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Correlation of Cardiac Systolic and Diastolic function with Child pugh score among liver cirrhosis patients

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Abstract

Background:

Liver cirrhosis is a progressive disorder that significantly affects various organ systems, including the cardiovascular system. Despite its clinical importance, the relationship between cardiac dysfunction and cirrhosis severity remains underexplored. Cirrhotic cardiomyopathy, characterized by systolic and diastolic dysfunction, is a common yet underdiagnosed complication of liver cirrhosis.

Objective:

This study aims to evaluate the correlation between cardiac systolic and diastolic function with the severity of liver cirrhosis, as measured by the Child-Pugh score.

Methods:

A cross-sectional study was conducted among 50 patients diagnosed with liver cirrhosis at Government Medical College, Kota. Echocardiographic parameters, including ejection fraction (EF), E/A ratio, and E/E', were assessed to evaluate cardiac function. The severity of cirrhosis was categorized using the Child-Pugh score. Statistical analysis was performed to examine associations between cirrhosis severity and cardiac dysfunction.

Results:

Among the study participants, the majority were male (86%) with a mean age of 44.6 years. Alcoholic liver disease (ALD) was the leading cause of cirrhosis (56%). Diastolic dysfunction was prevalent in 72% of patients, whereas systolic dysfunction was observed in only 6%. A significant association was found between diastolic dysfunction and cirrhosis severity ($p=0.001$), while systolic dysfunction also showed a notable correlation ($p=0.034$). No significant associations were found between age, gender, or cirrhosis etiology and cardiac dysfunction.

Conclusion:

The study highlights a strong correlation between worsening liver function and cardiac dysfunction, particularly diastolic abnormalities. Routine cardiac assessments, including echocardiography, should be considered in cirrhotic patients to improve clinical outcomes and guide management strategies.

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Introduction

Liver cirrhosis is a progressive disorder that disturbs the usual structure of the liver. Up to 90% of the liver parenchyma experiences damage before clinical manifestations of liver failure become apparent.[1] In developing nations, cirrhosis is predominantly attributed to Hepatitis B and C, while in developed nations, Alcoholic Liver Disease (ALD) and Non-Alcoholic Steatohepatitis (NASH), alongside Hepatitis C, are recognized as the primary culprits for the development of cirrhosis.[2]

The assessment of liver cirrhosis severity can be conducted using both the Child-Pugh score and the Model for End-Stage Liver Disease (MELD) score. Notably, the Child-Pugh score exhibits a higher sensitivity compared to the MELD score. This scoring system relies on factors such as jaundice, ascites, encephalopathy, serum albumin levels, and prothrombin time.[3] Despite being a concern often overlooked, cardiac dysfunction in cirrhosis, situated on the 'blind side of the heart,' presents a significant issue. Cirrhosis is associated with a spectrum of cardiovascular abnormalities, including hyperdynamic circulation, portal hypertension, hepato-pulmonary syndrome, and alterations in various vascular territories, such as the renal and cerebral vasculature.[4-5]

Liver cirrhosis is associated with a wide range of cardiovascular abnormalities. This was first described by Kowalski and Abelmann who noted a higher resting cardiac output and decreased systemic vascular resistance in patients with cirrhosis. However, despite the hyperdynamic circulation, impaired ventricular contractility in response to stimuli was described in cirrhotic patients[6.] These cardiovascular changes are termed as 'cirrhotic cardiomyopathy'[7-10.] Key features of cirrhotic cardiomyopathy are – systolic dysfunction, diastolic dysfunction, electrocardiographic changes (prolongation of QT interval, altered repolarization and increased susceptibility to arrhythmias), autonomic dysfunction (increased sympathetic tone and decreased parasympathetic activity), hemodynamic disturbances (increased cardiac output), implications for liver transplantation[11]. The exact prevalence of cirrhotic cardiomyopathy varies, and its diagnosis can be challenging due to the absence of specific diagnostic criteria. Diastolic dysfunction is present in the vast majority of patients with cirrhotic cardiomyopathy, and that simple echocardiographic indices such as the E/A ratio may detect diastolic dysfunction even at rest. The Child-Pugh score, a well-established clinical tool for assessing the severity of liver cirrhosis, incorporates objective measures of liver function, such as bilirubin, albumin, prothrombin time, ascites, and hepatic encephalopathy.[6] The relationship between liver cirrhosis and cardiac dysfunction is complex, involving intricate interactions between hemodynamic changes, neurohormonal activation, and the presence of cirrhotic cardiomyopathy. Understanding the cardiac implications of liver cirrhosis is crucial, as it may have implications for both the prognostication and management of patients with this condition. This study aims to explore therelationship between cardiac systolic and diastolic function, and the severity of liver cirrhosis as determined by the Child-Pugh score.

