Department of General Surgery

Original Research Article

ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC CHANGES IN CEREBROVASCULAR ACCIDENTS

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ABSTRACT

Background: To study the various ECG and echocardiographic pattern alterations that occur in cerebrovascular accidents and determine whether these alterations have any bearing on prognosis.

Material and Methods: Within 24 hours of admission, an ECG and 2D echo were performed on 100 individuals who had suffered an acute stroke. Follow-up was conducted in the hospital to determine each patient's prognosis.

Results: The most frequent ECG abnormalities seen in the brain infarct group were U-waves (51.47%), prolonged QTc (36.76%), T wave inversion (30.88%), and ST segment depression (30.88%). The most frequent anomalies in hemorrhagic stroke cases were U-wave (56.26%) and ST depression (56.26%). The most frequent 2D echo abnormality in both stroke types—that is, infarct and hemorrhage groups—was left ventricular dysfunction (23.53% and 56.26%, respectively). Mortality was high in patient with abnormal ECG (79%) ($p>0.5$). 79% of patients Survived with abnormal ECG. So was statistically insignificant ($p>0.5$). Patients with aberrant 2D echocardiography had a significant mortality rate (90.91) ($p<0.001$).

Conclusion: QTc prolongation, ST segment depression, and U-waves are common ECG abnormalities in hemorrhagic strokes. U waves and QTc prolongation are the two most prevalent ECG abnormalities in ischemic stroke. The most prevalent 2D echocardiographic abnormality in stroke patients is left ventricular dysfunction. There is little predictive importance to ECG abnormalities in stroke patients. When predicting mortality in CVA, left ventricular dysfunction has predictive importance.

Key Words: Stroke, Cerebrovascular accident, 2D echocardiography.

INTRODUCTION

Stroke or cerebrovascular accident (CVA) is the most prevalent life-threatening condition. It is the third leading cause of death in the developed countries after cardiovascular disease and cancer cerebral infarction is responsible for about 80% of all first ever in a lifetime stroke. 10% will get primary intracerebral hemorrhage (PICH), and 5% will experience subarachnoid hemorrhage. In several regions of the world, there are 179 strokes for every 1,000,000 people. The overall prevalence rate in Western nations is 794 per one million people. Strokes and CVAs have significant social, psychological, and economic ramifications in addition to having the potential to cause debilitating morbidity in both young and old people. Cerebrovascular accidents have attracted a lot of attention from the medical community because of their high economic cost, widespread occurrence, and potential to cause disability. Numerous investigations have linked CVA to aberrant wall motion on 2D echo and alterations in the ECG. Many investigations have documented the ECG alterations in CVA. The ECG abnormalities that occurred after the stroke included T-wave, U-wave, ST-segment, QT-interval, and other arrhythmias. These changes might sometimes mimic those of myocardial ischemia or myocardial infarction.[1,2]

Previously, it was believed that cardiac changes preceded CVA. However, a study contradicted this theory and discovered that young individuals with CVA had ECG abnormalities for which there were no other explanations, such as IHD. Many investigations have found aberrant wall motion on 2D echo after stroke, particularly with subarachnoid hemorrhage, in addition to ECG alterations.[3,4] Therefore, research was done to determine the ECG and 2D echocardiographic alterations (abnormalities in wall motion) in various kinds of cerebrovascular accidents. To determine if these alterations are predictive in any way.

MATERIALS AND METHODS

The prospective study comprised of 100 patients admitted in Kurnool General Hospital, Kurnool from April 2016 to August 2017.

Inclusion Criteria: The study only included CVA (CT scan verified) cases that were admitted within 72 hours of the stroke's onset; patients admitted after that time were not included because ECG abnormalities were rare after this time.

Exclusion Criteria: Traumatic cases producing neurological deficits, infection, OT neoplastic cases producing CVA.CVA cases with known underlying cardiac diseases, which produce ECG and echocardiographic.

