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ELECTROCARDIOGRAPHIC CHANGES AMONG PATIENTS WITH CIRRHOSIS RELATED TO VIRAL HEPATITIS

Original Research

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ABSTRACT

Background: Liver cirrhosis, characterized by regenerative nodules and fibrosis, is a major cause of morbidity and mortality worldwide, particularly in Asia. It is frequently associated with cardiac and electromechanical abnormalities, including prolonged QT intervals, low QRS voltage, left ventricular hypertrophy, and T-wave inversions. Although these abnormalities have been extensively studied in alcoholic liver disease, data on cirrhosis caused by viral hepatitis, particularly hepatitis B and C, remain limited.

Objective: This study aimed to document the frequency and types of electrocardiographic changes in patients with cirrhosis caused by viral hepatitis (hepatitis B and C).

Methods: This cross-sectional study was conducted at the Hepatogastroenterology Department of the Sindh Institute of Urology and Transplantation between March and August 2024. A total of 175 patients aged 18–65 years with cirrhosis secondary to hepatitis B or C were included using non-probability consecutive sampling. Patients with pre-existing cardiac diseases or other confounding conditions were excluded. Clinical and laboratory data, including Child-Turcotte-Pugh (CTP) and MELD scores, were collected. Electrocardiograms (ECGs) were assessed for QT prolongation, low QRS voltage, left ventricular hypertrophy, and ST-T wave changes. Data were analyzed using SPSS version 20, with results expressed as means and percentages.

Results: The mean age of participants was 48.9 ± 9.1 years, with 60% being male. Hepatitis C was the leading cause of cirrhosis (57.1%), followed by hepatitis B (22.9%) and hepatitis B-D co-infection (20%). ECG abnormalities were observed in 54.3% of patients, with prolonged QT intervals being the most frequent (22.3%), followed by combined low QRS voltage and ST-T changes (16%), isolated low QRS voltage (8.6%), and left ventricular hypertrophy (3.4%).

Conclusion: Electrocardiographic abnormalities, particularly QT prolongation and low QRS voltage, are common in cirrhotic patients with viral hepatitis and correlate with disease severity. Routine cardiac evaluations could enhance disease monitoring and prognostic assessment in this population.

Keywords: Cardiac changes, cirrhosis, electrocardiography, hepatitis B, hepatitis C, low QRS voltage, QT prolongation

INTRODUCTION

Cirrhosis is a chronic liver condition characterized by the histological development of regenerative nodules encased by fibrous tissue in response to prolonged liver injury, ultimately leading to portal hypertension and end-stage liver disease (1). It is a significant cause of morbidity and mortality, particularly in Asia, accounting for 62.6% of liver disease-related deaths (2). Beyond its systemic effects, cirrhosis is increasingly recognized for its impact on cardiac function, with various electromechanical and electrocardiographic (ECG) abnormalities directly correlating with the severity of liver disease (3). Among these, QT-interval prolongation, low QRS voltage, left ventricular hypertrophy, and T wave inversion are frequently reported. Previous studies have underscored the prominence of QTc-interval prolongation as the most common ECG abnormality in patients with cirrhosis, with a clear association between its prevalence and the Child-Pugh score (4,5). However, conflicting evidence exists, as Henriksen et al. and Leili Pourafkari et al. did not find a significant correlation between QT prolongation and liver disease severity (6,7). Other research highlights the role of etiology in the presentation of ECG abnormalities. For instance, Bal et al. observed that QTc prolongation was more prevalent in alcoholic cirrhosis compared to non-alcoholic forms (8). Similarly, low QRS voltage and left ventricular hypertrophy are more commonly associated with ascites, reflecting a potential link to disease progression (9,10). However, low-voltage ECG abnormalities, as documented by Madias et al., did not consistently resolve with interventions like paracentesis (10). Furthermore, decompensated cirrhosis appears to exhibit higher rates of prolonged QT intervals and low QRS voltage compared to compensated cases, as reported by Letitia Toma et al. (11).

