Original Article

Study Of ECG And Echocardiographic Abnormalities In Stroke Patients

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Abstract
Background: Of all strokes, 88% are ischemic and 12% are hemorrhagic in nature. Of the hemorrhagic strokes, 9% are due to an intracerebral hemorrhage, and 3% are due to a subarachnoid hemorrhage.

Objectives: To study the different changes in ECG and echocardiographic patterns in cases of cerebrovascular accidents.

Method: The present cross sectional study was conducted on 100 cases admitted to SRN hospital, Allahabad with acute stroke. Total 164 patients were taken in which 64 were excluded on the basis of exclusion criteria.

Results: Most of stroke patients were in between 61-70 years age group. Incidence of ischemic stroke was more common in 51-60 years age group while in hemorrhagic stroke it was more common in 61-70 years age group. Out of 100 stroke patients, 63 patients were of ischemic stroke and 37 patients were of hemorrhagic stroke. Out of 63 ischemic stroke patients, only 10 patients (15.87%) had normal 2D-echo while 53 patients (84.13%) had abnormal 2D-echo. Out of 37 hemorrhagic stroke patients only 3 patients (8.11%) had normal 2D-echo while 35 patients (94.60%) had abnormal 2D-echo. Out of 100 patients most common ECG finding in stroke patients was ST depression T-inversion that was present in 16% patients.

Conclusion: ECG and 2D-echo changes were present in most of the patients. Abnormal ECG changes were more common among hemorrhagic patients. 2D echo abnormalities were more common among haemorrhagic group.

Keywords: Ischemic stroke, 2D-echo, ECG, Hemorrhagic stroke

INTRODUCTION:

Stroke is common life threatening disorder. It is the third leading cause of death in developed countries after cardiovascular disease and cancer[1]. Every year, more than half a million people in the world suffer from acute cerebrovascular events, including ischemic stroke, intracerebral and subarachnoid hemorrhage, giving a mortality of nearly 20%[2].

Stroke is also the leading cause of neurological disability in adults. Of the hundreds of thousands of stroke survivors each year, approximately 30% require assistance with activities of daily living, 20% require assistance with ambulation, and 16% require institutional care[3].

Despite the increase in the global burden of stroke, advances are being made. In 2008, after years of being the third leading cause of death in the United States, stroke dropped to fourth[4]. Stroke is the second cause of disability and dementia in people aged more than 65 years worldwide[5].
Stroke also called 'Brain Attack' because it involves an acute insult to the brain, is a major disabling disease. But throughout the world, unfavourable trends in stroke risk factor profile, lack of prevention programs, lack of awareness of stroke risk factors and warning signals by the public and lack of emphasis on preventive training in medical schools, portend high stroke rates and serve to widen the stroke prevention gap[6].

Electrocardiographic (ECG) and 2D-Echo changes are reported frequently after acute strokes. Many reports have described ECG abnormalities and rhythm disturbances in stroke. It seems that cardiovascular effects of strokes are modulated by concomitant or pre-existent cardiac diseases, and are also related to the type of cerebrovascular disease and its localization. In addition, patients often have simultaneous hypertension or coronary atherosclerosis, leading to ECG abnormalities. In addition, many primary cardiac disorders, like myxoma, mural thrombus, endocarditis, and atrial septal defect with deep venous thrombosis, can lead to cerebral emboli; arrhythmias, heart block, and decreased cardiac output, which may precipitate cerebral ischemia. Hence this study was conducted to study the different changes in ECG and echocardiographic patterns in cases of cerebrovascular accidents.

MATERIALS AND METHODS: This cross sectional study was conducted at MLN Medical College, Allahabad and its associated SRN Hospital, Allahabad during a period from March 2016 to July 2017.

Case selection:
Patients aged > 18 years of either sex with Stroke confirmed by clinical and radiological criteria were enrolled in the study.

