

## Original Research Article

# Study of ECG changes in patients with acute stroke: a hospital based cross sectional study

Rambabu M. V., Viswajyothi Rao P.\*

Department of General Medicine, Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad, India

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### \*Correspondence:

Dr. Viswajyothi Rao P.,

E-mail: [viswajyothirao@gmail.com](mailto:viswajyothirao@gmail.com)

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## ABSTRACT

**Background:** Physicians are confronted on having ECG in patients with acute stroke as it can mimic that of myocardial infarction/ischemia. They should be aware of these changes taking place in patients with acute stroke and not due to myocardial infarction/ischemia. The objective of the present study was to study ECG changes in patients with acute stroke.

**Methods:** A hospital based cross sectional study was carried out for a period of six months at Malla Reddy Hospital. A total of 100 patients were included who were eligible for the presents study as per the inclusion and exclusion criteria. Detailed clinical examination, history, lipid profile, blood pressure, BMI, addictions, RBS and ECG were done for all selected patients. Data was analysed using means, proportions. Statistical tests like chi square test and t test were used.

**Results:** Majority of patients with acute stroke were above 60 years of age, males, urban residents, professional and skilled persons, and alcoholics. Based on the study of ECG among patients with acute stroke it was found that T wave inversion was the most common ECG change found in 33% and this was more in females (36.1%) compared to 31.3% in males. LVH was next common condition found on ECG of acute stroke patients but this time its incidence was more in males (25%) compared to females with only 13.9%. Factors like age, BMI, SBP, DBP, TC, TG, LDL, VLDL, HDL, addictions, residence, sex, family history were not found to be associated with ECG changes.

**Conclusions:** T wave inversion and left axis deviation along with left ventricular hypertrophy were common ECG changes in patients with acute stroke. No studied factor was found to be associated with ECG changes in patients with acute stroke.

**Keywords:** Acute stroke, ECG changes, Lipid profile

## INTRODUCTION

It has been estimated that globally the incidence of acute stroke is around five lakhs. Most of the strokes or acute cerebrovascular episodes also it is called is of two types. The most common is ischemic stroke and the less common type is hemorrhagic stroke. Hemorrhagic stroke can be intra-cerebral or subarachnoid type. The death rate has been estimated to be around 20% of the total cases of acute stroke.<sup>1</sup>

ECG changes are commonly found in cases of acute stroke and that too classically found in subarachnoid hemorrhage type. These changes mimic the changes seen in patients who suffered from myocardial infarction. Coexisting hypertension or simultaneous presence of coronary atherosclerosis is commonly seen in patients with acute stroke which can lead to an abnormal ECG. Associated cardiac disorders like mural thrombus, deep venous thrombosis, myxoma, atrial septal defect, endocarditis in these patients with acute stroke can be a cause for development of decreased cardiac output,

cerebral embolism, heart block and arrhythmias. This poses challenge for the treating physicians as clinical picture and ECG changes cause confusion. They are challenged by ECG picture as they need to distinguish between ECG changes because of acute stroke from that of ECG changes because of ischemic heart disease.<sup>2</sup>

Almost of the patients with acute stroke can have abnormal ECG and ECG changes like T wave abnormalities, ST segment abnormalities, P wave changes, etc. these changes are seen immediately after an attack of acute stroke. This may be due to “poor neurologic grade on admission”.<sup>3</sup>

Most of the patients with acute stroke can have disturbance of rhythm of heart in the initial few days of attack of acute stroke. The most common of these abnormalities are not dangerous and they include premature ventricular beats, sinus tachycardia, premature atrial beats, sinus bradycardia etc. Arrhythmia of clinical importance is not so common and can be seen in 1-4% of the patients with acute stroke.<sup>4</sup>

Thus, physicians are confronted on having ECG in patients with acute stroke as it can mimic that of myocardial infarction/ischemia. They should be aware of these changes taking place in patients with acute stroke and not due to myocardial infarction. Hence present study was carried out to study the ECG changes in patients with acute stroke.

