

Electrocardiogram Changes In Acute Stroke – A Cross Sectional Study

¹Tahakik Pranav, Junior Resident, Department of General Medicine, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur, Maharashtra 413006, India.

²Tattapure Abrar, Junior Resident, Department of General Medicine, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur, Maharashtra 413006, India.

³Sawarkar Lavish, Junior Resident, Department of General Medicine, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur, Maharashtra 413006, India.

Corresponding Author: Tahakik Pranav, Junior Resident, Department of General Medicine, Ashwini Rural Medical College, Hospital & Research Centre, Kumbhari, Solapur, Maharashtra 413006, India.

How to citation this article: Tahakik Pranav, Tattapure Abrar, Sawarkar Lavish, “Electrocardiogram Changes In Acute Stroke – A Cross Sectional Study”, IJMACR- March - 2023, Volume – 6, Issue - 2, P. No. 81 – 87.

Open Access Article: © 2023, Tahakik Pranav, et al. This is an open access journal and article distributed under the terms of the creative commons attribution license (<http://creativecommons.org/licenses/by/4.0>). Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Stroke is second leading cause of death worldwide, adverse effect of brain on cardiac function, as in acute stroke due to sudden increase in sympathetic flow leads to subendocardial myocyte damage leads to subsequent ECG changes.

Objective: To find out different ECG changes in patients of acute stroke, transientness of ECG changes in stroke and relationship between ECG changes and mortality in patients of acute stroke.

Material and methods: A cross sectional observational study done at ARMCH Solapur over period of 2 years, including 160 patients of acute stroke, presented to hospital within 24 hours of symptom onset of stroke. ECG were recorded at time of admission, 24 and 72

hours after admission and patients were followed up during hospital stay.

Results: ECG changes were seen in 135(84.37%) of cases of stroke in present study. Proportion of ECG changes was significantly high among cases of Ischemic stroke (89.42%) as compared to Haemorrhagic stroke. Most common ECG change among all study participants was QTc Prolongation contributing 49(30.62%) followed by T wave inversion in 38(23.75%), overall Arrhythmias 37(23.12%) (Atrial fibrillation 12, Sinus bradycardia 11, Sinus Tachycardia 10, Premature ventricular complexes 3, RBBB 1), left Ventricular Hypertrophy in 21(13.12%) and U wave 16(10%) cases respectively. Out of 135 cases of stroke with ECG changes at admission, the changes persisted in 103 (64.37%) cases after 24 hours and in only 21 patients

after 72 hours. Out of 21 cases with persistent ECG changes at 72 hrs., 18 (85.71%) patients died. So, persistence of ECG changes was associated with mortality in current study. Out of total 25 deaths, 24 (96%) cases shown ECG changes at the time of admission. However no statistically significant association was seen between ECG changes at admission and mortality. [p=1.149]

Conclusions: ECG changes in stroke are usually transient, persist for 24 hours but do not persist after 72 hours.

Persistence of ECG changes after 72 hrs. after admission is associated with higher mortality among cases of stroke.

Keywords: Acute Stroke, ECG In Stroke, Stroke Mortality, Transient ECG Changes.

Introduction

Stroke is one of the most common and devastating disorder. It is second leading cause of death worldwide¹. According to WHO stroke is defined as “ rapidly developing clinical signs of focal or global disturbance of cerebral function, with symptoms lasting 24 hrs or longer or leading to death, with no apparent cause other than of vascular origin” this definition includes subarachnoid haemorrhage but excludes transient ischemic attacks, subdural hematoma and haemorrhage or infraction caused by infection or tumor²

Acute stroke has been associated with variety of cardiac abnormalities.

Subarachnoid haemorrhage produces cardiac arrhythmias³, changes in 12 lead ECG⁴ and focal myocardial necrosis⁵. Cerebral infraction has also been reported to increase serum cardiac enzymes⁶ and causes repolarization changes on ECG suggestive of ischemia⁷.

It is common knowledge that decrease cardiac output below critical level such as in heart failure, myocardial infraction, rhythm and conduction abnormalities may lead to development of cerebral hemodynamic changes and primary cardiac disorder canlead to stroke⁸ but adverse effect of brain on cardiac function and subsequent ECG changes are less widely recognized and less appreciated. This study is of ECG changes after acute stroke recorded with in 24 hrs of admission.

