ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC MANIFESTATIONS IN PATIENTS OF CEREBROVASCULAR ACCIDENT

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Abstract:
Background: The rationale behind studying ECG and echocardiographic manifestations in patients with cerebrovascular accidents (CVAs) lies in the close relationship between the heart and the brain. Both organs are intricately connected through a complex network of neural and vascular pathways, and disturbances in one system can impact the other. **Aim:** Hence, the present study aimed at to study the echocardiographic (ECHO) and Electrocardiogram (ECG) changes in CVAs and to identify potential sources of embolism and subsequently establish stroke etiology. In addition, to know whether any changes have any prognostic significance and to identify an unsuspected source which can lead to specific cardiac treatment and thus reduce morbidity. **Materials & methods:** This study was conducted in VIMSAR, Burla from March 2021 to February 2023. This was a hospital based cross-sectional study. 112 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 infarct group were presence of U waves, prolonged QTc were most common followed by T wave inversion and ST segment depression. In cases of hemorrhagic stroke, ST depression and U wave were the most common abnormalities. LV dysfunction was the most common 2D echo abnormality in both ischemic and hemorrhagic groups. **Conclusion:** ST segment depression, QTc prolongation and U waves are the common ECG abnormalities in hemorrhagic stroke. QTc prolongation and U waves are the common ECG findings in ischemic stroke. LV dysfunction is the most common 2D echocardiographic abnormality in stroke patients. ECG abnormality in stroke patients do not have any prognostic significance but LV dysfunction has prognostic significance in predicting mortality in CVA.
Keywords: Echocardiogram; Cerebrovascular accidents; Transient ischemic attack; High blood pressure; Embolism.

INTRODUCTION:
The 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" [1]. By applying this definition Transient Ischemic Attack (TIA), which is defined to last less than 24 hours, and patients with stroke symptoms caused by subdural hemorrhage, tumors, poisoning, or trauma, are excluded [2].

Stroke continues to be the second leading cause of death worldwide (second only to cardiovascular disease). Annually, 15 million people worldwide suffer strokes. Of these, 5 million die and another 5 million are left permanently disabled, placing a burden on family and community [3]. In India, community surveys have shown a prevalence rate in range of 200 per 100,000 persons, nearly 1.5% of all urban hospital admissions, 4.5% of all

medical and around 20% of neurological cases [4]. High blood pressure is the most important risk factor for stroke, contributing to about 50% of all strokes.

The brain heart connection was described early in the 20th century when Levy showed that changes in central nervous system (CNS) metabolism influenced cardiac function [5]. Later, several reports have been published regarding the role of the hypothalamus in controlling cardiac rhythm, especially the function of the sinus node [6]. Morphological ECG changes of repolarization type occur when the hypothalamus and other parts of the brain are stimulated experimentally [7].

Cardiac abnormalities occur in 60–70% of patients after stroke [8]. The most common disturbances include minor ECG abnormalities, cardiac arrhythmias, myocardial injury and dysfunction. Distinguishing cardiac abnormalities

directly caused by stroke, however, remains difficult because the prevalence of preexisting cardiac disease is high, particularly among patients with ischemic stroke. Cardiac disturbances are the most common cause of death after stroke, accounting for up to 6% of unexpected deaths during the first month [9]. Clinical observational studies among stroke patients also suggest a loss of cardiac parasympathetic tone, loss of nocturnal vagal dominance and increased sympathetic tone [10].

The rationale behind studying ECG and echocardiographic (ECHO) manifestations in patients with cerebrovascular accidents (CVAs) lies in the close relationship between the heart and the brain. Both organs are intricately connected through a complex network of neural and vascular pathways, and disturbances in one system can impact the other. In essence, investigating ECG and echocardiographic manifestations in CVA patients serves to uncover underlying cardiac conditions, identify potential sources of emboli, guide treatment decisions, and ultimately improve patient outcomes by addressing both the neurological and cardiovascular aspects of their health. Hence, the present study aimed at to study the echocardiographic and ECG changes in CVAs and to identify potential sources of embolism and subsequently establish stroke etiology. In addition, to know whether any changes have any prognostic significance and to identify an unsuspected source which can lead to specific cardiac treatment and thus reduce morbidity.

MATERIALS & METHODS:
After obtaining Ethical clearance, the present study was initiated. This study was conducted in VIMSAR, Burla from March 2021 to February 2023. This was a hospital based cross-sectional study. A group of 112 subjects participated in this study. Inclusion criteria is all stroke patients who are hemodynamically stable, both ischemic and hemorrhagic strokes included, both sexes included. Exclusion criteria is stroke patients who are hemodynamically unstable, patients with stroke like symptoms caused by tumors, poisoning, trauma, meningitis, Bell's palsy or cerebral abscess are excluded.

