Original research article

Study of Electrocardiographic Changes in Patients with Cerebro Vascular Accidents

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Abstract

Background: Cardiac abnormalities occur in majority of patients after cerebrovascular accidents, accounting for unex-pected deaths during the first month. The most common disturbances include electrocardiogram (ECG) abnormalities, cardiac arrhythmias, and myocardial injury and dysfunction.

Material and Methods: This prospective study was carried out in a superspeciality hospital during 2 years which comprised of 100 patients. Patients were categorized based on computerized tomography findings into cerebral infarction, intracerebral hemorrhage, and subarachnoid hemorrhage. ECG changes are interpreted with rate, rhythm, and abnormal-ities and conclusions were derived.

Results: Stroke was most common in 5th and 6th decade. Cerebral infarction formed the largest group. Males had higher preponderance. Hypertension was the most common risk factor. In total, 74% had electrocardiographic abnormality. ECG changes are more common among cerebral hemorrhage and subarachnoid hemorrhage. Most common ECG abnormality was prolonged QTc interval. Overall immediate mortality was 23%. It was high in cerebral hemorrhage. Morality was high in patients with abnormal ECG, mostly with prolonged QTc and with T-wave inversion.

Conclusion: Patients with cerebrovascular accidents often have abnormal ECG in the absence of known organic heart disease or electrolyte imbalance. QTc prolongation and U-wave are the common ECG abnormalities in hemorrhagic strokes.

Keywords: Cerebrovascular accidents; electrocardiographic changes; mortality

Introduction

Cerebrovascular accident (CVA) or stroke is the most common life threatening disorder. It is the third leading cause of death in the developed countries after cardiovascular disease and cancer.

Cerebral infarction is responsible for about 80% of all first ever in a lifetime strokes[1]. Primary intracerebral hemorrhage (PICH) for 10% and subarachnoid hemorrhage for 5%. The incidence of stroke worldwide is 179 per 1,00,000 population in various parts. In Western

countries overall prevalence rate is 794 per 1,00,000 population. CVA or strokes are capable of causing crippling morbidity in young as well as elderly individuals. They also have marked social, psychological and economic implications. Due to its wide prevalence and its high cost in economic terms as well as human disability, cerebrovascular accidents have evoked much interest in medical fraternity. Many studies have shown CVA associated with ECG changes   The changes of ECG in CVA were reported in many studies.(Bayerset al[2],1947; Burchetal, 1954; Dimant J et al,1977).Changes occurring in ECG Following stroke were T-wave, U-wave, ST-segment, QT-interval and various arrhythmias, these ECG changes may resemble those of myocardial ischemia or sometime myocardial infarction. Earlier it was thought that CVA is preceded by changes in cardiac structure and function but Burch et al[3] (1954) disproved this view and found ECG changes in young patients with CVA in whom others causes like IHD for ECG changes could not be accounted.

Hence, study was undertaken to know the ECG changes in different types of cerebrovascular accidents and to know whether such changes have any prognostic significance.

Objectives
•To study the different changes in ECG patterns in the cases of cerebrovascular accidents.
•To assess the different changes have got any immediate prognostic significance in these cases.

Methodology
The material of the study comprised of 100 patients admitted in Indira Gandhi Institute of Medical Sciences Patna, Bihar. Study duration of 2 years . comprised of 100 patients. All patients with acute cerebrovascular accidents admitted in the medical ward within 72 h of onset of stroke were considered. After admission a detailed history regarding the temporal profile of the stroke including history of risk factors like hypertension, diabetes mellitus, smoking, history of ischemic heart disease, and rheumatic heart disease were obtained. Patients were categorized based on Computerized Tomography findings into cerebral infarction, cerebral hemorrhage and subarachnoid hemorrhage. ECG changes are interpreted with rate, rhythm, ST-segment, QRS complex, T-wave amplitude and morphology, and QTc interval were calculated.

Inclusion Criteria
Cases of CVA (CT scan proved) admitted within72 hours after the onset of stroke were selected for the study, patients admitted beyond 72 hours after onset of stroke were excluded as the incidence of ECG changes beyond this period were infrequent.

Exclusion Criteria
Traumatic cases producing neurological deficits, infection, neoplastic cases producing CVA. CVA cases with known underlying cardiac diseases, which produce ECG changes. After admission 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 were obtained.

ECG Criteria
•Heart rate less than 60/ min was regarded as

Table 1:

Age (years)	Male	Female	Total	Percent
21-30	2	1	3	3.00
31-40	6	4	10	10.00
41-50	15	5	20	20.00
51-60	16	11	27	27.00
61-70	14	14	28	28.00
71-80	4	4	8	8.00
81-90	-	2	2	2.00
91-100	1	1	2	2.00
Total	58	42	100	100.00

bradycardia and heart rate exceeding 100/ min was regarded as tachycardia.

