ORIGINAL RESEARCH PAPER

Neurology

PROGNOSTIC SIGNIFICANCE OF ELECTROCARDIOGRAPHY AND ECHOCARDIOGRAPHY IN PATIENTS OF ACUTE STROKE

KEY WORDS: Stroke; Ecg; 2d Echocardiography.

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ABSTRACT

INTRODUCTION: World Health Organization (WHO) definition of stroke is: "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, with symptoms lasting 24 hours or longer or leading to death, with no apparent cause other than of vascular origin Cerebrovascular accident (CVA) or stroke is the most common life threatening or disabling neurological condition in older population. CVA is often associated with ECG changes and wall motion abnormalities on 2D echo. The changes of ECG in CVA were reported 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. The aim of this study is to assess the different changes in ECG and echocardiographic patterns in the cases of cerebrovascular accidents and to determine whether these different changes have got any prognostic significance in these cases.

METHOD: 200 patients of acute stroke were considered and ECG and 2D echo of these patients were done within 24 hours of admission. In hospital follow-up was done to know the prognosis of all the patients.

RESULTS: ECG abnormalities noted among cerebral infarct group were presence of U- waves (51.47%), prolonged QTc (36.76%) were most common followed by T-wave inversion (30.88%), and ST segment depression (30.88%). In cases of hemorrhagic stroke, ST depression (56.26%) and U-wave (56.26%) were the most common abnormalities. LV dysfunction was the most common 2D echo abnormality in both the stroke types – 23.53% and 81.8% i.e., in infarct and hemorrhage groups respectively. Mortality was high in patients with abnormal ECG (24%) as compared to normal ECG (17.2%) ($p>0.5$). Mortality was high in patients with abnormal 2D echocardiography (90.91%) as compared to normal 2D ECHO(9.09%) ($p<0.001$).

CONCLUSION: ST segment depression, QTc prolongation and U-waves are the common ECG abnormalities in hemorrhagic strokes. QTc prolongation and U-waves are the common ECG abnormality in ischemic stroke. LV dysfunction is the most common 2D echocardiographic abnormality in stroke patients. ECG abnormalities in stroke patients do not have any prognostic significance. LV dysfunction has prognostic significance in predicting mortality in CVA.

INTRODUCTION

Cerebrovascular accident (CVA) or stroke is the most common life threatening or disabling neurological condition in older population. A stroke or cerebrovascular accident, is defined as an abrupt onset of a neurologic deficit that is attributable to a focal vascular cause[1].

Stroke in young adults posses a major socio economic health problem especially in developing countries. Stroke is the third most common cause of mortality and the fourth leading cause of disease burden in the world[2,3,4].

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[5,6]

There are two primary theories regarding the etiology of ECG changes seen following central nervous system insult. The first is that damage occurs to neurologic structures that have direct connections to the autonomic nervous system. Stimulation or destruction of these structures causes augmentation or inhibition of one or both divisions of the autonomic nervous system, resulting in ECG changes without permanent effects on the myocardium. The second is that the neurologic disease creates an imbalance between sympathetic and parasympathetic outputs favouring sympathetic dominance. The relative excess of sympathetic stimuli leads to an increase in plasma catecholamine levels that triggers ECG changes. These systemic effects develop more slowly but are also longer lasting and cause damage to the myocardium.[7]

Various studies have shown that patients with ECG and ECHO changes on presentation have poor prognosis and higher mortality. Therefore, ECG and 2D ECHO appear to have a role in determining the prognosis of CVA patients.[8,9]

This study was undertaken to assess the different changes in ECG and echocardiographic patterns in the cases of cerebrovascular accidents and to determine whether these different changes have got any prognostic significance in these cases.

MATERIAL AND METHODS

The study comprised of 200 patients admitted in Sanjay Gandhi Memorial Hospital, Rewa ,M. P. between April 2018 to June 2019.

INCLUSION CRITERIA:

Cases of CVA admitted within 72 hours after the onset of stroke were selected for the study, patients admitted beyond 72 hours after onset of stroke were excluded as the incidence of ECG changes beyond this period were infrequent.

Exclusion Criteria:

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

DATA COLLECTION AND METHODS:

A detailed history was taken and recorded. The patients were thereafter subjected to complete clinical examination and investigations including CT Scan / MRI, ECG, 2D ECHO. Patients were appropriately treated and monitored for complications.

STATISTICAL ANALYSIS:

SPSS software version 19 was used to analyse the data. Pages and Numbers from MacBook Air were used for data recording and analysis . Continuous variables were analysed using unpaired 't' test for normally distributed data. Discrete variables were studies using Wilcoxon rank sum test. Categorical variables were analysed using Chi square test. Odds ratio (OR) and 95% confidence intervals (CI) were calculated. A P value < 0.05 was taken as significant.

RESULTS:

During the period of April 2018 to June 2019 ,stroke patients were selected for the present study who met inclusion and exclusion criterion were analyzed with regard to 2D echo and ECG changes in stroke patients and the following observations were noted.

