormality in 68%. CPKMB was abnormal in 56% and Troponin-T in 14% of the patients in this study. **Conclusion:** A total of 50 subjects were studied for cardiac abnormalities by means of history, risk factors, ECG, 2D Echo and cardiac biomarkers. Hypertension, DM and smoking were the most common risk factors with varied findings in ECG and 2D Echo; from T-wave inversion to ST segment elevation and diastolic dysfunction to global hypokinesia, suggesting the presence of underlying cardiac complications in patients of acute ischemic stroke, who do not have known cardiac disease/symptoms.

**Key Word:** Stroke, ECG, 2D-Echo, Cardiac Biomarkers.

## Address for Correspondence:

Dr.Imran-ul-Haq, Department of Cardiology, Southern Railway Headquarters Hospital, CHENNAI - 600 023, INDIA.

Email: [drimranulhaqmd@yahoo.com](mailto:drimranulhaqmd@yahoo.com)

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## INTRODUCTION

Cerebrovascular accident (CVA) or stroke is the most common life threatening disorder. It is the third leading

cause of death in the developed countries after cardiovascular disease and cancer.<sup>1</sup>Cerebral infarction is responsible for about 80% of all first ever in a lifetime strokes-Primary intracerebral hemorrhage (PICH) for 10% and subarachnoid hemorrhage for 5%. The incidence of stroke worldwide is 179 per 1,00,000 population in various parts. In Western countries overall prevalence rate is 794 per 1,00,000 population. CVA or strokes are capable of causing crippling morbidity in young as well as elderly individuals. They also have marked social, psychological and economic implications. Due to its wide prevalence and its high cost in economic terms as well as human disability, cerebrovascular accidents have evoked much interest in medical fraternity. Many studies have shown CVA associated with ECG changes and wall

motion abnormalities on 2D echo. The changes of ECG in CVA were reported in many studies. Changes occurring in ECG following stroke were T-wave, U-wave, ST-segment, QT-interval and various arrhythmias, these ECG changes may resemble those of myocardial ischemia or sometime myocardial infarction.<sup>2,3,4</sup> Earlier it was thought that CVA is preceded by changes in cardia, but disproved this view and found ECG changes in young patients with CVA in whom others causes like IHD for ECG changes could not be accounted. Along with ECG changes many studies have shown wall motion abnormalities on 2D Echo following stroke, especially with subarachnoid hemorrhage.<sup>5,6</sup> A study conducted on 62 patients with acute ischemic stroke confirmed by CT Brain. Blood samples were obtained within 24 hours of stroke onset to measure the serum levels of CKMB and cTnT. ECG and Echo were performed to assess myocardial function and left ventricular ejection fraction. The study demonstrated that 20 patients [32%] had elevation in cTnT, while 28 patients [45%] had increased CKMB levels. Serum levels of cTnT and CKMB were higher in patients with ischemic stroke.<sup>7</sup> Hence this study is done to see the cardiac abnormalities in patients of acute ischemic stroke, which would help in early recognition and treatment of the same.

## AIMS AND OBJECTIVES

1. To find the association between cardiac abnormalities (both symptomatic and asymptomatic) and ischemic stroke, in terms of clinical parameters, ECG, ECHO and other ancillary investigations.
2. To determine the variations in presentation among either sex.

## METHODOLOGY

The material of the study comprised 50 patients admitted in Southern Railway Headquarters Hospital, Chennai between the period of January 2017 to June 2017.

### Inclusion Criteria

- Age above 18 years
- Presence of acute ischemic stroke proven by CT/MRI Brain.

### Exclusion Criteria:

- Age below 18 years

- Patients with known cardiac disease
- Patients with previous cerebrovascular accident
- CKD patients

**Duration Of Study:** Six months between the period of January 2017 to June 2017

**Study Place:** Southern Railway Headquarters Hospital, Chennai

**Method Of Collection Of Data:** After admission a detailed history regarding the temporal profile of the stroke including risk factors like hypertension, diabetes mellitus, smoking, history of IHD and rheumatic heart disease were obtained. Detailed neurological examination including fundoscopy and cardiovascular examination were carried out in all the cases.

