Study of Electrocardiographic Changes in Acute Stroke

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Abstract
Aims and Objectives: *The present study was undertaken to find out ECG abnormalities associated with acute stroke and relationship of these abnormalities in cerebrovascular accident with mortality and prognosis.*
Method: *The study consisted of total 100 cases with history and clinical manifestations suggestive of acute stroke and confirmed by CT head and admitted in medicine wards of hospital. ECG changes in various types of stroke were observed in all the cases and results were analyzed statistically.*
Results: *The ECG changes observed in patients with acute stroke were T Wave inversion in 28 (28%), LVH (12%), ST depression (10%), prolonged QTc in 10(10%) and U wave 2(2%) cases. Rhythm abnormalities commonly noticed were sinus tachycardia in 5 (5%) cases, sinus bradycardia in 4(4%), ventricular premature complexes in 3 (3%) and supraventricular tachycardia in 2 (2%) cases. T-wave inversion (27.58%) and ST segment depression (10.34%) were common ECG abnormalities in ischemic stroke whereas QTc prolongation (28.57%), LVH (16.66%) and T inversion (16.66%) in hemorrhagic stroke. The overall mortality rate was 40% with higher in stroke group with abnormal ECG than those with normal ECG. QTc prolongation had prognostic significance in predicting mortality in stroke patients. No correlation was found with ECG abnormalities with location of brain lesion*
Conclusion: *Different ECG changes are observed in acute stroke patients even in absence of primary cardiac disease and these ECG changes can be predictor of prognosis.*
Keywords: *ECG, Acute stroke**, Cerebrovascular accident, Prognosis, CT head, intracranial lesion.*

Introduction

Most cerebrovascular diseases are manifested by the abrupt onset of a neurological deficit. A stroke or cerebrovascular accident is defined as abrupt onset of a neurologic deficit that is due to vascular cause[1]. Stroke is sometimes called as brain attack; it can injure the brain like the heart attack injures the heart[2]. It is the leading cause of mortality and morbidity worldwide and accounts for 20% of all neurological admissions in India. Role of heart as a cause of stroke has received much attention in recent past years and the decompensation in either central nervous system or cardiovascular system may adversely affect each other, whether or not the patient has recognized disease of both systems[3].

Numerous studies have demonstrated the fact that primary neurologic abnormalities may produce ECG changes without any myocardial lesion. ECG changes affecting T wave, U wave, S-T segment, Q-T interval and arrhythmias have been reported. These changes may resemble those of myocardial ischemia and acute myocardial infarction, leading to misinterpretation and delay in operative management of subarachnoid hemorrhage[4]. There are evidences suggesting, that patients who had ECG changes following cerebrovascular accidents had poor prognosis compared to those who did not show any ECG changes[5].

In view of above speculations, the present study was undertaken to find out the electrocardiographic abnormalities associated with acute stroke and the relationship of these abnormalities in cerebrovascular accident with mortality and prognosis.

Materials and Methods

It was a descriptive observational study conducted in Department of Medicine, at Government tertiary care hospital during the period from December 2014 to October 2016. Study consisted of total 100 cases of either sex, age > 18 years and with cerebrovascular accidents (CT proven cases) presenting for the first time within 72 hours of onset and admitted in medicine wards of hospital. Prior to the commencement of study, ethical clearance was obtained from Institutional Ethics Committee and informed consent was taken from all patients /patients's relatives. Cases of head injury, transient ischemic attack, individuals with known cardiac diseases (e.g. RHD, congenital heart disease, IHD, heart surgery, etc) or detected to have cardiac disease by clinical / 2-D ECHO evaluation those with hepatic or renal disorders which are known to induce circulatory, metabolic and electrolyte imbalances, patients on antiarrhythmic drugs, calcium antagonists, digitalis, etc were excluded from the study.