Table-1: Relationship of CVA with ECG & 2D Echo Changes

	Normal		Abnormal	
	Total	%	Total	%
ECG	58	29.00	142	71.00
2D Echo	92	46.00	108	54.00

p<0.05

The above table shows the abnormalities of ECG (71%) and 2D Echo (54%) were more common in stroke patients and was **statistically significant.**

Relationship of CVA with ECG & 2D Echo Changes

Table-2: ECG changes in stroke patients

ECG changes	Ischemic (n=136)		Hemorrhage (n=64)	
	No	%	No	%
QTC prolongation	50	36.76	32	50.00
T-wave inversion	42	30.88	18	28.13
ST Segment depression	42	30.88	36	56.26
U waves	70	51.47	36	56.26
Tachycardia	48	35.29	32	
Bradycardia	0	0	4	

From the above table, it is evident that ECG abnormalities among infarct group, 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%). In cases of hemorrhage group ST segment depression (56.26%) and U-wave (56.26%) were the most common abnormalities followed by prolonged QTc (50%) and T-wave inversion (28.13%).

ECG changes in stroke patients

Table-3: 2D Echo changes in stroke patients

ECG Changes	Ischemic (n=136)		Hemorrhage (n=44)	
	No	%	No	%
LV dysfunction	32	23.53	36	81.8
LA thrombus	00	00	00	00
Mitral valve abnormality	28	20.59	00	00
Aortic valve abnormality	6	4.41	00	00
Normal	76	55.88	16	36.3

From the above table, it is evident that 2D echo abnormalities among the infarct group, LV dysfunction (23.53%) was most common, followed by mitral valve (20.59%) and aortic valve (4.41%) abnormality in cases of hemorrhagic strokes again **LV dysfunction (81.8%) was most commonest abnormality.**

Normal echo was seen in 55.88% of infarct and 36.3% in hemorrhagic stroke.

2D Echo changes in stroke patients

Table-4: Mortality in stroke types and its co-relation with ECG changes

Type of ECG changes	Ischemic (n=136)				Hemorrhage (n=64)			
	Survived		Not survived		Survived		Not survived	
	No	%	No	%	No	%	No	%
QTc prolongation	42	30.88	8	5.88	20	31.25	12	18.75
T wave inversion	34	25	8	5.88	12	18.75	6	9.3
ST Segment depression	38	27.94	4	2.9	20	31.25	16	25
U Wave	62	45.5	8	5.88	26	40.62	10	15.6

From the above table, it is evident that mortality was higher in patients with prolonged QTc in both infarct (5.88%) and hemorrhagic stroke (18.75%) and with T-wave inversion mortality was high in cases of hemorrhagic (9.3%) compared to infarct was less (5.88%) and with ST depression mortality was high in hemorrhagic stroke (25%) compared to infarct (2.9%) and with U-wave mortality was high in hemorrhage (15.6) compared to infarct (5.88%).

Mortality in stroke types and its co-relation with ECG changes

Table-5: Mortality in stroke patients and its correlation with ECG changes

Type of ECG Changes	Stroke patients				P Value	Chi-square
	Survived (n=156)		Not Survived(n=44)			
	No	%	No	%		
QTc prolongation	62	39.74	20	45.45	p>0.05	0.23
T Wave inversion	46	29.48	14	31.8	p>0.05	0.044
ST segment depression	58	37.17	20	45.45	p>0.05	0.49
U Waves	88	56.41	18	40.90	p>0.05	1.65

The above table shows, mortality was higher in patients of stroke with QTc prolonged (45.45) and ST segment depression (45.45%) followed by U waves (40.90) and least was with T-wave inversion (31.8%), but none of them were statistically significant.

Mortality in stroke patients and its correlation with ECG changes

Table-6: Mortality in stroke types and its co-relation with 2D Echo changes

2D Echo Changes	Ischemic				Hemorrhage			
	Survived		Not Survived		Survived		Not Survived	
	No	%	No	%	No	%	No	%
LV dysfunction	24	17.64	8	5.88	12	18.75	24	37.5
LA thrombus	0	0.00	0	0.00	0	0.00	0	0.00
Mitral value abnormality	24	17.64	4	2.94	0	0.00	0	0.00
Aortic valve Abnormality	6	4.41	0	0.00	0	0.00	0	0.00
Normal	76	55.88	0	0.00	12	18.75	4	6.25

The above table shows, mortality was higher in hemorrhagic stroke with LV dysfunction (37.5%) compared to infarct group

(5.88%) followed by mitral valve abnormality in case of infarct group (2.94).

Table-7: Mortality in stroke patients and its co-relation with 2D Echo changes

2D Echo changes	Stroke patients				P Value	Chi-square
	Survived (n=156)		Not Survived (n=44)			
	No	%	No	%		
LV dysfunction	36	23.00	32	72.72	P<0.05	18.85
LA thrombus	0	0.00	0	0.00	--	--
Mitral valve abnormality	24	15.38	4	9.09	p>0.05	0.56
Aortic valve abnormality	6	3.84	0	0.00	--	--
Normal	88	56.41	4	9.09	p>0.05	15.47

Above table shows mortality in patients of stroke was higher with LV dysfunction (72.72%) (p<0.05) and was **statistically significant** followed by mitral valve abnormality (9.09) (p>0.05).