Objectives:

- 1) To find out different ECG changes in patients of acute stroke.
- 2) To assess whether presence and absence of ECG changes are related to mortality of stroke patients during hospital stay.
- 3) To assess whether these ECG changes last even after 24 hrs. of onset of neurological deficit.

Material and Methods

Study design: Cross sectional observational study

Study setting: Medicine ward and ICU of a tertiary care centre.

Study duration: 2 years from November 2020 to November 2022

Study population: The study population included all the cases with strokes admitted at a tertiary care centre during data collection period of 1 January 2021 to 30 June 2022 who fulfilled the inclusion criteria and exclusion criteria.

Inclusion criteria

1. Patients of and above 18 years of age.
2. Patients of focal neurological deficit with radiological evidence of vascular cause

Exclusion criteria

1. Patient not giving informed consent

2. Neurological deficit due to tumour, metabolic cause, subdural hematoma, trauma or infection.
3. Patient with prior known history of cardiac disease.
4. Patients in whom hospital admission delayed more than 24 hours after appearance of acute stroke.

Sample size (N) = $4 \times P \times Q / L^2$

$P=92$ $Q=100-92=8$ $L=5\%$ Absolute

$N=4 \times 92 \times 8 / 25$ $N=117.76$

However, 160 subjects were included in the study.

Methods of Data Collection and Questionnaire

Pre-designed and pre-tested questionnaire was used questionnaires included general information, such as age, sex, religion, occupation, residential address, and date of admission. CT scan\MRI of brain within 24 hours of admission. Standard 12 lead ECG at time of admission, 24 hours and 72 hours after admission.

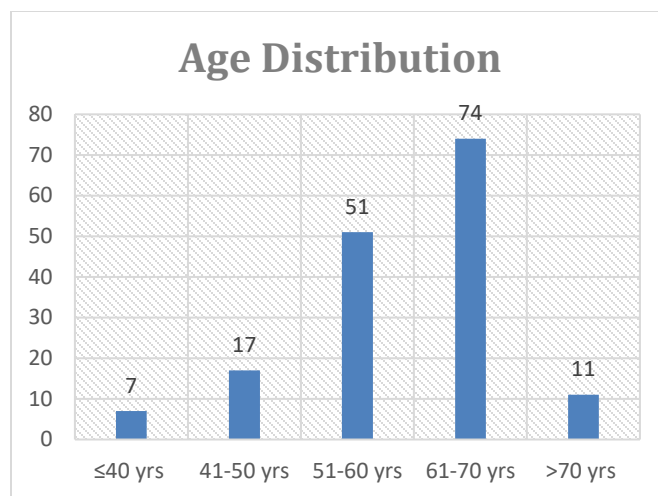
Data entry and analysis

The data were entered in Microsoft Excel and data analysis was done by using SPSS demo version no 21 for windows. The analysis was performed by using percentages infrequency tables and correlation of stroke. Chi square test was used to study association. $p < 0.05$ was considered as level of significance using the Chi-square test.

Result and observations

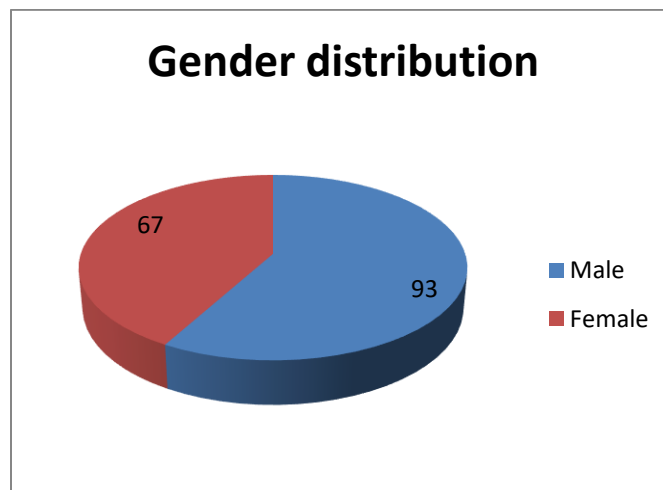
The present cross-sectional study was conducted to study ECG changes among cases of acute stroke at tertiary care hospital. A total of 243 cases presented as acute stroke during study period. Out of that, 160 subjects were included in the study as per inclusion and exclusion criteria. Mean age of study participants was 61.0625 ± 1.515 years. Male predominance was seen with M:F ratio of 1.38:1.

