

A Study on Electrocardiographic and 2D Echocardiographic changes in newly diagnosed acute stroke subjects

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final Manuscript

ABSTRACT

Background: In the industrialized world, stroke has acquired third place as an important cause of death. It has been estimated that annually >50 lakh people die due to stroke. But most of these second attacks can be seen within one year of first attack of stroke.

Aims: To find out occurrence and pattern of electrocardiographic and 2D Echocardiographic changes in newly diagnosed acute stroke subjects

Study Design: A Cross-Sectional Observational study.

Place and Duration of Study: Study was conducted at Department of general medicine, Dr D Y Patil Medical College, Pune, October 2020-september 2022.

Methodology: This study conducted in a semi-urban Teaching Hospital in Maharashtra, India. Data analysis was done using SPSS (Statistical Package for Social Sciences) Software version 20.

Results: No statistically significant difference was observed on comparing ECG findings like bradycardia, tachycardia, QTc prolongation, ST depression, LVH criteria, T wave inversion & U waves in subjects alive & died during treatment. No statistically significant difference was observed on comparing 2 D ECHO findings like Left ventricular dysfunction, Left ventricular hypertrophy, Global hypokinesia, Mild AR & Mild PAH in subjects alive and died during treatment.

Conclusion: From the present study it can be concluded that Electrocardiographic changes and 2 D Echo changes was observed in more than two third of cases with stroke. Common ECG changes seen in stroke patients are LVH criteria, ST depression, T wave inversion, Tachycardia and QTc prolongation. Common 2 D Echo changes observed in stroke patients are Left ventricular dysfunction, Left ventricular hypertrophy and mild AR.

Keywords: ischemic stroke, ECG, 2D echo

INTRODUCTION

Echocardiography is the mainstay investigation tool used in embolic stroke patients. Stroke has acquired third place as leading cause of death with ischemic stroke being very common among all the types of the stroke. Ischemic stroke can be classified as stroke due to atherosclerosis in large vessels and then the thrombi or emboli causing it, or stroke due to emboli which originated in the heart or stroke due to occlusion of the small blood vessel, or stroke can be classified as due to other determined causes or due to undetermined nature. 15-40% of the stroke cases are due to origin of the emboli in the heart while 30-40% is cryptogenic in nature. Diagnosis of stroke due to emboli arising in the heart is not easy. Such patients should undergo “echocardiography of both the thoracic region as well as TEE which will aid in proper diagnosis.”^[1,2] ICH generally presents as the abrupt onset of a focal neurologic deficit. Seizures are uncommon. Although clinical symptoms may be maximal at onset, commonly the focal deficit worsens over 30–90 min and is associated with a diminishing level of consciousness and signs of increased ICP such as headache and vomiting. The putamen is the most common site for hypertensive hemorrhage, and the adjacent internal capsule is usually damaged. Contralateral hemiparesis is therefore the sentinel sign.^[3]

Mansoureh Togha et al [2013] conducted study to assess Electrocardiographic abnormalities in acute cerebrovascular events in patients with/without cardiovascular disease. Study revealed the most common ECG abnormalities associated with stroke were T-wave abnormalities, prolonged QTc interval and arrhythmias, which were respectively found in 39.9%, 32.4%, and 27.1% of the stroke patients and 28.9%, 30.7%, and 16.2 of the patients with no primary cardiac disease.^[4] Niveditha R et al [2017] conducted study on Spectrum of electrocardiographic and echocardiographic changes in acute stroke. ST segment depression (53.1%) and U-waves (56.2%) followed by QTc prolongation (0.5 ± 0.7 ms) were the most

common abnormalities in haemorrhage group. Whereas in infarct type of stroke U-wave was the most common ECG finding (50.0%) among infarct group followed by QTc (0.45 ± 0.08 ms) and T-wave inversion (29.4%). None of the ECG changes had much significance on mortality and was statistically insignificant ($p > 0.05$) with either ischemic or hemorrhagic stroke. LV dysfunction, the most common abnormality was (29.4%) in infarct and haemorrhage (46.9%) stroke. LV dysfunction did not show significant impact on mortality in either of stroke subtypes ($p > 0.05$).^[5]