•ST segment depression of 0.5 mm or elevation of more than1mm were taken abnormal.

•T-wave was considered abnormal when inversion of T-waves in which it should have been upright i.e.,I, II, V_3–V_6 may be variable in III, aV_L,V_1 and V_2.

•QTc prolongation: The QT interval was measured from the beginning of the QRS complex to the end of T-wave, the rate corrected QTc was obtained by dividing the actual QT by the square root of the RR-interval (both measured in seconds). QTc was taken as prolonged if it more than 0.44 m-seconds.

•U-wave was taken as significant when exaggeration of U-wave voltage was noted, when appeared in more than 2-leads, when appeared in leads in which it was not normally seen (other than V_3-V_4).

•RVH: R-waves in right chest leads and the R-wave may be taller than the S- wave in lead V_1, persistent S-wave seen in V_5-V_6.

•LVH: If the sum of the depth of the S-wave in lead V_1 and the height of the R- wave in either lead V_5 or V_6 exceeds 35mm, an R-wave of 11to13mm or more in leada V_L is another criteria for LVH.

Results

This 12,623 were medical admissions and 385 were stroke patients, Period of two years, among this stroke patients were selected for the present study who met inclusion and exclusion criterion were analyzed with regard to ECG changes in stroke patients and the following observations were noted.

Table 2: Incidence of Risk Factors in stroke patients

Risk factors	No. of Cases	Percent
Hypertension	45	45.00
DM	13	13.00
Smoking	28	28.00
Hyperlipidemia	8	8.00
History of stroke	22	22.00

The above table shows that hypertension was the most common risk factor and was present in 45% of the cases, followed by smoking in 28%, history of stroke in 22%, diabetes mellitus in 13% of patients and hyperlipidemia in 8% in stroke patients.

Table 3: Clinical features in study group

Clinical Features	Ischemic (n=68)		Hemorrhage (n=32)	
	No	%	No.	%
Headache Present	17	25.00	21	65.62
Vomiting Present	13	19.11	25	78.12
Convulsions	6	8.82	4	12.50
Right side hemiplegia	35	51.47	6	18.75
Left side hemiplegia	15	22.00	2	6.25
Conscious	38	55.80	6	18.75
Drowsy	12	17.50	2	6.25
Unconscious	18	26.47	24	75.00

Chi Square = 68.44   d.f. = 5 $p<0.001$ In case of infarction,17 patients (25%) presented with headache, while 21 patients (65%) presented with headache in the hemorrhage group. Vomiting was present in 13 patients (19%) in infarction group, while in hemorrhage patients it was present in 25 patients (78.12%). Right sided hemiplegia was present in 35 patients (51.47%) in case of ischemic strokes, whereas in case of hemorrhagic strokes 6 patients (18.75%) had right sided hemiplegia. Left sided hemiplegia was present in 15 patients (22.%) of ischemic strokes, whereas in case of hemorrhage 2 patients (6.25%) had left sided hemiplegia. In case of infarction 18 patients (26.47%) were unconscious, whereas in case of hemorrhage 24 patients (75%) were unconscious. Convulsions were present in 6 patients (8.82%) in infarction group, whereas in hemorrhage group 4 patients (12.5%) presented with convulsions.

The above table shows the abnormalities of ECG (71%) were more common in stroke patients and was statistically significant.

Table 4: Relationship between stroke types and ECG changes

Type of Stroke	Total No. Of Cases	ECG Changes			
		Normal		Abnormal	
		No	%	No	%
Ischemic	68	22	32.35	46	67.64
Hemorrhage	32	7	21.8	25	78.12

In the above table, it is evident that ECG abnormalities were more common in patients of stroke. ECG abnormalities were more in hemorrhagic stroke (78.12%) compared to infarct (67.64%), which is statistically insignificant ($p>0.05$).

Table 5: Mortality in stroke types and its co-relation with ECG changes

Type of ECG changes	Ischemic(n=68)				Hemorrhage(n=32)			
	Alive		Dead		Alive		Dead	
	N	%	N	%	N	%	N	%
QTc prolongation	21	35.50	4	44.4	10	52.63	6	46.15
T-wave inversion	17	28.80	4	44.4	6	31.50	3	23.00
ST Segment depression	19	32.20	2	22.2	10	52.60	8	61.50
U-Wave	31	52.54	4	44.44	13	68.42	5	33.46

From the above table, it is evident that mortality was higher in patients with prolonged QTc in both infarct (4.44%) and hemorrhagic stroke (46.15%) and with T-wave inversion mortality was high in cases of infarct (44.4%) compared to hemorrhage was less (23%) and with ST depression mortality was high in hemorrhagic stroke (61.5%) compared to infarct (22.2%) and with U-wave mortality was high in infarct (44.44) compared to hemorrhage (33.46%).