Inclusion Criteria
1. Cases of CVA with symptoms lasting for more than 24 hours and admitted within 72 hours after the onset of stroke were selected for the study.
2. CVA cases without known underlying cardiac diseases, which produce ECG and Echocardiographic Changes

Exclusion Criteria
1. Patients admitted beyond 72 hours after onset of stroke.
2. Traumatic cases producing neurological deficits.
3. Infection, neoplastic cases producing CVA.
4. CVA with established cardiovascular diseases.
5. Neurological dysfunctions secondary to metabolic Encephalopathy

Methods:

A cross sectional study was done on 100 subjects diagnosed with stroke over the time period of one year. 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. Detailed neurological examination including fundoscopy and cardiovascular examination was carried out in all the cases. CT scan brain (plain) was done in all subjects to establish the ischemic lesion and hemorrhagic stroke. Each subject also underwent ECG and transthoracic 2D-echocardiogram to assess the presence of various ECG and 2D-echocardiographic changes in stroke patients.

ECG criteria

Heart rate less than 60/ min was regarded as bradycardia and heart rate, exceeding 100/ min was regarded as tachycardia. ST-segment depression of 0.5 mm or elevation of more than 1 mm was taken abnormal. T-wave was considered abnormal when inversion of T-waves in which it should have been upright, i.e., I, II V3–V6 may be variable in III, aVL, V1 and V2. QTc prolongation: The QT interval is measured from the beginning of the QRS complex to the end of T-wave, the rate corrected QTc is obtained by dividing the actual QT by the square root of the RR-interval (both measured in seconds). QTc is 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 V3-V4).LVH: If the sum of the depth of the S-wave in lead V1 and the height of the R- wave in either lead V5 or V6 exceeds 35 mm, an R-wave of 11 to 13 mm or more in lead aVL is another criteria for LVH. RBBB: QRS duration is increased to 120 ms, lead V1 reflects a tall, wide and frequently notched R` deflection and leads V5 and V6 reflect a prominent, delayed and widened S wave. LBBB: QRS prolonged to 120ms or more, lead V1 and V2 reflect a widened, notched QS complex or an rS complex, leads V5 and V6 reflect a tall and notched R wave, an RR or M shaped complex. Atrial fibrillation: P wave absent with fibrillary waves (irregular spiked waves of varying shape) with irregular rhythm.

2D Echo Criterion using Ultramark 6 2D echo with colour Doppler was used: LV ejection fraction was used to assess LV systolic function. LVEF was then categorized as normal (>50%), mildly (41% to 50%), moderately (31% to 40%) or severely (≤30%) decreased. Doppler indices (A>E across mitral valve) were used look for LV diastolic dysfunction Mitral valve opening using planimetry was used to look for mitral stenosis apart from this valve thickening, and doming of AML and paradoxical motion of PML were used. Flow across aortic valve was used to look for aortic stenosis including opening (severe AS if AVO <8 mm). Colour imaging and doppler were utilised for any regurgitation. 2-dimensional imaging was used to rule out left atrial thrombus

Statistical Analysis: Data was entered into excel spreadsheet. Continued data was presented as mean and standard deviation, Nominal data as numbers and percentages. Chi-square test was used to establish correlation between various indexes which were otherwise calculated from the observed values. Correlation was considered to be significant if p- value was found to be <0.05.

Results: Out of 100 stroke patients 63 (63%) were ischemic and 37 (37%) were hemorrhagic. It was found that prevalence of stroke was more in elderly age group. Most of stroke patients were in between 61-70 years age group. Incidence of ischemic stroke was more common in 51-60 years age group while in hemorrhagic stroke it was more common in 61-70 years age group.

Mean age of cases with ischemic stroke was 62.46 ± 9.33 years and that of hemorrhagic stroke was 64.30 ± 8.53 years. The difference was not found to be statistically significant (p-value 0.3284).

Out of 63 patients of ischemic stroke 46 (73.02%) were males and 17 (26.98%) were females. In 37 hemorrhagic stroke patients 24 (64.86%) were males and 13 (35.14%) were females and the difference was not found to be statistically significant (p value=0.3907).

Out of 100 patients, 90 patients (90%) had abnormal ECG while only 10 patients (10%) had normal ECG. Out of 100 patients, 87 patients (87%) had abnormal 2D-Echo while 13 stroke patients (13%) had normal 2D-Echo.

