ORIGINAL RESEARCH ARTICLE

Study of Incidence and Pattern of ECG Changes in Cerebrovascular Accidents

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A B S T R A C T

Introduction: The anatomy and physiology of pathways involved in brain-heart interaction have been elucidated in both animal and human studies. The ability to reproduce the arrhythmia by activation of the sympathetic nervous system suggested a neurogenic mechanism. Areas of cerebral cortex with connection to autonomic nervous system can also elicit cardiac response. Study aimed to record the incidence and pattern of ECG changes in patient with cerebrovascular diseases.

Material and Methods: The present observation study conducted on 50 patients. The patients were categorized into 3 different types based on the findings of brain CT scan. ECG was recorded for all the patients and analysed for finding the abnormalities.

Results: 78% of all stroke patients had some form of ECG abnormalities. 70% of patients with cerebral infarction, 89% of patients with cerebral hemorrhages (CH), 100% of patients with subarachnoid hemorrhages (SAH) had changes in ECG. ST segment changes were most commonly noted after cerebral hemorrhage.

Conclusion: The changes found in ECG of cardiovascular disease patients were not associated with any particular site of cerebral lesion. Cardiac disturbances are diverse and frequent in the setting of acute neurological injury.

Keywords: Cerebrovascular Accidents, Electrocardiogram, Hemorrhage, Stroke, Cerebral Hemorrhage(CH)

INTRODUCTION

The anatomy and physiology of pathways involved in brain-heart interaction have been elucidated in both animal and human studies. The ability to reproduce the arrhythmia by activation of the sympathetic nervous system suggested a neurogenic mechanism.[1] More recently emotion and stress induced cardiomyopathy has been described. First account of Electrocardiograph (ECG) changes, which consisted of Upright T waves, prolonged QTc in patients with sub arachnoid haemorrhage was published in1947.[2,3]

The insular cortex of the brain has widespread connectivity with other areas of brain, which are involved in autonomic control.[4] Majority of studies suggest that the insular cortex has a pivotal role in integrating autonomic response and is strongly associated with adverse cardiac events after neurological injury.

The insular cortex in rats is a site from which lethal cardiac arrhythmias and myocardial damage could be produced, resembling changes seen in patients after stroke and sudden death in patients with epilepsy.[4,5] These micro stimulation experiments in the rat posterior insular cortex produced stereo typed ECG changes from progressive atrio-ventricular block leading to complete heart block, interventricular block, QT-interval prolongation, ST-segment depression, ventricular ectopy and finally death in a asystole.[5]

Collective evidence supports that the belief that stroke can alter cardiovascular tone by directly damaging the insular cortex or other inter related areas shifting the balance towards a predominance of sympathetic activation. Right middle cerebral artery strokes were associated with increased incidence of supraventricular tachy arrythmias. Left parieto insular stroke was associated with an increased incidence of new onset atrial fibrillation.[5,6]

In analysis of North American symptomatic end arterectomy trial (NASCET), long term risk of sudden death was significantly increased in patients with left brain infarction.[7]

Several studies in human suggest that stroke isolated to the left anterior insular cortex or the right fronto-parietal cortex sparing the insula will have similar effects on cardiovascular outcomes.[8]

Abnormalities of ECG may also occur in extra cardiac condition. ECG abnormalities described in neurological disease are the most striking deviation from the normal.

ECG abnormalities were frequently found in patients with after subarachnoid hemorrhage and other cerebrovascular injury.[9] ECG pattern after stroke, consisting of large inverted T waves, prolonged QT intervals and large septal U waves that has become distinctive of cerebrovascular injury. Further evidence of a neurogenic mechanism of cardiac injury comes from studies of cardiac function after SAH, which typically affects younger patients without a history of co-existent cardiac disease.[10] Global or regional left ventricular systolic dysfunction on echocardiogram has been described after SAH with an approximate incidence of 10 to 28 percent.

Brain injury and subarachnoid haemorrhage have been reported to cause 'J' waves due to the prominent action potential notch in epicardium.[10,11] The present study has been undertaken to present the incidence and pattern of ECG changes in patients with cerebrovascular diseases.

MATERIAL AND METHODS

The current observational study was conducted at Government General Hospital, Vijayawada for the period of 6 months from July to December, 2017. Total 50 patients attended medical ward with acute cerebrovascular disease were studied. The study was approved by the institutional ethical committee. Patients with past history of underlying heart diseases previously diagnosed with ECG abnormalities and hepatic or renal diseases are excluded from the study.

Patients were categorized in to 3 different cardiovascular diseases based on the CT finding as cerebral infarction, cerebral haemorrhage and subarachnoid haemorrhage. ECG was then interpreted with rate, rhythm, ST segment, QRS complex, T wave amplitude and morphology and QT interval was calculated. QTc interval was calculated based on Bizet's formula.

STATISTICAL ANALYSIS

Microsoft office 2007 was used for the statistical analysis. Descriptive statistics like mean and percentages were used for the analysis.

