Prognostic Importance of ST-T Changes in ECG in Acute Stroke

Piyush Saxena[1], Lakshya Kumar[2], N C Dwivedi[3], P C Saxena[4]

ABSTRACT

Introduction: Patients of acute stroke without any primary heart disease develop changes in ECG, these ECG changes are many a times related with the prognosis. Aim of the study was to evaluate the significance of major and minor ST-T changes in ECG as a method of prediction of outcome in stroke patients without primary heart disease.

Material and Methods: This prospective study consisted 132 patients (82 males and 50 females) with acute stroke, presented to the hospital within 48 hours of onset of stroke during one year. Patients suffering from preexisting heart disease, previous stroke or electrolyte imbalance were excluded. The ECG were observed for ST-T changes and read according to the Minnesota Code. Follow-up assessment and outcome was evaluated during the hospital stay.

Results: Of the 132 patients with acute stroke included in this study, 61 (46.21%) patients had ischemic stroke and 71 (53.79%) patients had haemorrhagic stroke and; ST-T changes were seen in ECG of 72 (54.55%) patients while 60(45.45%) patients had normal ECG. In patients with ST-T changes, major ST-T changes i.e. ST-segment elevation were seen in 11.11% (n=8) whereas minor ST-segment changes i.e. ST-segment depression and T inversion were seen in 88.89% (n=64). Out of 72 patients with ST-T changes, 62.28% (n=47) expired during the hospital stay, among them 12.77% had major ST-T changes while 87.23% had minor ST-T changes, and 37.72% (n=25) survived [p value=0.596]. Out of 60 patients with normal ECG, 46.67% (n=28)expired and 53.33% (n=32) survived. This outcome was statistically significant [p value=0.036].

Conclusion: Patients of Stroke with ST-T changes in ECG had higher mortality than those with normal ECG. Thus, ST-T changes in ECG has poor prognosis in patients of Acute Stoke.

Keywords: Acute Stroke, Electrocardiogram (ECG), ST-T changes, Prognosis.

INTRODUCTION

Stroke or cerebrovascular accident defines an acute vascular event in the brain and is a leading cause of death and disability worldwide. Acute stroke is a multi factorial condition with respect to prognosis. It is not possible to predict exact outcome of stroke with accuracy. The chances of survival in stroke depend on a great variety of variables.Cardiovascular complications are extremely commonfollowing stroke and represent a major form ofmorbidity. In 1930, the effect on the heart was demonstrated in experimental animals with brain injury.[1] Subsequently, several studies investigated the effect of brain injury on the heart and very few studies addressed the issue of the prognostic significance of these changes.[2-3] The prognostic significance of various electrocardiographic changesin stroke like arrhythmiashas been well studied.[4] Our study was done to study the prognostic significance of ST-T changes in ECG in patients of Acute Stroke.

MATERIAL AND METHODS

This prospective study was conducted in the Department Medicine, S.R.N. Hospital, Allahabad, UP during a period of one year from July 2012 to July 2013. All patients (132 patients) of acute stroke presenting to the department within 48 hours of onset were included in the study, irrespective of age, sex or type of stroke and informed consent was taken from each patient. Patients presented after 48 hours of onset of acute stroke, prior stroke, intracerebral hemorrhage due to bleeding from brain tumor, stroke related to trauma, pre-existing heart disease, ECG changes other than ST-T changes and electrolyte disturbance (e.g. S. Calcium and Potassium) were excluded from the study.

Diagnosis of acute stroke was established in all the patients by cranial tomography (CT scan) or magnetic resonance imaging (MRI scan). Detailed history and neurological findings were recorded in all the patients. All the patients were evaluated for cardiac disease by detailed history and clinical examination. A 12 lead ECG was recorded at the time of admission for analyzingST-T change as per Minnesota Code (MC). Cardiac biomarker Troponin-I was done to exclude cardiac origin of ST-T changes in ECG.

Follow-up of patients was done during their hospital stay regarding the in-hospital mortality.

STATISTICAL ANALYSES

Comparisons between the two groups were done using appropriate statistical methods including the chi-square test. Data analysis was carried out using the appropriate stastical software. P values less than .05 were considered significant.