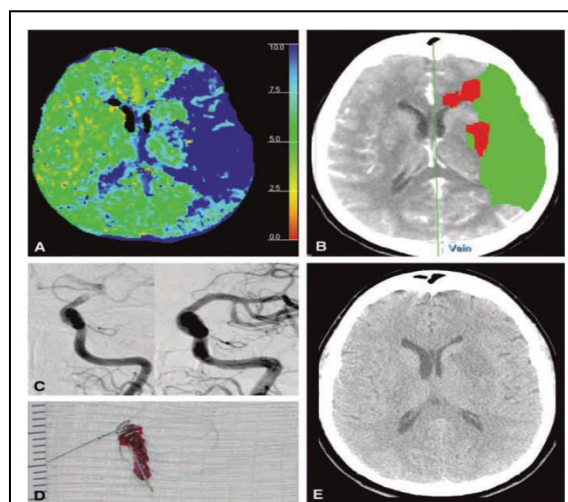
ECG Changes in stroke patients:

The changes of ECG in CVA were reported in many studies.^[6,7,8] 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. ST segment depression, QTc prolongation and U-waves are the common ECG abnormalities in hemorrhagic strokes. QTc prolongation and U-waves are the common ECG abnormality in ischemic stroke.⁹

2-D Echo Changes in stroke patients:

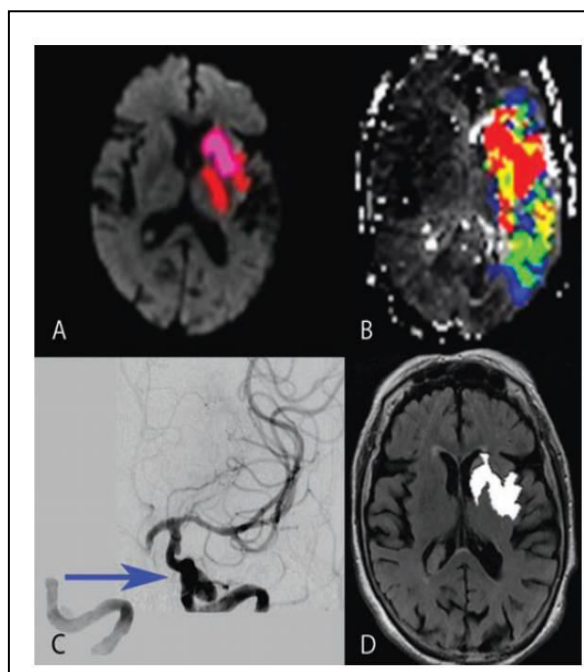
Along with ECG changes many studies have shown wall motion abnormalities on 2D echo following stroke, especially with subarachnoid hemorrhage.⁶⁻⁷ ^[10, 11] LV dysfunction is the most common 2D echocardiographic abnormality in stroke patients.^[12]

Diagnosis: A] CT Scans:



Acute left middle cerebral artery (MCA) stroke with right hemiplegia [Harrison] ^[13]

B] MRI:



Magnetic resonance imaging (MRI) of acute stroke. [Harrison page no. 3079] ^[13]

2. MATERIALS AND METHODS

100 Study subjects were General Medicine OPD and Wards and the Emergency Department. Study was conducted in a medical college and Hospital in Maharashtra, India.

Period of study was from October 2020 to September 2022.

2.1 INCLUSION CRITERIA

1. Patients in the age group of 18- 80 years,
2. Patients diagnosed as acute haemorrhagic or non-haemorrhagic stroke based on CT/MRI findings.

2.2 EXCLUSION CRITERIA

3. Patients with k/c/o- stroke.
4. Patients presenting with h/o head injury
5. Patients with existing bleeding disorder
6. Patients with past history of underlying coronary heart diseases, previously diagnosed with ECG abnormalities, congenital heart disease, valvular heart disease.