Out of 100 stroke patients, 63 patients were of ischemic stroke and 37 patients were of hemorrhagic stroke. Out of 63 ischemic stroke patients, only 8 patients (12.70%) had normal ECG while 55 patients (87.30%) had abnormal ECG. Out of 37 hemorrhagic stroke patients only 2 patients (5.4%) had normal ECG while 35 patients (94.60%) had abnormal ECG. The difference was not found to be significant (p-value 0.2405).

Table 1. Relationship Between Stroke Type And ECG Changes

Stroke type	ECG Changes		Chi-square test	p-value
	Normal	Abnormal		
Ischemic stroke (N = 63)	8(12.70%)	55(87.30%)	1.3776	0.2405
Hemorrhagic stroke (N= 37)	2(5.40%)	35(94.60%)		

Out of 63 ischemic stroke patients, only 10 patients (15.87%) had normal 2D-echo while 53 patients (84.13%) had abnormal 2D-echo. Out of 37 hemorrhagic stroke patients only 3 patients (8.11%) had normal 2D-echo while 35 patients (94.60%) had abnormal 2D-echo. The difference was not found to be significant (p-value 0.2649).

Table 2. Relationship Between Stroke Type And 2D-Echo Changes

Stroke type	2D-Echo Changes		Chi-square test	p-value
	Normal	Abnormal		
Ischemic stroke (N = 63)	10(15.87%)	53(84.13%)	1.2427	0.2649
Hemorrhagic stroke (N= 37)	3(8.11%)	34(91.89%)		

Out of 100 patients most common ECG finding in stroke patients was ST depression T-inversion that was present in 16% patients. QTc-prolongation was found in 12% patients, AF in 10% patients, LVH in 10% patients, LBBB in 9% patients, Q- wave in 9% patients, T-inversion in 8% patients, ST-elevation in 6% patients, RBBB in 4% patients, U-wave in 4% patients Sinus bradycardia was present in only 2% of patients that was least common ECG findings in stroke patients.10% patients had normal ECG findings.

Table 3. ECG Changes in Stroke patients

ECG changes	Number of Patients (N=100)	Percentage
ST depression T inversion	16	16%
QTc prolongation	12	12%
Atrial fibrillation	10	10%
LVH	10	10%
LBBB	9	9%
Q- wave	9	9%
T-inversion	8	8%
ST-elevation	6	6%
RBBB	4	4%
U-wave	4	4%
Sinus bradycardia	2	2%
Normal	10	10%

Out of 63 patients of ischemic stroke most common ECG finding was atrial fibrillation that was present in 10 (15.87%) patients followed by Q-wave that was present in 9 (14.29%) patients. ST depression T-inversion that was present in 8 (12.70%) patients. QTc-prolongation was found in 5 (7.94%) patients, LVH in 4 (6.35)% patients, LBBB in 5 (7.94%) patients, ST-elevation in 6 (9.52%) patients, RBBB in 4 (6.35%) patients, U- wave in 3 (4.76%) patients. T-inversion was found only 1 (1.59%) of patients that was least common ECG findings in ischemic stroke patients. 8 (12.70%) patients had normal ECG findings. None of the ischemic stroke patients had sinus bradycardia.

Table 4. ECG Changes in Ischemic Stroke patients

ECG changes	Number of Patients (N=63)	Percentage
ST depression T inversion	8	12.70%
QTc prolongation	5	7.94%
Atrial fibrillation	10	15.87%
LVH	4	6.35%
LBBB	5	7.94%
Q- wave	9	14.29%
T-inversion	1	1.59%
ST-elevation	6	9.52%
RBBB	4	6.35%
U-wave	3	4.76%
Normal	8	12.70%

Out of 37 patients of hemorrhagic stroke most common ECG finding was ST depression T-inversion that was present in 8 (21.62%) patients followed by QTc-prolongation and T-inversion that were found in 7 (18.92%) patients, LVH in 6 (16.22)% patients, LBBB in 4 (10.81%) patients, Sinus bradycardia in 2 (5.41%). U- wave was found only in 1 (2.70%) patients that was least common ECG findings in hemorrhagic stroke patients. 2 (5.41%) patients had normal ECG findings. None of the hemorrhagic stroke patients had Q-wave, RBBB, ST-elevation and AF.