Figure 1: Distribution of study participants as per age (N=160)



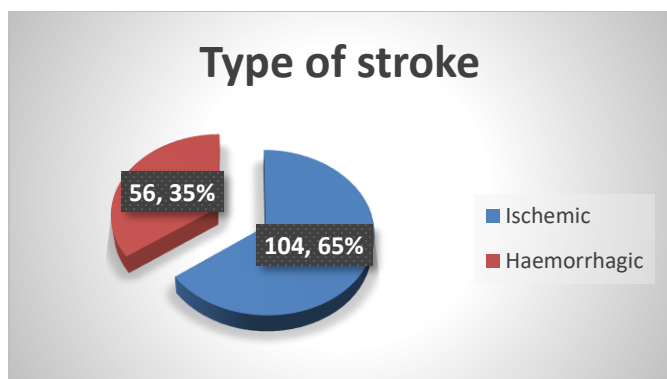
Mean age of the study subjects was 61.0625 ± 1.515 years. Most of the study subjects were from age group 61-70 yrs. Contributing 74 (46.25%) followed by 51-60 yrs. 51 (31.87%), 41-50 yrs. 17 (10.62%), >70 yrs. 11 (6.88%) and ≤ 40 yrs. 7 (4.37%) respectively.

Figure 2: Gender distribution (N=160)



Majority of the study subjects were males contributing 93 (58.12%) and females 67 (42.88%). M:F Ratio was 1.38:1.

Figure 3: Distribution of study subjects as per type of stroke (N=160)



Most of study subjects presented as ischemic stroke contributing 104(65%) and 56(35%) were Haemorrhagic stroke.

Table 1: Prevalence of ECG changes among study participants (N=160)

ECG changes	Frequency	Percentage
Present	135	84.37
Absent	25	15.63
Total	160	100

ECG changes were seen in 135(84.37%) of cases of stroke in present study.

with type of stroke (N=160)

Table 3: Relationship of ECG changes with type of stroke (N=160)

ECG changes	Type of stroke				Total	%	P*
	Ischemic		Hemorrhagic				
	N	%	N	%			
QTc Prolongation	35	71.42	14	28.57	49	30.62	0.257
T wave inversion	23	60.52	15	39.48	38	23.75	0.507
ST depression	17	54.83	14	45.16	31	19.37	0.186
U wave	9	56.25	7	43.75	16	10	0.439
Arrhythmias	23	62.16	14	37.83	37	23.12	0.679
Left Ventricular Hypertrophy	10	47.61	11	52.39	21	13.12	0.073
Other Changes**	4	50	4	50	8	5	0.3614

Table 2: Association of ECG changes with type of stroke (N=160)

Type of stroke	ECG changes				Total	p
	Present		Absent			
	N	%	N	%		
Ischemic	93	89.42	11	10.57	104	0.016
Haemorrhagic	42	75	14	25	56	
Total	135	84.37	25	15.63	160	

The chi-square= 5.7436. Df=1; Significant at $p < .05$.

Proportion of ECG changes was significantly high among cases of Ischemic stroke (89.42%) as compared to Haemorrhagic stroke.

Most common ECG change among all study participants was QTc Prolongation contributing 49(30.62%) followed by T wave inversion in 38(23.75%), overall Arrhythmias 37(23.12%) (Atrial fibrillation 12, Sinus bradycardia 11, Sinus Tachycardia 10, Premature ventricular complexes 3, RBBB 1), left Ventricular Hypertrophy in 21(13.12%) and U wave 16(10%) cases respectively

P* by Chi square test. Df=1, Not significant at p<0.05.

Most common ECG abnormality among cases of ischemic stroke was QTc Prolongation contributing 35 cases followed by T wave inversion in 23, Arrhythmias in 23, ST depression in 17, U wave in 9 and Left Ventricular Hypertrophy in 10 cases respectively.

Most common ECG abnormality among cases of Haemorrhagic stroke was T wave inversion in 15 cases followed by QTc Prolongation in 14 cases, Arrhythmias in 14, ST depression in 14, U wave in 7 and Left Ventricular Hypertrophy in 11 cases respectively. Other Changes**:

Inference: There was no statistically significant association between ECG change and type of stroke in present study. (p>0.05).

