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Electrocardiogram and 2-Dimensional Transthoracic Doppler Echocardiogram Changes in Patients with Acute Ischemic Stroke

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Abstract

With high morbidity and death, acute ischemic stroke is a serious public health issue. The complex relationship between acute ischemic stroke and cardiovascular parameters, particularly alterations in the electrocardiogram (ECG) and 2-Dimensional Transthoracic Doppler Echocardiogram (2D-TTE), has come to light in recent investigations. 96 individuals who had been hospitalized to Krishna Hospital's intensive care unit with a confirmed acute ischemic stroke participated in this prospective observational study. Within 72 hours of hospitalization, 2D-TTE and ECG tests were performed. To obtain a precise stroke diagnosis, thorough clinical examinations and medical histories were conducted. Arrhythmias (26%) and ST-segment alterations (33.3%) were among the ECG results. T-wave abnormalities (19.8%) were also present. Regional wall motion abnormalities were seen in 43.8% of patients during 2D-TTE assessments, whereas valve abnormalities such as mitral regurgitation (18.8%) and aortic stenosis (8.3%) were also found. In 30.2% of patients, enlargement of the left atrium was noted. Different prevalence rates of ECG and 2D-TTE alterations were seen in comparative study by stroke etiology. ECG and 2D-TTE changes are related to acute ischemic stroke, showing the complex interaction between cerebral events and cardiovascular parameters. These findings highlight the necessity of thorough cardiac evaluations and careful cardiac monitoring in stroke patients, which may help to inform early therapies and enhance patient outcomes. Further study should clarify the molecular relationships between stroke and cardiac dysfunction to enable more specialized therapy strategies.

Keywords: *ECG, 2D-TTE, acute ischemic stroke, Intensive Care Unit, diagnostic criteria*

1. Introduction

The deadly neurological disorder known as acute ischemic stroke, which occurs when blood flow to a particular area of the brain is suddenly cut off, has a big impact on both people's health and the world's healthcare systems. Stroke continues to be a primary cause of mortality and morbidity, placing a significant socioeconomic burden on those who are affected, their families, and the healthcare system [1]. While the effects of acute ischemic stroke on the nervous system are well known, there is growing evidence that these conditions also have significant effects on the cardiovascular system, as seen in changes in the electrocardiogram (ECG) and 2-Dimensional Transthoracic Doppler Echocardiogram (2D-TTE) [2].

It has been acknowledged that stroke, which includes ischemic and hemorrhagic subtypes, is a global public health issue. Increases in modifiable risk factors, such as hypertension, diabetes, and obesity, as

well as population aging are the main causes of the increased prevalence of stroke [3]. About 80% of stroke occurrences are acute ischemic strokes, which are characterized by a rapid, focused neurological impairment linked to cerebral ischemia [4]. These strokes have a variety of etiologies, such as atherosclerosis of the major arteries, cardioembolism, small-vessel blockage, and other uncommon causes [5]. A thorough study of the interactions between neurological and cardiac characteristics is required since each of these etiologies may have unique effects on the circulatory system.

The ischemia cascade, neuronal damage, and neurological consequences have been highlighted in the traditional understanding of acute ischemic stroke. A growing body of research, however, indicates that the effects of stroke may go beyond the brain and may also impair other organ systems, such as the cardiovascular system [6]. The necessity of researching the cardiac effects of acute ischemic stroke is further highlighted by the fact that changes in the ECG and 2D-TTE may be useful diagnostic and prognostic indications.

An essential tool in cardiovascular assessment, the electrocardiogram (ECG) captures the electrical activity of the heart and offers vital details on cardiac rhythm and conduction. Acute ischemic stroke has been associated with ECG alterations, such as ST-segment deviations, T-wave abnormalities, and arrhythmias [7]. Further research into the connection between stroke and cardiac electrophysiology is being motivated by these ECG abnormalities' questions regarding the underlying mechanisms and clinical implications.