2.3 DATA ANALYSIS

Data was analysed using SPSS (Statistical Package for Social Sciences) Software version 26. Categorical variable will be expressed in terms of frequency and percentage and continuous variables in terms of mean and SD. Association between Clinico- demographic profile and ECG and Echo Outcome will be analyzed using chi square test and difference in continuous variables between normal and abnormal group will be analysed using T test with $p < 0.05$ as statistically significant value at 95% Confidence interval.

RESULTS AND DISCUSSION

It was observed that most of the study participants i.e.39 were in the age group of 51-60 years followed by 32 participants in the age group of 41-50 years age, 13 participants in age group of 31-40 years, 12 participants in age group of 61-70 years and participants in the age group of 71-80 years.

It was observed that more than half i.e.61 subjects diagnosed with stroke were male & 39 subjects were females.

Most common risk factor observed in the study subjects was hypertension observed in 54 subjects followed by diabetes in 36 subjects, hypertension & diabetes in 23 subjects and ischemic heart disease in 8 subjects.

Most of the study subjects i.e. 76 diagnosed with ischemic stroke and 24 subjects with haemorrhagic stroke.

Out of total 100 study subjects abnormal ECG findings was observed in 76 subjects and normal ECG findings was seen in 24 subjects.

Most common ECG finding observed was LVH criteria in 41 subjects followed by ST depression in 36 subjects, tachycardia & T wave inversion in 31 subjects each, QTc prolongation in 27 subjects, bradycardia in 4 subjects and U waves in 2 subjects.

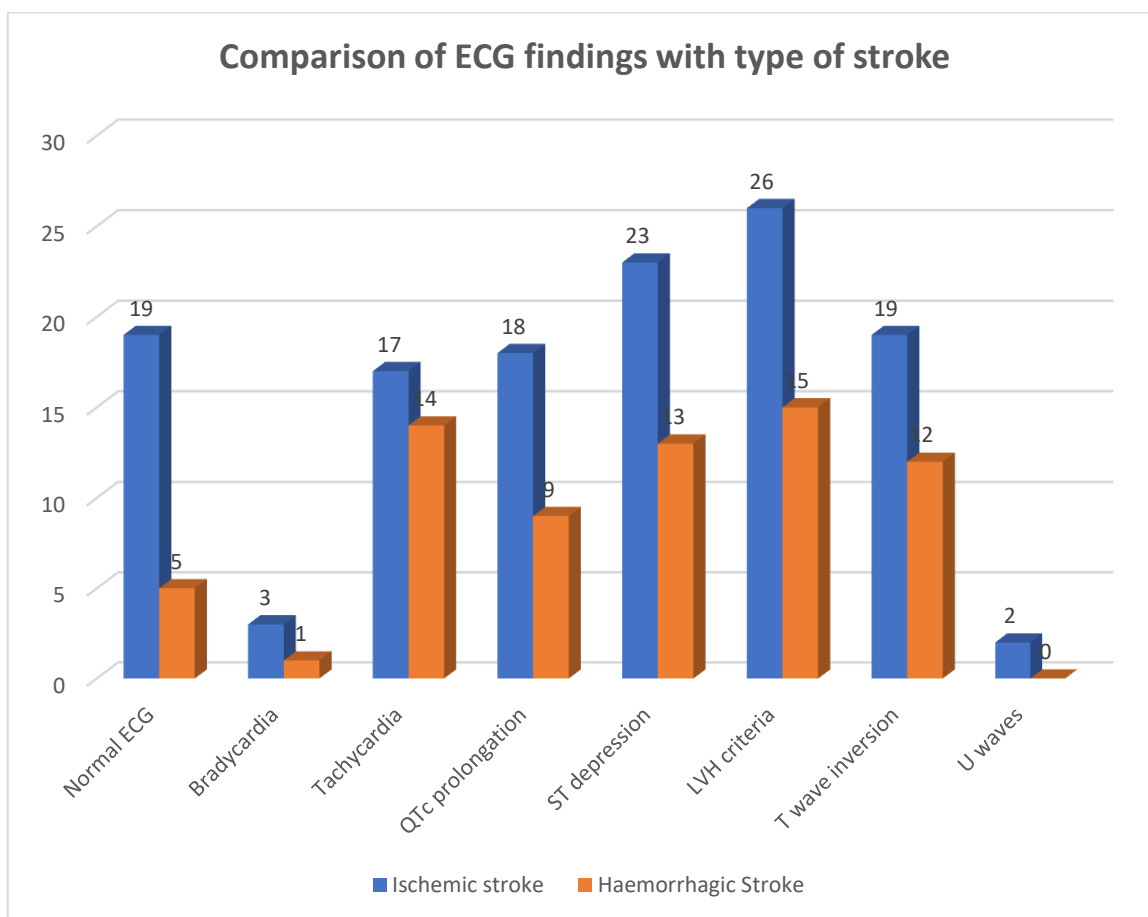
Abnormal 2D ECHO findings was observed in 75 subjects & finding was normal in 25 subjects.

