Original Article

A Study of Electrocardiogram Changes in Patient with Acute Stroke in a Medical College Hospital

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Abstract:
Electrocardiographic changes are frequently observed in acute stroke patients and create diagnostic dilemma with ECG changes found in cardiac disease. The aim of the study was to find out the ECG changes in patient with acute stroke who are not suffering from primary cardiac diseases. It was a hospital based prospective observational study conducted for a period of 18 months (January 2016 to July 2017) in a medical college hospital. Total 100 patients were enrolled in this study who presented with acute stroke both ischemic & haemorrhagic. Different ECG changes were observed (Table II) in present study including rhythm disturbances (tachycardia, bradycardia, atrial fibrillation, premature ventricular ectopic). Most important ECG findings were T-wave inversion (21.43%), prolong QT interval (12.5%), atrial fibrillation (10.71%), S-T segment change (8.93%), 1st & 2nd heart block (7.14%), Q-wave (8.9%). Two or more changes were also observed in 5.3% cases. There were no ECG changes in 10 patients out of 100 cases. T-wave inversion, prolong Q-T interval and atrial fibrillation followed by S-T segment changes were the most frequent ECG changes observed in this study. Cautious interpretation of ECG in acute stroke patient, which is not due to primary cardiac disease, is important to avoid unnecessary diagnosis and treatment.

Key words: Electrocardiographic change, Acute stroke

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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 causes other than of vascular origin[1]. It is due to secondary interruptions in blood flow or by haemorrhage in or around brain matter. Burden of stroke morbidity and mortality are alarming and well known.

Globally, in 2013 there were 6.5 million stroke deaths, making stroke the second leading cause of death behind ischemic heart disease[2]. Approximately 7,95,000 strokes occur in the United States each year[2]. Stroke is the third leading cause of death in Bangladesh. The World Health Organization ranks Bangladesh's mortality rate due to stroke as number 84 in the world[3]. The reported prevalence of stroke in Bangladesh is 0.3%, although no data on stroke incidence have been recorded[3,4].

Role of heart as a cause of stroke has received much attention in recent past years and decompensation in either central nervous system or cardiovascular system may adversely affect each other, whether or not patients has recognized diseases of the both systems[2].

ECG changes are present in 60-90% of patients with intra-parenchymal or subarachnoid bleeding and in about 5-20% of patients with acute-ischemic stroke[5].

Probable underlying basis is the disordered repolarization process. The possible mechanism is through disturbances in autonomic regulation and massive stimulation of the sympathetic nervous system[5,6].

Heart attack and strokes are both caused by diseases of the blood vessels. So they share the same risk factors and modification of these risk factors may reduce the possibility of stroke.

Numerous studies have demonstrated the fact that the primary neurological abnormalities may produce ECG changes without any myocardial lesion[7,16]. ECG changes affecting T-wave, U-wave, S-T segment, Q-T interval and arrhythmia have been reported[8,15,16]. These changes may resemble those of myocardial ischemic and acute myocardial infarction, leading to misinterpretation and delay in operative management of acute stroke. There are evidences suggesting that patients who had ECG changes following cardiovascular accidents had poor prognosis compared to those who did not show any ECG changes[7,8].

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Approximately 2-6% of all stroke patients die from cardiac causes in first three months after ischemic stroke[9,10]. So, change in pattern and ECG in acute stroke patients without any cardiac abnormalities have both diagnostic and prognostic values.

In the view of the above speculations, this study was undertaken to identify the ECG changes produced due to cerebrovascular accidents.

Methodology:
It was a prospective observational study which was conducted in the Department of Medicine, Eastern Medical College Hospital, Cumilla, Bangladesh. This study was carried out for a period of 1½ years (January 2016-July 2017). In total 100 patients were included in this study. During this period, data collection, organization, data presentation, data analysis and data interpretation were done. Inclusion and exclusion criteria were applied to include patients in this study.

Inclusion Criteria:
Patients presenting with acute stroke within 24 hours aged from 35 to 85 years.

Exclusion Criteria:
1. Cases of head injury.
2. Cases who came after 24 hours.
3. Patients with known cardiac diseases or biochemical cardiac markers like troponin I positive have been excluded.

