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Original Article

Cardiac Dysfunction in Patients with Liver Cirrhosis: A Prospective Observational Study

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ABSTRACT

Background: Cirrhosis is associated with significant cardiovascular alterations collectively termed cirrhotic cardiomyopathy. These include impaired contractile responsiveness to stress, diastolic dysfunction, and electrophysiological abnormalities, often in the absence of overt cardiac disease. Early identification of cardiac dysfunction in cirrhotic patients is essential, especially in those undergoing invasive procedures or liver transplantation.
Objectives: To assess the prevalence and pattern of cardiac dysfunction in patients with liver cirrhosis using echocardiographic and electrocardiographic parameters.
Methods: A prospective observational study was conducted over 12 months in patients diagnosed with liver cirrhosis. Clinical evaluation, biochemical parameters, Child-Pugh and MELD scores were recorded. All patients underwent 12-lead ECG and transthoracic echocardiography. Systolic and diastolic functions were assessed, and QTc interval was measured. Statistical analysis was performed to evaluate associations between severity of cirrhosis and cardiac dysfunction.
Results: A total of 120 patients were enrolled. Diastolic dysfunction was observed in 48% of patients, while 22% demonstrated prolonged QTc interval. Left ventricular systolic dysfunction at rest was present in 10% of cases. Cardiac dysfunction was significantly more common in Child-Pugh Class B and C patients ($p < 0.05$).
Conclusion: Cardiac dysfunction, particularly diastolic impairment and QTc prolongation, is highly prevalent in cirrhotic patients and correlates with disease severity. Routine cardiac evaluation should be considered in patients with advanced liver disease.

Keywords*: Liver cirrhosis, Cirrhotic cardiomyopathy, Diastolic dysfunction, QTc prolongation, Echocardiography.*

INTRODUCTION

Liver cirrhosis is a chronic, progressive condition characterized by diffuse hepatic fibrosis and nodular regeneration, leading to distortion of the normal liver architecture and impairment of hepatic function. It represents the end stage of various chronic liver diseases and is associated with significant morbidity and mortality. In addition to well-known complications such as portal hypertension, ascites, variceal bleeding, and hepatic encephalopathy, cirrhosis produces substantial systemic effects. One of the most important extrahepatic manifestations is its impact on the cardiovascular system.[1]

Cirrhosis is associated with a hyperdynamic circulatory state characterized by increased cardiac output, reduced systemic vascular resistance, and arterial vasodilatation. These hemodynamic alterations result from complex mechanisms including increased production of vasodilatory substances, activation of neurohormonal pathways, and autonomic dysfunction. Although cardiac output is elevated at rest, this compensatory state masks underlying myocardial abnormalities. Over time, chronic circulatory stress leads to structural and functional cardiac changes.[2,3]

The term cirrhotic cardiomyopathy describes a spectrum of cardiac dysfunction observed in patients with cirrhosis in the absence of pre-existing heart disease. It is characterized by impaired systolic contractile response to stress despite preserved resting ejection fraction, diastolic dysfunction due to impaired ventricular relaxation and stiffness, and electrophysiological abnormalities such as prolonged QT interval. These abnormalities are often clinically silent under resting conditions but become evident during periods of physiological stress such as infections, gastrointestinal bleeding, transjugular intrahepatic portosystemic shunt (TIPS) placement, or liver transplantation.[4]

Given the potential impact of cardiac dysfunction on clinical outcomes, particularly in advanced liver disease, early identification is essential. Evaluating cardiac abnormalities and understanding their relationship with the severity of cirrhosis may improve risk stratification and guide management decisions. Therefore, the present study aims to assess cardiac dysfunction in patients with liver cirrhosis and determine its association with disease severity.

MATERIALS AND METHODS

This prospective observational study was conducted in the Department of cardiology at Valluvanad hospital, a tertiary care hospital over a period of 12 months. The study aimed to evaluate the prevalence and pattern of cardiac dysfunction in patients diagnosed with liver cirrhosis and to assess its association with the severity of liver disease. The primary objective of this study was to determine the prevalence of cardiac dysfunction in patients with liver cirrhosis using electrocardiographic and echocardiographic parameters. The secondary objectives were to assess the association between the severity of cirrhosis, as determined by Child-Pugh class and MELD score, and cardiac dysfunction, and to evaluate electrocardiographic abnormalities, particularly QTc prolongation and rhythm disturbances, in this patient population. A total of 120 consecutive patients fulfilling the inclusion criteria were enrolled during the study period.