RESULTS

The study included 132 patients, 82 (62.12%) were males and 50 (37.88%) were females. The mean age of the patients was 67.04±8.90 years (range 50-89 years). Majority of the patients suffered hemorrhagic stroke n=71 (53.79%) as compared to ischemic stroke n=61 (46.21%). On analyzing ECG, 72 (54.55%) patients had ST-T changes while 60 (45.45%) had normal ECG. According to the Minnesota Code for ST-T changes in ECG, 8 (11.11%) patient had ST-segment elevation, 24 (33.33%) had ST-segment depression and 40 (55.56%) patients had T-wave

[1]Assistant Professor, [2]Resident, [3]Professor, Department of Medicine, [4]Professor, Department of Cardiology, MLN Medical College, Allahabad, India

Corresponding author: Dr Piyush Saxena MD, 18, Hamilton Road, George Town, Allahabad-21102, UP, India

How to cite this article: Piyush Saxena, Lakshya Kumar, N C Dwivedi, P C Saxena. Prognostic -mportance of ST-T changes in ECG in acute stroke. International Journal of Contemporary Medical Research 2016;3(7):1999-2001.

inversion. Both the groups had similar age wise, sex wise and type of stokewise distributionof patients as shown in table-1 and 2.

Patients with ST-T changes, 3 (0.04%) had mildly elevated troponin I level, which was done on next day of admission to the hospital while no patient with normal ECG had elevated level of troponin-I. This elevated troponin-I level was statistically insignificant.

Among patients with ST-T changes, 47 (62.28%) patients expired during the hospital stay and 25 (37.72%) patients survived i.e. discharged from hospital; and the average duration of hospital stay was 7.4±1.1 days. Similarly, among patients with normal ECG, 28 (46.67%) expired and 32 (53.33%) patients survived; and the average duration of hospital stay was 6.6±0.8 days (Table-3). This comparative outcome of acute stroke patients with ST-T changes in ECG and normal ECG was statistically significant (p value=0.036).

In both the groups, mortality of patients with haemorrhagic stroke was higher (74.36% with ST-T changes and 59.37% with normal ECG) than the patients with ischemic stroke (54.54% with ST-T changes and 32.14% with normal ECG).

ECG Finding	Ischemic	Hemorrhagic	Total
ST-T changes	33 (45.83%)	39 (54.17%)	72
Normal ECG	28 (46.67%)	32 (53.33%)	60

Table-1: Stroke wise distribution

ECG Finding	Mean age (Years)	Male	Female
ST-T changes	66.04±8.90	44 (61.11%)	28 (38.89%)
Normal ECG	68.40±9.67	38 (63.33%)	22 (36.67%)

Table-2: Age and sex wise distribution

ECG Finding	Expired	Survived	Average Hospital Stay(Days)
ST-T changes	47 (62.28%)	25 (37.72%)	7.4±1.1
Normal ECG	28 (46.67%)	32 (53.33%)	6.6±0.8

Table-3: Outcome of patients

DISCUSSION

Primary cardiac disorders can lead to stroke[5], but the idea that CNS disorder such as stroke may produce ECG changes is fairly recent. The electrocardiographic changes in patients with cerebrovascular accidents were noticed as early as 1937 by Dozzi.[6] ECG changes are present in anywhere from 60-90% of patients with intra-parenchymal or subarachnoid bleed and in about 5-20% of patients with acute ischemic stroke.[7] The underlying basis is disordered repolarization process.[2] There is a relation between these changes and sudden death in sufferers of stroke.[8] The possible mechanism is through disturbances in autonomic regulation and massive stimulation of the sympathetic nervous system.[9] The ECG abnormalities most frequently noted are ischemic changes 35%, prolongation of QT interval 45% and disturbances in rate and rhythm 25%, which include atrial fibrillation, premature atrial and ventricular complexes, supra-ventricular and ventricular tachycardia (SVT and VT), torsadesde pointes or polymorphic ventricular tachycardia.[10,11] Stroke induced ECG changes are evanescent, resolving over a period of days to months. However, the frequency and severity of ECG changes is highest within 48 hours of the onset of stroke which explains the importance of continuous ECG monitoring for these patients.[12]