The diagnosis of CVA was made on the basis of the following criteria:

- Temporal profile of clinical syndrome
- Clinical examination
- CT/MRI Brain

A 12 lead ECG and 2D Echocardiography was done within 24hs of admission and also CPK-MB and Troponin-T.

All patients underwent-

1. Complete blood count
2. Random blood sugar
3. 12 lead ECG
4. 2D ECHO
5. CT/MRI Brain
6. Serum levels of CKMB, Troponin-T
7. Serum creatinine
8. Serum electrolytes

**2D ECHO:** Parasternal, apical and sub-xiphoid windows were used in order to investigate the pathological changes of left atrium, LV, aortic valve, mitral valve and their appendages.

**TROPONIN-T:** An immunological assay, Trop-T assay (Roche Diagnostics) has been used to measure serum levels of cTnT quantitatively.

**CPK-MB:** Is done by enzymatic method. Normal value is up to 25 IU/L.

**Statistical Analysis:** The collective data as well as the proportions and percentages of variables are projected by appropriate charts, tables and graphs. The statistical analysis was done by Chi Square Test.

**RESULTS**

During the study period of six months i.e. from January 2017 to June 2017, those who met the inclusion and exclusion criteria were included in the study. A total of 50 patients were analyzed in the study.

**Table 1: Age & Sex Distribution**

Age Group (Years)	Distribution of Patients						$\chi^2$ Value
	Male		Female		combined		
	N	%	N	%	N	%	
30-50	10	28.6	2	13.3	12	24.0	3.06 Not significant
51-70	14	40.0	10	66.7	24	48.0	
>70	11	31.4	3	20.0	14	28.0	
<b>Total</b>	<b>35</b>	<b>100.0</b>	<b>15</b>	<b>100.0</b>	<b>50</b>	<b>100.0</b>	

\*Significant at 5% Level, NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

As is evident from the above table No. 1; that the incidence of stroke is more common in the age group of 5<sup>th</sup> to the 7<sup>th</sup> decade with male being 40.0% and female being 66.7%, which was statistically insignificant.

**Table 2: Cardiac Symptoms In Stroke Patients**

Symptoms	Response						$\chi^2$ Value
	Male N=35		Female N=15		Combined N=50		
	N	%	N	%	N	%	
Chest pain	5	14.3	1	6.7	6	12.0	0.58 NS
Palpitation	1	2.9	0	0.0	1	2.0	1.01 NS
Orthopnea	1	2.9	2	13.3	3	6.0	2.04 NS
PND*	0	0.0	0	0.0	0	0.0	0.0 NS

\*Paroxysmal Nocturnal Dypnea NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

The common cardiac symptoms in stroke patients were chest pain in 12% of patients (male were 14.3% and female were 6.7%). The next common cardiac symptom is orthopnea in 6% (male were 2.9% and female were 6%). Palpitation was seen in 2% of the patients (male were 2.9% and female were 2%). However, the cardiac symptoms were not statistically significant when compared to male and female patients. (Table No. 2)

**Table 3: Risk factors in stroke patients**

Risk factors	Response						$\chi^2$ Value
	Male N=35		Female N=15		Combined N=50		
	N	%	N	%	N	%	
Hypertension	25	71.4	10	66.7	35	70.0	0.11 NS
Diabetes Mellitus	13	37.1	6	60.0	19	38.0	0.04 NS
Smoking	17	48.6	0	0.0	17	34.0	11.04 *
Alcohol	10	28.6	0	0.0	10	20.0	5.36 *

\*Significant at 5% Level, NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

Most of the patients presented with co-morbid risk factors hence, from the above table it is evident that, hypertension was the most common risk factor 70% (male were 71.4% and female were 66.7%). Diabetes mellitus was the next common risk factor in this study 38% (male were 37.1% and female 19%). Smoking as a risk factor was seen in 34% (male were 17% and female were 0%). Alcohol in 20% (male were 28.6% and female were 0%). As is evident from the above table, smoking and alcohol were statistically significant when compared to male and female patients. (Table No. 3)