Adult patients aged 18 years and above with a confirmed diagnosis of liver cirrhosis based on clinical features, biochemical parameters, and radiological findings were included in the study. Patients with pre-existing cardiac conditions that could independently affect cardiac function—such as known ischemic heart disease, hypertension, valvular heart disease, congenital heart disease, or alcoholic cardiomyopathy unrelated to cirrhosis—were excluded. Additionally, patients with chronic kidney disease and diabetes mellitus with established cardiac involvement were excluded to avoid confounding factors.

All enrolled patients underwent a comprehensive clinical evaluation. A detailed medical history was obtained, including duration and etiology of cirrhosis. Clinical examination focused on identifying complications such as ascites, hepatic encephalopathy, and variceal bleeding. Baseline laboratory investigations were performed in all patients, including complete blood count, liver function tests, serum electrolytes, prothrombin time/international normalized ratio (INR), and serum creatinine.

Severity of liver disease was assessed using the Child-Pugh classification and Model for End-Stage Liver Disease (MELD) score. These scoring systems were used to stratify patients according to disease severity and to evaluate their association with cardiac dysfunction.

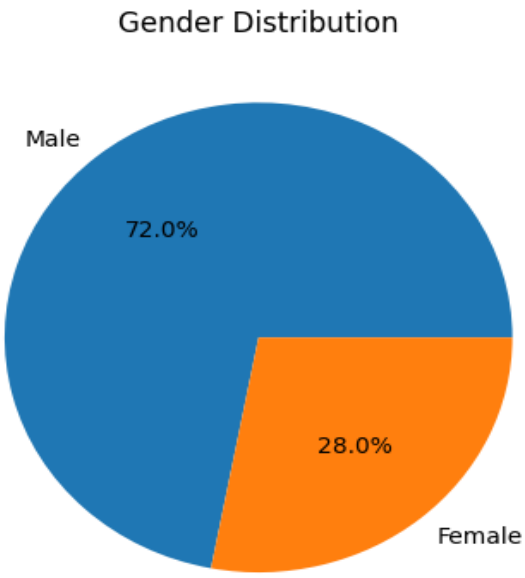
All patients underwent a 12-lead electrocardiogram (ECG) to assess cardiac rhythm and conduction abnormalities. The corrected QT (QTc) interval was calculated using Bazett's formula. QTc prolongation was defined as a QTc interval greater than 440 milliseconds in men and greater than 460 milliseconds in women.

Transthoracic two-dimensional echocardiography was performed in all patients using standard techniques. The parameters assessed included left ventricular ejection fraction (LVEF) to evaluate systolic function, transmitral E/A ratio, deceleration time, isovolumetric relaxation time, and left atrial size to assess diastolic function. Systolic dysfunction was defined as LVEF less than 55%. Diastolic dysfunction was diagnosed when the E/A ratio was less than 1 or when other relaxation parameters were abnormal, consistent with impaired ventricular relaxation.

All collected data were entered into and analyzed using the Statistical Package for the Social Sciences (SPSS) software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The association between cardiac dysfunction and severity of liver disease, particularly Child-Pugh classification, was evaluated using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