Table 4: ECG changes at the time of admission, at 24 hrs. and 72 hrs. after admission among study subjects (N-160)

ECG changes	At admission		At 24 hrs.		At 72 Hrs.	
	N	%	N	%	N	%
Present	135	84.37	103	64.37	21	13.12
Absent	25	15.63	32	20	114	71.25

Out of 135 cases of stroke with ECG changes at admission, the changes persisted in 103 (64.37%) cases after 24 hours and in only 21 patients after 72 hours. At 24 Hrs. most persistent ECG change was QTc Prolongation in 49 cases, followed by T wave inversion in 33, ST depression in 17, U wave 12, Arrhythmias in 24 and Left Ventricular Hypertrophy in 3 cases respectively. At 72 Hrs., most persistent ECG change was QTc Prolongation in 12 cases, followed by T wave inversion in 8, ST depression in 8, U wave in 1, Arrhythmias in 6 [AF 3, Premature ventricular complexes 1, Sinus Tachycardia 1, RBBB 1] and Left Ventricular Hypertrophy in 3 cases respectively. Out of 21 cases with persistent ECG changes at 72 hrs., 18

(85.71%) patients died. So, persistence of ECG changes was associated with mortality in current study.

Table 5: Association between ECG Changes at admission and mortality (N=160)

Mortality	ECG changes				Total	p
	Present		Absent			
	N	%	N	%		
Died	24	96	1	4	25	0.149
Survived	111	82.22	24	17.78	135	
Total	135	84.37	25	15.63	160	

The chi-square with Yates correction = 2. 0821.Df=1; Not significant at p< .05.

Out of total 25 deaths, 24 (96%) cases shown ECG changes at the time of admission. However no statistically significant association was seen between ECG changes at admission and mortality. [p=1.149].

Discussion

The present cross-sectional study was done among 160 cases of stroke at tertiary care hospital to study electrocardiogram changes in acute stroke.

ECG changes and stroke

ECG changes were seen in 135(84.37%) of cases of stroke in present study. A study by Adeoye AM et al⁹ in 2017 revealed that,65.5% had ischemic stroke and ECG changes were seen in nearly 85% of cases. A study by Goldstein DS et al¹⁰in 1979found that, Of the 150 patients with stroke, 138 (92%) showed ECG abnormalities

Proportion of ECG changes was significantly high among cases of Ischemic stroke (89.42%) as compared to Haemorrhagic stroke. There was no statistically significant association between ECG change and type of stroke in present study. (p>0.05) Most common ECG change among all study participants was QTc Prolongation contributing 49(30.62%) followed by T wave inversion in 38(23.75%), overall Arrhythmias

37(23.12%) (Atrial fibrillation 12, Sinus bradycardia 11, Sinus Tachycardia 10, Premature ventricular complexes 3, RBBB 1), left Ventricular Hypertrophy in 21(13.12%) and U wave 16(10%) cases respectively.

Most common ECG abnormality among cases of ischemic stroke was QTc Prolongation contributing 35 cases followed by T wave inversion in 23, Arrhythmias in 23, ST depression in 17, U wave in 9 and Left Ventricular Hypertrophy in 10 cases respectively. Most common ECG abnormality among cases of Haemorrhagic stroke was T wave inversion in 15 cases followed by QTc Prolongation in 14 cases, Arrhythmias in 14, ST depression in 14, U wave in 7 and Left Ventricular Hypertrophy in 11 cases respectively.

A study by **Purushothaman S et al¹¹** in 2014 found that, Among the ischemic group, the changes noted in the ECG were: T wave inversion (34.48%), ST segment depression (32.75%), QTc prolongation (29.31%), and presence of U waves (27.58%). In cases of haemorrhagic stroke, it was: T wave inversion (33.33%), arrhythmias (33.33%), U waves (30.95%), and ST segment depression (23.80%).

Transientness of ECG changes in stroke

A study by **Lindgren A et al¹²** in 1994 found that, the most common abnormalities in ECG were transient ST-T changes in lateral leads, seen in 13 cases. The typical findings were flat or slightly negative T waves, horizontal or down-sloping ST segments and sometimes a small ST depression. A transient prolonged QT interval was seen in three patients and transient U waves in four.

