International Journal of Medical and Health Research
ISSN: 2454-9142
www.medicalsciencejournal.com
Volume X; Issue X; May XXXX; Page No. XX-XX

Study of electrocardiographic changes in patients of stroke and its correlation with mortality: A prospective study

Dr. Shyam Sundar Rajput[1], Dr. Dinesh Udeniya[2*], Dr. OP Jatav[3]
[1] Department of Medicine, GRMC, Gwalior, Madhya Pradesh, India
[2] Professor & HOD, Department of Neurology, GRMC, Gwalior, Madhya Pradesh, India
[3] Professor & HOD, Department of Medicine, GRMC, Gwalior, Madhya Pradesh, India

Abstract
Background: Incidence of stroke is rising in India with great impact on morbidity and mortality. One of the most important predictor linked with poor outcome among stroke patients is electrocardiographic (ECG) changes resulting from massive autonomic discharge that interferes with cardiac autonomic control.
Aims and Objectives: To study and compare ECG changes in ischemic and hemorrhagic stroke and correlate with patient's outcome.
Materials and methods: One hundred and four stroke patients were studied in Department of Neurology, GR Medical College and JA Group of Hospitals, Gwalior from May 2015 to August 2016. Patients were diagnosed as stroke by WHO classification and confirmed by brain imaging as CT scan or MRI. Stroke patients were assessed for the severity of stroke as per the ICH and GCS score followed by brain imaging and various lab parameters assessment.
Results: Ischemic stroke (58.65%) was more prevalent compared to hemorrhagic (41.34%). Stroke was more common in male population (65.38%)]. Among risk factors in ischemic and hemorrhagic group smoking (21 vs. 21 respectively), hypertension (32 vs 33 respectively) and diabetes (17 vs 8 respectively) were common risk factors. Mortality was high among the hemorrhagic group (n=20) compared to ischemic group (n=6). Eleven ECG patterns were identified out of which ST segment elevation, ST segment depression; tall T wave, T wave depression and presence of U wave were dominant. These parameters were significantly seen in patients who expired in hemorrhagic group whereas in ischemic group distribution of patients who were alive and expired was comparable.
Conclusion: Different ECG changes are observed in stroke patients even in absence of primary cardiac disease and these ECG changes can be predictor of prognosis.

Keywords: ECG pattern, ischemic stroke, hemorrhagic stroke, electrocardiography

Introduction

Stroke has been recorded as the second most common reason for mortality worldwide [1]. About two-thirds of these deaths are occurring in developing countries. Stroke incidence is also expected to rise in the future as the populations is undergoing what has been referred to as the health transition [2].

Stroke may produce ECG changes and arrhythmia. Byre and colleagues, for the first time in 1944, described the ECG changes in sufferers of subarachnoid haemorrhage [3]. ECG changes have been reported in 60-90% of patients with intra-parenchymal or subarachnoid bleed and in about 5-20% of patients with acute ischemic stroke [4].

ECG findings may also have prognostic significance in stroke patients. Ventricular arrhythmias, concurrent MI, and a prolonged QTc interval have all been associated with increased mortality in stroke patients [5]. In India, there have been few studies to associate ECG changes in stroke patients with morbidity/mortality outcome. In present study we tried to evaluate ECG changes in ischemic and hemorrhagic stroke and correlate with patient's outcome.

Materials and Methods

Present prospective study included 104 stroke patientsin Department of Neurology, GR Medical College and JA Group of Hospitals, Gwalior from May 2015 to August 2016.

Institutional Ethics Committee approval was obtained before starting the study. Patients were diagnosed as stroke by WHO classification and confirmed by brain imaging as CT scan or MRI. Written informed consent was taken from each patient after informing them about the nature of the study and the investigations desired for the study.

All patients of cerebrovascular stroke age more than 14 years with written consent were included. All patients of cerebrovascular stroke age less than 14 years, patient taking any drug known to affect cardiac repolarization like digoxin, anti-arrhythmic, phenothiazine, tricyclic anti-depressants, lithium carbonate, erythromycin, theophylline and levodopa were excluded.