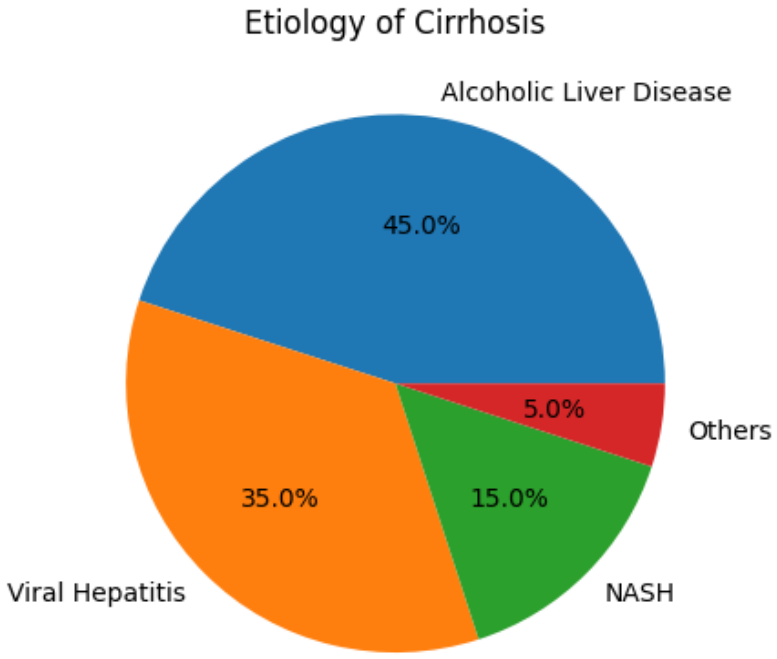
RESULTS

A total of 120 patients with liver cirrhosis were included in the study. The mean age of the study population was 52 ± 11 years, indicating that the majority of patients were in the middle to late adult age group. There was a clear male predominance, with males constituting 72% of the study population, while females accounted for 28%. This gender distribution likely reflects the higher prevalence of alcohol-related liver disease among men in the study setting.



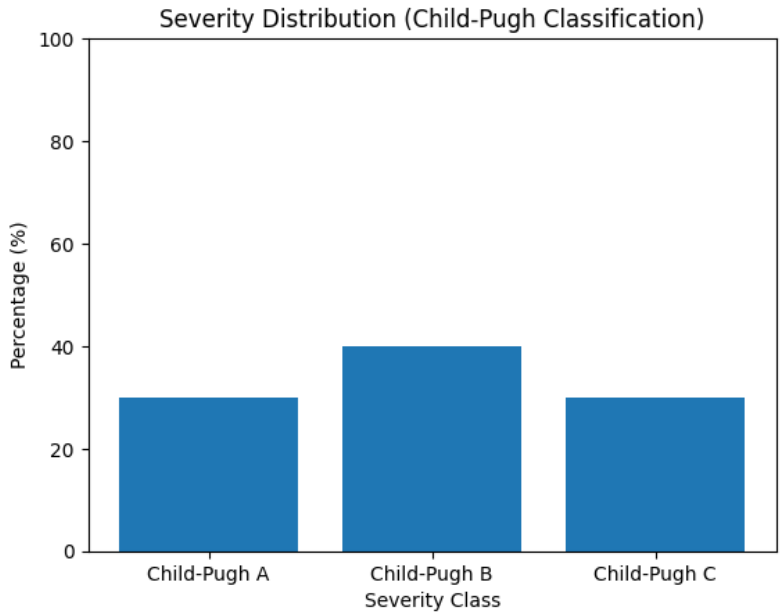
Graph 1: Demographic profile

Alcoholic liver disease was the most common etiology of cirrhosis in the study cohort, accounting for 45% of cases. Viral hepatitis was the second most common cause, observed in 35% of patients. Non-alcoholic steatohepatitis (NASH) contributed to 15% of cases, while other causes, including autoimmune and cryptogenic cirrhosis, comprised 5% of the total cases. This distribution highlights the shifting epidemiological trends with metabolic liver disease emerging as an important contributor.