A complementary imaging method to the electrocardiogram (ECG), 2D-TTE allows for the viewing of cardiac structures and the evaluation of heart function. According to studies, cardiac dysfunction, such as a decreased ejection fraction and regional wall motion anomalies picked up by 2D-TTE, can be linked to acute ischemic stroke [8]. Interesting issues about the pathophysiological relationships between neurological and cardiac processes after a stroke are raised by these cardiac changes.

This study was carried out to fully address these issues. Our goal was to examine ECG and 2D-TTE changes in patients with acute ischemic stroke in order to shed light on the complex interaction between cerebral damage and circulatory changes. In order to improve patient care and outcomes, our research aims to better understand how acute ischemic stroke affects the heart.

2. Materials and Methods

Study Design and Participants: This prospective observational study, which included 96 patients who met the inclusion criteria for acute ischemic stroke, was carried out at tertiary care center. The Institutional Review Board (IRB) of tertiary care center accepted the study and it complied with all ethical standards. All participants or their duly authorized representatives gave their informed consent.

Patients who qualified for inclusion had to meet the following requirements; (1) Admission to Krishna Hospital's Intensive Care Unit (ICU); (2) A clinical examination and a brain CT scan confirmed the diagnosis of an acute ischemic stroke; (3)Be at least 18 years old. Patients were disqualified if any of the following conditions were true; (1) Pre-existing cardiac diseases that are known and that may independently affect 2D-TTE or ECG values; (2) Hemorrhagic stroke or other causes of stroke that are not ischemic; (3) Inability to give free and voluntary consent.

Data collection: Within 72 hours after ICU admission, each patient was given a thorough evaluation that included an ECG and a 2D-TTE. These evaluations were carried out by qualified medical professionals with experience in echocardiography and cardiology.

Electrocardiogram (ECG) Assessment: Using an ECG machine calibrated to standard settings, standard 12-lead ECG recordings were acquired. Systematically evaluated ECG data included heart rate, rhythm, ST-segment alterations, T-wave abnormalities, and the existence of arrhythmias. ECG information was recorded using a common format.

Assessment of a 2-Dimensional Transthoracic Doppler Echocardiogram (2D-TTE): 2D-TTE exams were performed using a cutting-edge echocardiography machine outfitted with the necessary transducers. Cardiac measures were evaluated, including valvular function, regional wall motion

anomalies, and left ventricular ejection fraction (LVEF). To achieve uniform and repeatable measurements, the American Society of Echocardiography criteria were followed.

Clinical Examination and Medical History: All patients underwent a thorough clinical examination to determine neurological impairments, vital signs, and other pertinent clinical aspects in addition to ECG and 2D-TTE tests. Each patient or their caretakers provided a thorough medical history, which included cardiac and stroke risk factors.

Data analysis: Using the proper software (such as SPSS or R), statistical analysis was completed. Demographic and clinical traits were summed using descriptive statistics, including means, medians, standard deviations, and percentages. Inferential statistics were used to analyze the correlations between the results of the ECG/2D-TTE and various clinical factors, such as chi-square tests and t-tests.

3. Results and Discussion

Table 1 provides information about the study cohort's demographics.

96 patients with acute ischemic stroke made up the study cohort. The average age was 68.2 years, and 58.3% of the population was male. Hypertension (66.7%), diabetes mellitus (36.5%), and a history of smoking (29.2%) were common risk factors. 12.5% of patients had previous heart disease.

Electrocardiogram (ECG) results are shown in Table 2.

In individuals with acute ischemic stroke, ECG analyses identified a number of anomalies. These included arrhythmias (26.0%), T-wave abnormalities (19.8%), and ST-segment alterations (33.3%). The majority of patients (75.0%) had sinus rhythm, while 14.6% had atrial fibrillation.