Case Definition:
Patients with clinical presentation of stroke presented within 24 hours of episodes having infarct or bleeding on CT scan of Brain/ MRI of Brain.

Demographic factors and general physical examinations carried out along with detailed systemic examinations with the emphasis to nervous system and cardiovascular systems were done.

Investigations:
1. Non-contrast CT Brain/ MRI Brain done at the time of presentation to hospital.
2. ECG: 1st ECG was taken at the time of admission and 2nd ECG after 48 hours of acute stroke.
3. Cardiac markers and the other relevant investigations.

Table-I: Prevalence of Different Types of Strokes

Types of Stroke	No. of Patients (%)	ECG Change
Ischemic/ Thromboembolic	60	56 (62.2%)
Haemorrhagic (including SAH)	40	34 (37.78%)
Total	100	90 (90%)

Table-II: Pattern of ECG changes in different groups of stroke patients

Variables	Ischemic Group		Haemorrhagic Group		Total	
	1st ECG	2nd ECG	1st ECG	2nd ECG	1st ECG	2nd ECG
Heart rate						
Tachycardia	5/56 (8.93%)	4/56 (7.14%)	3/34 (8.82%)	2/34 (5.88%)	8/90 (8.88%)	6/90 (6.67%)
Bradycardia	3/56 (5.36%)	4/56 (7.14%)	2/34 (5.88%)	3/34 (8.82%)	5/90 (5.55%)	7/90 (7.78%)
Rhythm abnormalities						
Atrial fibrillation	6/56 (10.71%)	5/56 (8.93%)	3/34 (8.82%)	2/34 (5.88%)	9/90 (10%)	7/90 (7.78%)
Premature ventricular contraction (PVC)	6/56 (10.71%)	3/56 (5.36%)	2/34 (5.88%)	2/34 (5.88%)	8/90 (8.88%)	5/90 (5.55%)
T-wave inversion	12/56 (21.43%)	14/56 (25%)	8/34 (23.53%)	9/34 (26.47%)	20/90 (22.22%)	23/90 (25.56%)
ST segment change	5/56 (8.93%)	6/56 (10.71%)	4/34 (11.76%)	3/34 (8.82%)	9/90 (10%)	9/90 (10%)
1° and 2° heart block	4/56 (7.14%)	4/56 (7.14%)	2/34 (5.88%)	3/34 (8.8s2%)	6/90 (6.67%)	7/90 (7.78%)
Prolong QT interval	7/56 (12.5%)	8/56 (14.28%)	5/34 (14.70%)	5/43 (14.70%)	12/90 (13.33%)	13/90 (14.44%)
Q-wave	5/56 (8.93%)	5/56 (8.93%)	3/34 (8.82%)	3/34 (8.82%)	8/90 (8.88%)	8/90 (8.88%)
Two or more than two changes	3/56 (5.36%)	3/56 (5.36%)	2/34 (5.88%)	2/34 (5.88%)	5/90 (5.55%)	5/90 (5.55%)

Statistical Analysis:
Data was analyzed using standard statistical method and results were compared.

Results:
During 1½ years of study, total 100 patients were included having age between 35 to 85 years with a mean age of 56 years. CT scan (non-contrast) was used to identify the type of stroke.

Table-I, shows the different types of strokes and their ECG changes. 1st ECG was taken within 24 hours of stroke and the next ECG within 48 hours of hospital admission. On the basis of CT findings, 60 (60%) patients had ischemic stroke and 40 (40%) patients were haemorrhagic. Out of 100 stroke patients, 90 patients revealed ECG changes and rest 10 patient's ECG reading was normal within the given time.

In Table-II, ischemic stroke showed more ECG changes than the haemorrhagic stroke (62.2% vs 37.7%). The most important Electrocardiography changes observed in patients with acute ischemic stroke were T-wave inversion in 12 (21.43%), prolong QT interval 7 (12.51%), atrial fibrillation 6 (10.71%), followed by ST segment changes 5 (8.93%), 1° & 2° heart block 4 (7.14%), Q-wave 5 (8.9%). Tachycardia 5 (8.9%) and Bradycardia 3 (5.36%). Two or more than two changes were also observed in 3 (5.3%) cases. In case of 2nd ECG reading, which was taken within 72 hours of study, some ECG changes became normalized or improved like tachycardia and atrial fibrillation, but in most cases T-wave inversion persisted.