Comparison of ECG findings with type of stroke

ECG findings		Type of stroke		Total	Chi square test	P value	Significance
		Ischemic stroke (76)	Haemorrhagic Stroke (24)				
Normal ECG	Present	19	5	24	0.174	0.676	Not significant
	Absent	57	19	76			
Bradycardia	Present	3	1	4	0.002	0.964	Not significant
	Absent	73	23	96			
Tachycardia	Present	17	14	31	11.03	0.0008	Significant
	Absent	59	10	69			
QTc prolongation	Present	18	9	27	1.766	0.183	Not significant
	Absent	58	15	73			
ST depression	Present	23	13	36	4.523	0.033	Significant
	Absent	53	11	64			
LVH criteria	Present	26	15	41	6.034	0.014	Significant
	Absent	50	9	59			
T wave inversion	Present	19	12	31	5.33	0.020	Significant
	Absent	57	12	69			
U waves	Present	2	0	2	0.644	0.422	Not significant
	Absent	74	24	98			

Tachycardia, ST depression, LVH criteria and T wave inversion were the common ECG findings associated with haemorrhagic stroke as compared to ischemic stroke and the difference observed was statistically significant. No statistically significant difference was

observed on comparing ECG findings like bradycardia, QTc prolongation and U wave among ischemic and haemorrhagic stroke subjects.