Methodology

This cross-sectional study was conducted among patients with liver cirrhosis admitted under the Department of General Medicine, Government Medical College, Kota. The sample size

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was calculated using the formula ($N=Z^2$ PQ/ D^2), where Z is 1.96 (corresponds to 95% confidence interval), P as 79% (prevalence of prolonged QT interval in liver cirrhosis from Karki N et al study, Q as 1-P, and D as 0.12 (absolute error). Replacing the values, the sample size was 45, and accounting for a 10% non-response rate, the final sample size was adjusted to 50. This paper only describes the relationship of systolic and diastolic dysfunction with liver cirrhosis severity, the relationship with QT interval will be published somewhere else. Patients meeting the inclusion criteria were recruited from the indoor wards. Inclusion criteria was – patient aged 18 years and above with liver cirrhosis bases on history, clinical examination, and standard investigative protocols. Exclusion criteria were – patients with coronary artery disease, valvular disease, or risk factors for cardiomyopathy other than cirrhosis, patients with history of recent bleeding, hypertension, diabetes, chronic anemia (haemoglobin < 7g/dl), or chronic renal failure.

Data was collected using a pre-structured proforma designed to systematically record demographic details, medical history, and specific clinical parameters related to liver cirrhosis and cardiac function. Outcome Variables were – 1) Echocardiographic Parameters:E/A ratio (ratio of early to late ventricular filling velocity), average E/E' (ratio of early mitral inflow velocity to tissue velocity of the mitral annulus), ejection fraction (measured via 2D echocardiography), 2) Child-Pugh Score Components:Serum bilirubin, serum albumin, prothrombin Time/INR, ascites (categorized according to EASL guidelines), hepatic encephalopathy (graded using the West Haven Criteria).The diagnosis of liver cirrhosis was established through a combination of clinical history, physical examination, and ultrasonography of the abdomen. The investigation procedures performed on each participants were – complete blood count, liver function tests, prothrombin time/ INR, electrocardiography, echocardiography. Parameters such as the E/A ratio, average E/E', and ejection fraction were evaluated. The average E/E' was calculated by averaging the E/E' septal and E/E' lateral wall measurements.Diastolic dysfunction was graded according to standard criteria, which included parameters such as septal and lateral e' velocities, left atrium volume index (LA), E/A ratio, deceleration time (DT), average E/E', Ar-A, and the Valsalva ΔE/A. Data was checked for completeness and accuracy before being entered into Microsoft Excel and analyzed using SPSS software version 24.0. Descriptive statistics were used to summarize the data, including frequencies for categorical variables and measures of central tendency and dispersion for continuous variables. Independent t-tests were used to compare continuous variables, and chi-square tests were applied for categorical variables. A p-value of <0.05 was considered statistically significant.