Table 5. ECG Changes in hemorrhagic Stroke patients

ECG changes	Number of Patients (N=37)	Percentage
ST depression T inversion	8	21.62%
QTc prolongation	7	18.92%
LVH	6	16.22%
LBBB	4	10.81%
T-inversion	7	18.92%
U-wave	1	2.70%
Sinus bradycardia	2	5.41%
Normal	2	5.41%

Out of 100 stroke patients LVH LVDD grade I was the most common 2D-echo abnormality that was present in 44 (44%) patients. LVH LVDD grade II was found in 6 (6%)patients , global hypokinesia (EF 25-30%) in 3 (3%) patients, global hypokinesia (EF 30-35%) in 9 (9%) patients, hypokinesia of LAD territory (EF 35-40%) in 8 patients, hypokinesia of LAD territory (EF 40-45%) in 6 (6%), hypokinesia of RCA territory (EF 40-45%) in 6 (6%), thickened mitral valve in 2 (2%) patients, degenerative aortic valve was present in 2 (2%).LA thrombus was present only in 1(1%) patient that was least common 2D-echo finding in stroke patients. 13 (13%) patients had normal 2D-echo.

Table 6. 2D Echo changes in stroke patients

2D-Echo changes	Number of patients (N= 100)	Percentage
LVH LVDD grade I (EF 50-55%)	44	44%
LVH LVDD grade II (EF 45-50%)	6	6%
Global hypokinesia (EF 25-30%)	3	3%
Global hypokinesia (EF 30-35%)	9	9%
Hypokinesia of LAD territory (EF 35-40%)	8	8%
Hypokinesia of LAD territory (EF 40-45%)	6	6%
Hypokinesia of RCA territory (EF 40-45%)	6	6%
Thickened mitral valve (EF 50-55%)	2	2%
Degenerative aortic valve (EF 50-55%)	2	2%
LA thrombus EF (50-55%)	1	1%
Normal (EF >55%)	13	13%

DISCUSSION:

The mean age of study population was 63.14 ± 9.04 years. Mean age of males were 63.51 ± 9.72 years and that of females were 62.27 ± 7.32 years. The difference was not found to be statistically significant (p-value 0.3284). Out of 100 stroke patients 63 (63%) were ischemic and 37 (37%) were hemorrhagic. Out of 63 patients of ischemic stroke 46 (73.02%) were males and 17 (26.98%) were females. In 37 hemorrhagic stroke patients 24 (64.86%) were males and 13 (35.14%) were females and the difference was not found to be statistically significant (p value=0.3907). Mean age of cases with ischemic stroke was 62.46 ± 9.33 years and that of hemorrhagic stroke was 64.30 ± 8.53 years. The difference was not found to be statistically significant (p-value 0.3284). It was found that prevalence of stroke was more in elderly age group. Most of stroke patients were in between 61-70 years age group. The findings about age,[7] sex distribution[8] and subtypes of stroke[9] were concordant with previous studies.

ST-segment depression was seen in 27% in a study of Goldstein et al[10] while in the present study it was present in 16%. Prolonged QTc was seen in 45% of cases in a study of Goldstein et al[10], while in our study it was present in 12%. Atrial fibrillation was seen in 14% in a study of Goldstein et al[10], while in our study it was present in 10%. LVH was seen in 26% in a study of Goldstein et al, while in our study it was present in 10%. LBBB was seen in 2% in a study of Goldstein et al, while in our study it was present in 9%. Q-wave was seen in 20% in a study of Goldstein et al, while in our study it was present in 9%. T-inversion was seen in 29% in a study of Goldstein et[10] al, while in our study it was present in 8%. ST-elevation was seen in 6% in a study of Goldstein et al[10], while in our study it was present in 6% that is comparable. RBBB was seen in 7% in a study of Goldstein et al, while in our study it was present in 4%. U-wave was seen in 28% in a study of Goldstein et al[10], while in our study it was present in 4%. Sinus bradycardia was seen in 8% in a study of Goldstein et al, while in our study it was present in 2%. Normal ECG was seen in 8% patients in study of Goldstein et al[10], while in our study it was present in 10% of the patients.

