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Electrocardiographic changes in acute stroke patients

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Abstract

Background: Cerebrovascular events are a major cause of morbidity and mortality worldwide. The primary reason is atherosclerotic disease of the cerebral arteries. Other causes are embolism, hemorrhage and hypo perfusion. ECG changes simulating myocardial ischemia are common accompaniments. The aim of this study was to document and delineate the various ECG changes in stroke patients.

Methods: Eighty consecutive patients fulfilling the clinical definition of stroke were included in the study. The diagnosis of stroke was confirmed by Imaging –CT/MRI. A 12 lead ECG recording was done at time of admission and then on subsequent days during stay in the hospital. Results were compiled and statistical analysis was done.

Results: Majority of cases were having ischemic stroke. Mean age of presentation was 63 years. No ECG abnormalities were found in 11.25 % cases. The most common ECG change observed was T wave inversion seen in 32.5 % cases. QTc prolongation was the most common ECG change in intracerebral hemorrhage cases. Other ECG changes were ST depression in 25 %, bradycardia in 12.5%, tachycardia in 5%, atrial fibrillation in 3.75% and U waves in 7.5% cases.

Conclusion: This study confirms the role of ECG in workup of acute stroke patients. Electrocardiographic changes are very common in cases of CVA, even in those having no history of coronary heart disease. Interpretation of these ECG changes can aid the treatment of patients with respect of revascularization and surgical interventions.

Keywords: Stroke, Ischemic stroke, intracerebral hemorrhage.

Introduction

Stroke is the fourth killer and number one cause of adult disability in the United States¹. The prevalence of stroke and the cost of treatment will gradually increase with aging population². Every year more than half a million people in the world suffer from acute cerebrovascular events including ischaemic stroke, intracerebral and subarachnoid haemorrhage, giving a mortality of nearly 20%.² Major causes of ischemic strokes are thrombosis of a vessel, embolism, systemic hypoperfusion and venous thrombosis^{3,4,5}

Patients with stroke have increased incidence of ECG abnormalities⁶. The mechanisms postulated for ECG changes are sustained sympathetic stimulation, direct damage to cardiac innervation or imbalance between left and right sympathetic outflows to the heart or asymptomatic undetectable primary heart disease⁷. Overactivation of beta adrenergic receptors by catecholamine excess can lead to tonic openings of calcium channels and defects in repolarization and ECG abnormalities⁸. Correlation between arrhythmias and T wave abnormalities have been reported with cerebral haemorrhage. Many of the ECG changes resemble those of myocardial ischaemia and infarction and can lead to misinterpretation and delay in management especially surgical management of sub arachnoid haemorrhage.⁹

This study was planned to study ECG changes in acute stroke patients and analyze their temporal relationship with the types of stroke.

Aims and Objectives

1. To study electrocardiographic changes in acute stroke patients.
2. To study frequency of various ECG changes.
3. To study co-relation of various ECG changes in ischemic and hemorrhagic stroke.

Materials and Methods

This was a prospective observational study conducted in Rajindra Hospital Patiala from 2014 to 2017. Eighty patients of acute stroke admitted

in medical wards of Rajindra Hospital with diagnosis of cerebrovascular accident proved by CT/MRI were included in the study. Detailed history, comprehensive neurological and systemic examination was carried out and necessary biochemical investigations were done. A 12 lead ECG was taken within 24 hours of admission, repeat ECG was taken on 3rd day and at time of discharge. Results were compiled and statistical study done.

Results

In our study the mean age of patients was 63.06 ± 12.68 years. 88.75 % of cases were above 50 years of age while 11.25 % were young strokes (<50 years). In case of ischemic stroke, 90 % of cases were more than 50 years of age while in hemorrhagic strokes, 85 % were above 50 years of age. Ischemic strokes constituted 75 % (n=60) while the rest 25 % (n=20) were hemorrhagic strokes.

Study of ECG changes revealed that 11.25% cases of all CVA patients (n=9) had normal ECG while 88.75% cases (n=71) had some ECG changes.