Results

A total of 50 participants were recruited in this study. Mean age of the participants was 44.6 years (±12.3). Approximately half (46%) of the patients were in age category 41-60 years. Majority of the participants were male (86%), Approximately half of the participants had mild ascites (46%), followed by moderate ascites (40%), severe ascites (10%) and no ascites (4%). Over half of the patients (52%) had any grade of encephalopathy. One half of patients (56%) had cirrhosis due to alcohol liver disease, followed by hepatitis B infection (24%), hepatitis C (2%) and idiopathic aetiology in 9 patients (18%). Out of all patients, 21 (42%) had category B child pugh score followed by category C (32%) and category A (26%).Majority of patients had any grade of diastolic dysfunction (72%), with 28 patients had grade 1 and 8 patients had grade 2 diastolic dysfunction. Only a few patients had systolic dysfunction (6%). (Table 1)

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Table 1: Baseline characteristics of study participants (N=50)

Variable	Category	n (%)
Age-cat	≤ 40 years	21 (42)
	41-60 years	23 (46)
	>60 years	6 (12)
Gender	Female	7 (14)
	Male	43 (86)
Ascites	None	2 (4)
	Mild	23 (46)
	Moderate	20 (40)
	Severe	5 (10)
Encephalopathy	Grade 1	12 (24)
	Grade 2	12 (24)
	Grade 3	2 (4)
	None	24 (48)
Etiology of cirrhosis	ALD	28 (56)
	Hep b	12 (24)
	Hep c	1 (2)
	Idiopathic	9 (18)
Child Pugh Score	A	13 (26)
	B	21 (42)
	C	16 (32)
Diastolic dysfunction	1	28 (56)
	2	8 (16)
	Normal	14 (28)
Systolic dysfunction	No	47 (94)
	Yes	3 (6)

A significant association was found between severity of ascites (p 0.001), severity of encephalopathy (p 0.019), presence of diastolic (p 0.001) and systolic dysfunction (p 0.001) with severity of liver cirrhosis. There was no significant association found between age category (p 0.1999), gender (p 0.1999) and aetiology for liver cirrhosis (p 0.179) with severity of liver cirrhosis. (Table 2)

Table 2: Association of selected factors with severity of Child Pugh score

Variable	Category	Child Pugh Score			P value
		A	B	C	
Age	≤ 40 years	6 (46.2)	10 (46.6)	5 (31.3)	0.199
	41-60 years	4 (30.8)	11 (52.4)	8 (50)	
	>60 years	3 (23.1)	-	3 (18.8)	
Gender	Female	1 (7.7)	3 (14.3)	3 (18.8)	0.199
	Male	12 (92.3)	18 (85.7)	13 (81.3)	
Ascites	None	2 (15.4)	-	-	0.001

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	Mild	9 (69.2)	11 (52.4)	3 (18.8)	
	Moderate	2 (15.4)	10 (47.6)	8 (50)	
	Severe	-	-	5 (31.3)	
Encephalopathy	None	11 (84.6)	8 (38.1)	5 (31.3)	0.019
	Mild	2 (15.4)	7 (33.3)	3 (18.8)	
	Moderate	-	6 (28.6)	6 (37.5)	
	Severe	-	-	2 (12.5)	
Etiology	ALD	6 (46.2)	9 (42.9)	13 (81.3)	0.179
	Hep b	3 (23.1)	6 (28.6)	3 (18.8)	
	Hep c	-	1 (4.8)	-	
	Idiopathic	4 (30.8)	5 (23.8)	-	
Diastolic dysfunction	Normal	5 (38.5)	15 (71.4)	8 (50)	0.001
	Grade 1	-	-	8 (50)	
	Grade 2	8 (61.5)	6 (28.6)	-	
Systolic dysfunction	Yes	13 (100)	21 (100)	13 (81.3)	0.034
	No	-	-	3 (18.8)	

Discussion

Liver cirrhosis is a progressive, chronic condition that not only affects the liver but also has far-reaching impacts on other organ systems, particularly the cardiovascular system. Among the cardiovascular complications associated with cirrhosis are systolic and diastolic dysfunctions. These cardiac abnormalities can complicate the clinical management of cirrhosis, contributing to higher morbidity and mortality rates in affected patients.

In this study, we explored the prevalence of cardiac dysfunctions, including both systolic and diastolic abnormalities, and their correlation with the severity of liver cirrhosis, as assessed by the Child-Pugh score. Our findings provide crucial insights into the intricate relationship between liver function deterioration and cardiovascular health.

