International Journal of Research and Review
www.ijrrjournal.com E-ISSN: 2349-9788; P-ISSN: 2454-2237

Original Research Article

Electrocardiographic Changes in Acute Cerebrovascular Accidents: An Observational Study

Shyam Murari Garg[1], Nitish Thakur[2], P. K. Prasher[3], Tejinder Talwar[1], Richa Goel[4], Himanshu Devender Kumar[5], Shivani Saini[2]

[1]Associate Professor, [3]Professor, [5]Junior Resident,
Department of Medicine, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India 133207
[2]Senior Resident, Department of Medicine, MM Medical College & Hospital, Kumarhatti-Solan, Himachal Pradesh, India
[4]Senior Resident, Department of Biochemistry, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India 133207

Corresponding Author: Richa Goel

ABSTRACT

Objectives: To study the occurrence and pattern of electrocardiographic changes in patients with acute cerebrovascular accidents.
Material and Methods: 50 patients selected using purposive sampling technique admitted in the Department of Medicine, Maharishi Markandeshwar Institute of Medical Sciences And Research, Mullana, Ambala. Patients were divided into 2 groups of cerebral thrombosis and cerebral hemorrhage according to the type of acute intracranial lesions based on CT scan findings and other relevant investigations. Patients with evidence of heart disease, electrolyte imbalance and previous episode of cerebrovascular diseases or intracranial space-occupying lesions were excluded. The collected data were analyzed using appropriate statistical test between the variables.
Results: Out of the 50 patients in this study, 76% had ECG changes. The most common changes noted were QTc (corrected QT) prolongation followed by that of T wave changes and ST segment changes. Disorders of rate and rhythm were also found to be common in these patients. The ECG changes were common in patients with cerebral hemorrhage (81.8%) than in those with cerebral infarction (78.5%). Reversal to normal was noted in 38.53% of the cases in whom a 2nd ECG was done. The reversal of prolonged QTc interval to normalcy was statistically significant.
Conclusion: ECG changes are common in cerebrovascular diseases and intracranial space occupying lesions. The changes were more common in cerebral hemorrhage among the cerebrovascular events.

Keywords: Cardiac, cerebrovascular attack, electrocardiography

INTRODUCTION

Abnormalities of the electrocardiogram (ECG) are extremely useful in the recognition of heart disease, but they also occur in a variety of states in which the primary pathology is non-cardiac. The association between central nervous system (CNS) disease and ECG changes was first described in 1938. [1] These ECG changes were further evaluated, and their association was found with spontaneous subarachnoid hemorrhage (SAH).

Numerous animal studies have shown the role of CNS in the genesis of ECG abnormalities. [2] Electrocardiographic changes have been reported in a wide range of neurologic disorders including meningitis, trauma, Guillain-Barre

syndrome, epilepsy, [5] cerebrovascular diseases, tumor etc. [3,4]
Therefore this study was planned to look into the electrocardiographic changes due to acute intracranial lesions only.

METHODOLOGY

This study was conducted at M.M. Institute of Medical Sciences and Research Mullana, Ambala, Haryana. Fifty patients fulfilling the inclusion criteria of acute intracranial lesions from OPD or indoor wards of Department of Medicine were enrolled in the study after informed written consent. Patients were divided into 2 groups of cerebral thrombosis, cerebral hemorrhage according to the type of acute intracranial lesions based on computed tomography (CT) scan findings and other relevant investigations.

Criteria for selection:

Inclusion Criteria

- Patients with acute infarct, cortical venous thrombosis, subarachnoid hemorrhage etc. and those with acute intracranial space occupying lesions.
- CT documented cases of acute intracranial lesions

Exclusion Criteria:

- Stroke due to trauma
- Stroke due to dissecting aortic aneurysm
- Patients with previous documented cardiac disease

A detailed history regarding the clinical profile of stroke including risk factors like hypertension, diabetes mellitus, dyslipidemia, history of cardiac diseases and smoking was taken. In all patients' detailed neurological examination along with complete blood count, fasting blood-sugar levels (10 hours of fasting), fasting lipid profile (10 hours of fasting), serum electrolytes and CT scan of the brain, and ECG recording (within 24 hours of admission) was done. The data collected was analyzed based on descriptive statistics.