The most common ECG changes on the day of admission in cases of ischemic strokes were T wave inversion (35 %), ST depression (26.66 %), QTc prolongation (23.33%), Bradycardia (8.33%), Tachycardia (11.66%), Atrial fibrillation (3.33%), and presence of U waves (6.66%).

In the subgroup of patients having hemorrhagic strokes, the most common findings were QTc prolongation (30%), T wave inversions (25%), ST depression (20%), Bradycardia (25%), Atrial fibrillation (5%), and 10% cases had U waves on ECG. None of the patients of hemorrhagic stroke had tachycardia.

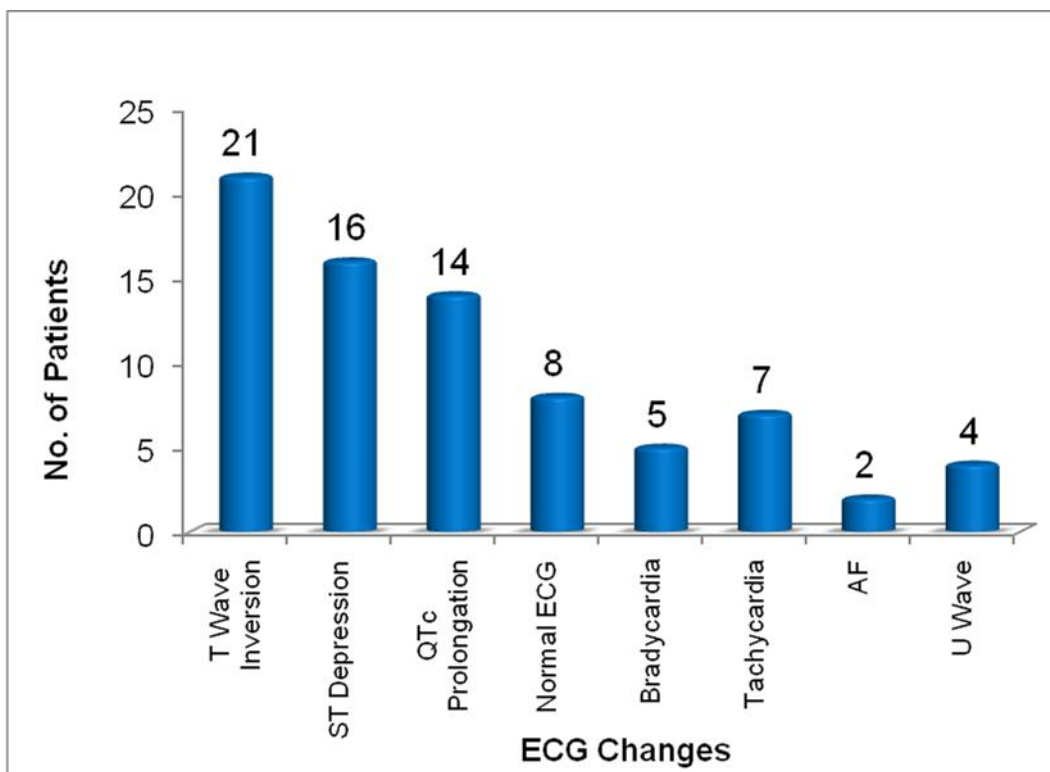
ECG Changes in infarct cases on day 1

ECG Changes	Ischemic		Hemorrhage	
	No. of Patients	%age	No. of Patients	%age
T Wave Inversion	21	35%	5	25%
ST Depression	16	26.66%	4	20%
QTc Prolongation	14	23.33%	6	30%
NORMAL ECG	8	13.33%	1	5%
Bradycardia	5	8.33%	5	25%
Tachycardia	7	11.66%	0	0%
AF	2	3.33%	1	5%
U Wave	4	6.66%	2	10%