Mortality in stroke patients and its co-relation with ECHO changes

Table-8: Relationship of mortality with abnormal ECG in stroke patients

	Electro Cardiogram (ECG)			
	Normal		Abnormal	
	No	%	No	%
Survived	48	82.8	108	76
Not Survived	10	17.2	34	24

p > 0.5 (Insignificant)

From the above table, it is evident that morality was high in patients with abnormal ECG (24%) in contrast to normal ECG (17.2%).

Relationship of mortality with abnormal ECG in stroke patients

Table-9: Relationship of mortality with abnormal 2D Echo in stroke patients

	Normal		Abnormal	
	No	%	No	%
Survived	88	56.41	68	43.59
Not Survived	4	9.09	40	90.91

p < 0.01 (Significant)

From the above table, it is evident that mortality was high in patients with abnormal 2D echocardiography i.e. having severe reduced ejection fraction (90.91%) (p<0.001) compared to normal 2D echo (9.09)or mild abnormal 2D echocardiography changes .Mismatch is due to variation in sample size and due to stroke induced 2D Echo changes.

Relationship of mortality with abnormal 2D Echo in stroke patients

DISCUSSION

The present study "ECG and 2D ECHO changes in Cerebrovascular Accident without coronary Artery Disease" was carried out in 200 patients admitted in Department of Medicine SGMH Rewa, Madhya Pradesh during January 2018 to June 2019.Hospital based prospective study was done to know the ECG and 2D echo changes had any prognostic significance in stroke patients.

In this study, CT scan was mandatory in the inclusion criteria to prove the stroke and type of stroke.

In this study, 68% of the patients has ischemic stroke, which was comparable with that found in the studies of Daniele et al (Jan 2002) , Roy et al and Mikolich et al(Sept 1981) i.e., 78.20%, 71.00% and 93.33% respectively. 32% had stroke in the present study comparable with 21.80%, 29% and 6.66% in the Danieleco et al, Roy et al and Mikolich et al studygroup[10,11,12]

Increased QTc was seen in 32% of cases in Goldstein et al (May 1979), while in our study it is 41%. T-wave inversion was seen in 15% by Goldstein et al while in our study it is 30%. ST-segment depression was seen in 13% in Goldstein while in the present study it was 38.5%. U-wave was seen in 28% in Goldstein et al, while in our study it was seen in 53%. Tachycardia was seen in 2% in Goldstein et al while in our study it was 40%. Bradycardia was seen in 8% in Goldstein et al, while in the present study it was 2%[13]. In the present study, LV dysfunction in ischemic stroke was present in 23.53% of cases, which is comparable to the series of Gagliardi et al and Uma et al who reported 22% and 26% respectively. Mitral valve abnormality was present in 14% comparable to Uma et al who present 30%. Aortic wall abnormality in present study was 3% compared to the other studies it varied, Gagliardi et al and Uma et al 18.5% and 20% respectively[14,15].

In infarct group 2D echo was normal in 55.88% (38 out of 68 patients) while LV dysfunction was seen in 23.53% (16 out of 68 patients) and mitral valve abnormality in 20.59% (14 out of 68 patients) and aortic wall abnormality in 4.41% (3 out of 68 patients) and no patients had LA thrombus.

In the hemorrhage group a high number of patients 18 out of 22 i.e., 56.26% had LV dysfunction. None had LA thrombus, mitral valve or aortic valve abnormality and 25% were normal (8 out of 22).

In the either group LV dysfunction was the most common abnormality noticed.

The percentage of normal ECGs in patients who survived stroke is 35% (48 out of 156), while 22.72% (10 out of 44) succumbed to stroke, 79% (108 out of 156) of stroke survivors had abnormal ECG, while 77.27% (34 out of 44) of patients who died of stroke had abnormal ECG (p>0.5) and is statistically insignificant.

Among stroke survivors 56.41% (88 out of 156) had normal 2D echo findings while 43.59% (68 out of 156) had abnormal 2D echo study, while among patient died due to stroke had 90.91% (40 out of 44) abnormal 2D echo finding, wherein only 9.09% (4 out of 44) patients had normal echo findings so the mortality in abnormal 2D echo was high and was statistically significant (p<0.001).

CONCLUSION

1. ST segment depression, QTc prolongation and U are the common ECG abnormalities in hemorrhagic strokes.
2. QTc prolongation and U-waves are the common ECG abnormality in ischemic stroke.
3. LV dysfunction is the most common 2D echocardi ographic abnormality in stroke patients.
4. ECG abnormalities in stroke patients do not have any prognostic significance.
5. LV dysfunction has prognostic significance in predicting mortality in CVA.

CONFLICT OF INTEREST:

None

LIMITATION:

A prospective study of the impact of time from symptom onset to investigation of ECG and 2D ECHO may be warranted to determine when, after CVA, the ECG and 2D

ECHO becomes reliable.

Single centre study.

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