In case of haemorrhagic stroke, following ECG changes were present. T-wave inversion 8 (23.5%), prolong QT interval 5 (14.7%), atrial fibrillation 3 (8.8%), premature ventricular contraction (PVC) 2 (5.8%), Q-wave 3 (8.8%), two or more than two changes 2 (5.8%). In the 2nd ECG, which was done in 72 hours of incidence, Tachycardia, Bradycardia, atrial fibrillation became near normal, but T-wave inversion and prolong Q-T interval remained persistent.

Discussion:
The patient with acute stroke either ischemic or haemorrhagic with an abnormal ECG represents a common diagnostic challenge to the clinician, because ECG changes in stroke mimics the findings those of myocardial ischemia, arrhythmia and other cardiac disorders[11]. Abnormal ECG findings are very common in stroke patients without primary cardiac diseases, although many cardiac diseases may lead to cerebrovascular diseases[11,12].

The mechanism by which acute cerebrovascular events causes ECG changes are still an unresolved issue. It has been suggested that changes in the autonomic nervous system activities can be primarily responsible for these ischemic, arrhythmic and repolarization changes[13,14].

Sustained sympathetic stimulation results in structural damage to the myocardium, which may be mediated by a sudden increase in intracranial pressure, hypothalamus and cardiac nerve stimulation or through an arrhythmogenic centre in the insular cortex[13,14]. Moreover, direct damage to the cardiac innervation or imbalance between the left and the right sympathetic outflows to the heart, underlying atherosclerotic or the hypertensive cardiovascular diseases or undetectable primary heart diseases are among the suggested causes[13,14,15].

Our present study revealed some important ECG findings of acute stroke patients without primary cardiac diseases. Most common ECG findings in our study was T-wave inversion in ischemic stroke (21.4%) and in haemorrhagic stroke (23.5%) which was similar in many other studies[11,12,15,16]. Akbar MA et al. found atrial fibrillation is 17.24% of ischemic group, not in haemorrhagic group, but our study revealed atrial fibrillation is 10% in ischemic group and 8% in haemorrhagic stroke which is not similar with their study[18].

ST-T changes were seen in 10% of ischemic groups and 11% in haemorrhagic group in our study. Haemorrhagic group has slightly higher incidence of ST-T changes. This was in contrast to the study of Ebrahim et al., who found ischemic changes, ST-T changes to abnormal T-wave to be the predominant findings in his series of ischemic stroke with changes in 37% patients[19]. Fure et al. found higher incidence of T-wave changes in his study (17.8%) which is similar with our study[20]. Higher incidence of ST-T changes in ischemic stroke may be found due to some underlying ischemic heart diseases which we could not study.

Why there is a significant ECG change in acute stroke patients without primary cardiac diseases is yet to be settled but different school of thoughts persist about this issue. Changes in ECG in acute stroke may reflect deranged central nervous system influences on cardiac autonomic functions in the autonomic neuronal stimulation from the hypothalamus or from the elevated circulating catecholamine[19, 20, 21]. There might also be an actual concomitant myocardial injury that may or may not be due to underlying cardiac diseases[22,23].

Limitations:
Our sample size was small. We could not compare the ECG changes of both groups with some relevant statistical tests. Immediate and long term outcome of patients on the basis of ECG changes could not be evaluated in this study.

Conclusion:
Different types of ECG changes including T-wave inversion, prolong Q-T interval, atrial fibrillation, S-T, T-wave changes were the most important findings in this prospective observational hospital based study. ECG changes in acute stroke patients may present without primary cardiac disease but concomitant cardiac pathology may also present which should be ruled out by doing continuous ECG monitoring and other relevant investigations to reduce the mortality and morbidity of the patients.

Conflict of interest:
Authors declare no conflict of interest.

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