RESULTS

A total of 50 patients were included in this study; cerebral thrombosis occurred in the largest group comprising 56% (28) of cases followed by cerebral hemorrhage which occurred in 48% (24) of cases. The sex distribution was (64.3% men) in the thrombotic group and hemorrhagic group (68.2% men) with the predominance of the male gender. In our study mean age of patients was 53.00±14.96 years. The minimum age of the study participants was 18 year where as the maximum age of the patients was 80 years.

As shown in Table 2, sinus rhythm was noted in 46 cases while AF was noted in 2 cases. Sinus arrhythmia was noted in 2 cases. P pulmonale was seen in only 1 case. Prolonged PR interval was noted in 1(2%) case. In those cases where the PR interval could not be calculated were in AF. Ventricular ectopics were noted in 3 cases while supra-ventricular ectopics were seen in 2 cases out of 50 cases. Left axis deviation (LAD) was noted in 5 cases while right axis deviation was not observed in any case. 8 cases out of 50 showed LVH.

Ten (20%) cases of ST-segment depression were noted while none had ST-segment elevation in this study. T inversion was noted in 16 cases. Tall T was not observed in any of study cases. The statistical significance of these values cannot be ascertained as there is no control group. QTc prolongation was noted in 18 cases. U waves were noted in 8 cases. QTc prolongation was the commonest abnormality noted (36%) followed by T inversion (32%) and then ST depression (20%) (Table 2).

DISCUSSION

In the present study, 50 patients with the cerebrovascular accident were studied for ECG changes. The changes observed were attributed to the acute intracranial lesions after ruling out other possibilities like electrolyte disturbances or myocardial ischemia or infarction. The patient with acute intracranial lesions 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.

In the present study mean age of the patients was 53 years with male preponderance (66%). This finding is in conformity with the findings of Kumar HNH who found 67.8% males and 32.2% females in their study. [5] Similar findings were observed by Jaikar BSK et al who found 60 % males and 40% females. [6] The lower incidence of stroke seen in women is attributable to a variety of factors which include genetic susceptibility, estrogenic effects on the cerebral circulation, and to reduced blood pressure values compared to men.

Cases of cerebral thrombosis were 32.67% in the study by Goldstein,[7] 74.3% in the case of Purushothaman S et al study [8] and it was 56% in the present study. The case of cerebral hemorrhage was 10.67% in Goldstein study, [7] 53.8% in Purushothaman S et al study [8] and 44% in the present study (Table 1).

In contrast to the present study, Jaikar BSK et al [6] and Saxena P et al [9] have shown a higher incidence of ischemic stroke than hemorrhagic stroke (Table 1). Hemorrhagic stroke is less common than ischemic stroke, but cause a significant number of deaths worldwide. Hemorrhagic stroke causes severe, morbid damage to cerebral tissue that can leave individuals paralyzed or weak, with difficulty in motor activities and cognitive abilities. [10]

Table 1 - Comparison of no. of patients in the CVA events studied

Type of event	Present study	Goldstein [7]	Póvoa R et al [11]	Purushothaman S et al [8]	Kumar HNH et al [5]
Cerebral thrombosis	28(56%)	49 (32.67%)	44 (27.3%)	58 (74.3%)	56%
Cerebral hemorrhage	22 (44%)	16 (10.67%)	25 (15.5%)	42(53.8%)	21.1%

As shown in table 2, QTc prolongation is the commonest abnormality in the present study. Goldstein DS met with similar finding reporting QTc prolongation as the commonest abnormality. [7] In Purushothaman S et al study, the commonest abnormality noted is T inversion (34%) which is the second commonest abnormality in our study. [8] In contrast to our finding, Povoa R et al found ST segment depression as most common abnormality their study. [11]