Despite the documented relationship between these cardiac changes and patient outcomes, ECG abnormalities are not routinely incorporated into liver transplant evaluations or used as prognostic tools (12). The majority of studies in this area focus on alcoholic cirrhosis, leaving a gap in understanding the electrocardiographic manifestations in cirrhosis caused by viral hepatitis, particularly in hepatitis B and C infections (8,13). Given the high prevalence of viral hepatitis in certain populations, this gap presents a critical area for investigation. This study aims to address this gap by evaluating the frequency and patterns of ECG changes in patients with cirrhosis caused by hepatitis B and C viruses. The findings are expected to provide valuable insights into the cardiac implications of viral hepatitis-induced cirrhosis and inform management strategies for chronic liver disease patients in this subset.

METHODS

This cross-sectional study was conducted at the Department of Hepatogastroenterology, Sindh Institute of Urology and Transplantation, from 1st March 2024 to 31st August 2024, after obtaining ethical approval from the institutional review board. The study aimed to evaluate electrocardiographic (ECG) changes in patients with cirrhosis of viral etiology. The required sample size was calculated using an estimated prevalence of low voltage QRS complexes in cirrhotic patients of 57.7% (19), with a 5% margin of error and a 95% confidence level, resulting in a total of 138 participants. Patients were enrolled through non-probability consecutive sampling. Eligible participants included cirrhotic patients aged 18 to 65 years with a confirmed diagnosis of hepatitis B or C. Exclusion criteria were applied rigorously to ensure the accuracy of results, and patients with a history of cardiac disease, including myocardial infarction, congestive heart failure, valvular or pericardial disease, and coronary revascularization, were excluded. Additionally, patients with cardiac pacemaker placement, end-stage renal disease requiring hemodialysis, endocrinological abnormalities such as diabetes or thyroid disorders, hypo- or hypercalcemia, chronic obstructive pulmonary disease, or amyloidosis were excluded from the study. Written informed consent was obtained from all participants after a detailed explanation of the study's purpose and procedures.

Following enrollment, comprehensive data collection was performed. Laboratory investigations, including complete blood count, renal and liver function tests, serum albumin, coagulation profiles (pT/INR), and serum calcium levels, were conducted upon admission. Disease severity was assessed using the Child-Turcotte-Pugh (CTP) score and the Model for End-Stage Liver Disease (MELD) score. A standard 12-lead ECG, recorded on a calibrated device with a paper speed of 25 mm/second and an amplitude of 10 mm/mV, was used to document electrocardiographic findings, including left ventricular hypertrophy, prolonged QT interval, T wave inversion, and low QRS voltage. Data were analyzed using the Statistical Program for Social Sciences (SPSS) version 20 (IBM Corporation, Armonk, NY, USA). Continuous variables such as age, hemoglobin, total leukocyte count, platelet count, serum albumin, total bilirubin, alanine transaminase (ALT), aspartate transaminase (AST), and MELD score were expressed as mean ± standard deviation. Categorical variables, including gender, cause of chronic liver disease, ECG findings, and CTP class, were summarized as frequencies and percentages.

RESULTS

A total of 175 patients were included in the study, of which 105 (60%) were male, with a mean age of 48.5 ± 12.1 years. The most common cause of chronic liver disease was hepatitis C virus infection, observed in 100 patients (57.1%), followed by hepatitis B virus in 40 patients (22.9%) and hepatitis B and D co-infection in 35 patients (20%). At the time of presentation, 89 patients (50.9%) were

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classified as Child-Turcotte-Pugh (CTP) class B, while 86 patients (49.1%) were in CTP class C. Baseline laboratory parameters revealed a mean hemoglobin level of 8.45 ± 1.61 g/dL, total leukocyte count of 5.9 ± 2.9 × 10⁹/L, platelet count of 93 ± 51 × 10⁹/L, serum creatinine of 1.7 ± 0.99 mg/dL, and serum albumin of 2.7 ± 0.72 g/dL. Other findings included an international normalized ratio (INR) of 1.5 ± 0.81, serum calcium of 7.8 ± 0.62 mg/dL, serum potassium of 3.8 ± 0.7 mmol/L, total bilirubin of 5.2 ± 7.5 mg/dL, aspartate transaminase (AST) of 72 ± 61.7 U/L, and alanine transaminase (ALT) of 44.4 ± 22.1 U/L.