Statistical analysis:
Data will be analyzed by MS excel and SPSS and expressed in the form of numbers and percentages. The Chi square test was used to establish the significance level between groups. P value of < 0.05 was significant.

RESULTS:
112 cases of stroke were analyzed in our study for ECG and echocardiogram findings. Years and the age of study group ranged from 30 years to 85 years. Maximum number of cases (57%) belonged to the above 60years age group. There were 10.71% cases in less than 40 years age group and32.14% cases in 40-60 years age group. Mean of total age group is 61.10 and STD deviation is 13.92. Among 76 cases of ischemic stroke, there were 38 cases with normal Echocardiogram and 38 cases with abnormal Echocardiogram while among 36 cases of hemorrhagic stroke; there were 3 cases with normal Echocardiogram and 33 cases with abnormal Echocardiogram as shown in below table. The table showing 2D echo abnormalities in patients of stroke and was more common in patients of hemorrhagic stroke (91.66%) compared to infarct (50%) and was statistically significant (p<0.01). The chi-square statistic is 18.2755. The *p*-value is .000019. Significantat *p* <.05, df -1.

Table 1: Relationship between Stroke Types And Echo Changes

Types of stroke	No ofcases	Echo changes				p-value
		Normal		Abnormal		
		No	%	No	%	
Ischemic	76	38	50%	38	50%	0.000019
Hemorrhagic	36	3	8.33%	33	91.66%	

Types of ECG changes in ischemic and hemorrhagicstroke:
Among 76 ischemic stroke cases, the most common change is u wave(51.31%) followed by QTC prolongation (36.84%), T wave inversion (30.26%), ST depression (30.26%) and s=ST elevation (6.57%). Among 36 Hemorrhagic stroke cases, the most common change is ST depression (55.55%) and U waves (55.55%), QTC prolongation (50%), T inversion (27.77%), ST elevation (2.77%) as in table 2.

Table 2: Types of ECG Changes In Ischemic And Hemorrhagic Stroke

ECG	Ischemic (N=76)		Hemorrhage (N=36)	
	No	%	No	%
ST depression	23	30.26%	20	55.55%
ST elevation	5	6.57%	1	2.77%
T inversion	23	30.26%	10	27.77%
QTC prolongation	28	36.84%	18	50%
U wave	39	51.31%	20	55.55%
Atrial fibrillation	10	13.15%	3	8.33%

Table 3: ECHO abnormalities in ischemic andhemorrhagic stroke:

ECHO	Ischemic (N=76)		Hemorrhage (N=36)	
	No	%	No	%
LV Dysfunction	18	23.68%	20	55.55%
LVH	16	21.05%	19	52.77%
Mitral valve abnormality	16	21.05%	3	8.33%
Aortic valve abnormality	4	5.26%	----	-----

Among 76 ischemic stroke cases, the most common change is LV dysfunction (23.68%) followed by mitral valve abnormality (21.05%), LVH (21.05%). Among 36 Hemorrhagic stroke cases, the most common change isLV dysfunction (55.55%) followed by LVH (52.77%).

Table 4: Mortality In Stroke Types And its co-relation With ECG Changes

ECG	ISCHEMIC				HEMMORAGE			
	ALIVE(N=66)		DEAD (N=10)		ALIVE (N=21)		DEAD(N=15)	
	NO	%	NO	%	NO	%	NO	%
ST depression	21	31.81%	2	20	11	52.38	9	60
ST elevation	4	6.06%	1	10	1	4.76	---	---
T inversion	19	28.78%	4	40	7	33.33	3	20
QTC prolongation	24	36.36%	4	40	11	52.38	7	46.66
U wave	35	53.03%	4	40	14	66.66	6	40

DISCUSSION:

112 cases of stroke were analyzed in our study for ECG and echocardiogram findings. The mean age of study population is 61.10 years and the age of study group ranged from 30 years to 85 years. Maximum number of cases (32%) belonged to the 51-60 years age group. There were 4% cases in less than 40 years age group and 13% cases in 71-80 years age group according to [10], There were 58 males and 42 females among 100 cases of stroke. This shows stroke prevalence is higher in males than females.

Among 112 cases, Hypertension was the most common risk factor (59%), followed by Dyslipidemia (53%), smoking (32%), Diabetes (31%) and alcoholism (28%). This is like other studies where hypertension is most common risk factor [5-9] (45%) Among 112 cases of stroke, 68 cases were ischemic stroke, and 32 cases were hemorrhagic. This is similar to study conducted by [9] where the incidence of infarction was more common (68%) compared to hemorrhage (73%) [8].