Electrocardiographic changes without demonstrable cardiac cause have been found in some patients with cerebrovascular accidents.[13,14-17] FentzV et al[18] in a study found that ECG changes are present in 60-90% of patients with intraparenchymal or subarachnoid bleed and in about 5-20% patients with acute ischemic stroke. Similarly in another study ECG changes found in 60% to 70% of patients with intracerebral hemorrhage, 40% to 70% of patients with subarachnoid hemorrhage, and 15% to 40% of patients with ischemic stroke.[19] The ECG abnormalities most frequently noted are ischemic changes (35%), prolongation of QT-interval (45%), and disturbances in rate and rhythm (25%) e.g. atrial fibrillation, premature atrial and ventricular complexes, supra ventricular and ventricular tachycardia (SVT and VT), torsade de pointes or polymorphic ventricular tachycardia.[11] Goldstein et al[10] found that in stroke the commonest ECG alterations are: QT prolongation (32%), U wave alterations (13%), ST changes (21%), T wave inversion (15%). ECG abnormalities were present in 100 patients with acute cerebrovascular disease and previously normal heart, the abnormalities were more often seen in patients with intracerebral and subarachnoid hemorrhages, was reported in a study. QTc prolongation and ST segment and T-wave abnormality were the most common changes.[1] In a study of Lindgren et al[20] transient ST-T changes were found in 54% of patients with ischemic stroke with no primary heart disease.In our study, as we included stroke patients with only ST-T changes in ECG, so we could not compare the frequency of various ECG changes in stroke patients. In this study 33.33% (n=24) patients had ST-segment depression, 11.11% (n=8) had ST-segment elevation and 55.56% (n=40) patients had T-wave inversion, which showed frequency of various ST-T changes according to previous studies.

Among the total of 72 stroke patients with ST-T changes in ECG,45.83% (n=33) patients suffered from ischemic stroke and 54.17% (n=39) patients suffered from haemorrhagic stroke. In the same study, 60 stroke patients with normal ECG were, 46.67% (n=28) had ischemia and 53.33% (n=32) had haemorrhage. A higher number of haemorrhagic stroke patients could be explained by the fact that the study was hospital based and cannot be generalised to whole population as shown by several studies.

In this study, in both the groups, maximum number of patients (with ST-T changes n=33 patients and with normal ECG n=40 patients) were in age group 61-70 years. S Vermeer et al[21] found that age of 65 years or more doubled the risk of occurrence of stroke. Similar observation was made by TZ Ong et al[22] in their study on stroke patients where the mean age of the stroke patients was 65 years.

Peter Appelros et al[23] in a systemic review in 2009 found that the higher incidence rates of ischemic and intracerebral stroke observed in males than females of the same age, based on age-adjusted data. A study conducted by Marwat MA et al[24] in 88 selected cases of stroke in which male were 62 (70.5%) and female were 26 (29.5%). Similar ratio of male and female patients was found in our study i.e. among the patients with ST-T changes, 44 (61.11%) were male and 28 (38.89%) were female

while among the patients with normal ECG, 38 (63.33%) were male and 22 (36.67%) were female respectively.

The most common cause of death in patients with stroke is cardiac.[1] Earlier studies suggest that new ECG changes in the acute phase of stroke are associated with higher mortality.[2] Dogan A et al[25] concluded that regardless of origin, ST-segment change in ECG can be a predictor of early mortality. In our study, 62.28% patients expired who had ST-T changes in ECG, as compared to 46.67% patients expired with normal ECG. The value were found to be statistically significant (p value=0.036). Ischemia like and repolarization changes in ECG, that occurs in patients with acute stroke have been thought to be due to myocardial stunning, changes in autonomic nervous system and catecholamine mediated injuries. Some have attributed these changes to lesions in the insular cortex, which can lead to cardiac abnormalities such as ischemic-like changes, arrhythmias and even myocytolysis. This sometimes makes it difficult to make a diagnosis of heart disease in the presence of acute stroke.[26]

CONCLUSION

The observations of our study suggested that acute stroke patients with ST-T changes in ECG had higher mortality i.e. poor prognosis than acute stroke patients with normal ECG. And in acute stroke, every patient with ST-T changes in ECG may not have concurrent myocardial ischemia.