**Table 4: ECG changes in stroke patients**

ECG Changes	Response						$\chi^2$ Value
	Male N=35		Female N=15		Combined N=50		
	N	%	N	%	N	%	
QTc Prolongation	1	2.9	3	20.0	4	8.0	4.19 *
T wave inversion	10	28.6	9	60.0	19	38.0	4.40 *
ST segment Depression/Elevation	6	17.1	4	26.7	10	20.0	0.06 NS
U Wave	0	0.0	0	0.0	0	0.0	0.00 NS
AF	1	2.9	2	13.3	3	6.0	2.04 NS

\*Significant at 5% Level, NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

The present study shows that, T wave inversions was present in 38%, (male were 28.6% and female were 60%), this was followed by ST segment depression/elevation in 20%, (male were 17.1% and female were 26.7%). QTc prolongation was seen in 8% and AF in 6%. However, QTc prolongation and T-wave inversion were statistically significant when compared to males and females. (Table No. 4)

**Table 5: 2d echo changes in stroke patients**

Echo Changes	Response						$\chi^2$ Value
	Male N=35		Female N=15		Combined N=50		
	N	%	N	%	N	%	
LVH	20	57.1	14	93.3	34	68.0	6.32*
Global Hypokinesia	3	8.6	1	6.7	4	8.0	0.05 <sup>NS</sup>
Diastolic Dysfunction	26	74.3	12	80.0	38	76.0	0.19 <sup>NS</sup>
Systolic dysfunction	1	2.9	2	13.3	3	6.0	2.04 <sup>NS</sup>
Calcified AV	8	22.9	7	46.7	15	30.4	2.83 <sup>NS</sup>
AF	0	0.0	2	13.3	2	4.0	4.86 <sup>NS</sup>
MR	1	2.9	0	0.0	1	2.0	0.44 <sup>NS</sup>
LA Clot	1	2.9	0	0.0	1	2.0	0.44 <sup>NS</sup>
MS	1	2.9	0	0.0	1	2.0	0.44 <sup>NS</sup>

\*Significant at 5% Level, NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

The above table No.5; shows that Diastolic dysfunction was seen in 76%, which was statistically not significant when compared to males and females. Left Ventricular Hypertrophy (LVH) was seen in 68% of patients (males were 57.1% and females 93.3%, which was statistically significant. The other echo abnormalities were calcified aortic valve 30.4%, Atrial Fibrillation (AF) in 4%, Mitral Regurgitation (MR) in 2%, Left Atrial (LA) clot in 2% and Mitral Stenosis (MS) in 2%, which were statistically not significant.

**Table 6: Cardiac Markers In Stroke**

Marker	Abnormal Response						$\chi^2$ Value
	Male N=35		Female N=15		Combined N=50		
	N	%	N	%	N	%	
CPK-MB	16	45.7	12	80.0	28	56.0	5.01*
Troponin-T	4	11.4	3	20.0	7	14.0	0.64 <sup>NS</sup>

\*Significant at 5% Level, NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

In this study, CPK-MB was abnormal in 56% (males were 45.7% and females were 80%), which was statistically significant. Troponin-T was abnormal in 14% (males were 11.4% and females were 20.0%), which was statistically not significant as shown in Table No. 6.

**Table 7: Cranial Imaging**

Territory of Infarct	Response						$\chi^2$ Value
	Male N=35		Female N=15		Combined N=50		
	N	%	N	%	N	%	
ACA	2	5.7	1	6.7	3	6.0	0.12 <sup>NS</sup>
MCA	18	51.4	14	93.3	32	64.0	8.00*
VBI	8	22.9	5	33.3	13	26.0	0.60 <sup>NS</sup>
Watershed	2	5.7	0	0.0	2	4.0	0.89 <sup>NS</sup>

\*Significant at 5% Level, NS: Non-Significant,  $\chi^2$  (0.05, 1df) = 3.841

The above table No.7 shows that, Middle Cerebral Artery (MCA) was the most common territory of infarct in ischemic stroke patients in this study i.e. 64% (males were 51.4% and females 32%), which was statistically significant. This was followed by vertebrobasilar insufficiency (VBI) in 26%, Anterior Cerebral Artery (ACA) infarct in 6% and watershed infarct in 4%, which was statistically not significant.