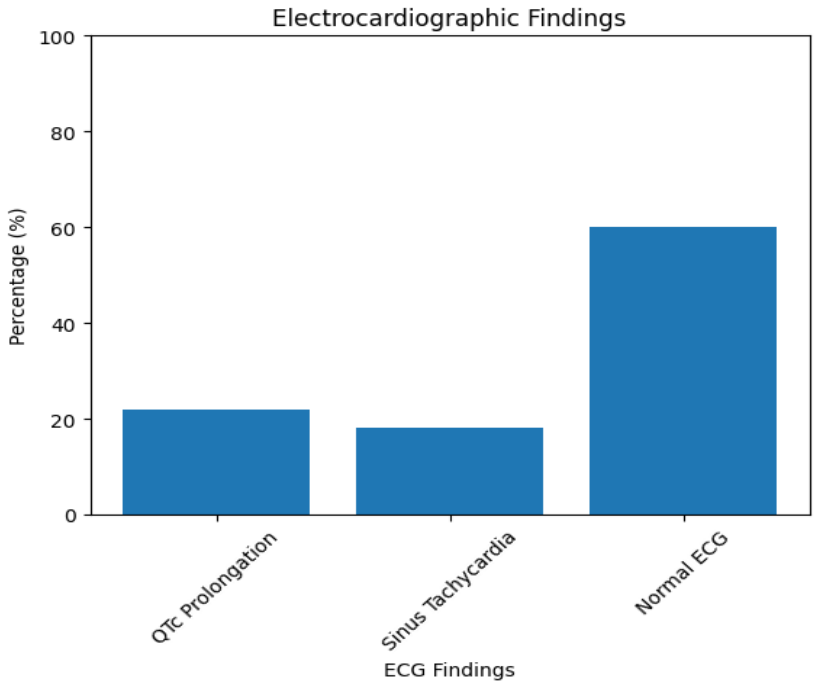
Graph 2: Etiology of Cirrhosis

Assessment of liver disease severity using the Child-Pugh classification showed that 30% of patients belonged to Child-Pugh Class A, 40% to Class B, and 30% to Class C. Thus, the majority of patients (70%) had moderate to severe liver disease (Class B and C), providing a suitable population to assess the relationship between advanced cirrhosis and cardiac dysfunction.



Graph 3: severity of liver disease

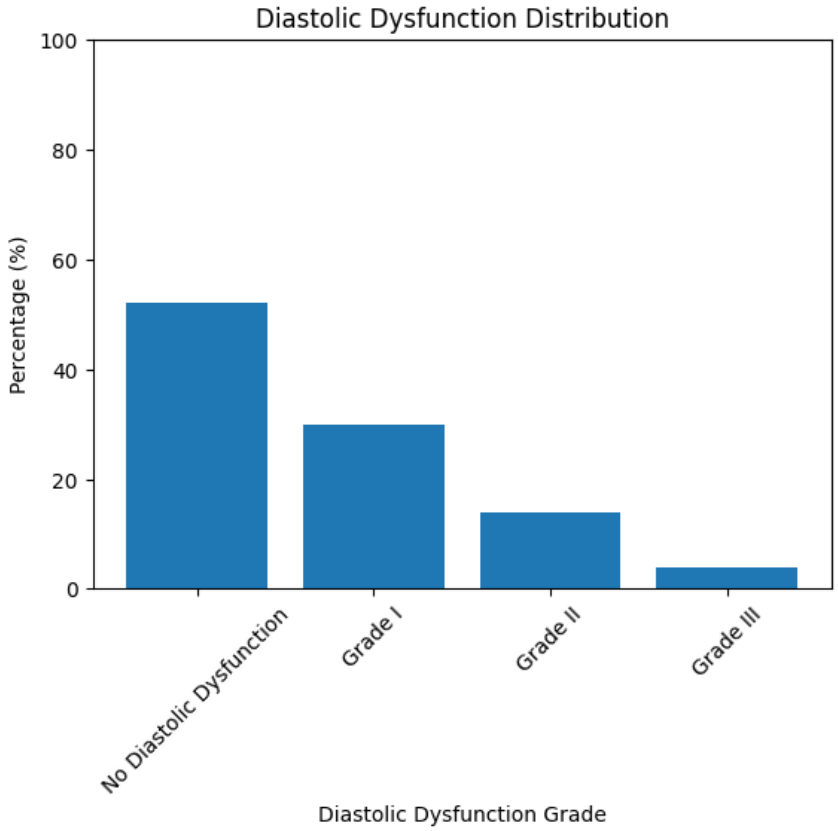
Electrocardiographic evaluation revealed QTc prolongation in 22% of patients. Sinus tachycardia was observed in 18% of cases, while 60% of patients showed no significant ECG abnormalities. Notably, QTc prolongation was significantly more common among patients with Child-Pugh Class C cirrhosis compared to those in Classes A and B ($p = 0.02$), suggesting a strong association between electrophysiological abnormalities and advanced liver disease.



Graph 4: echocardiographic finding

Echocardiographic assessment demonstrated a high prevalence of diastolic dysfunction, which was present in 48% of patients. Among these, Grade I diastolic dysfunction was the most common (30%), followed by Grade II (14%) and Grade III (4%). In contrast, systolic dysfunction at rest was relatively uncommon and was observed in only 10% of patients.

Importantly, diastolic dysfunction showed a statistically significant association with advanced liver disease, being more prevalent in patients with Child-Pugh Class B and C cirrhosis ($p < 0.01$). These findings suggest that diastolic impairment is an early and predominant feature of cardiac involvement in cirrhosis and becomes more pronounced with increasing severity of hepatic dysfunction.