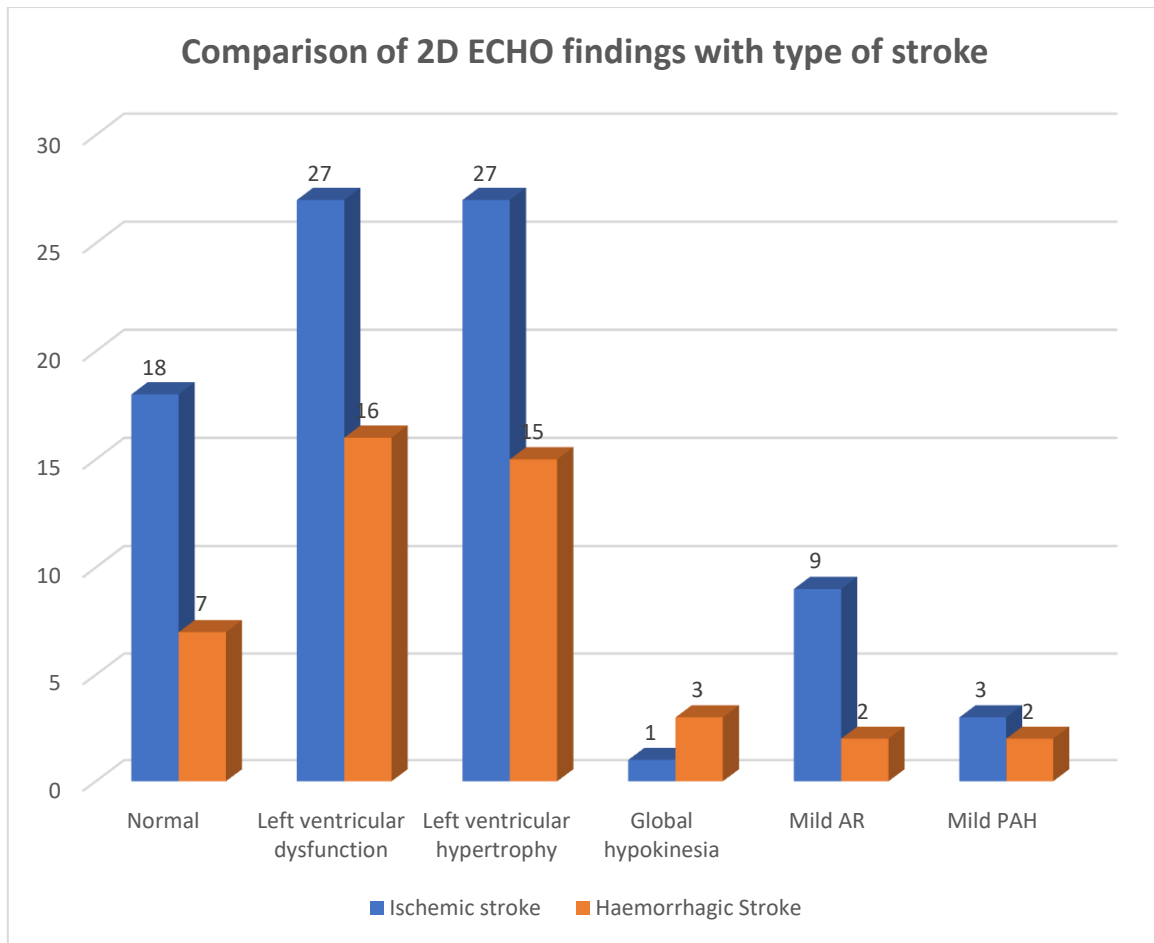


Comparison of 2D ECHO findings with type of stroke

2D Echo findings		Type of stroke		Total	Chi square test	P value	Significance
		Ischemic stroke (76)	Haemorrhagic Stroke (24)				
Normal	Present	18	7	25	0.292	0.588	Not significant
	Absent	58	17	75			
Left ventricular	Present	27	16	43	7.217	0.007	Not significant

dysfunction	Absent	49	8	57			
Left ventricular hypertrophy	Present	27	15	42	5.448	0.019	Not significant
	Absent	49	9	58			
Global hypokinesia	Present	1	3	4	5.942	0.014	Significant
	Absent	75	21	96			
Mild AR	Present	9	2	11	0.229	0.632	Not significant
	Absent	67	22	89			
Mild PAH	Present	3	2	5	0.739	0.389	Not significant
	Absent	73	22	95			

It was observed that Left ventricular dysfunction, Left ventricular hypertrophy and Global hypokinesia were statistically significantly associated with haemorrhagic stroke as compared to ischemic stroke. While no statistically significant difference was observed on comparing 2D ECHO findings like Mild AR and Mild PAH in ischemic and haemorrhagic stroke subjects.



Distribution of study subjects as per outcome

Outcome	Ischemic stroke	Haemorrhagic Stroke	Total
Alive	72 (94.74%)	19(79.17%)	91 (91%)
Dead	04 (5.26%)	05(20.83%)	09 (09%)
Total	76	24	100 (100%)