**Table 8: Comparison of Incidence of Stroke Patients above age group of 51 years**

Study group	Venkataraman <i>et al</i>	Carlo <i>et al</i>	Present study
Incidence of stroke	41%	71.8%	48%

**Table 9:** Comparison of risk factors

Risk factors	Smith %	Present study %
Hypertension	87.00	70.00
Diabetes Mellitus	50.00	38.00
Smoking	35.22	34.00
Alcohol	30.00	20.00

**Table 10:** Comparison of ECG findings

	Present study	Goldstein <i>et al</i>
QTc prolongation	8	32
T wave inversion	38	15
ST segment depression	20	13
AF	6	9
U wave	-	28

**Table 11:** COMPARISON OF 2D ECHO FINDINGS

2D ECHO	S.Pujadas (2004)	PRESENT STUDY
IHD	20.1%	4
RHD	12%	1
AF	79.1%	4
MR	2%	2
LVH	30%	68

**Table 12:** Comparison Of Cardiac Biomarkers

	PRESENT STUDY (n=50)	Ismail apake <i>et al</i> (n=36)
CPKMB	56%	45%
TROPONIN-T	14%	32%

## DISCUSSION

Cardiac abnormalities are one of the important causative factors in stroke. The present study helps to evaluate cardiac abnormalities by means of ECG, 2D ECHO, cardiac biomarkers in evaluating acute ischemic stroke. A total of 50 subjects were studied, of which males constituted 35 and females 15. The majority of subjects were male 70%. The cases of stroke were common in the age of 5<sup>th</sup> -7<sup>th</sup> decades, making 48% of it, which is comparable to a study done by Venkataramana *et al*<sup>8</sup> in which the percentage of stroke cases above the age of 51 years was 41% and in the study by Carlo *et al*<sup>9</sup> it was 71.8% as shown in table No. 8. Stroke is one of the leading causes of death in many countries. Several factors have been reported to increase the risk of stroke. Although there was a lack of unanimity, several factors have been reported to increase the risk of stroke. Reports from different countries have implicated different factors associated with high risk of stroke. To evaluate the risk factors, a prospective survey of a given population of the years as done in the Framingham Heart Study<sup>10</sup> was essential. The epidemiological study of Abraham *et al* (1970) who found hypertension, diabetes mellitus, hypercholesteremia and syphilis to be the risk factors associated in hemiplegia patients.<sup>11</sup> Sharper *et al* in 1991 concluded that, hypertension; cigarette smoking and pre-existing IHD were found to be major risk factors.<sup>12</sup> In this

present study, the risk factors- *hypertension* was present in majority of the cases i.e., 70%, which is comparable with that found in the studies of Smith *et al*<sup>13</sup> i.e. 87%, and the next common risk factor was diabetes mellitus in 38% and smoking 34%, which are comparable with that found in Smith (2005) i.e., diabetes mellitus 50% and smoking in 35% as shown in table No. 9. Increased QTc was seen in 32% of cases in Goldstein *et al*,<sup>14</sup> while in our study it is 8%. T wave inversion was seen in 15% by Goldstein *et al* while in our study it is 38%. ST segment depression was seen in 13% in Goldstein while in the present study it was 20%. U wave was seen in 28% in Goldstein *et al*, while in our study there was no presence of U wave. Atrial fibrillation (AF) was seen in 9% in Goldstein *et al*,<sup>14</sup> while in the present study only 6% of the cases had AF as shown in table No.10. In the present study, IHD was present in 4%, which was comparable to study done by S. Pujadas (2004),<sup>15</sup> in which IHD was present in 20.1%. RHD was present in 1% in the present study, 12% was present in study done by R.Pujadas. Atrial fibrillation was present in 79.1% in study done by S.Pujadas, in the present study AF was seen in 2%. Mitral regurgitation was seen in 2% in the study done by S.Pujadas, in the present study also it was 2%. Left Ventricular Hypertrophy was seen in 30% in the study done by S.Pujadas,<sup>15</sup> and in the present study LVH was seen in 68% cases as shown in table No.11. In this present



study, CPKMB was positive in 56% and this was made in comparison to study done by Ismail apak *et al*,<sup>16</sup> where CPKMB was positive in 45% of patients. Troponin-T was seen 32% of patients in a study done by Ismail Epak *et al*,<sup>16</sup> where as in the present study Troponin-T was seen in 14% as shown in table No.12.