Demographics and Etiology

Our study population primarily consisted of middle-aged males, which aligns with the typical demographic profile of liver cirrhosis. The mean age of participants was 44.6 years, with the majority (46.0%) aged between 41 and 60 years. The male predominance (86.0%) is consistent with the higher incidence of cirrhosis in males, likely due to risk factors such as alcohol abuse, which was the leading cause of cirrhosis in our study (56.0%).

The age and gender distribution in our study is consistent with other studies[12-14], although our male-to-female ratio was higher compared to some reports. The predominance of Alcoholic Liver Disease (ALD) as the primary etiology is significant, reflecting the high burden of alcohol-related liver disease in our population. Hepatitis B also contributed notably to cirrhosis cases, highlighting the importance of ongoing efforts in vaccination and screening.

Cardiac Dysfunction in Cirrhosis

Diastolic dysfunction was the most prevalent cardiac abnormality observed, affecting 72.0% of our patients. This finding underscores the concept of cirrhotic cardiomyopathy, where

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diastolic dysfunction is a common feature. The predominance of Grade 1 diastolic dysfunction suggests that cardiac changes may begin early in the course of cirrhosis, even before overt cardiac symptoms manifest.

In contrast, systolic dysfunction was less common, observed in only 6.0% of patients. This is in line with the understanding that systolic function is often preserved in cirrhotic cardiomyopathy, becoming compromised primarily under stress conditions rather than at rest. Similar findings were reported by other studies.[15-16]

Correlation with Cirrhosis Severity

Our study revealed statistically significant correlations between the severity of liver cirrhosis, as measured by the Child-Pugh score, and several cardiac parameters. Specifically, we found strong associations between diastolic dysfunction and the severity of liver disease. These findings are consistent with other studies[15-16] that have reported similar trends, reinforcing the link between worsening liver function and the progression of cardiac abnormalities.

Interestingly, while systolic dysfunction was less prevalent, we still observed a significant association between it and cirrhosis severity. This suggests that even subtle changes in systolic function may occur with advancing cirrhosis, highlighting the need for comprehensive cardiac evaluation in these patients.

The correlations between ascites, encephalopathy, and cirrhosis severity observed in our study[15-16]are consistent with the natural history of cirrhosis, where these complications typically worsen as liver function deteriorates. The significant association between reduced ejection fraction and cirrhosis severity further supports the need to monitor cardiac function closely in patients with advanced liver disease.

Implications for Clinical Management

The findings from our study underscore the complex interplay between liver dysfunction and cardiovascular health in cirrhotic patients. Given the high prevalence of cardiac abnormalities, particularly diastolic dysfunction, it is crucial to include comprehensive cardiac evaluations in the management of cirrhotic patients, particularly those with advanced disease.

Understanding the relationship between liver cirrhosis severity and cardiac dysfunctions can enhance clinical management strategies, potentially improving outcomes for these patients. Early detection and intervention for cardiac complications may help mitigate the increased morbidity and mortality associated with liver cirrhosis, emphasizing the need for an integrated approach to patient care.

Strengths of the study were, comprehensive assessment of multiple aspects of cardiac function, including systolic and diastolic function, analysis of cardiac parameters in relation to Child-Pugh scores provides valuable insights into the progression of cardiac changes with advancing liver disease, inclusion of patients with various etiologies of cirrhosis enhances the generalizability of the findings. There were some limitations as, being conducted at a single center may limit the generalizability of the findings to other populations or healthcare settings and absence of a healthy control group makes it challenging to determine the true prevalence of cardiac abnormalities attributable to cirrhosis.

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Conclusion and Recommendations

The study highlights the complex interplay between liver dysfunction and cardiovascular abnormalities in cirrhosis. The predominance of diastolic dysfunctioneven in the absence of overt systolic dysfunction, aligns with the concept of cirrhotic cardiomyopathy as a distinct clinical entity. Thers is need of implementation of routine cardiac evaluation, including echocardiography and ECG, for all patients with liver cirrhosis, particularly those with advanced disease. Incorporate cardiac parameters into risk assessment models for cirrhotic patients to aid in clinical decision-making, including transplantation eligibility.

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