## METHODS

Present study was carried out at department of General Medicine, Malla Reddy Institute of Medical Sciences, Suraram, Hyderabad. It is a hospital based cross sectional study. Present study was carried out over a period of six months from December 2017 to May 2018. During the study period it was possible to study 100 cases of acute stroke as per the inclusion and exclusion criteria laid down for the present study. Institutional Ethics Committee permission was taken. Verbal informed consent was taken from all willing and eligible participants.

### Inclusion criteria

- Patients with diagnosis of acute stroke only
- Patients willing to give their consent to participate in the present study.

### Exclusion criteria

- Patients of acute stroke who were bed ridden
- Seriously ill patients with acute stroke.

It was possible to study 100 patients with acute stroke. Their baseline details as well as other clinical and investigation details were recorded in the pre-designed, pre tested, and semi structured study questionnaire.

Detailed history pertaining to age, sex, residence, occupation, total family members, total family income, family history of diabetes, hypertension, coronary heart disease, stroke, obesity etc., history of addictions like smoking, alcohol, tobacco use etc., was asked and recorded.

Anthropometric measurements like height; weight was measured as per the standard guidelines. Based on height and weight, BMI was calculated. BMI between 18.5-24.99 kg/m<sup>2</sup> was taken as normal. BMI between 25-29.99 kg/m<sup>2</sup> was taken as overweight and BMI more than 30 kg/m<sup>2</sup> was considered as obesity as per the standard practice.

Addictions like smoking of any form like cigarette, bidi, chutta or any other forms similar as well as alcohol in any form and tobacco eating or chewing or snuffing in any form was asked. Only those with current addictions and having this habit not more than six months before were labelled as having addictions. Blood pressure was measured in sitting position as per the standard guidelines laid down by WHO.

Investigations like lipid profile (total cholesterol, triglycerides, high density lipoproteins, low density lipoproteins, very low-density lipoproteins etc.), random blood sugar and ECG was done for all study subjects. ECG changes like rate, rhythm, T wave depression, ST segment depression, QRS changes and any other changes as suggested by ECG study were recorded separately for each and every patient.

### Statistical analysis

The data was entered in the Excel sheet and analysed using proportions and means. Statistical tests like t test and chi square test were used. If p value was less than 0.05, then it was taken as statistically significant.

## RESULTS

Majority of patients with acute stroke were above 60 years of age (38%) followed by age group of 51-60 years (32%). Males were found affected more 64% compared to females (36%). Urban residents had 53% incidence of acute stroke compared to rural residents. Incidence of acute stroke was similar in literate and illiterate people. Incidence was more in professional and skilled persons i.e. 54% compared to 46% among other occupation groups. Among addictions, alcoholics had the highest incidence of 68% followed by smokers at 43%.

Overall 79% of patients with acute stroke had ECG changes. ECG was totally normal in 21% of the cases. Based on the study of ECG among patients with acute stroke it was found that T wave inversion was the most common ECG change found in 33% and this was more in females (36.1%) compared to 31.3% in males.

**Table 1: Distribution of patients as per baseline characteristics.**

Baseline characteristics		Number	%
Age	33-40	09	09
	41-50	21	21
	51-60	32	32
	> 60	38	38
Sex	Male	64	64
	Female	36	36
Residence	Urban	53	53
	Rural	47	47
Literacy	Illiterate	51	51
	Literate	49	49
Occupation	Professional, skilled	54	54
	Unskilled, labourers	46	46
Addictions	Smoking	43	43
	Alcohol	68	68
	Tobacco	26	26

LVH was next common condition found on ECG of acute stroke patients but this time its incidence was more in males (25%) compared to females with only 13.9%. ST segment depression was found in only one case which was female. Eight cases showed changes in QRS out of which three were males and five were females. LAD was found in 10 cases out of which majority were males. LAD with LVH was found in only one case and that was male. RVH was also found in only one case and that was female. PPRW and RBBB were found in four cases out of which two were males and two were females.

Table 3 shows association of various factors with mean values with ECG changes. Mean age, BMI, DBP, RBS was more in patients with ECG changes than patients without ECG changes, but this difference was not found to be statistically significant. Other factors like mean TC, LDL was more in patients without ECG changes, but difference was not significant.