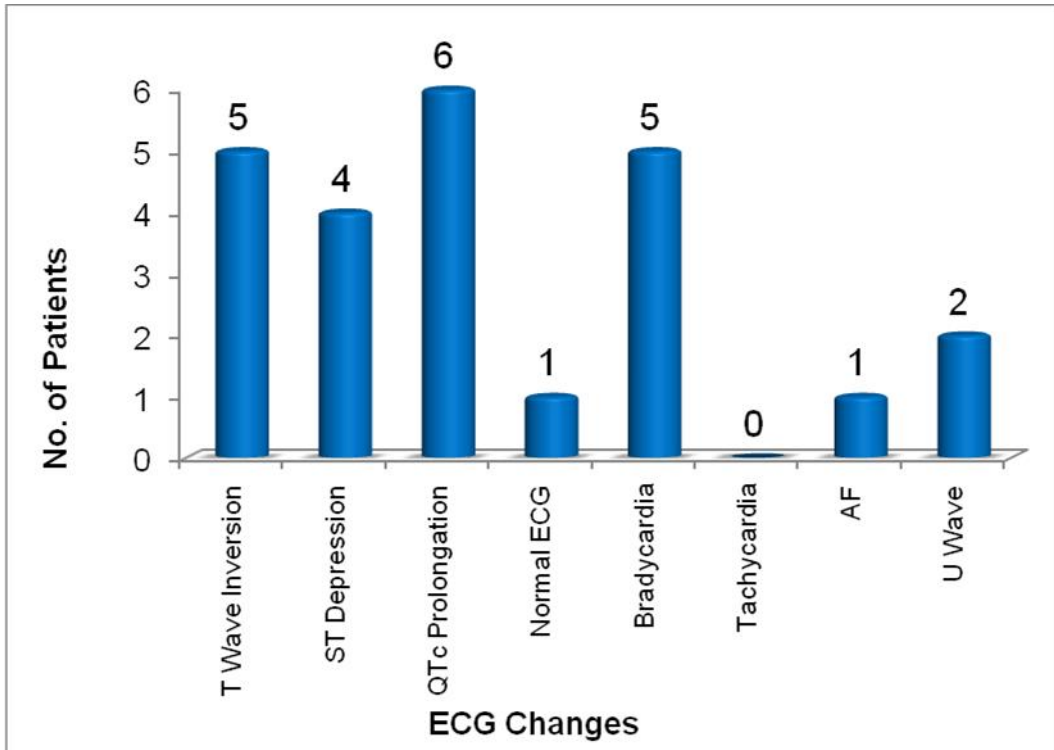
On the 3rd day of admission, in ischemic stroke patients, the common findings were T wave inversions (35%), ST depression (26.66%), and QT prolongation (21.66%) cases. In comparison the most frequent finding in hemorrhagic stroke patients were QTc prolongation (30%), T wave inversions (25%) and ST segment depression (20%).

T wave changes were the commonest finding (31.66%) while in the hemorrhagic CVA the commonest finding was QTc prolongation (25%). The other changes in order of prevalence in the ischemic group were ST depression (21.66%) and QTc prolongation (13.33%), while in the hemorrhagic group the common findings were T wave changes and ST depression in 20% of patients.