24 % patients were seen with normal ECG, this is comparable to 22% normal ECG in a study by Purushothaman S et al. [8] In Goldstein DS study, only 8% had normal ECG. [7] In contrast, to present study Povoa R et al noted 64.5% normal ECG in their study. [11] In our study, ECG abnormalities seen among patients were sinus tachycardia (10%), sinus bradycardia (8%), sinus arrhythmias (4%), and atrial fibrillation (4%). In contrast to the present study, Goldstein DS found a greater percentage in their study of rhythm abnormalities, Sinus tachycardia (28%), Sinus bradycardia (8%), sinus arrhythmias (7%), atrial fibrillation (14%). [7]

In the present study, PR interval prolongation was found in only 1 (2%) patient. Studies by Goldstein DS [7] and Purushothaman et al [8] found prolonged PR interval in 9% and 11% patients respectively. QTc Prolongation (36%) was found as the commonest abnormality which is comparable to findings of Goldstein DS who found prolonged QTc interval in 45% patients with stroke. [7]

P-wave abnormalities including P pulmonale was found only in 1(2%) patient in our study. In contrast, Purushothaman S et al reported P pulmonale in 11% of patients. [8] U wave was seen in 16% of abnormal ECG. Goldstein DS and Purushothaman S et al found more patients with U wave i.e. 28% [7] and 29% [8] respectively. In contrast to the present study, Povoa R et al found a much lower percentage of patients with U wave in 1.9%. [11]

20% of patients were observed with ST segment depression in ECG. Similar

results were obtained by Goldstein DS, [7] Purushothaman S et al [8] and Povoa R et al [11] who also found ST-segment depression in ECG of patients in their study, their percentage is 27%, 29%, and 21.7% respectively. T wave inversion was seen in 32% of cases. A similar finding was seen by Purushothaman S et al who found 34% patients with T wave inversion. [8] Goldstein DS found 29% with T wave inversion respectively. [7] In contrast, to present study, Povua R et al reported very low (2.5%) cases with T wave inversion. [11]

Q waves were noted in 20% of cases in the Goldstein DS [7] study while none was noted in the present study. Also left bundle branch block (LBBB) was noted in 2% of the cases in the Goldstein DS study while none was noted in the present study. [7] ST segment elevation was found by many researchers namely Goldstein DS, [7] Purushothaman S et al [8] and Povoa R et al [11] but it was not recorded in our study.

Table 2: Comparison of ECG changes among various studies

Types of ECG changes	Goldstein DS [7]	Purushothaman S et al [8]	Present study
Sinus tachycardia	42(28%)	26 (26%)	5 (10 %)
Sinus bradycardia	12 (8%)	10 (10%)	4 (8%)
Atrial fibrillation	21 (14%)	-	2 (4%)
Sinus arrhythmia	10 (7%)	-	2 (4%)
P pulmonale	-	11(11%)	1(2%)
Prolonged PR interval	12 (9%)	11 (11%)	1(2%)
Supraventricular ectopics	10 (7%)	-	2 (4%)
Ventricular ectopics	18 (12%)	-	3 (6%)
LVH	39 (26%)	-	8 (16%)
QTc prolongation	68 (45%)	25 (25%)	18 (36%)
U waves	42(28%)	29 (29%)	8 (16%)
ST-segment depression	41 (27%)	29 (29 %)	10 (20%)
ST-segment elevation	9 (6%)	10 (10%)	-
T inversion	43 (29%)	34 (34%)	16 (32%)
Tall T waves	-	11 (11%)	-
LAD	12 (8%)	-	5 (10%)
RBBB	10 (7%)	-	-
Normal	12 (8%)	22 (22%)	12 (24%)

Table 3 shows the comparison of ECG abnormalities in cases of cerebral thrombosis. Here again, QTc prolongation was the commonest abnormality seen in patients with cerebral thrombosis. This is comparable with findings of Goldstein DS, [7] Purushothaman S et al [8] and Familoni OB et al [12] who also found the same results.