**Table 2: Distribution of patients as per ECG changes present.**

ECG changes	Male		Female		Total	
	Number	%	Number	%	Number	%
T wave inversion	20	31.3	13	36.1	33	33
ST segment depression	0	0	01	2.8	01	01
QRS changes	03	4.7	05	13.9	08	08
LAD	08	12.5	02	5.6	10	10
LAD with LVH	01	1.6	0	0	01	01
LVH	16	25	05	13.9	21	21
RVH	0	0	01	2.8	01	01
PPRW and RBBB	02	3.2	02	5.6	04	04
No ECG changes	14	21.9	07	19.4	21	21
ECG changes present	50	78.1	29	80.6	79	79

**Table 3: Association of various factors with ECG changes in acute stroke (MEANS).**

Various factors	ECG changes (mean±SD)		T value	P value
	Present (N = 65)	Absent (N = 35)		
Age	60.2±13.5	57.3±10.7	1.0979	0.2750
BMI	24.6±3.6	23.7±3.9	1.1581	0.2497
SBP	153.7±28.4	153.7±26.4	0	1
DBP	92.2±13.6	91.3±14.9	0.3052	0.7609
TC	183.3±49.5	191.9±41.4	0.8756	0.3834
HDL	36.8±8.1	36.6±8.1	0.1178	0.9065
LDL	109.2±38.3	116.1±38.6	0.8570	0.3936
VLDL	33.5±18.1	36.5±18.3	0.7875	0.4329
TG	189.7±116.8	189.8±118.7	0.0041	0.9968
RBS	191.7±104.5	181.5±105.5	0.4640	0.6437

More females had ECG changes than males. Urban residents had shown more changes in ECG than rural

residents. Family history of NCDs was more common in patients with ECG changes. Smoking, alcohol and

tobacco users' proportion was more in patients with ECG changes compared to their counterparts, but these all

differences were not found to be statistically significant.

**Table 4: Association of various factors with ECG changes (proportions).**

Various factors		ECG changes		Chi square	P value
		Present (N = 65)	Absent (N = 35)		
Sex	Male	40 (62.5%)	24 (37.5%)	0.2308	0.6309
	Female	25 (69.4%)	11 (30.6%)		
Residence	Urban	35 (66%)	18 (34%)	0.0004411	0.9832
	Rural	30 (63.8%)	17 (36.2%)		
Family h/o NCDs	Yes	15 (78.9%)	04 (21.1%)	1.32	0.2513
	No	50 (61.7%)	31 (38.3%)		
K/C/O NCDs	Yes	53 (63.1%)	31 (36.9%)	0.3957	0.5293
	No	12 (75%)	04 (25%)		
Smoking	Yes	30 (69.8%)	13 (30.2%)	0.4309	0.5116
	No	35 (61.4%)	22 (38.6%)		
Alcohol	Yes	45 (66.2%)	23 (33.8%)	0.01818	0.8927
	No	20 (62.5%)	12 (37.5%)		
Tobacco	Yes	19 (73.1%)	07 (26.9%)	0.5849	0.4444
	No	46 (62.2%)	28 (37.8%)		

## DISCUSSION

Majority of patients with acute stroke were above 60 years of age (38%) followed by age group of 51-60 years (32%). Males were found affected more 64% compared to females (36%). Urban residents had 53% incidence of acute stroke compared to rural residents. Incidence of acute stroke was similar in literate and illiterate people.

Incidence was more in professional and skilled persons i.e. 54% compared to 46% among other occupation groups. Among addictions, alcoholics had the highest incidence of 68% followed by smokers at 43%.

Based on the study of ECG among patients with acute stroke it was found that T wave inversion was the most common ECG change found in 33% and this was more in females (36.1%) compared to 31.3% in males.

LVH was next common condition found on ECG of acute stroke patients but this time its incidence was more in males (25%) compared to females with only 13.9%. ST segment depression was found in only one case which was female. Eight cases showed changes in QRS out of which three were males and five were females.