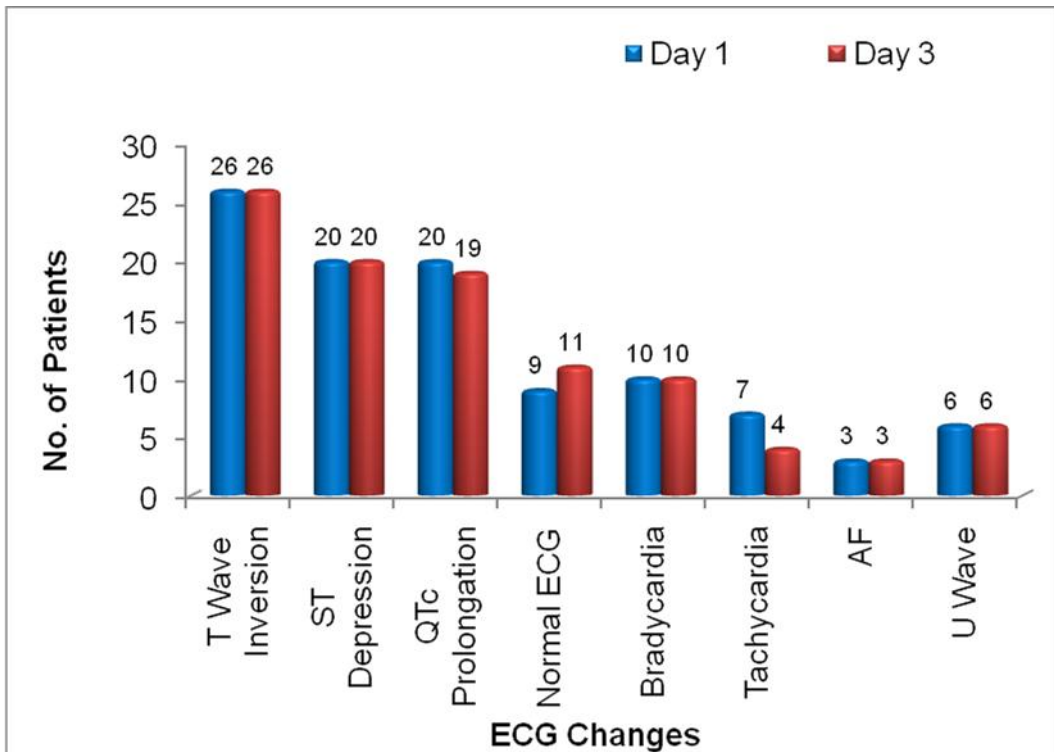
At the time of discharge, the same pattern of ECG changes was noticed. In the ischemic group,



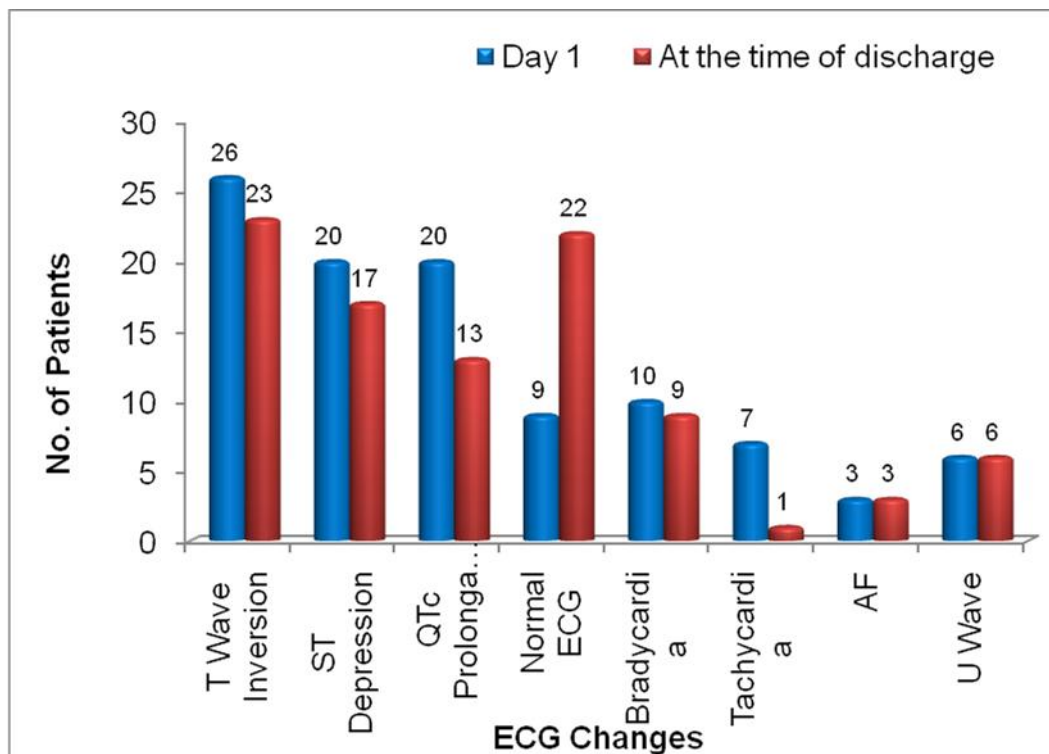
Bar diagram showing ECG changes in infarct cases on day 1