REFERENCES

1. Oppenheimer SM. Neurogenic cardiac effects of cerebrovascular disease. CurrOpinNeurol. 1994;7:20-4.
2. Oppenheimer SM, Hachinski VC. The cardiac consequences of stroke. NeurolClin. 1992;10:167-76.
3. Korpelainen JT, Sotaniemi KA, Huikuri HV, Myllya VV. Abnormal heart rate variability as a manifestation autonomic dysfunction in hemispheric brain infarction. Stroke. 1996;2059-63.
4. Sacco RL, Benjamin EJ, Broderick JP et al: American Heart Association Prevention Conference IV: Prevention and rehabilitation of stroke: risk factors. Stroke. 1997; 28:1507-17.
5. Cheyenne J. A case of apoplexy in which the fleshy part of the heart was converted into fat. Dublin Hosp Rep. 1818; 2:216.
6. Dozzi DL. Cerebral embolism as a complication of coronary thrombosis.Amer. J.Med.Sci. 1937;194:824.
7. Fentz V, Gormsen J. Electrocardiograph patterns in patients with acute cerebrovascular accidents. Circulation. 1962;25: 22-8.
8. Ince B, Celik Y, Bingol H, Harmanci H, Denktas H. Electrocardiographic findings and prognosis inischemic stroke. Cerrahpasa J Med. 1998;29:70-4.
9. Melville KI, Blum B, Shistr HE. Cardiac ischemic changes and arrhythmias induced by hypothalamic stimulation. Am J Cardiol. 1963;12:78.
10. Goldstein DS. The electrocardiogram in stroke: Relationship to pathophysiological type and comparison with prior tracings. Stroke. 1979;10:253-9.
11. Connor R. Myocardial damage secondary to brain lesions. Am Heart J. 1969;78:145-8.
12. Suffer J, Dreifus LS, Michelson E. Polymorphous ventricular tachycardia associated with normal and long QT intervals. Am J Cordiol. 1982;49:2021-9.
13. Burch G.E, et al: A new electrocardiographic pattern in patients with cerebrovascular accidents. Circulation, 1954;9:719.
14. Byei, E., Ashman R et al. Electrocardiogram with large upright T-waves and long Q-T intervals. Am. Heart J. 33: 796,1947.
15. Levine H.D. Non-specificity of the electrocardiogram associated with coronary heart disease. Am. J. Med. 1953; 15: 344.
16. Wasserman F, Choquette G, Casinelli R, Bellet S. Electrocardiographic observations in patients with cerebrovascular accidents. Report of 12 cases. Am. J. M. Sc. 1956;231:502.
17. Cropp GJ, Manning GW. Electrocardiographic changes simulating myocardial ischemia and infarction associated with spontaneous intracranial hemorrhage. Circulation. 1960;12:25.
18. Fentz V, Gormsen J. Electrocardiograph patterns in patients with acute cerebrovascular accidents. Circulation. 1962;25:22-8.
19. Khechinashvili G, Asplund K. Electrocardiographic changes in patients with acute stroke:A systematic review. Cerebrovasc Dis. 2002;14:67-76.
20. Lindgren A, Wohlfart A, Pahlm O, Johansson BB. Electrocardiographic changes in stroke patients without primary heart disease. ClinPhsiol. 1994;14:223-31.
21. Vermeer SE, Algra A, Franke CL, Koudstaal PJ, Rinkel GJE. Long-term prognosis after recovery from primary intracerebral hemorrhage. Neurology. 2002;59:205-9.
22. T Z Ong, A A Raymond et al. Risk Factors for Stroke and Predictors of One-Month Mortality. Singapore Med J. 2002;43:517-521.
23. Sex Differences in Stroke Epidemiology: A Systematic Review Peter Appelros, BirgittaStegmayr and Andreas Terént Stroke 2009;40:1082-1090.
24. Marwat MA, Usman M, Hussain M. Stroke and its relationship to risk factors. Gomal J Med Sci. 2009;7:17-21.
25. Dogan A, Tune E, Ozturk M, Erdemglu AK. Comparison of electrocardiographic abnormalities in patients with ischemic and hemorrhagic stroke – original investigation. Anat J Cardiol. 2004;4:135-40.
26. Familoni OB, Odusan SA, Ogun SA. The pattern and prognostic features of QT intervals and dispersion in patients with acute ischemic stroke. J Natl Med Assoc 2006;98:1758-62.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 27-05-2016; **Published online**: 28-06-2016