Out of 135 cases of stroke with ECG changes at admission, the changes persisted in 103 (64.37%) cases after 24 hours and in only 21 patients after 72 hours.

At 24 Hrs. most persistent ECG change was QTc Prolongation in 49 cases, followed by T wave inversion in 33, ST depression in 17, U wave 12, Arrhythmias in 24 and Left Ventricular Hypertrophy in 3 cases respectively.

At 72 Hrs., most persistent ECG change was QTc Prolongation in 12 cases, followed by T wave inversion in 8, ST depression in 8, U wave in 1, Arrhythmias in 6 [AF 3, Premature ventricular complexes 1, Sinus Tachycardia 1, RBBB 1] and Left Ventricular Hypertrophy in 3 cases respectively.

There was no statistically significant association between ECG change and Hypertension in present study. ($p>0.05$)

Association between ECG changes and mortality

Out of 21 cases with persistent ECG changes at 72 hrs., 18 (85.71%) patients died. So, persistence of ECG changes was associated with mortality in current study. A similar study by **Purushothaman S et al¹¹** in 2014 found that, Mortality was higher in patients with ST-T changes in ischemic group (66.66%) and in patients with positive U waves (60%) in haemorrhagic group.

Out of total 25 deaths, 24 (96%) cases shown ECG changes at the time of admission. However no statistically significant association was seen between ECG changes at admission and mortality. [$p=1.149$].

Conclusion

ECG abnormalities are common in stroke patients. The Present study shown ECG changes in 84% of the cases of stroke. Most common ECG change among all study participants was QTc Prolongation followed by T wave inversion ECG changes in stroke are usually transient, persist for 24 hours but do not persist after 72 hours.

Hypertension was most common risk factor for stroke followed by type 2 DM. Parameters like level of consciousness at admission, Type of stroke and SBP at admission were associated with mortality in current study. Persistence of ECG changes after 72 hrs. after admission is associated with higher mortality among cases of stroke.

References

1. Wade s. smith, S. Caliborne Johnson, J. Claude: Cerebrovascular disease, Harrison 20th edition ;3068 ,2015
2. Bonita R. Epidemiology of stroke. Lancet 1992;339Worlow CP., Dennisms, Van Gij et al.: stroke practical guide to management; oxford 1996
3. Weilder DJ: Myocardial damage and cardiac arrhythmias after intracranialhaemorrhage. A critical review. Stroke 5:759-764 1974
4. Byer E Ashman R, Toth LA Electrocardiograms with large upright T waves and long Q-T intervals. AM heart J 33: 796-806 1947
5. Connor RCR: Focal myocytolysis and fuchinophillic degeneration of the myocardium of patients dying with various brain lesions Ann NY acad. sci 261-270 1969
6. Dimant J., Grob D.: electrocardiographic changes in patients with acute cerebrovascular accidents.; Stroke 8 448-455 1977
7. Lavy S. Stern S, Herishianu Y etal: Electrocardiographic changes in ischemic stroke. J Neurol Sci 7: 409-415 1968
8. Cheyne J: A case of apoplexy in which the fleshy part of the heart was converted into fat. Dublin hosp.rep.216 1818
9. Adeoye AM, Ogah OS, Ovbiagele B, Akinyemi R, Shidali V, Agyekum F et al. SIREN Team as part of the H3Africa Consortium. Prevalence and Prognostic Features of ECG Abnormalities in Acute Stroke: Findings From the SIREN Study Among Africans. Glob Heart. 2017 Jun;12(2):99-105
10. Goldstein DS. Electrocardiogram in stroke. Relationship with pathophysiological type and comparison with prior tracing. Stroke.1979;10(3):253-9.
11. Purushothaman S, Salmani D, Prarthana KG, Bandelkar SM, Varghese S. Study of ECG changes and its relation to mortality in cases of cerebrovascular accidents. J Nat Sci Biol Med. 2014 Jul;5(2):434-6. doi: 10.4103/0976-9668.136225. PMID: 25097430; PMCID: PMC4121930.
12. Lindgren A, Wohlfart B, Pahlm O, Johansson BB. Electrocardiographic changes in stroke patients without primary heart disease. Clin Physiol. 1994 Mar;14(2):223-31.