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Research Article

Study of Electrocardiography and Echocardiography changes in patients of acute cerebrovascular accidents presenting to the Emergency Department

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ABSTRACT

Cardiac abnormalities commonly accompany Acute Cerebrovascular accidents (CVA). This heart-brain interaction is reflected in the echocardiography and electrocardiographic changes. There is limited data on the assessments in the emergency ward of Indian hospitals. This study aims to evaluate the patterns of cardiac presentations among cases of CVA. The study was prospective observational in nature. The sample size was 67. All cases were above 18 years of age. All cases with any form of stroke underwent 12 lead ECG and an echo. Chi-square/Fisher's exact test analysed the associations between stroke type and the cardiac findings. All *p-values* <0.05 were considered to be statistically significant. The mean age of cases was 57.9 years. More males were affected, and cases of ischemic stroke were higher (53.7%). Abnormality with cardiac findings was seen with 94% cases. Left ventricular dysfunction was predominant. Across the stroke subtypes, cardiac findings did not differ statistically. There is a higher prevalence of cardiac abnormalities among acute CVA cases. Routine cardiac evaluation should be carried out among patients before transferring them further to departments. Early treatment will help to prevent complications and reduce mortality rates.

Keywords: CVA, 2D echo, ECG, Haemorrhagic, Ischemic

INTRODUCTION

A stroke or cerebrovascular accident (CVA) is an acute compromise of the vasculature or cerebral perfusion. Around 85% of these are ischemic strokes (IS)(1). The rest are mostly haemorrhagic stroke (HS), presenting as intracerebral and subarachnoid haemorrhage(2). This is a leading cause of loss of functional and cognitive activities (3,4). Post neural injury, cardiac dysfunction is a quite a common finding(5,6). Even if there is no history of cardiac disease, acute brain injury (ABI) can induce cardiac dysfunction, increasing mortality risk and leading to long-lasting complications like heart failure (7). There is a direct association between cardiac outcomes with brain injury and intracranial haemorrhage (8), and this is also a major cause of death in cerebrovascular accidents (CVA) (9). These manifestations are due to the excess release of catecholamines due to the neuro-endocrine axis and inflammatory response to the brain injury(10). The involvement of the right insular cortex leads to sympathetic augmentation(11). Such an activation is known to cause cardiac damage, identified by electrocardiographic changes (ECG) (12). Most changes are seen as T-wave inversions, ST changes, and QT interval prolongation (13). Recent studies on echocardiography have also demonstrated results related to stroke(14,15). Studies have mainly been in hospital setups, seldom involving data from the Emergency department. The present study aims to study the patterns of changes in ECG and Echocardiography (Echo) studies in cases presenting to the emergency department with CVA in a tertiary care centre of urban India.

MATERIALS AND METHODS

Ethical clearance was obtained from the institutional ethics committee of Jehangir Hospital, Pune, before the start of the study. The cases were patients reporting to the OPD of the Accident and Emergency department of Jehangir Hospital, Pune. All procedures performed in studies involving human participants were in accordance with the ethical standards of ICMR. Informed consent was obtained from the patients immediate representatives regarding the use of their clinical data. All the patient-specific data was kept in strict confidence. All cases above 18 years of age and presenting within 72 hours of signs and symptoms of stroke were included in the study. Cases with neurological deficit or previous cerebrovascular accidents were excluded from the study. The data was collected over a span of 6 months from June 2025 to December 2025. Total 67 cases agreed to provide a written consent for their data to be used for the study purpose. Upon arrival, the case history was

recorded as the standard protocol. A detailed neuro and cardiac evaluation was done. Echocardiographic evaluation was performed using standard transthoracic echocardiography in accordance with routine institutional protocols. Left ventricular systolic dysfunction was assessed qualitatively based on visual estimation of ejection fraction and categorized as normal or reduced. Left ventricular hypertrophy was identified based on interventricular septal and posterior wall thickness measurements obtained during diastole. Valvular abnormalities were documented when structurally significant lesions or hemodynamically relevant regurgitant/ stenotic lesions were identified on routine examination. Regional wall motion abnormalities, chamber dilatation, and other structural abnormalities were recorded where present. Due to emergency department workflow constraints, advanced echocardiographic techniques and quantitative strain analysis were not performed. Cases with abnormal ECG findings were admitted to either the ward or ICU (depending upon the severity) and followed up to manage the cardiac abnormalities. We noted the outcomes in terms of mortality/ morbidity. The data was noted in Microsoft Excel 2019. It was cleaned for incomplete entries. SPSS 26.0 IBM Analytics (U.S.A) was used to carry out the statistical analysis. All *p-values* <0.05 were considered to be statistically significant. There was no bias in the assessment of the outcome, as it was cross-examined by two other authors apart from the first author primarily involved in the data collection procedure.