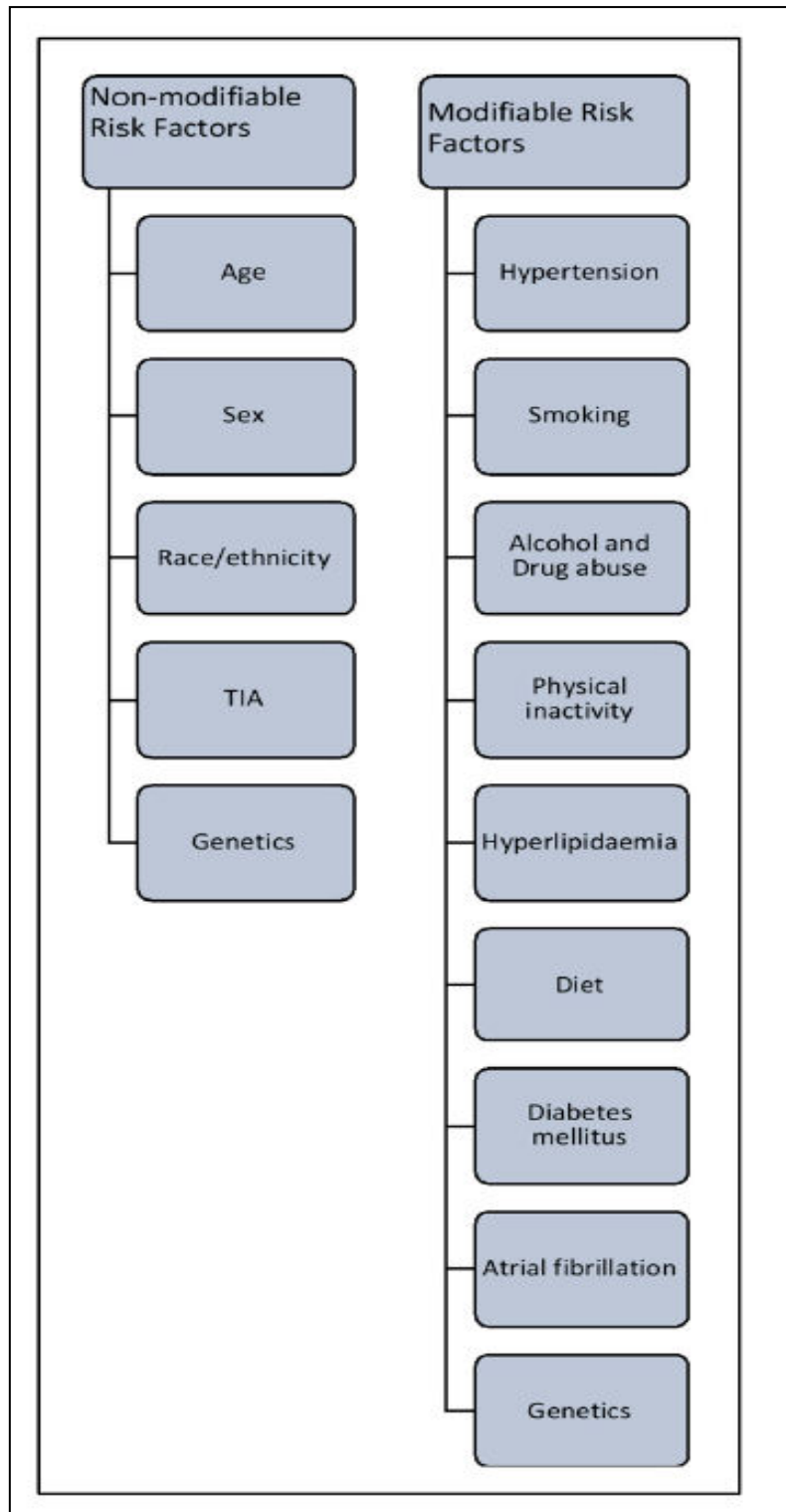
Out of 100 study subjects with stroke 91% were alive & 9% died during the treatment. The proportional mortality among the haemorrhagic stroke patients was higher (20.83%) as compared to ischemic stroke patients.

Study conducted by Chandrababu Devarapu et al revealed death in 32% subjects. Study conducted by Niveditha R et al revealed death in 22% subjects during the treatment.