Stroke patients were assessed for the severity of stroke according to ICH score and GCS score, then all patients were subjected to brain imaging and various lab parameters were

assessed. The data was filled in a pre-approved proforma. Depending on type of stroke, cases were divided into ischemic group (ischemic stroke patients) and hemorrhagic group (hemorrhagic stroke patients).

All the data was analyzed using IBM SPSS Ver. 20. Chi-square test was used for qualitative data whereas student t-test was used to analyze quantitative data. Cross tabulation and frequency distribution was used to prepare table. P value <0.05 is considered as significant.

Results

Out of 104 stroke patients, 61(58.65%) were of ischemic stroke and 43(41.34%) were of hemorrhagic stroke. Stroke was more common in males [68 (65.38%)]. Stroke was more common with advancing age in both male (n=63) and female (n=33) having age ≥40 years. Male have higher frequency of ischemic stroke in age group of 61 -70(n=12) and female (n=7) in age group of 71-80 years. Similarly in hemorrhagic group male (n=10) and female (n=9) both have higher frequency in age group 51-60 years. Twenty one patients in each ischemic and hemorrhagic group were smokers.

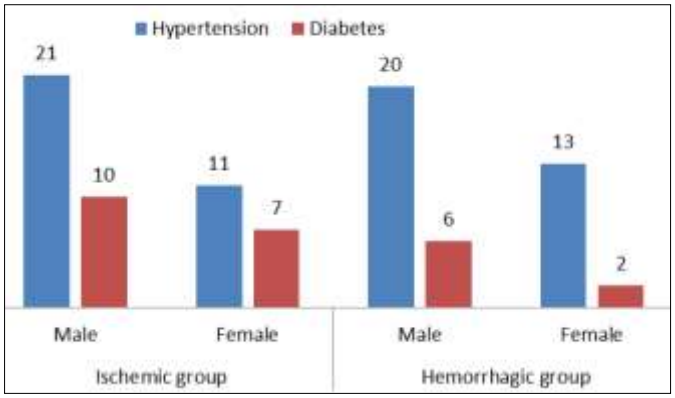

Fig 1: Showing distribution of diabetes and hypertension in both the groups

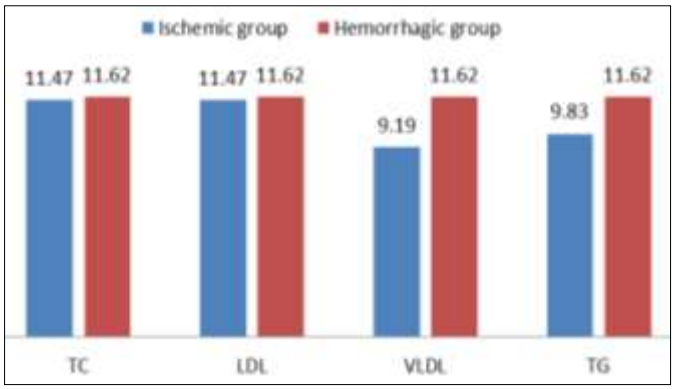

Fig 2: Distribution of elvated lipid level among study cohort

In ischemic group, 21 male and 11 female had hypertension, 10 male and 7 female had diabetes and 7 (11.47%), 7 (11.47%), 5 (8.19%) and 6 (9.83%) patients had elevated serum cholesterol, LDL, VLDL and triglyceride respectively whereas in hemorrhagic group 20 male and 13 female had hypertension, 6 male and 2 female had diabetes and 5 (11.62%) patients each had elevated serum cholesterol, LDL, VLDL and triglyceride respectively.

Among ischemic group 6 patients expired, most of them were having GCS score between 13-15whereas 20 patients expired in hemorrhagic group most of them had GCS score 3-8 [18(62.06% out of 29 patients).

Table 1: Distribution of patients according to ECG abnormality between groups

ECG abnormality	Ischemic Group	Hemorrhagic group
Tachycardia	17	9
Bradycardia	8	2
P wave abnormality	8	3
QTc Prolongation	17	8
ST segment elevation	7	4
ST segment Depression	19	10
Tall T Wave	5	2
T Wave Inversion	20	14
PR Abnormality	8	6
U Waves	16	17
Arrhythmias	12	14

Data is expressed as numbers.