A detailed clinical history, thorough clinical and physical examination with emphasis to nervous system and cardiovascular system was done as per the standard proforma. A detailed history regarding the temporal profile of the stroke including history of risk factors like hypertension, diabetes mellitus, smoking, history of IHD and rheumatic heart disease was obtained and detailed neurological examination including fundoscopy and cardiovascular examination was carried out in all the cases. GCS (Glasgow Coma Scale) was recorded. In all cases, diagnosis was confirmed by CT Head. The report of CT scan was read by expert Radiologist who was unaware of the clinical details and diagnosis. ECG, 2D ECHO and all other investigation of these patients were done within 24 hours of admission. Those patients showing abnormal ECG changes were subjected to 2D ECHO evaluation. Results were analyzed with reference to age, sex, risk factors and clinical examination, CT findings and ECG findings.

Statistical Analysis

The collected data was analyzed using descriptive tool. Comparisons between the two groups (Ischemic/Hemorrhaghic) and (Survived/Died) was done by Chi-square test. P values less than 0.05 were considered significant.

Observations and Results

The present study included 100 patients having age between 30 to 85 years with maximum cases in the age group of 45 to 74 years (86 (86%) and mean age calculated was 55.72 years. Out of 100 cases, female contributes to 34(34%) and male to 66(66%) with male to female ratio of 1.9:1. CT scan was used to identify the type of stroke. Table 1 show the incidence of different types of stroke and also table predict that the ischemic stroke was more common than hemorrhagic stroke.

Table 1: Pattern of stroke in study population

Type of stroke	Males (n=66)	Females (n=34)	Total
	No. of cases (%)	No. of cases (%)	
Ischemic	34 (51.51)	24 (70.58)	58
Hemorrhagic	32 (48.48)	10 (29.41)	42

Hypertension was most common risk factor in ischemic and hemorrhagic stroke while other risk factors were diabetes, smoking and alcohol (Figure 1). In both ischemic and hemorrhagic

group, gangliocapsular region was most common site of lesion.

Figure 1: Risk factors in study population
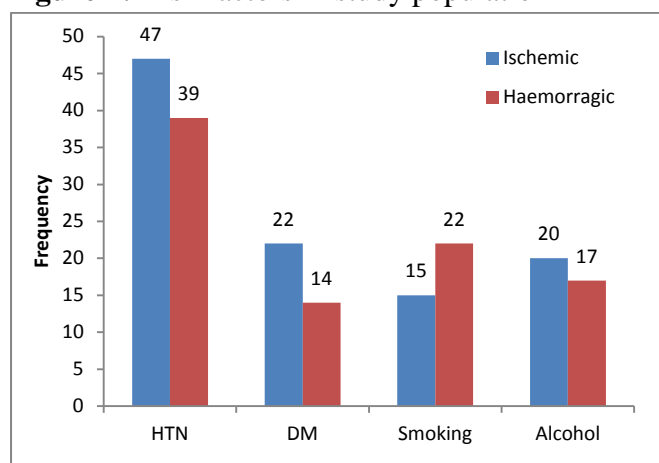
Out of 100 cases, normal ECG was observed in 28(28%) cases while abnormal ECG was observed in 72(72%). The incidence of ECG abnormalities was more in ischemic group (40 out of 58 cases) compared to hemorrhagic group (32 out of 42 cases). Mortality rate in present study was 40 (40%) and it was higher in hemorrhagic stroke group [30, (71.42%)] as compared to ischemic group [10 (17.24%)], (p value <0.0001). 4(10%) out of 40 patient died had normal ECG and remaining had abnormal ECG (36 cases). Normal ECG was more commonly observed in cases who survived as compared to those who died and this difference was found to be statistically significant, (p value <0.05). Mortality was higher in patients with abnormal ECG as compared to those with normal ECG.