Bar diagram showing ECG changes in hemorrhagic cases on day 1



Bar diagram showing ECG changes in acute stroke patients on day 1 and day 3 (both infarct and hemorrhage)



Bar diagram showing comparison of ECG changes on day 1 and at the time of discharge (both infarct and hemorrhage)

Discussion

In the present study, the mean age was 63.48 ± 14.16 years. Kumar et al¹⁰ reported a mean age of 63 ± 12.68 years in their study, while Saxena et al¹¹ reported a mean age of 67 ± 8.90 years. In our study 11.25 % cases were in patients less than 50 years of age (young strokes).

The prevalence of ischemic strokes in our study was 75% and hemorrhagic strokes were 25%. Zhang et al¹² in their study reported 78% as ischemic strokes, 22% had hemorrhagic strokes while Jain and Garg¹³ reported ischemic strokes in 65.45 % of cases while hemorrhagic strokes were present in 34.55% cases.

In our study, ECG was normal in 11.25% cases. Goldstein et al¹⁴ reported 8% of cases of CVA had no ECG changes, Purshothaman et al¹⁵ reported normal ECG in 22% cases while Dimant et al⁴ reported that 10% of cases of CVA had no ECG changes.

Among the common ECG changes in our study were T wave inversions (32%), QTc prolongation (25%) and ST depression (25%). Purshothaman et al¹⁵ reported T wave inversions in 34% cases, QT prolongation in 25% and ST depression in 29% cases. Tandur and Sundragiri et al¹⁶ and Channapa et al¹⁷ reported T wave inversions in 24 % and 34% cases, QT prolongation in 20 % and 25 % cases, and ST depression in 31.08% and 29% cases respectively. Togha et al¹⁸ reported QT prolongation in 32.4% cases while T wave inversions were the most common ECG changes present in 43.9% cases. Golstein et al¹⁴ detected QT prolongation in 45% cases while Dogan et al¹⁹ reported QT prolongation in 26 % cases.

T wave inversions were reported in 36.1 % cases by Kumar et al¹⁰ while Tandur and Sundragiri¹⁶ reported T wave inversions in 24 % cases. Togha et al¹⁸ reported T wave inversions in 39.9% cases, Purshothaman et al¹⁵ in 34.8% cases, Somasundaram²⁰ in 22.3% cases while in the present study prevalence of T wave changes was 32.5% cases.

ST depression was present in 25% cases of CVA in our study. Kumar et al¹⁰ reported ST changes in 16.4% cases, Tandur et al¹⁶ in 20% cases, Golstein et al¹⁴ reported ST changes in 39% cases and Dogan et al¹⁹ in 65% cases. Mc Dermott et al²¹, on the other hand reported ST changes in only 8% of cases of CVA without history of coronary heart disease and in 60% cases having coronary disease.

Ischemia like ST changes and T wave inversions are quite common in cases of CVA. It has been reported that advancing age of presentation may itself be responsible for these changes. The accurate interpretation of these changes is essential and can assist the clinician towards a proper diagnosis. Surgical interventions like for managing subarachnoid aneurysmal bleed can be undertaken in time if proper diagnosis of ECG changes can be made.

Various researchers have tried to correlate the ECG changes with the location of the lesion in brain. Cropp and Manning²², Shuster²³ and Hunt²⁴ et al have not been able to show any relationship with the location of the lesion. Dogan et al¹⁹ observed that insular cortex lesions leads to various anomalies on the ECG like ischemia and arrhythmias.

Slight changes in the ECG were observed between the day of admission and on the third day but the results were not statistically significant.

Conclusion

This study confirms the role of ECG in workup of acute stroke patients. Electrocardiographic changes are very common in cases of CVA, even in those having no history of coronary heart disease. Interpretation of these ECG changes can aid the treatment of patients with respect of revascularization and surgical interventions.

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