Table 2: Comparing ECG parameters with the patient's outcome

ECG parameters		Ischemic Group		Hemorrhagic group		P value*
		Alive	Expired	Alive	Expired	
QT	Normal	40	4	19	16	NS, NS
	prolong	15	2	4	4	
ST Segment	Elevation	5	2	2	2	NS, 0.04
	Depression	17	2	2	8	
	Normal	33	2	19	10	
T Wave	Tall	5	0	2	0	NS, 0.07
	Depression	18	2	10	4	
	Normal	42	4	11	16	
U Wave	Present	16	0	4	12	NS, 0.01
	Absent	39	6	19	8	
Arrhythmia	Present	12	0	6	8	NS, NS
	Absent	43	6	17	12	

Data is expressed as no of patients, NS; not significant, * first p value is between Ischemic group, second p value is between Hemorrhagic group, P value <0.05 is considered as significant

Discussion

The brain - heart connection was described early in 20th century when Levy showed that changes in CNS influenced the cardiac function. In clinical practice, physician regularly encounter patients with ECG changes related to CNS lesions [6]. For the clinician, it is important to know whether ECG abnormalities encountered in stroke patients are caused by coexisting acute coronary symptom, as this would call for cardiology intervention. Thus far little is known about the clinical consequences of ECG changes in acute cerebrovascular disease [7, 8].

Using the WHO definition of stroke, incidence of stroke type in present study was found to be 58.65% for ischemic stroke and 41.34%% for hemorrhagic stroke. Banerjee *et al.* [9] performed neuroimaging in 59.2% cases and reported cerebral infarct in 68% and cerebral hemorrhage in 32% cases. The finding was also consistent with Feigin *et al.* [10] who found

50-85% ischemic stroke and 7-27% hemorrhagic stroke. Sridharam *et al.* [11] found 83% of ischemic stroke and 15.4% of hemorrhagic stroke. Nagaraga *et al.* [12] found ischemic stroke in 73.8% and hemorrhagic in 26.2%. There were relatively more cases of cerebral hemorrhage then that of observed in western countries may be due to varied risk factors and genetics.

In present study, incidence of stroke was more in males than females. In a study done by Fure *et al.* [16] there were 58.8% males. Nagaraja *et al.* [12] reported 67% patients to be males with M/F ratio of 2:1.These studies were consistent with findings of present study. Men are more likely to have stroke then women, difference may be due to risk factors such as smoking and drinking which is more prevalent among men in India compared with women [13].

In present study higher incidence of stroke was seen in patients from 51-70 years age group. In present study, young stroke defined as stroke in age <40 years was found in (7.77%) patients. Bhattacharya *et al.* [14], Dalal *et al.* [15] and Sridharan *et al.* [11] reported common age of stroke in India ranging from 63-65 for men and 57-68 for women which is consistent with present study. Fure *et al.* [16] studied 164 patients with mean age of 69.8 years, Nagaraja *et al.* [12] reported the mean age of stroke patients as 54.5 year with two third (65.6%) being 50 plus and 18% below 40 years.

In the present study 52 patients were addicted to various forms of addiction. Among the addicted subjects, 40.38% were addicted to tobacco smoking, 28.84%were addicted to alcohol and 19.23% were addicted to both alcohol and smoking. Shah *et al.* [17] found that alcohol consumption was seen in 22.5 % in Indian population. In Fure *et al.* [16] study, 279 patients were enrolled among them 37.3% had positive smoking history. Tripathi *et al.* [18] reported 46% incidence of smoking in men in Indian population which is consistent with present study. Nagaraja *et al.* [12] studied 1174 patient and among them tobacco users were 32.6%, alcohol user were 25.1% patients. Sridharam *et al.* [11] reported that 26.8% of 261 male patients smoked tobacco. The incidence of smoking was much lesser in other studies which may be due to observation bias or *bidi* smoking in Indian subcontinent.

High blood pressure is strongly associated with stroke [19]. Cross sectional community based case control study for risk factor analysis in Kolkata demonstrated that hypertension was the most important risk factor for stroke with odds ratio of 5.04 in women and 21.87 in men [20]. Hypertension was more in advanced age group with male predominance. Fure *et al.* also found hypertension in 58.1%patients [16].