RESULTS

Of 67 cases [33(49.3%)males,34(50.7%)females] majority of cases were between 61–80 years (32 cases, 47.8%), 13 cases (19.4%) between 51–60 years and 18 cases (27.0%) between 31–50 years, 3 cases (4.5%) were less than 30 years, and one case (1.5%) was above 80 years. The mean age was 57.87±15.22years. All cases had at least one of the major risk factors for cardiac complications. Hypertension was present in 30 cases (44.8%), 31 cases (46.3%) were active smokers, 18 cases (26.9%) had diabetes mellitus, and 26 cases (38.8%) had hyperlipidaemia. The following Table 1 shows the distribution of the cases based on stroke type.

In case of infarction, 10 patients (27.7%) presented with headache, while 20 patients (71.4%) presented with headache in the haemorrhage group and 3 patients (100%) presented with headache in another group. Vomiting was present in 6 patients (16.6%) in the infarction group, while in haemorrhage patients, it was present in 14 patients (50%) and 3 patients (100%) presented with vomiting in another group. Right sided hemiplegia was present in 14 patients

Table 1: Distribution of type of CVA (CT/MRI) among the cases

Stroke type	*N*	*%*
IS	36	53.7
HS	28	41.8
Others*	3	4.5
Total	67	100.0

*The 'other' stroke category included patients with uncommon cerebrovascular etiologies that did not fit clearly into ischemic or hemorrhagic stroke classifications, including mixed radiological patterns and atypical cerebrovascular presentations.

(38.8%) in case of IS, whereas in case of haemorrhagic strokes 11 patients (39.38%) had right sided hemiplegia and 1 patient(33.3%) had right sided hemiplegia in the other group. Left-sided hemiplegia was present in 13 patients (36.11.%) of IS, whereas in the case of haemorrhage, 17 patients (60.71%) had left-sided hemiplegia and 1 patient (33.3%) had left-sided hemiplegia in the other group. In case of infarction, 4 patients (11.11%) were unconscious, whereas in case of haemorrhage, 5 patients (17.85%) were unconscious. Convulsions were present in 3 patients (8.33%) in the infarction group, whereas in the haemorrhage group, 6 patients (21.4%) presented with convulsions and 1 patient (33.3%) had convulsions. Of 67 cases, 63 (94.0%) had abnormal ECG findings and the remaining 4 cases (6.0%) had normal ECG findings (Table 2).

Overall, out of 67 cases, 60 (89.6%) had abnormal Echocardiography findings and the remaining cases (10.4%) had normal Echocardiography findings. The findings did not differ significantly across the 3 CVA groups (Table 3).

Among the 10 deaths overall, 4 cases (12.1%) in ischemic stroke and 6(21.4%) cases with HS showed abnormal ECG and Echo findings, which were not significant on comparison.

DISCUSSION

We observed a high burden of cardiac abnormalities based on ECG and Echo findings in the current study population. This reinforces the brain-heart interaction complex, especially in acute stroke cases (16). There were more cases of ischemic stroke than HS. Globally, ischemic stroke comprises of 62% under cases below 70 years of age(17). HS presented with a higher association with headaches, vomiting, consciousness loss or convulsions, and cortical irritation. HS provokes a sympathetic activation and surge in the catecholamine levels, indicating cardiac abnormalities. Although electrocardiographic abnormalities in acute stroke have been described previously, data regarding simultaneous electrocardiographic and echocardiographic assessment in emergency department presentations from resource-limited tertiary care settings remain comparatively limited. The present study contributes prospective observational data regarding the frequency and spectrum of cardiovascular abnormalities encountered during the acute evaluation of cerebrovascular accidents in routine clinical practice. In our findings, Q wave, ST interval, and tachycardia were higher among HS cases as reported in previous literature (18–20). Almost nine-tenths of cases had abnormal echo findings. This highlights that stroke is a factor and not any pre-existing neurological condition that triggered the cardiac conditions in these cases. Zhang et al. reported that 72% of the stroke cases showed ischemic ST-segment changes and 9.5% had arrhythmias. This was much higher than our findings, where only 22% of the cases exhibited ST-segment changes(21). The presence of conventional risk factors such as smoking, diabetes and hypertension indicates the common pathways of Cerebro and cardiovascular diseases (22). The presence of any one cardiac risk factor may increase the risk for neuro-cardiac injury. This may be disproportionate in terms of ECG or Echo findings, possibly because of the independent effects of stroke itself(23). Another study reported that gender (male-63.2%), smoking (35.8%) and dyslipidaemia (40.5%) being significantly associated with stroke subtypes(24).