Increased QTc was seen in 41% in a study of A.P.S Tomar et al[11] while in our study it was present in 12%. T-wave inversion was seen in 30% in a study of A.P.S Tomar et al while in our study it was present in 8%. ST-segment depression was seen in 20% in a study of A.P.S Tomar et al[11] while in the present study it was present in 16%. U-wave was seen in 53% while in our study it was present in 4%. Bradycardia was seen in 2% in a study of A.P.S Tomar et al[11] while in our study it was present in 2%.

Out of 63 ischemic stroke patients, only 10 patients (15.87%) had normal ECG and out of 37 hemorrhagic stroke patients only 3 patients (8.11%) had normal ECG. The difference was not found to be significant (p-value 0.2649). In ischemic stroke most common ECG finding was atrial

fibrillation that was present in 10 (15.87%) followed by Q-wave that was present in 9 (14.29%) patients. None of the ischemic stroke patients had sinus bradycardia. In hemorrhagic stroke most common ECG finding was ST depression T-inversion that was present in 8 (21.62%) followed by QT-prolongation and T-inversion that were found in 7 (18.92%) patients. None of the hemorrhagic stroke patients had Q-wave, RBBB, ST-elevation and AF.

In the present study, LV dysfunction in ischemic stroke was present in 41.27% of cases, while in the study of Gagliardiet al[12] (1985) and Uma et al[13] (1999) it was present in 22% and 26% of the patients, respectively.

In infarct group 2D echo was normal in 55.88% in a study of A.P.S Tomar et al while LV dysfunction was seen in 23.53%, mitral valve abnormality in 20.59% and aortic wall abnormality in 4.41% and no patients had LA thrombus while in present study 2D-echo was normal in 15.87% patients in ischemic stroke patients, LV systolic dysfunction was present in 41.27% patients, LV diastolic dysfunction was present in 34.93% patients. Mitral valve abnormality present in 3.17% and aortic wall abnormality in 3.17% and 1.59% patients had LA thrombus. In the hemorrhage group a high number of patients 56.26% had LV dysfunction in the study of A.P.S Tomar et al, None had LA thrombus, mitral valve or aortic valve abnormality and in 25% 2D echo was normal, while in present study 32.43% had LV systolic dysfunction while LV diastolic dysfunction was present in 75.66%, 8.11% had normal 2D-echo. None had LA thrombus, mitral valve or aortic valve abnormality.

In a study of Irappa Basappa Ganiger et al[14]Echocardiographic changes of LVSD was present in 23% and LVDD in 37% in ischemic stroke patients, while in present study LVSD was present in 41.27% patients, LVDD was present in 34.93% patients.

In the study of A.P.S Tomar et al none of the ECG changes had much significance on mortality and was statistically insignificant and LV dysfunction showed significant mortality in stroke patients and was statistically significant. In the study of Niveditha R et al both ECG and ECHO abnormalities in stroke patients do not have any prognostic significance predicting mortality in CVA, while on our study LBBB on ECG, Severe LV systolic dysfunction (EF 25-30%) and LV diastolic dysfunction (LVDD grade II) showed significant mortality in stroke patients and was statistically significant.

13% patients of stroke had normal 2D-echo. In ischemic stroke patients 2D-echo was normal in 15.87% patients while in hemorrhagic stroke patients only 3 patients (8.11%) had normal 2D-echo. The difference was not found to be significant (p-value 0.2649).

In ischemic stroke patients LV systolic dysfunction was most common abnormality while in hemorrhagic stroke LV diastolic dysfunction was most common abnormality.

CONCLUSION:

ECG and 2D-echo changes were present in most of the patients. Abnormal ECG changes were more common among hemorrhagic patients. 2D echo abnormalities were more common among hemorrhagic group. Atrial fibrillation, Q-wave and ST-depression T-inversion were common ECG abnormalities in ischemic stroke patients. ST-depression, QTc prolongation, T-inversion and LVH were common ECG abnormalities in hemorrhagic stroke patients. In either group LVH with LVDD grade I was most common 2D-echo abnormality.

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