Diabetes is an important risk factor for ischemic stroke. In the present study of diabetes was seen in 19.23% patients. Incidence of diabetes was seen more in ischemic group (16.34%) as compared to hemorrhagic group (8.65%). Tripathi *et al.* [18] reported 3-12% prevalence of diabetes among stroke patients. These studies are consistent with the present study. Rincon *et al.* [21] studied 654 patients and found 295 patients of diabetes (45.1%) in ischemic stroke.

In the present study overall ECG was normal in 22.11% patients and abnormal in 77.88% patients. Most common abnormality was T wave depression in both ischemic and hemorrhagic stroke. Another common abnormality was arrhythmia which was more in hemorrhagic group than ischemic. Prosser *et al.* 2007 reported arterial fibrillation in 31.5%, as found in our study. Goldstein [22] reported arrhythmias of any type in 27% of patients. In same study arterial fibrillation was reported in 14% patient. Goldstein also reported ECG abnormality in 92% patients, and most common ECG abnormality reported was prolonged QTc interval (45%), ST elevation in 6% patients and ST depression in 27% of patients which correlate with present study. Goldstein also reported T wave inversion in 29% of patients which consistent with present study [22]. Author also reported LVH in patients with more incidence in hemorrhagic group than ischemic group as seen in present study also. Melin *et al.* [23] detected ST changes in 26.31% of patients and T changes in 28% which is similar to our present study. Rudehill *et al.* [24] found that 10.3% of the patients had ST changes, and 31.77% had T changes. Several other studies reported ST changes at a percentage between 39.8% and 50%; T wave changes between 25-50% [25, 26] which are consistent with our study.

In the present study of 104 patients, 25% died during hospital stay. Mortality was more in hemorrhagic group (76.92%) as compared to ischemic group (23.07%). Mortality was higher in comatose patients with GCS score between 3-8 (62.06%) and least in alert patient with GCS score between 13-15 (9.09%).

Mortality was higher in hypertensive, diabetes and smoker. Present study showed that QT prolongation in hemorrhagic patient have significant mortality rate as compared to ischemic stroke patient, which was similar to the results of Fure *et al.* [16], Tripathi *et al.* [18] Rudehill *et al.* [24] and Dalal PM 1997 [27].

Conclusion

ECG having importance for physicians as it reflect various changes in response to metabolic changes and disease process especially atherosclerotic. Coronary artery diseases predominantly related to atherosclerotic process and similar pathological process affect cerebral arteries so that both may become clinically evident simultaneously. Acute coronary events may be triggered by stroke or metabolic stresses, hence serial ECG are very important in patients of CV stroke. As in the present study the patients who had ECG changes during the course of hospitalization were having higher mortality as compare to who had no changes.

References

1. Global status report on noncommunicable diseases 2010. Geneva: World Health Organization; 2011 (http://www.who.int/nmh/publications/ncd_report_full_en.pdf, accessed 23March 2018).
2. Owolabi MO, Arulogun O, Melikam S. The burden of stroke in Africa: a glance at the present and a glimpse into the future. Cardiovascular Journal of Africa. 2015; 26(2 H3Africa Suppl):S27-38.
3. Byer E, Ashman R, Toth LA. Electrocardiograms with large upright T-waves and long QT intervals. Am Heart J 1947; 33:796-806.
4. Kanrar A, Chaudhuri A, Ghosh A, Adhya D, Das P, Banerjee S, *et al.* Electrocardiographic changes in patients of post cerebrovascular accident in rural population of Eastern India. Saudi J Sports Med 2015;

