



ELECTROCARDIOGRAPHIC AND ECHOCARDIOGRAPHIC ASSESSMENT IN PATIENTS PRESENTING WITH STROKE IN OUR GENERAL MEDICINE DEPARTMENT

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ABSTRACT

Background: Stroke is a major cause of mortality and long-term disability worldwide and is frequently associated with cardiovascular abnormalities. Electrocardiographic (ECG) and echocardiographic changes are commonly observed in acute stroke patients and may influence prognosis and clinical outcomes. This study aimed to evaluate ECG and echocardiographic abnormalities in patients with stroke.

Methodology: This hospital-based observational study was conducted in the Department of General Medicine at Sree Mookambika Institute of Medical Sciences from January 2025 to December 2025. A total of 100 patients aged above 18 years with clinically and radiologically confirmed stroke were included. Detailed clinical evaluation, 12-lead ECG, and two-dimensional echocardiography were performed in all patients. Statistical analysis was carried out using SPSS version 25.0, and $p < 0.05$ was considered statistically significant.

Results: Among 100 stroke patients, 63 had ischemic stroke and 37 had hemorrhagic stroke. Abnormal ECG findings were observed in 90% of patients, while abnormal 2D-echocardiographic findings were present in 87% of patients. ST depression with T-wave inversion (16%) was the most common ECG abnormality, followed by QTc prolongation (12%) and atrial fibrillation (10%). Left ventricular hypertrophy with grade I diastolic dysfunction (44%) was the most common echocardiographic finding. Cardiovascular abnormalities were more frequent in hemorrhagic stroke patients, though statistically insignificant.

Conclusion: ECG and echocardiographic abnormalities are highly prevalent in stroke patients. Routine cardiac evaluation may help in early diagnosis, risk stratification, and improved management of stroke-related cardiovascular complications.

Keywords: Stroke, Electrocardiography, Echocardiography, Ischemic Stroke, Hemorrhagic Stroke, Cardiovascular Abnormalities.

INTRODUCTION

Stroke is one of the leading causes of mortality and long-term disability worldwide and represents a major global health burden. It is an acute neurological condition caused by an interruption of cerebral blood flow due to ischemia or hemorrhage, leading to rapid loss of brain function. Globally, millions of individuals suffer from acute cerebrovascular events each year, including ischemic stroke, intracerebral hemorrhage, and subarachnoid hemorrhage, contributing significantly to morbidity, mortality, and healthcare expenditure [1].

According to the World Health Organization, stroke remains the second leading cause of death and one of the primary causes of disability among adults worldwide [2].

Stroke is often referred to as a “brain attack” because of its sudden onset and devastating neurological consequences. Despite advances in preventive strategies and acute stroke management, the incidence of stroke continues to rise, particularly in developing countries due to increasing prevalence of hypertension, diabetes mellitus, dyslipidemia, obesity, smoking, and sedentary lifestyle [3]. Stroke survivors frequently experience significant neurological deficits, with many requiring assistance in activities of daily living, ambulation support, or long-term institutional care. Furthermore, stroke is a major contributor to cognitive decline and vascular dementia in elderly populations [4].

Cardiovascular abnormalities are commonly associated with acute stroke and may occur either as pre-existing conditions or as consequences of



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neurogenic cardiac dysfunction following cerebral injury. Electrocardiographic (ECG) changes and echocardiographic abnormalities are frequently observed in patients with acute stroke and may influence prognosis and clinical outcomes [5]. Various ECG abnormalities such as ST-segment changes, T-wave inversion, QT interval prolongation, atrial fibrillation, ventricular arrhythmias, and conduction defects have been reported in stroke patients. These cardiac manifestations are thought to result from autonomic nervous system imbalance, excessive catecholamine release, and myocardial stress induced by acute cerebral insults [6].