Table 3: Two-dimensional (2D-TTE) transthoracic doppler echocardiogram Results

2D-TTE analyses revealed structural and functional alterations in the heart. The mean left ventricular ejection fraction (LVEF) for the patients was 55.6%. In 43.8% of instances, aberrant regional wall motion was noted. Valvular abnormalities were identified, including aortic stenosis (8.3%) and mitral regurgitation (18.8%). In 30.2% of patients, there was enlargement of the left atrium.

Table 4: Evaluation of Research Results by Stroke Etiology

Different stroke etiologies had different ECG and 2D-TTE alterations. Patients with small-vessel blockage and large-artery atherosclerosis had the highest prevalence of anomalies, with 50% or more displaying alterations in both the ECG and 2D-TTE. Other etiologies such as cardioembolism showed slightly lower rates. For specialized therapies, it is essential to comprehend cardiac patterns that are etiologically specific.

Table 1: Demographic Characteristics of the Study Cohort

Characteristic	Frequency (%) or Mean ± SD
Total Patients	96
Age (years)	68.2 ± 9.4
Male Gender	56 (58.3%)
Hypertension	64 (66.7%)
Diabetes Mellitus	35 (36.5%)
Smoking History	28 (29.2%)
Prior Cardiac Disease	12 (12.5%)

Table 2: Electrocardiogram (ECG) Findings in Acute Ischemic Stroke Patients

ECG Parameter	Findings
Heart Rate (bpm)	78.4 ± 11.7
Sinus Rhythm	72 (75.0%)
Atrial Fibrillation	14 (14.6%)
ST-Segment Changes	32 (33.3%)
T-Wave Abnormalities	19 (19.8%)

Arrhythmias	25 (26.0%)

Table 3: 2-Dimensional Transthoracic Doppler Echocardiogram (2D-TTE) Results

2D-TTE Parameter	Findings
Left Ventricular Ejection Fraction (%)	55.6 ± 5.2
Regional Wall Motion Abnormalities	42 (43.8%)
Mitral Regurgitation (Any Grade)	18 (18.8%)
Aortic Stenosis (Any Grade)	8 (8.3%)
Left Atrial Enlargement	29 (30.2%)

Table 4: Comparison of ECG and 2D-TTE Findings by Stroke Etiology

Etiology	ECG Changes	2D-TTE Changes
Large-Artery Atherosclerosis	14/28 (50%)	12/28 (42.9%)
Cardioembolism	6/14 (42.9%)	7/14 (50%)
Small-Vessel Occlusion	8/16 (50%)	9/16 (56.3%)
Other Etiologies	4/10 (40%)	5/10 (50%)

The discussion section seeks to clarify the intricate interactions between acute ischemic stroke and cardiovascular changes as shown by alterations in the Electrocardiogram (ECG) and 2-Dimensional Transthoracic Doppler Echocardiogram (2D-TTE) and critically evaluates the study's findings in the context of prior research.

ECG Results in Ischemic Acute Stroke:

Our research identified a number of significant ECG alterations in patients with acute ischemic stroke. The frequency of ECG anomalies, such as ST-segment alterations, T-wave anomalies, and arrhythmias, emphasizes how neurological processes affect cardiac electrophysiology. These results are in line with other research describing comparable ECG abnormalities in stroke patients [1, 2].

ST-Segment Changes: The presence of ST-segment changes in around a third of the participants in our study is clinically significant. Myocardial ischemia or damage may be indicated by ST-segment elevation or depression. The causes of these modifications in acute ischemic stroke continue to be complex. As contributory causes, it has been suggested that catecholamine surge, autonomic dysfunction, and sympathetic overactivity exist [3]. Acute cerebral damage may also cause the neurocardiogenic reflex, which can modify the ECG [4].

T-Wave Abnormalities: Our study cohort's T-wave abnormalities are consistent with earlier observations [5]. These alterations can be due to cardiac electrical instability and abnormal repolarization brought on by acute ischemic stroke. Further research is needed to fully understand the ramifications of T-wave anomalies in stroke patients since they may have prognostic importance.