Electrocardiographic abnormalities were observed in 95 patients (54.3%). The most frequent abnormality was prolonged QT interval, found in 39 patients (22.3%). A combination of low QRS voltage and ST-T wave inversion was observed in 28 patients (16%), while isolated low QRS voltage and left ventricular hypertrophy were recorded in 15 patients (8.6%) and 6 patients (3.4%), respectively. ST-T wave inversion alone was seen in 3 patients (1.7%).

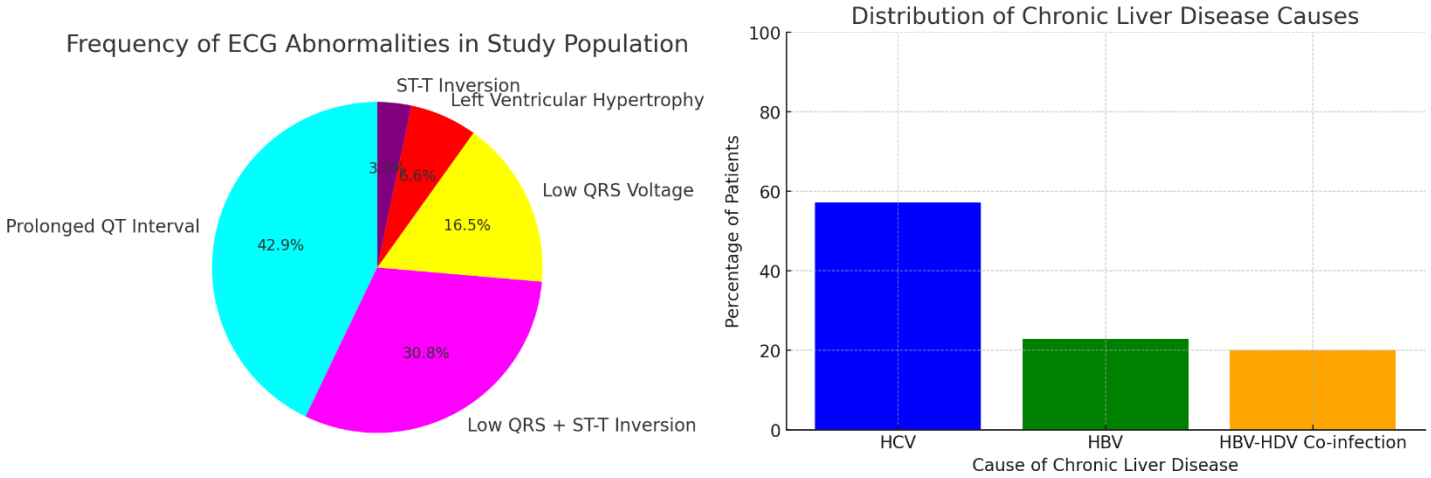

Table-1: Baseline characteristics of the studied population (n-175)

Variables		**n (%), Mean ± S.D.**
Gender	**Male**	105 (60)
	Female	70 (40)
Cause of chronic liver disease	**HCV**	100 (57.1)
	HBV	40 (22.9)
	HBV-HDV coinfection	35 (20)
CTP class	**B**	86 (49.1)
	C	89 (50.9)
ECG changes	**Prolonged QT interval**	39 (22.3)
	ST-T-wave inversion	3 (1.7)
	Low QRS complex	15 (8.6)
	Low QRS complex and ST - T-wave changes	28 (16)
	Left ventricular hypertrophy	6 (3.4)
Mean Age (years)		48.9 ± 9.1
Hemoglobin (g/dl)		8.45 ± 1.61
TLC (x10^9/L)		5.9 ± 2.9
Platelet (x10^9/L)		93 ± 51
Serum Creatinine (mg/dl)		1.7 ± 0.99

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Total Bilirubin (mg/dl)	5.2 ± 7.5
AST (U/L)	72 ± 61.7
ALT (U/L)	44.4 ± 22.1
Serum Albumin (g/dl)	2.7 ± 0.72
INR	1.5 ± 0.81
Serum potassium (mmol/L)	7.5 ± 0.62
Serum calcium (mg/dl)	3.8 ± 0.7