Table 3 - Comparison of ECG changes seen in cerebral thrombosis with other studies

Types of ECG changes	Goldstein DS [7]	Familoni OB et al [12]	Purushothaman S et al [8]	Present study
Sinus tachycardia	7 (14%)		17 (29.31%)	3 (10.7%)
Sinus bradycardia	4 (8%)	7.8%	08 (13.79%)	1 (3.5%)
Atrial fibrillation	0	18.2%	-	2 (7.1%)
Sinus arrhythmia	3 (6%)	34.4%	-	1 (3.5%)
P pulmunale	-		08 (13.79%)	-
Prolonged PR interval	3 (6%)		05 (8.62%)	-
Supraventricular ectopics	4 (8%)	9.1%	0	2 (7.1%)
Ventricular ectopics	8 (16%)		0	2 (7.1%)
LVH	12 (24%)	85%	-	4 (14.3%)
QTc prolongation	18 (37%)	43.8%	17 (29.31%)	9(32.1%)
U waves	13 (27%)		16 (27.59%)	6(21.4%)
ST segment depression	12 (24%)	29.7%	19 (32.76%)	6(21.4%)
ST segment elevation	2 (4%)		06 (10.34%)	-
T inversion	12 (24%)	21.8%	20 (34.48%)	8 (28.6%)
Tall T waves	-		05 (8.62%)	-
LAD	7(14%)		-	3 (10.7%)
RBBB	5(10%)		-	-
Overall Arrythmias	15 (30%)		12 (20.69%)	7 (25%)

Table 4 shows the comparison of the ECG abnormalities seen in the cases of cerebral hemorrhage. QTc prolongation was seen in 50% of cases of the cerebral hemorrhage in Goldstein DS study [7] and 40.9% of the cases in the present study. Even though the number of cases of hemorrhage in the Goldstein DS study was only 16, [7] it is to be noted that the percentage of cases of cerebral hemorrhage with QTc prolongation is more than that of cerebral infarction in both the studies.

Table 4 - Comparison of ECG changes seen in cerebral hemorrhage with other studies

Types of ECG changes	Goldstein DS [7]	Kumar S et al	Purushothaman S et al [8]	Present study
Sinus tachycardia	7 (44%)		9 (21.43%)	3 (13.5%)
Sinus bradycardia	3 (19%)	21.4%	02 (4.6%)	3 (13.5%)
Atrial fibrillation	1 (6%)	23.2%	0	-
Sinus arrhythmia	1 (6%)		-	1 (4.5%)
P pulmonale	-		03 (7.14%)	1 (4.5%)
Prolonged PR interval	1 (6%)	5.5%	06 (14.29%)	1 (4.5%)
Supraventricular ectopics	2 (13%)		-	-
Ventricular ectopics	1 (6%)		-	1 (4.5%)
LVH	7 (44%)	14.3%	-	4 (18.2%)
QTc prolongation	5 (50%)	44.6%	08 (19.05)	9 (40.9%)
U waves	7 (44%)		13 (30.95%)	4 (18.2%)
ST segment depression	12 (24%)	10.7%	10 (23.81%)	4 (18.2%)
ST segment elevation	2 (4%)	10.8%	4 (9.52%)	-
T inversion	6 (38%)	28.6%	14 (33.33%)	8 (36.4%)
Tall T waves	-	8.9%	05 (8.62%)	-
LAD	1 (6%)		-	2 (9.1%)
RBBB	1 (6%)		-	-
Overall Arrhythmias	5 (31.25%)		14 (33.33%)	2 (9.1%)

Studies have suggested that insula has a cardiac chronotropic organization, and it may be related to origin of arrhythmias seen in seizures or after cerebral hemorrhage or stroke. [13] The physiological mechanism by which the lesions of the nervous system influence the electrocardiogram is most likely the direct effect of the autonomic nervous system on the electrophysiological behavior of the heart. Considerable evidence has been accumulated that brain damage is associated with autonomic (sympathetic) activity imbalance, arrhythmias, and sudden death. Multiple neurological disorders such as epilepsy, brain tumors or stroke, show this relationship. Another possibility suggested by the changes is irritation of Area 13 on the orbital surface of the frontal lobe as vagus nerve is thought to have cortical representation in this area. Scattered myocardial damage or myocardial myocytolysis and sub-endocardial petechial hemorrhages have also been implicated in the causation of the electrocardiographic changes. [14]

CONCLUSION

This study nearly correlates with some of the previous study reports and confirms the fact that neurological events frequently produce ECG changes and a knowledge of these changes is necessary especially to prevent unnecessary delay in patients where the operative procedure is planned, which would otherwise be postponed thinking that these changes are due to myocardial ischemia.