Graph 5: systolic dysfunction distribution

DISCUSSION

In this prospective observational study of 120 patients with liver cirrhosis, we observed a high prevalence of subclinical cardiac dysfunction, predominantly in the form of diastolic impairment and QTc prolongation. These findings support the concept of cirrhotic cardiomyopathy as a frequent yet often clinically silent complication of advanced liver disease.

Diastolic dysfunction was present in 48% of patients in our study, with Grade I dysfunction being the most common abnormality. This finding is consistent with previous literature. Møller and Henriksen[1] described diastolic dysfunction in approximately 40–60% of cirrhotic patients and emphasized that impaired ventricular relaxation is an early manifestation of myocardial involvement in cirrhosis. Similarly, Zardi et al.[2] reported diastolic dysfunction in nearly half of their study population, highlighting its predominance over systolic abnormalities. Our finding that diastolic dysfunction was significantly associated with advanced liver disease (Child-Pugh B and C) is also in agreement with El-Adi et al.[3], who demonstrated a clear relationship between worsening hepatic function and progressive impairment of left ventricular relaxation. These observations suggest that myocardial stiffness and impaired relaxation worsen in parallel with the severity of cirrhosis.

Systolic dysfunction at rest was identified in only 10% of patients. This relatively low prevalence aligns with earlier studies indicating that resting left ventricular ejection fraction is usually preserved in cirrhotic cardiomyopathy. Gulberg et al.[4] reported that overt systolic dysfunction at rest is uncommon and that the characteristic feature of cirrhotic cardiomyopathy is a blunted contractile response to stress rather than baseline systolic failure. Because stress echocardiography was not performed in our study, it is possible that latent systolic dysfunction may have been underestimated. Nevertheless, our findings are comparable to those reported in prior observational studies.

Electrocardiographic abnormalities were also significant. QTc prolongation was observed in 22% of patients and was more frequent among those with Child-Pugh Class C cirrhosis. Bernardi et al.[5] documented QTc prolongation in up to 30% of cirrhotic patients and suggested that it results from autonomic dysfunction and altered cardiac ion channel activity. Likewise, Koshy et al.[6] found a progressive increase in QTc interval with advancing liver disease severity. The association observed in our study between QTc prolongation and advanced Child-Pugh class further supports the hypothesis that electrophysiological disturbances intensify as hepatic dysfunction progresses. Clinically, QT prolongation may predispose patients to ventricular arrhythmias, particularly during stress, electrolyte imbalance, or invasive procedures.

The demographic profile in our study, with a mean age of 52 years and male predominance, is similar to findings reported by Denninger et al.[7], who noted a higher prevalence of cirrhosis among middle-aged men, particularly in alcohol-related cases. Alcoholic liver disease was the most common etiology in our cohort, followed by viral hepatitis and NASH, reflecting patterns reported by Gines et al.[8] in their evaluation of systemic manifestations of cirrhosis. The increasing contribution of NASH highlights the growing role of metabolic factors in chronic liver disease and may have additional implications for cardiovascular risk.

Overall, our findings are consistent with those of Feldman et al.[9], who demonstrated that the severity of liver dysfunction, as assessed by Child-Pugh and MELD scores, correlates with the degree of cardiac involvement. The significant association between advanced cirrhosis and both diastolic dysfunction and QTc prolongation in our study reinforces the importance of routine cardiac evaluation in patients with moderate to severe liver disease.

LIMITATIONS

Although our study provides valuable insight into the prevalence of cardiac dysfunction in cirrhotic patients, certain limitations must be acknowledged. It was conducted at a single center and did not include stress echocardiography or long-term follow-up. Despite these limitations, the results strengthen existing evidence that cirrhotic cardiomyopathy is common and clinically relevant. Early identification of cardiac dysfunction, particularly in patients with advanced disease, may improve risk stratification and guide management decisions, especially in those undergoing invasive procedures such as TIPS placement or liver transplantation.

CONCLUSION

Cardiac dysfunction is common in patients with liver cirrhosis, particularly in advanced disease. Diastolic dysfunction and QTc prolongation are the most frequent abnormalities. Routine cardiac screening using ECG and echocardiography should be considered, especially in patients with Child-Pugh Class B and C cirrhosis.

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