Table 6: Total Analysis in patients of stroke who died

Type of stroke	No. of died patients (n=22)	Percentage
Ischemic	9	40.00
Hemorrhagic	13	59.00
ECG abnormalities		
QTc prolongation	10	45.00
T-wave inversion	7	31.81
ST-segment depression	10	45.00
U-waves	9	40.90

From the above table, it is evident that among the total number of patients who died of stroke, hemorrhage was the culprit in 59% and ischemia in 40%. QTc prolongation and ST-depression was the common ECG abnormality present in 45% of cases. U-wave stood second with 40.90% and the least was T-wave inversion with 31.81%.

Discussion
A hospital based prospective study was done to know the ECG changes had any prognostic significance in stroke patients. This study, CT scan was mandatory in the inclusion criteria to prove the stroke and type of stroke. Among the 100 patients 58 were males and 42 were females (sex ratio was M:F–1.4:1),age ranged from 24-92 years and the mean age of patients of alive and dead were 58.73 and 54 years respectively[4]. The cases of stroke were more common in the 5th and 6th decade, making 55%, which is comparable to Venkataramana et

al[5] study in which the percentage of stroke cases above the age of 51 years was 41% and in the Carlostudy (2003) was 71.8%.

Table 7: Comparison of Incidence of Stroke Patients above age group of 51 years

Study group	Venkataraman et al	Carlo et al	Present study
Incidence of stroke	41%	71.8%	55%

Stroke is one of the leading causes of death in many countries. Although there was a lack of unanimity, several factors have been reported to increase the risk of stroke[6]. Reports from different countries have implicated different factors associated with high risk of stroke. To evaluate the risk factors, a prospective survey of a given population of the years as done in the Framinghan Study was essential. The only epidemiological study of Abraham et al[7] (1970) who found hypertension, diabetes mellitus, hypercholesterolemia and syphilis to be the risk factors associated in hemiplegia patients. Shaper et al[8] in1991concluded that, hypertension, cigarette smoking and pre-existing IHD was found to be the major risk factors.

Table 8: Comparison of association of risk factors in different studies

Risk factors	Smith[11] (2005) (%)	Carlo et al[10] (2003) (%)	Present Study (%)
Hypertension	87.00	48.00	45.00
Diabetes mellitus	50.00	20.90	13.00
Smoking	35.22	--	28.00
History of stroke	39.30	12.50	22.00
Hyperlipidemia	22.95	--	8.00

In the present study, hypertension was present in majority of the cases i.e., 45%, which is comparable with that found in the studies of Smith (2005) and Carlos (2003) i.e., 87% and 48% respectively and next commonest risk factor was smoking (28%) and history of stroke (22%), which are comparable with that found in Smith (2005) i.e., 35.22% and 39.30% and diabetes mellitus was present in 13% of the patients in the present study and the least was hyperlipidemia.

Table 9: Comparison of Clinical Features in Patients with Stroke

Clinical features	Mohr et al[12] (%)	Foulkes et al[13] (%)	Present study (%)
Headache	36.00	41.00	38.00
Vomiting	44.00	49.00	38.00
Convulsions	7.00	9.00	10.00

In the present study, headache was present in 38% of the cases, which is comparable to the series of Mohr et al[14] (1978), who reported an incidence of 26%. Foulkes reported severe headache in 41% of cases. Vomiting was present. In 38% of our patients, which is comparable to Mohr et al (44%), Foulkes et al[9], who reported frequency of headache in 49% of the cases. Convulsions in the present series were present only in10% of the total patients,

which is comparable to that of Mohr et al (1978) and Foulkes et al, who reported frequency of 7% and 9% respectively.

Table 10: Comparison of Type of Strokes

Type of Strokes	Present study	Daniele et al[15] (2002)	Roy et al (1995)	Mikolich et al (1981)
Ischemic	68.00	78.28	71.00	93.33
Hemorrhage	32.00	21.80	29.00	6.66

In this study, 68% of the patients has ischemic stroke, which was comparable with that found in the studies of Daniele et al, Roy et al and Mikolich et al i.e.,78.20%,71.00% and 93.33% respectively. 32% had stroke in the present study comparable with 21.80%, 29% and 6.66% in the Danieleco et al, Roy et al and Mikolich et al[16] study group.

Conclusion

ST segment depression, QTc prolongation and U-wave are the common ECG abnormalities in hemorrhagic strokes.

• QTc prolongation and U-waves are the common ECG abnormality in ischemic stroke.
• ECG abnormalities in stroke patients do not have any prognostic significance.

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