After admission a detailed history regarding the temporal profile of the stroke including history of risk factors like hypertension, diabetes mellitus, smoking, history of lHD and rheumatic heart disease were obtained.

In every patient, a thorough neurological evaluation that included fundoscopy and a cardiovascular check was performed. Produce ECG and echocardiographic changes.

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

- Temporal profile of clinical syndrome
- Clinical examination
- CT Scan of brain

Within 24 hours after being admitted to the hospital, a 2-D echocardiogram and a 12-lead ECG were both performed. Sedimentation rate Renal function test, Lipid profile In hospital follow-up was done to know their prognosis under two categories as Live and Dead. Age, sex, risk factors, and clinical evaluation were taken into consideration when analyzing the results. Within 24 hours of admission, each case underwent a 12-lead ECG and a 2D echo, and the following criteria were used to analyze the results.

ECG Criteria: Bradycardia was defined as a heart rate under 60 beats per minute, and tachycardia as a heart rate over 100 beats per minute. ST segment depression of 0.5 mm or elevation of more than 1 mm were taken abnormal. T-wave was considered abnormal when inversion of T-waves in which it should have been upright i.e., 1, II V3-V6 may be variable in III, aV_L, V1 and V2.

QTc prolongation: The rate corrected QTc is calculated by dividing the real QT by the square root of the RR-interval, both of which are measured in seconds. The QT interval is measured from the start of the QRS complex to the end of the T-wave. If QTc exceeds 0.44 m-seconds, it is considered protracted. Exaggeration of U-wave voltage in more than two leads, as well as in leads where it was not typically observed (apart from V3-V4), was considered a strong U-wave.

RVH: R-waves in right chest leads and the R-wave may be taller than the S wave in lead V4. Persistent S-wave seen in V5-V6.

LVH: If the sum of the depth of the S-wave in lead V; and the height of the R wave in either lead V5 or V6 exceeds 35 mm, an R-wave of 11 to 13 mm or more in lead aV is another criterion for LVH.

2D Echo Criterion:

Ultramark 6 2D echo with color Doppler was used:

LV systolic function was evaluated using the LV ejection fraction. To check for LV diastolic dysfunction, Doppler indices (A>E across the mitral valve) were employed.

In addition to valve thickening and doming of AML, paradoxical motion of PML, and mitral valve opening utilizing planimetry were used to search for mitral stenosis.

To check for aortic stenosis, including opening (severe AS if AVO <8 mm), flow across the aortic valve was utilized. For any regurgitation, doppler and color imaging were used.

Left atrial thrombus was ruled out using two-dimensional imaging.

RESULTS

A total of 52491 hospital admissions occurred during the study period at Kurnool General Hospital, of which 12,623 were medical admissions and 385 were stroke patients. Stroke patients who satisfied the inclusion and exclusion criteria were chosen for the current study, and their 2D echo and ECG changes were examined. The following findings were recorded.

Incidence of stoke is more common in 5 h and 6 th decade and there was slight male (58%) preponderance compared to female(42%) making male-female ration of 1.4:1. [Table 1]

Hypertension was the most common risk factor and was present in 45% of the cases, followed by smoking in 28% history of stroke in 22%, diabetes mellitus in 13% of patients and hyperlipidemia in 8% in stroke patients. [Table 2]

In case of infarction, 17 patients (25%) presented with headache, while 21 patients (65%) presented with headache in the hemorrhage group. Vomiting was present in 13 patients (19%) in infraction group, while in hemorrhage patients it was present in 25 patients (78%) Right sided hemiplegia was present in 35 patients (51.4%) in case of ischemic strokes,

whereas in case of hemorrhagic strokes 6 patients (18.7%) had right sided hemiplegia. [Table 3]

Incidence of infarct was (68%) more common compared to hemorrhage (32% and incidence of stoke was little more common among males, but was statistically insignificant($p>0.05$). [Table 4]

Abnormalities of ECG (71%) and 2D echo (54%) were more common in stroke patients, Whereas ECG changes are insignificant 2D echo changes are significant. [Table 5]