Table 2: Association between stroke type and ECG findings

		Ischemic (n=36)		*Hemorrhagic (n=28)*		*Other (n=3)*		
ECGfindings		*n*	%	*n*	%	*n*	%	*P-value*
P wave	Normal	35	97.2	28	100.0	3	100.0	0.646
	Abnormal	1	2.8	0	0.0	0	0.0	
QRS complex	Normal	25	69.4	18	64.3	2	66.7	0.909
	Abnormal	11	30.6	10	35.7	1	33.3	
ST segment	Normal	28	77.8	22	78.6	2	66.7	0.895
	Abnormal	8	22.2	6	21.4	1	33.3	
T wave	Normal	19	52.8	11	39.3	1	33.3	0.505
	Abnormal	17	47.2	17	60.7	2	66.7	
U wave	Normal	34	94.4	24	85.7	3	100.0	0.410
	Abnormal	2	5.6	4	14.3	0	0.0	
QT Interval	Normal	24	66.7	15	53.6	2	66.7	0.555
	Abnormal	12	33.3	13	46.4	1	33.3	
Tachycardia	Normal	31	86.1	20	71.4	3	100.0	0.231
	Abnormal	5	13.9	8	28.6	0	0.0	
Bradycardia	Normal	35	97.2	26	92.9	2	66.7	0.094
	Abnormal	1	2.8	2	7.1	1	33.3	
Arrythmia	Normal	34	94.4	26	92.9	3	100.0	0.874
	Abnormal	2	5.6	2	7.1	0	0.0	
Overall	Normal Abnormal	3 33	8.3 91.7	0 28	0.0 100.0	1 2	33.3 66.7	0.046*

Table 3: Association between type of stroke and 2D echo findings

		Ischemic (n=36)		*Hemorrhagic (n=28)*		*Other (n=3)*		*p-value*
Echofindings		*n*	%	*n*	%	*n*	%	
Left ventricular dysfunction (LVD)	Normal	7	19.4	5	17.9	0	0.0	0.700
	Abnormal	29	80.6	23	82.1	3	100.	
Left ventricular hypertrophy (LVH)	Normal	15	41.7	8	28.6	2	66.7	0.315
	Abnormal	21	58.3	20	71.4	1	33.3	
Mitralvalve abnormalities	Normal	19	52.8	15	53.6	2	66.7	0.898
	Abnormal	17	47.2	13	46.4	1	33.3	
Aorticvalve abnormalities	Normal	25	69.4	23	82.1	3	100.	0.304
	Abnormal	11	30.6	5	17.9	0	00.0	
Ejection fraction	Normal	26	72.2	23	82.1	2	66.7	0.604
	Abnormal	10	27.8	5	17.9	1	33.3	
Regional wall motion abnormalities (RWMA)	Normal	35	97.2	26	92.9	2	66.7	0.094
	Abnormal	1	2.8	2	7.1	1	33.3	
Other	Normal	25	69.4	17	60.7	2	66.7	0.766
	Abnormal	11	30.6	11	39.3	1	33.3	
Overall	Normal	5	13.9	2	7.1	0	0.0	0.568
	Abnormal	31	86.1	26	92.9	3	100.	

The burden of electrical instability varies with the nature of cerebral damage(25). Lack of any significant differences in the ECG patterns may be due to the small sample size as well as lesion heterogeneity (size, location, centres involved, etc.). Echo can be helpful in demarcating chronic or acute changes in stroke cases (26). The abnormalities with the mitral/aortic valve indicate that the cardiac damage is stress-induced in stroke cases, as supported by the literature(23). A study reported that 60% of cases with ischemic stroke reported of LVD(27). We observed this to be much higher (82.1%) in the HS group. Chung et al. reported that a lesion with the right insula or left parietal cortex can lead to LVD, even if there are no previous cardiac damages (28). Early identification of LVD is essential in stroke cases, as their risk for mortality is 2.5 times higher than that of those without it (29).In our study, the echo findings were detected quite early, prompting a faster intervention. We observed a higher abnormal ejection fraction with the IS (27.8%) than with the HS cases. The increased prevalence of left ventricular hypertrophy observed in the study likely reflects underlying chronic hypertension and pre-existing cardiovascular remodeling rather than an acute consequence of the cerebrovascular event itself. Acute stroke is unlikely to directly induce structural myocardial hypertrophy within the observed clinical timeframe. Study reports that for every 5% reduction in left ventricular ejection fraction, the mortality risk rises by 18% (30). Another study among 14000 stroke cases reported that those with <60% of ejection fraction had a high short-term mortality risk and this kept rising with further decreasing ejection fraction levels (31). Early identification of such complications can always lead to better outcomes of the intervention, substantially reducing the risks on long term basis in such cases.

The present study was designed as an observational descriptive study and therefore cannot establish absolute causality between acute cerebrovascular events and the observed cardiac abnormalities. Larger multicentric studies with longitudinal cardiac follow-up, prior cardiac status documentation, and advanced echocardiographic characterization would be required to better delineate the mechanisms underlying neurocardiac interactions in acute stroke. Overall, the study adds to the existing body of evidence to focus on cardiac effects also in acute CVCs, especially in the emergency department. The high prevalence of findings suggests the need to routinely evaluate cardiac conditions, irrespective of the type of stroke. We recommend further studies with serial ECG and Echo for better prediction on progression of the cases. Studies with neural imaging and cardiac biomarkers will add strength to the existing evidence.

CONCLUSION

The study demonstrates that the burden of cardiac abnormalities among acute cerebrovascular accident cases was higher. There was a high prevalence of LVD and other abnormalities, stressing the need to routinely carry out cardiac screening among such cases.

CONFLICT OF INTEREST

None.

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