RESULTS

Table 1 shows that out of 50 cerebrovascular disease patients, 78% of all stroke patients had some form of ECG abnormalities. 70% of patients with cerebral infarction, 89% of patients with cerebral hemorrhages (CH), 100% of patients with subarachnoid hemorrhages (SAH) had changes in ECG.

ST segment changes were most commonly noted after cerebral hemorrhage. 33% of patients with infarction have ST depression. ST elevation was found in 50% of patients with CH. T wave changes were present in 45% of patients with CH. 30% of patient with infarct had T wave changes. 50% of patients with CH had QTc prolongation. 29.6% of patients with infarct have QTc prolongation. 33% of patients with SAH have ECG changes. Rhythm disturbances were present in 15% of patients with infarct. 40% of patients with CH have changes of which 20% had sinus tachycardia and 20% has bradycardia. 100% of patients with SAH have ECG changes. Present study shows only 7% of patients with pathological Q waves. None of the patients with CH have Q wave changes.

DISCUSSION

Present study was carried out in medicine ward to find out the abnormalities in ECG of cerebrovascular disease. CT scan brain was taken within 24-48 hrs and analyzed and patients were categorized into cerebral infarct, intra cerebral haemorrhage and SAH.

The most common abnormality noted was ST segment changes in patient with cerebral haemorrhage. Findings of our study are in agreement with the study of Frentz and Gorsmen who reported an incidence of ST segment changes 71% with ICH and 15% with infarction. The study of Lindgren et al,[12] also showed ST segment depression in

Cerebrovascular diseases	No. of Cases	Abnormal ECG	Percentage (%)
Cerebral infarction	27	19	70
Cerebral Hemorrhage	20	17	89
Subarachnoid Hemorrhage	3	3	100
Total	50	39	78

Table-1: Incidences of abnormal ECG's in Cerebro-vascular diseases.

ECG changes	Cerebral infarction (n=27)	Cerebral Hemorrhage (n=20)	Subarachnoid Hemorrhage (n=03)
Elevated ST	3%	50%	33.3%
Depression of ST	33.3%	10%	0
Tall 'T' wave	7%	35%	33.3%
'T' wave inversion	22.2%	10%	0
Prolonged 'QTc" Interval	29%	50%	33%
QWave	7%	0	0
U wave	0	0	0

Table-2: Pattern of changes found in ECG in cerebrovascular disease patients.

Cerebrovascular diseases	Sinus Tachycardia	Sinus Bradycardia
Cerebral infarction (n=27)	4(15%)	0
Cerebral Hemorrhage (n=20)	4(20%)	4(20%)
Subarachnoid Hemorrhage (n=03)	3(100%)	0

Table-3: Incidences of Rhythm disturbances in ECG in cerebrovascular disease patients.

lateral leads.

QTc prolongation was the next common abnormality noted in our study. 50% of patients with intra cerebral haemorrhage had QTc prolongation. Similar kinds of observations are reported by Arruda and Lacerda[13], Keller and Williams[14] in stroke patients. Cruickshank et al[15], observed Tall T waves, short PR interval in cerebrovascular disease as reported in present study. T wave inversion was observed in 10% of patients with intra cerebral haemorrhage and 20% patients with cerebral infarction. The study of Hugen holtz et al[16], consisting of extremely inverted and wide T waves, prominent U waves and prolongation of QTc interval in stroke patients. Rhythm disturbance was observed in 15% of patients with cerebral infarction and 40% of patients with ICH and 100% of patients with SAH. These findings showed some correlation with study of MG Myers et al[17], on cardiac sequelae in stroke patients. This finding is also in conformity with study of A. Andreoli and colleagues[18] on rhythm disturbances in patients with subarachnoid haemorrhage in the acute phase. The study conducted by P J Brouwers et al[19], also revealed rhythm disturbances in 100% of patients with aneurysmal subarachnoid haemorrhage. Yamour et al[20], studied using the computerized tomographic (CT) scan, suggested that frontal lobe haemorrhages were associated especially with the ECG abnormalities of corrected QT interval (QTc) prolongation and neurogenic T waves.

These findings suggest that the structures related to cardiovascular function are widely distributed within the central nervous system. Therefore, it is likely that cerebrovascular accidents (CVA) lesions not only in the frontal lobe, but also in the temporo-parietal lobe and basal ganglia can destroy or irritate such widely spread neurons or pathways regulating the cardiovascular system, resulting in ECG changes.

CONCLUSION

The changes found in ECG of cardiovascular disease patients were not associated with any particular site of cerebral lesion. Cardiac disturbance are diverse and frequent in the setting of acute neurological injury. Furthermore, the presence of cardiac abnormalities has significant impact on clinical management and affects cardiac and neurological outcome.

Understanding that these ECG changes which are occurring in patients with cerebrovascular accidents is important because it may lead to erroneous judgment of assigning these patients as cardiac dysfunction.

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