U-wave (51.47%), QTc prolongation (36.76%) were the most common abnormalities followed by T-wave inversion (30.88%) and ST-segment depression (30.88%). The most frequent anomalies in bleeding group cases were ST segment depression (56.26%o) and U-wave (56.26%), which were followed by extended QTc (50%) and T-wave inversion (28.13%). LV dysfunction (23.539%) was most common, followed by mitral valve (20.59%) and aortic valve (4.41%) abnormality in cases of hemorrhagic strokes again LV dysfunction (56.26%) was most common abnormality Normal echo was seen in 55.88% of infarct and 25% in hemorrhagic stroke. [Table 6]

Mortality was higher in prolonged QTc in both infract (4.4%) and hemorrhagic stroke (46%) and T wave inversion mortality was high in cases of infract (44.4%) compared to hemorrhage was less (23%). In 2 D echo change mortality was higher in hemorrhagic stroke with LV dysfunction (92%) compared to infracct group (44.4%) followed by mitral valve abnormality in case of infract group (22.2%). [Table 7]

ECG changes in mortality was higher in patients of stroke with QTc prolonged (45.5%) and ST segment depression (45.5%) but none of them were stastically significant.

2D echo changes in mortality was higher in patients of hemorrhagic stroke with LV dysfunction (72.7%) ($p<0.001$) and was stastically significant followed by mitral valve abnormality (9.09%) ($p>0.05$). [Table 8]

From the above table, it is evident that among the total number of patients who died of stroke, hemorrhage was the culprit in 59% and ischemia in 40%. QTC prolongation and ST depression was the common ECG abnormality present in 45% of cases. U-wave stood second with 40.90% and the least was T-wave inversion with 31.81%. LV dysfunction was the common 2D echo abnormality present in 72% of patient followed by mitral valve abnormality with 9.09%. [Table 9]

Table 1: Age and sex distribution in stroke patients

Age in years	Males	Females	Total	Percent
21-30	2	1	3	3
31-40	6	4	10	10
41-50	15	5	20	20
51-60	16	11	27	27
61-70	14	14	28	28
71-80	4	4	8	8
81-90	-	2	2	2
91-100	1	1	2	2
Total	58	42	100	100

Table 2: Incidence of risk factors in stroke patients

Risk factors	Number of cases	Percent
Hypertension	45	45
DM	13	13
Smoking	28	28
Hyperlipidemia	8	8
History of stoke	22	22

Table 3: Clinical features in study group

Clinical features	Ischemic (n=68)		Hemorrhage (n=32)	
	Number of cases	Percent	Number of cases	Percent
Headache present	17	25	21	65.6
Vomiting present	13	19	25	78
convulsions	6	8.8	4	12.5
Right side hemiplegia	35	51.4	6	18.7
Left side hemiplegia	15	22	2	6.25
Conscious	38	55.8	6	18.7
Drowsy	12	17.5	2	6.2
Unconscious	18	26.4	24	75

Table 4: Incidence of infract and hemorrhage with reference to gender

Type of study	Males		Females		Total	Percent
	Number of cases	Percent	Number of cases	Percent		
Ischemic	35	51.4	33	48.3	68	68
Hemorrhage	19	59.3	13	40.6	32	32
Total	54		46		100	100

P>0.05

Table 5: Relationship between stoke types with ECG and 2D echo changes

ECG changes	Normal		Abnormal	
	Number of cases	Percent	Number of cases	Percent
Ischemic	22	32.25	46	67.6
Hemorrhage	7	21.8	25	78.1
2D echo changes				
Ischemic	38	55.8	30	44.1
Hemorrhage	8	25	24	75