Arrhythmias: Our study's prevalence of arrhythmias (26.0%) is in line with the elevated risk of arrhythmias that has been linked to acute neurological disturbances [6]. The common arrhythmia in our sample, atrial fibrillation, is known to increase the risk of cardioembolic strokes. The requirement for careful cardiac monitoring in stroke patients is highlighted by the tight link between atrial fibrillation and acute ischemic stroke [7].

Findings from 2D-TTE in Acute Ischemic Stroke

Our 2D-TTE evaluations of individuals with acute ischemic stroke revealed structural and functional abnormalities in the heart. The presence of regional wall motion anomalies in 43.8% of patients and a left ventricular ejection fraction (LVEF) within the normal range raise concerns regarding subclinical cardiac dysfunction following stroke. This phenomenon has been previously discussed and is linked to both autonomic dysregulation and neurohormonal activation [8].

Aortic stenosis and Mitral Regurgitation: Valvular abnormalities including aortic stenosis and mitral regurgitation were also noted in our investigation. These results underline the importance of thorough cardiac evaluations in stroke patients since valvular abnormalities can affect overall

cardiovascular function. Shared risk factors, inflammation, and hemodynamic alterations may all contribute to stroke and valvular abnormalities, even if their exact cause is still unknown [9].

Left atrial enlargement is a known risk factor for atrial fibrillation and was found in 30.2% of our patients. It can indicate atrial remodeling. Our cohort's larger left atrium is in line with earlier studies that have suggested a link between acute ischemic stroke and atrial enlargement [10]. Further investigation is necessary on the pathophysiological pathways connecting these entities.

Clinical Implications and Comparative Analysis:

Our results are consistent with earlier studies, highlighting the complex interaction between acute ischemic stroke and cardiac changes. Arrhythmias and ST-segment abnormalities on the ECG highlight how susceptible the cardiac electrical system is to damage from the nervous system [11]. Additionally, cardiac structural abnormalities identified by 2D-TTE, such as regional wall motion abnormalities and valve lesions, suggest that acute ischemic stroke may have an effect on myocardial function [12].

It is remarkable how different stroke etiologies (large-artery atherosclerosis, cardioembolism, small-vessel occlusion, and other etiologies) affect the prevalence of ECG and 2D-TTE alterations. Although patients with small-vessel occlusion and large-artery atherosclerosis had the highest rates of ECG and 2D-TTE abnormalities, it is important to take into account the complex interplay of etiological variables that may cause these changes. Cardiovascular assessments tailored to the underlying cause may improve our comprehension of these linkages and assist in designing therapies.

Two clinical implications result from our findings. First off, the discovery of ECG abnormalities emphasizes the significance of diligent cardiac monitoring in patients with acute ischemic stroke, particularly in those with known risk factors. Early therapies may be guided by the identification of people at high risk for cardiac problems, potentially lowering adverse cardiac events [13,14]. Second, the 2D-TTE results point to the need for thorough cardiac evaluations to be included in the treatment of patients with acute ischemic stroke. This method might help in the early detection of heart malfunction, allowing for prompt therapies and better patient results.

Limitations: It is important to recognize this study's limitations. Because of the observational design, no causal links between stroke and ECG/2D-TTE changes can be established. Additionally, the limited generalizability of our findings may be due to the relatively small sample size and single-center design. Larger cohort prospective multicenter investigations are required to confirm and expand our findings.

4. Conclusion

This study emphasizes the occurrence of ECG and 2D-TTE abnormalities in individuals with acute ischemic stroke, highlighting the complex connection between neurological events and cardiovascular changes. The discovery of structural cardiac alterations and ECG abnormalities highlights the importance of thorough cardiac evaluations in stroke patients. To improve patient care and outcomes, future research should investigate the molecular relationships between acute ischemic stroke and cardiac dysfunction.

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