REFERENCES

1. Love WS, Brugler GW, Winslow N. Electrocardiographic Studies in Clinical and Experimental Pulmonary Embolization. Ann Intern Med [Internet] 1938;11(12): 2109–23. Available from: http://annals.org/article.aspx?doi=10.7326/0003-4819-11-12-2109
2. Togha M, Sharifpour A, Ashraf H, Moghadam M, Sahraian MA. Electrocardiographic abnormalities in acute cerebrovascular events in patients with/without cardiovascular disease. Ann Indian Acad Neurol [Internet] 2012;15(1): 66–71. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3644785&tool=pmcentrez&rendertype=abstract

3. Mehta SS, Kronzon I LS. Electrocardiographic changes in meningitis. Isr J Med Sci 1974;10(7): 748–52.
4. Marion DW, Segal R, Thompson ME. Subarachnoid hemorrhage and the heart. Neurosurgery 1986;18(1):101–6.
5. Harsha Kumar H, Kalra B, Goyal N. A study on stroke and its outcome in young adults (15-45 Years) from coastal South India. Indian J Community Med [Internet] 2011;36(1):62. Available from: http://www.ijcm.org.in/text.asp?2011/36/1/62/80798
6. Sharat Kumar B Jaikar, Divya NS RC. Analysis of Electrocardiographic Changes in Cerebrovascular\nAccidents\n. IOSR J Dent Med Sci [Internet] 2014;13(5):25–9. Available from: http://www.iosrjournals.org/iosr-jdms/papers/Vol13-issue5/Version-5/F013552529.pdf
7. Goldstein DS. The Electrocardiogram in Stroke : Relationship to Pathophysiological Type and Comparison with Prior Tracings. Stroke 1979;19(3):253–9.
8. Purushothaman S, Salmani D, Prarthana KG, Bandelkar SMG, Varghese S. Study of ECG changes and its relation to mortality in cases of cerebrovascular accidents. J Nat Sci Biol Med [Internet] 2014;5(2):434–6. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4121930/
9. Saxena P, Kumar L, Dwivedi NC, Saxena PC. Prognostic Importance of ST-T Changes in ECG in Acute Stroke. Int J Contemp Med Res 2016;3(7): 1999–2001.
10. Torpy JM, Burke AE, Glass RM. Hemorrhagic Stroke. J Am Med Assoc [Internet] 2010;303(22):2312. Available from: http://dx.doi.org/10.1016/j.rcl.2010.07.011
11. Póvoa R, Cavichio L, de Almeida AL, Viotti D, Ferreira C, Galvão L, et al. Electrocardiographic abnormalities in neurological diseases. Arq Bras Cardiol [Internet] 2003;80(4):351–8. Available from: papers3://publication/uuid/91757A9F-A8B6-47F1-B53D-C18417D8A0A7
12. Familoni OB, Odusan O, Ogun SA. The pattern and prognostic features of QT intervals and dispersion in patients with acute ischemic stroke. J Natl Med Assoc [Internet] 2006;98(11):1758–62. Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2569774&tool=pmcentrez&rendertype=abstract
13. Oppenheimer S. Cerebrogenic Cardiac Arrhythmias and Their Role in Sudden Death. Arch Neurol 1990;47:513–9.
14. Greenhoot JH, Reichenbach DD. Cardiac injury and subarachnoid hemorrhage. J Neurosurg [Internet] 1969;30(5):521–31. Available from: http://thejns.org/doi/abs/10.3171/jns.1969.30.5.0521

How to cite this article: Garg SM, Thakur N, Prasher PK et al. Electrocardiographic changes in acute cerebrovascular accidents: an observational study. International Journal of Research and Review. 2017; 4(8):53-58.

******