Echocardiography also plays a vital role in the evaluation of stroke patients by identifying structural and functional cardiac abnormalities that may contribute to cerebrovascular events. Conditions such as left ventricular hypertrophy, valvular heart disease, atrial enlargement, intracardiac thrombus, reduced ejection fraction, and cardiomyopathy are important risk factors for cardioembolic stroke [7]. Detection of these abnormalities is clinically important because it helps in identifying the underlying etiology of stroke, assessing prognosis, and planning appropriate therapeutic interventions, including anticoagulation and secondary prevention strategies.

Several studies have demonstrated that the type and severity of ECG and echocardiographic changes may vary depending on the type, location, and extent of cerebrovascular involvement [8]. Patients with stroke frequently have associated hypertension, coronary artery disease, or other cardiovascular disorders that may further complicate the clinical picture. Therefore, comprehensive cardiac evaluation in stroke patients is essential for early diagnosis and management of potentially life-threatening cardiac complications.

The present study aims to evaluate electrocardiographic and echocardiographic abnormalities in patients with stroke and to analyze the prevalence and pattern of these cardiac changes. Understanding the association between cerebrovascular events and cardiac abnormalities may improve clinical management, reduce complications, and enhance overall patient outcomes through timely cardiovascular assessment and intervention [9].

Aim

To evaluate the electrocardiographic and echocardiographic abnormalities in patients presenting with stroke and to assess their association with cerebrovascular disease.

Objectives

1. To identify the common electrocardiographic (ECG) abnormalities observed in patients with stroke.

2. To evaluate echocardiographic findings among stroke patients.

METHODOLOGY

This hospital-based observational study was conducted in the Department of General Medicine at Sree Mookambika Institute of Medical Sciences during the study period from January 2025 to December 2025. The study aimed to evaluate electrocardiographic and echocardiographic abnormalities in patients presenting with stroke. Patients aged more than 18 years of either sex with stroke confirmed by clinical examination and radiological investigations such as computed tomography (CT) scan or magnetic resonance imaging (MRI) of the brain were enrolled in the study.

Patients with cerebrovascular accident (CVA) whose neurological symptoms persisted for more than 24 hours and who were admitted within 72 hours from the onset of stroke were included in the study. Only patients without known underlying cardiac diseases capable of producing electrocardiographic or echocardiographic abnormalities were selected to minimize confounding factors. Both ischemic and hemorrhagic stroke patients satisfying the inclusion criteria were included for evaluation.

Patients admitted beyond 72 hours after the onset of stroke were excluded from the study. Cases of traumatic brain injury producing neurological deficits, infective or neoplastic conditions causing cerebrovascular manifestations, and neurological dysfunction secondary to metabolic encephalopathy were also excluded. Additionally, patients with established cardiovascular diseases such as ischemic heart disease, valvular heart disease, cardiomyopathy, chronic arrhythmias, or congenital cardiac disorders were excluded from the study to ensure that the observed ECG and echocardiographic changes were related primarily to acute stroke.

Detailed demographic and clinical data including age, gender, presenting complaints, duration of symptoms, history of hypertension, diabetes mellitus, smoking, alcohol consumption, and other associated risk factors were recorded using a structured proforma. All patients underwent complete neurological examination and cardiovascular assessment at the time of admission. Electrocardiographic evaluation was performed using a standard 12-lead ECG within 24 hours of hospitalization to identify abnormalities such as arrhythmias, ST-segment changes, T-wave inversion, QT interval prolongation, and conduction defects. Two-dimensional echocardiography was performed in all patients to assess structural and functional cardiac abnormalities including left ventricular hypertrophy, valvular lesions, left atrial

enlargement, wall motion abnormalities, intracardiac thrombus, and ejection fraction.

The collected data were compiled and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25.0. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were represented as frequencies and percentages. Chi-square test and Student's t-test were used to determine the association between electrocardiographic and echocardiographic abnormalities with different stroke types and clinical variables. A p-value of less than 0.05 was considered statistically significant.