## CONCLUSION

The present study helped to understand the cardiac abnormalities in patients of acute ischemic stroke. A total of 50 subjects were studied for cardiac abnormalities by means of history, risk factors, ECG, 2D Echo and cardiac biomarkers. Hypertension, DM and smoking were the most common risk factors with varied findings in ECG and 2D Echo from T-wave inversion to ST segment elevation and diastolic dysfunction to global hypokinesia, suggesting the presence of underlying cardiac complications in patients of acute ischemic stroke, who do not have known cardiac disease/symptoms. Thus this study underlies the importance of studying the cardiac abnormalities in patients of acute ischemic stroke which would help early recognition of the same and in-turn better treatment of patients which helps in decreasing mortality and morbidity of these patients.

## REFERENCES

1. Kamath S. API Textbook of Medicine, 11th Ed. Mumbai: Jaypee Brothers Medical Publishers: 2017.
2. Byer E, Ashman R, Toth LA. Electrocardiograms with large upright T-waves and long QT intervals. *American Heart Journal*; 1947; 33: 796-806.
3. Baruch GE, Meyers R, Abildskov JA. A new electrocardiographic pattern observed in cerebrovascular accidents. *Circulation*. 1954; 9:719- 723.
4. Dimant J, Grob D. Electrocardiographic changes and myocardial damage in patients with acute CVA. *Stroke*. 1977; 8(4):448-55.
5. Davies KR, Geld AW, Mannien PH, Boughner DR, Bisnaire D. Cardiac function in aneurysmal SAH- A study of electrocardiographic and echocardiographic abnormalities. *British Journal of Anaesthesia* 1991; 67(1):58-63.
6. Sakka SG, Haettemann E, Renhart K. Acute left ventricular dysfunction and Subarachnoid hemorrhage. *J. Neurosurg Anesthesiol* 1999; 11(3):209-13.
7. I. Apak, K. Iltumur, Y. Tamam. Serum Cardiac Troponin-T Levels as an Indicator of Myocardial Injury in Ischemic and Hemorrhagic Stroke patients. *Tohoku J Exp Med*. 2005; 205(2):93-101.
8. Venkataraman S *et al*. Cerebrovascular accidents-Clinical and radiological features. *JAPI* 1977; 25(8):523.
9. Carlo AD *et al*. Sex difference in the clinical presentation, resource use and 3 month outcome of acute stroke in Europe. *Stroke*. 2003; 34: 1114-9.
10. Framingham Heart Study [Internet]. Framinghamheartstudy.org. 2018 [cited 25 May 2018]. Available from: <https://www.framinghamheartstudy.org/>
11. Abraham et al. Risk factors in stroke. *Lancet* 1970; 32:464-966.
12. Sharper AG, Philips AN, Pocock SJ et al. Risk factors of stroke in middle aged British men. *BMJ* 1991; 302:1111-5.
13. Melinda A. Smith, Lynda D. Lisabeth, Devin L. Brown, Lewis B. Morgenstern. Gender comparisons of diagnostic evaluation for ischemic stroke patients. *Neurology*. 2005; 65(6):855-8.
14. Goldstein DS. The electrocardiogram in stroke: relationship to pathophysiological type and comparison with prior tracings. *Stroke*. 1979; 10(3):253-9.
15. S. Pujadas, Gautham P. Reddy, Oliver Weber, Jennifer J. Lee, Charles B. Higgins. MR imaging assessment of cardiac function. *Journal of Magnetic Resonance Imaging* 2004; 19:789-99.
16. Ismail Apak, Kenan Iltumur, Yusuf Tamam, Nurettin Kaya. Serum Cardiac Troponin T Levels as an Indicator of Myocardial Injury in Ischemic and Hemorrhagic Stroke Patients. *The Tohoku Journal of Experimental Medicine*. 2005; 205(2):93-101.

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