DISCUSSION

The present study explored the prevalence and pattern of electrocardiographic changes in patients with cirrhosis of viral etiology, specifically hepatitis B and C infections, providing valuable insights into the cardiac manifestations of chronic liver disease. The findings revealed that more than half of the participants exhibited ECG abnormalities, emphasizing the potential cardiac burden associated with cirrhosis in a population where viral hepatitis is a major contributing factor. This study fills a significant knowledge gap by examining ECG parameters, including QT interval prolongation, low QRS voltage, left ventricular hypertrophy, and ST-T wave changes, and offers a foundation for improved clinical management of cirrhotic patients. The observation of prolonged QT intervals in 22.3% of participants aligns with previous reports identifying QT prolongation as a hallmark of cirrhotic cardiomyopathy. Studies have documented a correlation between QT interval prolongation and the severity of liver dysfunction, as measured by the Child-Turcotte-Pugh score (4). However, conflicting findings in other studies suggest that QT prolongation may not be universally present and could depend on the population studied, the etiology of cirrhosis, or variations in methodology (6,7). The emphasis on viral etiology in this study provides a unique perspective, suggesting that underlying causes of cirrhosis may influence the manifestation of cardiac electrical abnormalities.

Low QRS voltage, observed in 16% of patients, is consistent with findings in other studies that reported its association with decompensated liver disease (11). This study further highlighted the link between low QRS voltage and advanced CTP classes, underscoring the role of disease severity in cardiac electrical alterations. Previous research has suggested that low QRS voltage may persist despite the reduction of ascites, pointing to underlying myocardial or pericardial changes rather than purely mechanical effects of fluid overload (11). Left ventricular hypertrophy was observed in only 3.4% of participants, a lower prevalence compared to studies that examined alcoholic cirrhosis. This suggests that LVH may be less frequent in viral etiologies. Variations in diagnostic criteria and the exclusion of conditions like hypertension could also account for this discrepancy. Isolated and combined ST-T wave changes were seen in 16% of patients, which aligns with reports suggesting their frequent occurrence in cirrhotic individuals (11,18). These changes may reflect electrolyte disturbances, altered myocardial repolarization, or subclinical ischemia, warranting further investigation into their pathophysiological basis.

The study's cross-sectional design was a limitation, as it precluded the assessment of the progression or reversibility of ECG abnormalities. Additionally, the single-center nature of the research may limit the generalizability of the findings to other populations with diverse genetic, environmental, or healthcare factors. Furthermore, reliance on ECG alone limited the ability to evaluate structural or functional cardiac abnormalities, which could have been addressed through the inclusion of echocardiographic assessments. Despite these limitations, the study's focus on viral hepatitis, a major cause of cirrhosis in the region, adds significant value by addressing a gap in the existing literature. Future research should consider longitudinal designs to explore the progression of ECG abnormalities and their reversibility following interventions. Multicenter studies incorporating echocardiographic and advanced imaging modalities would provide a more comprehensive understanding of cardiac abnormalities in cirrhotic patients and enhance the generalizability of findings. This study underscores the importance of routine cardiac evaluations in cirrhotic patients, particularly those with advanced disease, to guide timely management and improve outcomes.

CONCLUSION

This study highlighted the prevalence and pattern of electrocardiographic abnormalities in patients with cirrhosis caused by viral hepatitis, with prolonged QT intervals, low QRS voltage, and ST-T wave alterations being the most common findings. These abnormalities were found to correlate with disease progression, underscoring their potential role as markers for advanced liver disease and predictors of adverse outcomes. The results emphasize the need to integrate routine cardiac assessments into the clinical evaluation and management of cirrhotic patients, particularly in the context of liver transplant evaluations. By addressing these cardiac implications, healthcare providers can improve disease monitoring and potentially reduce the mortality associated with cirrhosis.

AUTHOR CONTRIBUTIONS

Author	Contribution
Nadar Ali	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Hina Ismail	Methodology, Investigation, Data Curation, Writing - Review & Editing
Ali Hyder	Investigation, Data Curation, Formal Analysis, Software
Raja Taha Yaseen Khan	Software, Validation, Writing - Original Draft
Muhammad Usama Kiyani	Formal Analysis, Writing - Review & Editing
Azhar Ali	Writing - Review & Editing, Assistance with Data Curation
Abbas Ali Tasneem	Formal Analysis, Writing - Review & Editing
Nasir Hasan Luck	Writing - Review & Editing, Assistance with Data Curation

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