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Mean age, BMI, DBP, RBS was more in patients with ECG changes than patients without ECG changes, but

this difference was not found to be statistically significant. Other factors like mean TC, LDL was more in patients without ECG changes, but difference was not significant.

More females had ECG changes than males. Urban residents had shown more changes in ECG than rural residents. Family history of NCDs was more common in patients with ECG changes. Smoking, alcohol and tobacco users' proportion was more in patients with ECG changes compared to their counterparts, but these all differences were not found to be statistically significant.

Togha M et al, found that the T wave abnormality (39.9%) was the most common ECG changes followed by presence of arrhythmias (27.1%) and prolonged QTc interval (32.4%) and authors also found that T wave inversion present in 33% of the cases.<sup>5</sup>

The authors observed that these changes in ECG can occur in any patient with acute stroke and can lead to injury of myocardium. They noted that T wave abnormalities were associated with posterior fossa bleeding. They concluded that abnormal ECG is common in patient with acute stroke. They emphasized on need for further study to prove the heart-brain connection in this regard.

Khechinashvili GR et al, noted that ECG changes similar to that seen in ischemic heart disease were present in patients with acute stroke. In their review they stressed that these findings for the physicians can lead to confusion in the diagnosis and management of such cases.<sup>6</sup> Authors also found that the ECG changes were

similar to that seen in ischemic heart disease in patients of the present study. In their review the authors found that overall 76% of the cases of stroke due to subarachnoid hemorrhage had ECG changes and 90% in patients with ischemic stroke. Most of these cases had heart disease prior to episode of stroke. They cautioned that these ECG changes occurring during the attack of acute stroke were not specific for the diagnosis of AML. They concluded that ECG abnormalities and cardiac arrhythmias are common in patients with acute stroke, but the pathophysiology of these changes is still not clear.

McDermott MM et al, observed that 29% of the patients had depression in ST segment and 35% had arrhythmias of ventricles in their study of 51 patients.<sup>7</sup> They noted that ST segment depression was significantly associated with left sided neurological event and increasing age. But authors did not find that age was associated with ECG changes.

Similar to the findings of the present study the authors also found that risk factors of atherosclerosis, prior presence of heart disease, and other factors were not significantly associated with ST segment depression. Authors also found that none of the factors were associated with ECG changes.

Stanojevic M et al, studied ECG changes in patients with anemia.<sup>8</sup> They divided the patients into two groups. They found that ECG changes were significantly more in patients with anemia compared to patients without anemia.

They concluded that the rate of ECG changes in patients with anemia was 63%. Most common was ST segment depression observed in 33% of the cases while T wave inversion was seen in 10% of the cases. 27% have shown prolonged QT interval.

Dogan A et al, found that the mean age of patients with ischemic stroke was 64 years compared to 57 years in patient with hemorrhagic stroke.<sup>9</sup> But there was no difference in case of other characteristics.

They noted that prevalence of "Ischemia-like ECG changes" was 65% in patients with ischemic stroke compared to 57% in patients with hemorrhagic stroke. Atrial fibrillation was significantly more i.e. 34% in patients with ischemic stroke compared to only 13% in patients with hemorrhagic stroke. But other types of ECG changes were comparable in the two groups.

Liu Q et al, studied 304 patients, out of which 67.1% had ECG changes.<sup>10</sup> Authors also found that 79% had some or the other ECG changes. The authors listed out these abnormal things as conduction block, QTc prolongation, T wave inversion, ST-T changes. They concluded that these ECG changes "not related to the level of the cerebral lesion but were related to the location of the cerebral lesion and the outcome."

Schuiling WJ et al, concluded after their study on 121 patients with subarachnoid hemorrhage with aneurysms that delayed cerebral ischemia cannot be predicted based on ECG changes. ECG value was limited in predicting poor outcome.<sup>11</sup>

## CONCLUSION

T wave inversion and left axis deviation along with left ventricular hypertrophy were common ECG changes in patients with acute stroke. No studied factor was found to be associated with ECG changes in patients with acute stroke.

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