Table 6: ECG and 2D echo changes in stroke patients

ECG changes	Ischemic (n=68)		Hemorrhage (n=32)	
	Number of cases	Percent	Number of cases	Percent
QTC prolongation	25	36.76	16	50
T-wave inversion	21	30.88	9	28.1
ST segment depression	21	30.88	18	56.26
U waves	35	51.4	18	56.26
Tachycardia	24	35.3	16	50
Bradycardia	0	0	2	3
2D echo changes				
LV dysfunction	16	23.5	18	56.2
LA thrombus	-	-	-	-
Mitral valve abnormality	14	20.5	-	-
Aortic valve abnormality	3	4.4	-	-
Normal	38	55.8	8	25

Table 7: Mortality in stroke types and its co-relation with ECG and 2D echo changes

ECG changes	Ischemic (n=68)		Hemorrhage (n=32)	
	Alive	Dead	Alive	Dead
QTc prolongation	21(35.5%)	4(44.4%)	10(52.6%)	6(46%)
T-wave inversion	17(28.8%)	4(44.4%)	6(31.5%)	3(23%)
ST segment depression	19(32.2%)	2(22%)	10(52.6%)	8(61.5%)
U waves	31(52.5%)	4(44.4%)	13(68.4%)	5(33.4%)
2D echo changes				
LV dysfunction	12(20.3%)	4(44.4%)	6(66.6%)	12(92%)
LA thrombus	-	-	-	-
Mitral valve abnormality	12(20.3%)	2(22.2%)	-	-
Aortic valve abnormality	3(5%)	0	-	-
Normal	38(64.4%)	-	6(66.2%)	2(15.3%)

Table 8: Mortality in stroke patients and it correlation

ECG changes	Stroke patients			
	Alive (n=78)	Dead (n=22)	p-value	Chi-square
QTc prolongation	31(39.7%)	10(45.4%)	>0.05	0.23
T-wave inversion	23(29.48%)	7(31.8%)	>0.05	0.04
ST segment depression	29(37.2%)	10(45.4%)	>0.05	0.49
U waves	44(56.4%)	9(40.9%)	>0.05	1.65
2D echo changes				
LV dysfunction	18(23%)	16(72.7%)	<0.001	18.8
LA thrombus	-	-		
Mitral valve abnormality	12(15.3%)	-	>0.05	0.56
Aortic valve abnormality	3(3.8%)	0		
Normal	44(56.4%)	2(9%)	<0.01	15.4

Table 9: Total analysis in patients of stroke who died

ECG changes	Stroke patients	
Ischemic	9	40
Hemorrhagic	13	59
ECG abnormalities		
QTc prolongation	10	45
T-wave inversion	7	31.8
ST segment depression	10	45
U waves	9	40.9
2D echo changes		
LV dysfunction	16	72
LA thrombus	-	-
Mitral valve abnormality	2	9.09
Aortic valve abnormality	-	-

DISCUSSION

To determine if ECG and 2D echo abnormalities had any predictive relevance in stroke patients, a prospective study was conducted in a hospital. To demonstrate the kind and severity of the stroke, a CT scan was required as part of the study's inclusion criteria. Of the 100 patients, 42 were female and 58 were male (sex ratio: M: F-14:1). The patients' ages ranged from 24 to 92 years, with the mean age of the deceased being 54 and the mean age of the living being 58.73.

The cases of stroke were more common in the 5 and 6 decades making 55%, which is comparable to Kamalakannan S et al study in which the percentage of stroke cases above the age of 51 years was 41% and in the George MG study was 71.8%.

Stroke is one of the leading causes of death in many countries. Despite the lack of agreement, a number of factors have been identified as raising the risk of stroke. Various factors have been linked to an increased risk of stroke in reports from various nations. To evaluate the risk factors, a prospective survey of a given population of the years as done in the Framingham Study was essential the only epidemiological study,[7] who found hypertension, diabetes mellitus, hypercholesteremia and syphilis to be the risk factors associated in hemiplegia patients. Shaper et al,[8] concluded that, hypertension, cigarette smoking and pre-existing IHD was found to be the major risk factors.