Niveditha R et al [2017] conducted study on Spectrum of electrocardiographic and echocardiographic changes in acute stroke. ST segment depression (53.1%) and U-waves (56.2%) followed by QTc prolongation (0.5 ± 0.7 ms) were the most common abnormalities in haemorrhage group. Whereas in infarct type of stroke U-wave was the most common ECG finding (50.0%) among infarct group followed by QTc (0.45 ± 0.08 ms) and T-wave inversion (29.4%). None of the ECG changes had much significance on mortality and was statistically insignificant ($p>0.05$) with either ischemic or hemorrhagic stroke. LV dysfunction, the most common abnormality was (29.4%) in infarct and haemorrhage (46.9%) stroke. LV dysfunction did not show significant impact on mortality in either of stroke subtypes ($p>0.05$).¹⁴

Gurdeep Kaur et al [2020] conducted a study of Clinico-radiological and Socio-demographic Profile of Patients with Stroke in a Tertiary Care Hospital of South West Rajasthan. Study revealed mean age of stroke in present study was 60.46 ± 14.84 years, Hypertension as a risk factor was present in 52.5% of our patients followed by Dyslipidaemia (25.8%). 79.4% had ischemic stroke and 19.4 % haemorrhagic stroke. Supratentorial lesions were seen in 86.4% patients, infratentorial lesions in only 10% anterior circulation strokes (MCA>ACA) are more common than posterior circulation strokes. Motor and sensory symptoms are common in acute strokes rather than change in consciousness or speech abnormalities. 70.2% patients had moderate disability at the end of 28 days. Early presentation to hospital (<3hrs) is associated with better outcome and less morbidity in a stroke patient.¹⁵

Proper rehabilitation of the stroke patient includes early physical, occupational, and speech therapy. It is directed toward educating the patient and family about the patient's neurologic deficit, preventing the complications of immobility (e.g., pneumonia, DVT and pulmonary embolism, pressure sores of the skin, and muscle contractures), and providing encouragement and instruction in overcoming the deficit. The goal of rehabilitation is to return the patient home and to maximize recovery by providing a safe, progressive regimen suited to the individual patient.¹⁶



Risk factors associated with stroke¹⁷

There is a very considerable heterogeneity regarding ECG changes in patients with stroke. Electrocardiographic spectrum seems to be related to the type of cerebrovascular disease and its localization. The autonomic and cardiovascular effects of stroke; however, are modulated by concomitant factors such as pre-existent cardiac diseases and electrolyte

disorders. Many reports have described ECG abnormalities and rhythm disturbances in stroke, especially subarachnoid haemorrhage.¹⁸

Global burden of disease study shows that of the 9.4 million deaths in India, 619,000 were due to stroke. The Disability Adjusted Life Years (DALYs) lost were 28.5 million highlighting the fact that CVD leads to considerable mortality and morbidity.¹⁹ Therefore, there is likely to be a major crisis in India unless national measures to prevent or control risk factors of CVD are instituted and adequate services are put in place for the management and rehabilitation of stroke. Another issue of concern is that 20–30% of strokes occur in people younger than 45 years and is more frequently seen in India compared to the west.²⁰ Stroke burden has been rising in India as compared to the developed countries where it has reached plateau or decreased. Overall, ischemic strokes account for about 80% of all strokes in India and intracranial atherosclerosis tends to be commoner in Indian people.²¹

CONCLUSION

- From the present study it can be concluded that Electrocardiographic changes and 2 D Echo changes was observed in more than two third of cases with stroke. Common ECG changes seen in stroke patients are LVH criteria, ST depression, T wave inversion, Tachycardia and QTc prolongation. Common 2 D Echo changes observed in stroke patients are Left ventricular dysfunction, Left ventricular hypertrophy and mild AR. Ischemic stroke was more common compared to hemorrhagic stroke. Electrocardiographic changes like Bradycardia, QTc prolongation, ST depression, LVH criteria , T wave inversion and U waves and 2 D Echo changes like Left ventricular dysfunction, Global hypokinesia, Mild AR and Mild PAH in study participants who are alive and dead was statistically significant, indicating prognostic significance predicting mortality in CVA. Statistically significant difference was observed for Bradycardia, Tachycardia and LVH criteria among subjects alive & died during treatment.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

All authors have declared that “Written informed consent were taken from all study subject”.

ETHICAL APPROVAL

All authors hereby declare that the study was approved by the Institutional ethics sub-committee of Dr. D. Y. Patil Medical College, Hospital & Research Centre, Pimpri (I.E.S.C./10/2020)

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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