The electrocardiographic changes observed in patients with acute stroke were T Wave inversion in 28 (28%) (Figure 2a), LVH (12%), ST depression (10%), prolonged QTc in 10(10%) (Figure 2a) and U wave 2(2%) cases. Rhythm abnormalities commonly noticed were sinus Tachycardia in 5 (5%) cases (Figure 2b), sinus bradycardia in 4(4%), (Figure 2c), ventricular premature complexes in 3 (3%) and supraventricular tachycardia in 2 (2%) cases (Figure 2d). In ischemic stroke group, most common ECG abnormalities was T wave inversion (27.58%) followed by ST depression (10.34%), QTc prolongation (8.62%) and LVH

(8.62%). In hemorrhagic stroke group, most common ECG abnormalities were QTc prolongation (28.57%) followed by T inversion (16.66%), LVH (16.66%) and ST depression (9.52%). ECG abnormalities in patients who died were QTc prolongation in 15 (37.5%) patients, T inversion in 10(25%), LVH in 6 (15%) ST depression was observed in 4(10%) patients, SVT in 2 (5%) patients and U wave in 1 (2.5%) patient. QTc prolongation was most common ECG abnormality (37.5%) amongst died patients followed by T wave inversion (25%). QTC prolongation was more common in cases who died as compared to those who survived and this difference was found to be statistically significant, (p <0.05).

Discussion

The patient with stroke and with an abnormal ECG represents a common diagnostic challenge to the clinician, because ECG changes in stroke mimic the finding those of myocardial ischemia, rhythm disorders, other cardiac disorders, etc thereby affecting the assessment of immediate prognosis and thus delaying the definite surgical management in these stroke patients.

In present study, the mean age of the patients was 55.72 years, ranging from 30-85 years; the maximum cases (42%) were from age group 45-54 followed by 32% cases from age group 55-64 and 12% patients from age group of 65-74 years. There was a male preponderance in our study. The age distribution and male preponderance was similar to other studies [6-11]. Out of 100 cases studied, 58(58%) had ischemic stroke while 42 (42%) had hemorrhagic stroke, thus the ischemic stroke was more common than hemorrhagic stroke in our study. Amongst 66 male cases, 34(51.55%) had ischemic stroke and 32(48.48%) had hemorrhagic stroke while amongst 34 female cases, 24(70.58%) had ischemic stroke and 10(29.41%) and hemorrhagic stroke. Thus the male preponderance was present in both ischemic and hemorrhagic stroke group. Similar findings were noticed in previous studies [6,10,12].

Figure 2: ECG Suggestive of a) T Inversion- I, II, III, V3-V6 and QTc prolongation, b) Sinus Tachycardia, c) Sinus Bradycardia, d) Supraventricular Tachycardia
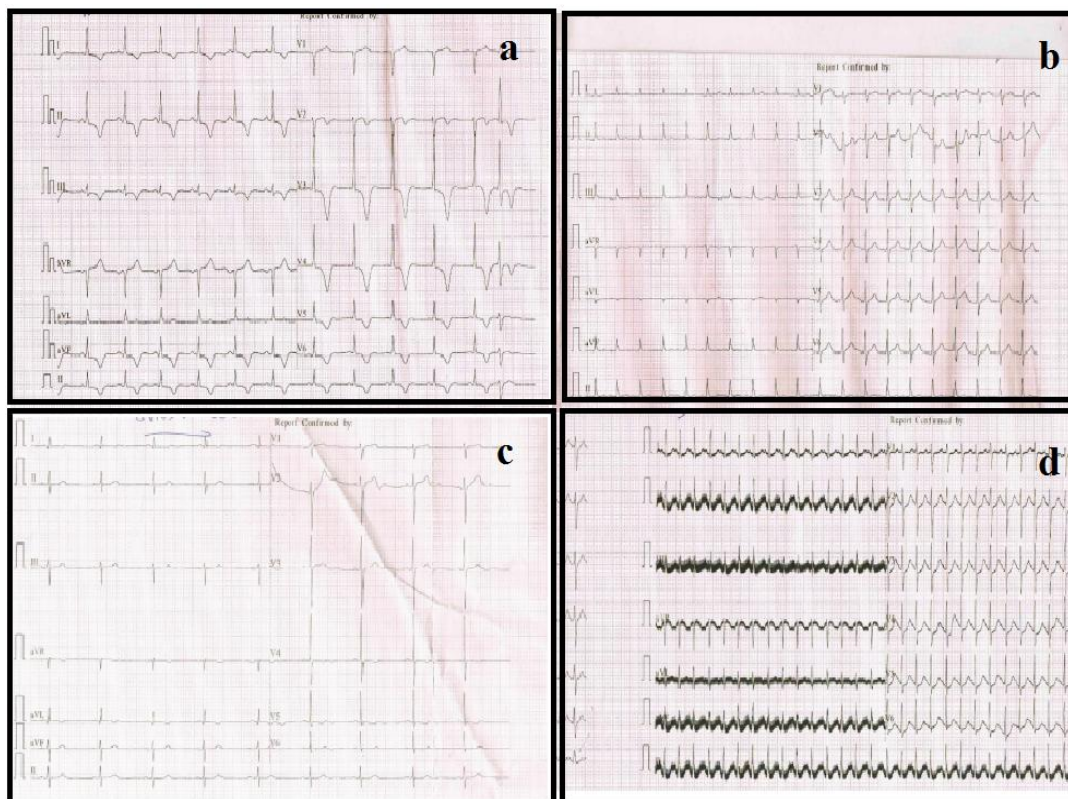
Hypertension was found to be commonest (86%) risk factor and most of the patients were presented as recently detected hypertension. In ischemic stroke, 47(81.03%) patients had hypertension and in hemorrhagic stroke, 39(92.85%) patients had hypertension. Other risk factors were diabetes mellitus observed in total 36(36%) patients [ischemic group-22 (37.93%) and hemorrhagic group-14(33.33%)], 37 (37%) patients were smokers and 37 (37%) cases were alcoholic, this was similar to prior studies [8-10].