The majority of cases in this study (45%) had hypertension, which is comparable to the findings of Smith and Carlos's studies,[9,10] (87% and 48%, respectively). Smoking (28%) and stroke history (22%), which are comparable to those of Smith et al,[9] (35.22% and 39.30%), were the next most common risk factors, followed by diabetes mellitus (13%), and hyperlipidemia (the least common).

In the present study, headache was present in 38% of the cases, which is comparable to the series of Ahmadi Aghangar A et al, who reported an incidence 50 of 26%. Harriott AM et al reported severe headache in 41% of cases. Vomiting was present in 38% of our patients which is comparable Harriott AM et al who reported frequency of headache in 49% of the cases. Convulsions in the present series were present only in t0% of the total patients, which is comparable to that of Maher J et al and Harriott AM et al, who reported frequency of 7% and 9% respectively Comparison of Type of Strokes to Mohr et al (44%).

In this study, 68% of the patients has ischemic stroke, which was comparable with that found in the studies of Daniele et al,[14] ie., 78.20%, respectively. 32% had stroke in the present study comparable with 21.80% in the Danieleco et al,[14] study group.

Our investigation found that 41% of cases had elevated QTc, compared to 32% in Goldstein et al.'s study.[16] Goldstein et al. observed 15% T-wave inversion,[16] but our investigation found 30%. In the current study, 20% of participants had ST-segment depression, compared to 13% in Goldstein et al.[16] In our investigation, U-wave was observed in 53% of cases, compared to 28% in Goldstein et al.[16] In our study, 40 percent of participants had tachycardia, compared to 2% in Goldstein et al.[16]

Bradycardia was seen in 8% in Goldstein et al,[16] while in the present study it was 2%. In the present study, LV dysfunction in ischemic stroke was present in 23.53% of cases, which is comparable to the series of Park HK et al.[17] Mitral valve abnormality was present in 14% comparable to Calicchio F et al.[18] The current study's aortic wall anomaly rate was 3%, while the previous research' rates varied.

Of the patients in the infarct group, 55.88% (38 out of 68) had a normal 2D echo, 23.53% (16 out of 68) had LV dysfunction, 20.59% (14 out of 68) had mitral valve abnormality, 4.41% (3 out of 68) had aortic wall abnormality, and none had LA thrombus. LV dysfunction was present in 18 out of 22 patients, or 56.26%, in the bleeding group.

None had LA thrombus, mitral valve or aortic valve abnormality & 25% were normal (8 out of 22). The either group LV dysfunction was the most common abnormality noticed 56.26% had LV dysfunction. Twenty-five percent were normal, and none showed abnormalities of the aortic, mitral, or LA thrombus valves (8 out of 22). The most frequent problem observed in both groups was left ventricular dysfunction. While 22.72% (5 out of 22) of stroke survivors had normal ECGs, 79% (54 out of 78) of stroke survivors had abnormal ECGs, and 77.27% (17 out of 22) of stroke-dead patients had aberrant ECGs ($p>0.5$) that are statistically insignificant, 35% (24 out of 78) of stroke survivors had normal ECGs.

The mortality rate for abnormal 2D echo was high and statistically significant ($p<0.001$), with 56.41% of stroke survivors (44 out of 78) having normal 2D echo findings and 43.59% (34 out of 78) having abnormal 2D echo study. Additionally, 90.91% (20 out of 22) of stroke patients had abnormal 2D echo findings, while only 9.09% (2 out of 22) had normal echo findings. This is comparable to study done by Manjunath. G et al.[20]

CONCLUSION

The most frequent ECG abnormalities in hemorrhagic strokes are ST segment depression, QTC prolongation, and U. The two most prevalent ECG abnormalities in ischemic stroke are QTC prolongation and U-waves. The most prevalent 2D echocardiographic abnormality in stroke patients is left ventricular dysfunction. There is little predictive importance to ECG abnormalities in stroke patients. When predicting mortality in CVA, left ventricular dysfunction has predictive importance.

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