RESULT

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 present study evaluated electrocardiographic (ECG) and echocardiographic abnormalities among patients with ischemic and hemorrhagic stroke admitted to Sree Mookambika Institute of Medical Sciences. The findings demonstrated a high prevalence of cardiovascular abnormalities in stroke patients, supporting the close association between cerebrovascular disease and cardiac dysfunction. Abnormal ECG findings were observed in 90% of patients, while abnormal two-dimensional echocardiographic findings were present in 87% of patients. Similar observations have been reported in previous studies, emphasizing that acute stroke can produce significant neurocardiac manifestations through autonomic dysregulation and catecholamine-mediated myocardial injury [10].

In the present study, abnormal ECG findings were more common in hemorrhagic stroke patients (94.60%) compared to ischemic stroke patients (87.30%), although the difference was not statistically significant ($p = 0.2405$). Likewise, abnormal 2D-echocardiographic findings were also slightly higher in hemorrhagic stroke patients (91.89%) compared to ischemic stroke patients (84.13%), but without statistical significance ($p = 0.2649$). These findings suggest that both ischemic and hemorrhagic strokes are associated with substantial cardiovascular involvement [11]. Previous studies have similarly demonstrated that autonomic imbalance and increased intracranial pressure, particularly in hemorrhagic stroke, can precipitate various cardiac abnormalities [12].

Among the ECG abnormalities, ST-segment depression with T-wave inversion was the most

common finding observed in 16% of patients, followed by QTc prolongation in 12% and atrial fibrillation in 10% of patients. These ECG changes are believed to occur secondary to sympathetic overactivity and myocardial repolarization disturbances following acute cerebral injury [13]. QTc prolongation is particularly important because it predisposes patients to potentially fatal ventricular arrhythmias. Similar findings have been reported by Goldstein et al. and Khechinashvili et al., who described ST-T changes and QT prolongation as common ECG manifestations in stroke patients [14,15].

In ischemic stroke patients, atrial fibrillation was the most frequent ECG abnormality, observed in 15.87% of cases. This finding is clinically significant because atrial fibrillation is a well-established risk factor for cardioembolic stroke and is associated with increased morbidity and mortality [16]. Q-wave abnormalities were also commonly observed in ischemic stroke patients, indicating the coexistence of underlying silent ischemic heart disease. In contrast, hemorrhagic stroke patients more commonly exhibited ST depression with T-wave inversion and QTc prolongation. Sinus bradycardia was observed only in hemorrhagic stroke patients, likely due to raised intracranial pressure and autonomic disturbances affecting cardiac rhythm [17].

The echocardiographic evaluation revealed that left ventricular hypertrophy (LVH) with grade I left ventricular diastolic dysfunction was the most common abnormality, present in 44% of patients. This finding may reflect the high prevalence of chronic hypertension among stroke patients, as

longstanding hypertension contributes to structural cardiac remodeling and impaired ventricular compliance [18]. Other abnormalities such as regional wall motion abnormalities, reduced ejection fraction, valvular abnormalities, and left atrial thrombus were also identified. Detection of these abnormalities is important because they may serve as potential sources of embolism and predictors of poor prognosis in stroke patients [19]. Overall, the study highlights the importance of routine ECG and echocardiographic evaluation in all patients presenting with acute stroke. Early identification of cardiovascular abnormalities may help guide management strategies, reduce complications, and improve clinical outcomes. Comprehensive cardiac assessment should therefore be considered an integral component of stroke evaluation and secondary prevention programs [20].

CONCLUSION

The present study demonstrated a high prevalence of electrocardiographic and echocardiographic abnormalities among patients with acute stroke. Abnormal ECG findings such as ST-segment depression with T-wave inversion, QTc prolongation, atrial fibrillation, and left ventricular hypertrophy were frequently observed, while echocardiographic evaluation commonly revealed left ventricular hypertrophy with diastolic dysfunction. Although cardiovascular abnormalities were more common in hemorrhagic stroke compared to ischemic stroke, the difference was not statistically significant. The findings highlight the strong association between cerebrovascular and cardiovascular dysfunction and emphasize the importance of routine cardiac evaluation in stroke patients. Early identification of ECG and echocardiographic abnormalities may aid in prompt management, risk stratification, prevention of complications, and improvement of overall clinical outcomes in patients with stroke.

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