Right hemiplegia was present in 33(33%) patients and left hemiplegia in 48 (48%) patients. In ischemic stroke, right hemiplegia/ hemiparesis was present in 20(34.48%) while left hemiplegia/ hemiparesis was present in 30 (51.72%). In hemorrhagic stroke group, right hemiplegia/ hemiparesis was present in 13(30.95%) while left hemiplegia/ hemiparesis present in 18(42.85%). Similar findings were found in study of Channappa et al[10]. Table 2 shows the anatomical site of hemorrhagic and ischemic stroke, this distribution by anatomical site of stroke comparable with different studies [7,13].

Table 2: Anatomical site of different stroke

Site of Hemorrhagic stroke	Total cases	Site of ischemic stroke	Total cases
GCA (Gangliocapsular Area)	24(57.14%)	Lobar	29(50%)
Lobar hemorrhages	8(19.04%)	GCA	22(37.93%)
Subarachnoid hemorrhage	6((14.28%)	Lobar and GCA	3(5.17%)
Pontine hemorrhage	3(7.14%)	Thalamus	1(1.7%)
Cerebellar hemorrhage	1(2.3%)	cerebellum	3(1.7%)
Total	42	Total	58

Amongst 58 cases of ischemic stroke group, 18(31.03%) patients had normal ECG and 40 (68.96%) patients had abnormal ECG while amongst hemorrhagic stroke group, 10(23.80%)

had normal ECG and 32(76.19%) had abnormal ECG. Similar findings were noticed in previous studies [6,14,15]. The overall mortality rate was 40 (40%) of which 10 (17.24%) in ischemic group and 30(71.42%) in hemorrhagic group, indicates higher mortality rate in hemorrhagic stroke group and this higher mortality was due to late presentation of most patients to our hospital. Out of 100 cases, 72 had abnormal ECG, of which 36 (50%) survived and 36(50%) died. The normal ECG was observed in 28 cases, of which 24 (85.71%) survived and 4 (14.28%) died. Thus, it was observed that mortality was higher in patients with ECG abnormalities which was statistically significant (p <0.05). Similar findings were observed by Purushothaman et al [6] and Saxena et al [15].