15:160-5
5. Morris JG, Duffis EJ, Fisher M. Cardiac workup of ischemic stroke. Can we improve our diagnostic yield? Stroke 2009; 40:2893–8.
6. Oppenheimer S. Cerebrogenic cardiac arrhythmias: Cortical lateralization and clinical significance. ClinAuton Res, 2006; 16:6-11.
7. Bozluolcay M, Ince B, Celik Y, Harmanci H, Ilerigelen B, Pelin Z, *et al*. Electrocardiographic findings and prognosis in ischemic stroke. Neurol India. 2003; 51:500-2.
8. 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 2006; 98:1758-62.
9. Banerjee TK, Das SK. Fifty years of stroke researches in India. Ann Indian Acad Neurol. 2016; 19(1):1-8.
10. Feigin VL, Lawes CM, Bennett DA, Barker-Collo SL, Parag V. Worldwide stroke incidence and early case fatality reported in 56 population-based studies: A systemic review. Lancet Neurol. 2009; 8:355-69.
11. Sridharan SE, Unnikrishnan JP, Sukumaran S, Sylaia PN, Nayak SD, Sarma PS, *et al.* Incidence, types, risk factors, and outcome of stroke in a developing country: The Trivandrum Stroke Registry. Stroke. 2009; 40:1212-8.
12. Nagaraja D, Gururaj G, Girish N, Panda S, Roy AK, Sarma GR, *et al.* Feasibility study of stroke surveillance: Data from Bangalore, India. Indian J Med Res 2009; 130:396-403.
13. Banerjee TK, Chowdhury D, Das A, Sekhar A, Roy D, Sen S, *et al*. Analysis of hospital based registry in a neurological centre in Kolkata. J Indian Med Assoc 2005; 103:665-8.
14. Bhattacharya S, Saha SP, Basu A, Das SK. A 5 year prospective study of incidence, morbidity and mortality profile of stroke in a rural community of eastern India. J Indian Med Assoc., 2005; 103:655-9.
15. Dalal PM, Malik S, Bhattacharjee M, Trivedi ND, Vairale J, Bhat P, *et al.* Population-based stroke survey in Mumbai, India: Incidence and 28-day case fatality. Neuroepidemiology, 2008; 31:254-61.
16. Fure B, Wyller BT, Thommessen B. Electrocardiographic and troponin T changes in acute ischaemic stroke. Journal of Internal Medicine, 2006; 259:592-597.
17. Shah B. Assessment of Burden of Non-Communicable Diseases. New Delhi: Indian Council of Medical Research, 2004.
18. Tripathy A, Jeemon P, Ajay V, Prabhakaran D, Reddy K. CVD profile of India. IC Health and WHO 2007, 226-43.
19. Goldstein LB, Amarenco P, Szarek M, Callahan A, Hennerici M, Sillesen H, *et al.* SPARCL investigators. Hemorrhagic stroke in the stroke prevention by aggressive reduction in cholesterol levels study. Neurology, 2008; 70:2364-70.
20. Banerjee TK, Mukherjee CS, Sarkhel A. Stroke in the urban population of Calcutta: An epidemiological study. Neuroepidemiology, 2001; 20:201-7.
21. Rincon F, Dhamoon M, Moon Y, Paik MC, Boden-Albala B, Homma S, *et al.* Stroke Location and Association With Fatal Cardiac Outcomes Northern Manhattan Study (NOMAS) Stroke, 2008; 39:1-12.
22. Goldstein DS. The electrocardiogram in stroke-Relationship to pathophysiological type and comparison with prior tracings. Stroke, 1979; 10:253-59.
23. Melin J. ECG findings in subarachnoid hemorrhage. Acta Med. Scand., 1983; 213:5-8.
24. Rudehill A, Gordon E, Sundqvist K, Wahlgren N. A study of ECG abnormalities and myocardial specific enzymes in patients with subarachnoid haemorrhage. Acta Anaesthesiologica Scandinavica. 1982; 26(4):344-50
25. Aronow WS, Ahn C, Mercando AD. Prevalence and association between silent myocardial ischemia and coronary events in older men and women with and without cardiovascular disease. J Am Geriatr Soc., 2002; 50:1075-8.
26. Asmar R, Benetos A, Pannier B. Prevalence and circadian variation of ST-segment depression and its concomitant BP changes in asymptomatic systemic hypertension. Am J Cardiol. 1996; 77:384-90.
27. Dalal PM. Studies in young and elderly: Risk factors and strategies for stroke prevention. J Assoc Physicians India. 1997; 45:125-31.