Among 112 cases of stroke, there were 9.82% cases with normal ECG and 90% cases with abnormal ECG. There were 38.39% cases with normal echocardiogram and 61% cases with abnormal echocardiogram according to [8] the abnormalities of ECG (71%) and 2D Echo (54%) [8].

ECG-Among 76 cases of ischemic stroke, there were 8 cases with normal ECG and 68 cases with abnormal ECG while among 36 cases of hemorrhagic stroke; there were 3 cases with normal ECG and 33 cases with abnormal ECG it is evident that ECG abnormalities were more common in patients of stroke. ECG abnormalities were more in Hemorrhagic stroke (91.66%) compared to infarct (89.47%), which is statistically insignificant (p<0.05). Study [9] also found that ECG abnormalities were more among cases of hemorrhagic stroke 125 Among 68 cases of ischemic stroke, there were 22 cases with normal ECG and 46 cases with abnormal ECG while among 32 cases of hemorrhagic stroke, there were 7 cases with normal Echocardiogram and 25 cases with abnormal ECG. p > 0.05 In the above table, it is evident that ECG abnormalities were more common in patients of stroke. ECG abnormalities were more in hemorrhagic stroke (78.12%) compared to infarct (67.64%), which is statistically insignificant (p>0.05) [7].

ECHO- Among 76 cases of ischemic stroke, there were 38 cases with normal Echocardiogram and 38 cases with abnormal Echocardiogram while among 36 cases of hemorrhagic stroke; there were 3 cases with normal Echocardiogram and 33 cases with abnormal Echocardiogram.

2D echo abnormalities in patients of stroke was more common in patients of hemorrhagic stroke (91.66%) compared to infarct (50%) and was statistically significant (p<0.01). The chi-square statistic is 18.2755. The p-value is .000019. Significant at p < 0.05 , df -1. A study [11] was also found that ECHO abnormalities were more among cases of hemorrhagic stroke 125Among 68 cases of ischemic stroke, there were 38 cases with normal Echo and 30 cases with abnormal Echo while among 32 cases of hemorrhagic stroke, there were 8 cases with normal Echocardiogram and 24 cases with abnormal Echo. 2D echo abnormalities in patients of stroke and was more common in patients of hemorrhagic stroke (75%) compared to infarct (44.125) and was statistically significant (p<0.01).

Left ventricular dysfunction was seen in 38 cases in our study out of which 10 were dilated cardiomyopathy and 9 were due to Ischemic heart disease. This is in accordance to [12]. In our study LVH with strain pattern was seen in 29% (32) which is similar to study done by [12].

ECG CHANGES IN STROKE - Among 76 ischemic stroke cases, the most common change is u wave (51.31%) followed by QTC prolongation (36.84%), T wave inversion (30.26%), ST depression (30.26%) and ST elevation (6.57%).

Among 36 Hemorrhagic stroke cases, the most common change is ST depression (55.55%) and U waves (55.55%), QTC prolongation (50%), T inversion (27.77%), ST elevation (2.77%) According to [8] 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%).125

ECHO FINDINGS IN STROKE -Among 76 ischemic stroke cases, the most common change is LV dysfunction (23.68%) followed by mitral valve abnormality (21.05%), LVH (21.05%). Among 36 Hemorrhagic stroke cases, the most common change is LV dysfunction (55.55%) followed by LVH (52.77%). According to [9] 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 (56.26%) was commonest abnormality. Normal echo was seen in 55.88% of infarct and 25% in hemorrhagic strokes.

MORTALITY IN ECG-Among stroke patients who were alive, number of 49 (56.32%) patients had U wave interval followed by 35 (40.22%) patients QTC prolongation, 32(36.76%) patients with ST depression. 26(29.88%) patients had T waves and 5 (5.74%) patients had ST elevation. Among stroke patients who were dead, maximum number of 11 (44%) patients had prolonged QTc interval followed by 11(44%) patients had ST depression, 10 (40%) patients with U wave, 7(28%) patients had T wave, and 1(4%) patient had ST elevation. According to [8] the 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.125

MORTALITY IN ECHO-Among stroke patients who were alive, number of 23(26.43%) of LVH, 19 (21.83%) of LV Dysfunction, 15 (17.24%) of MB Abnormalities and 3(3.44%) AV abnormalities were alive. Among stroke patients

who were dead, number of 19(76%) of LV dysfunction, 12 (48%) of LVH, 4(16%) of MVA and 1(4%) AV abnormalities were dead. According to [8] Mortality in patients of stroke was higher with LV dysfunction (72.72%) (p0.05). 125.

Conclusion:

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

Conflict of interest:

None.

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