T wave inversion was observed in total 23 (23%) stroke patients. In ischemic stroke, 16(27.58%) cases had T inversion whereas in hemorrhagic group 7(16.66%) had T inversion. ST depression was observed in 10(10%) cases, 6(10.34%) from ischemic stroke group and 4(9.5%) from hemorrhagic stroke group. The frequency of T wave inversion and ST depression was higher in ischemic stroke as compared to hemorrhagic group. QTc prolongation was observed in 17 (17%) cases, 5(8.62%) from ischemic stroke and 12(28.57%) from hemorrhagic stroke group. The percentage of QTC prolongation was higher in hemorrhagic group as compared to ischemic group which was found to be statistically significant (p value <0.05). The LVH was observed in 12(12%) patients, 5(16.66%) patients from ischemic group and 7(16.66%) patients from hemorrhagic group. Uncontrolled hypertension in patients might be the cause of LVH in our study. Sinus tachycardia was observed in 5(5%) patients, 4(6.89%) patients from ischemic group and 1(2.38%) patient from hemorrhagic group while sinus bradycardia was observed in 4 (4%) cases, 2(3.44%) from ischemic stroke and 2(4.76%) patients from hemorrhagic stroke group. VPC were observed in (3%) patients, 2(3.44%) from ischemic stroke and 1 (2.38%) patient from

hemorrhagic group. U waves were observed in 2% patients, 1(1.72%) from ischemic group and 1(2.3%) patient from hemorrhagic group. Supraventricular tachycardia (SVT) noted in 2(2%) patients, 1 (1.72%) from ischemic stroke and 1(2.38%) patient from hemorrhagic group. Overall arrythmias in our study was 15%, (Sinus tachycardia, sinus bradycardia, VPC, SVT etc). The results of various ECG changes observed in stroke patients were correlated with other studies [6-10, 12-14, 16-17].

Total number of patients died was 40, amongst which T inversion was observed in 10(25%), ST depression was observed in 4(10%) patients, QTc prolongation was observed in 15 (37.5%) patients, LVH was observed in 6 (15%) patients, U waves were observed in 1 (2.5%) patient, SVT were observed in 2 (5%) patients and normal ECG was observed in 4 (10%) patients. QTc prolongation was most common ECG abnormality (37.5%) amongst died patients followed by T wave inversion (25%). QTC prolongation was more common in cases who died as compared to those who survived and this difference was found to be statistically significant, (p <0.05). Thus, QTC prolongation was also found to have prognostic significance in present study. Normal ECG was more commonly observed in cases who survived as compared to those who died and this difference was found to be statistically significant (p value <0.05). Similar finding was observed by Saxena et al [15]. In our study, no correlation was found with ECG abnormalities with location of brain lesion, this was compared with other studies [18-20].

Limitations

There are some limitations of the study which includes- 1. Sample size may not be appropriate representative of the population. 2. Present study was carried out in Government tertiary care hospital where most of the stroke patients were admitted and treated in general medicine wards. So, continuous telemetry monitoring was not done due to lack of resources in government centre. 3. Patients were followed only during the period of

hospitalisation. Therefore, follow up of patients can also be considered to look for reversal of ECG changes.

Conclusion

Different ECG changes were observed in acute stroke patients even in absence of primary cardiac disease. T-wave inversion and ST segment depression were common ECG abnormalities in ischemic stroke, whereas QTc prolongation, LVH and T wave inversion were common ECG abnormalities in hemorrhagic stroke. Mortality was higher in stroke group with abnormal ECG, therefore it is important to monitor cardiac activity in all the patients of stroke to detect abnormal ECG changes. QTc prolongation had prognostic significance in predicting mortality in stroke patients. Relationship between specific ECG changes to the site of intracranial lesion could not be established.

The study suggested that the mortality was higher in stroke group with abnormal ECG therefore, continuous ECG monitoring should be advisable to patients with acute stroke for detection of these changes and urgently management of life threatening arrhythmia if occur, may improve the survival outcomes of such patients. Further studies are required to more precisely clarify the causal connection between ECG abnormalities and the intracranial lesion.

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