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2D ECHOCARDIOGRAPHY CHANGES IN THE PATIENTS OF CHRONIC LIVER DISEASE

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ABSTRACT

Background: Cirrhotic cardiomyopathy is a recognized complication of chronic liver disease, often remaining subclinical but influencing peri-procedural outcomes. Two-dimensional echocardiography provides a non-invasive method to detect structural and functional cardiac alterations and assess their relationship with disease severity. **Objectives:** To evaluate 2D and Doppler echocardiographic changes in chronic liver disease patients and correlate cardiac findings with severity indices including Child–Pugh class and MELD score. **Methodology:** This prospective observational study was conducted at a tertiary care center over six months, including 45 adult patients with confirmed chronic liver disease. Patients with pre-existing cardiac conditions were excluded. Clinical evaluation, laboratory investigations, ECG, and standardized transthoracic 2D echocardiography with Doppler assessment were performed. Cardiac parameters including systolic function, diastolic indices, chamber dimensions, and pulmonary artery pressure were analyzed and correlated with Child–Pugh and MELD scores. **Results:** Most patients were middle-aged males (80%), with alcohol being the predominant etiology (67%). Echocardiography revealed normal structural findings in 71.11% of cases, while abnormalities included chamber enlargement (8.89%), pericardial effusion (8.89%), diastolic dysfunction (6.67%), and pulmonary hypertension (2.22%). Mean left ventricular ejection fraction was preserved (62.35±13.16%). Doppler analysis showed mean pulmonary artery pressure of 20.52 mmHg and E/A ratio of 1.03, indicating largely preserved diastolic function. However, significant associations were observed between worsening Child–Pugh class and increasing left ventricular dimensions, ejection fraction, pulmonary artery pressure, and E-wave deceleration time ($p<0.05$). ECG abnormalities were present in nearly half of patients. These findings indicate that although overt systolic dysfunction is uncommon, subtle structural and functional cardiac changes increase with disease severity, consistent with early cirrhotic cardiomyopathy. **Conclusion:** Chronic liver disease is associated with subclinical cardiac alterations detectable on echocardiography, which correlate with disease severity. Routine cardiac evaluation is essential for early detection and risk stratification, particularly in moderate-to-severe cirrhosis.

KEYWORDS : Chronic Liver Disease; Cirrhotic Cardiomyopathy; Echocardiography; Child–Pugh Score; Doppler Imaging

INTRODUCTION

Cirrhotic cardiomyopathy represents a spectrum of structural, functional, and electrophysiological cardiac abnormalities that occur in patients with chronic liver disease in the absence of primary heart disease. With increasing survival and broader indications for invasive procedures such as transjugular intrahepatic portosystemic shunting and liver transplantation, subclinical cardiac dysfunction has emerged as an important determinant of peri-procedural risk and long-term outcomes in this population[1]. Two-dimensional echocardiography, complemented by Doppler techniques, offers a non-invasive, widely available tool to characterize systolic and diastolic function, chamber dimensions, and pulmonary pressures in chronic liver disease[2].

Multiple studies have shown that diastolic dysfunction, subtle systolic impairment under stress, chamber dilatation, and increased pulmonary artery pressures are common even in compensated cirrhosis and correlate with the severity of hepatic dysfunction[3]. Early recognition of these changes allows risk stratification, optimization of hemodynamics, and individualized planning before major interventions, thereby potentially reducing morbidity and mortality. However, the prevalence, pattern, and clinical correlates of echocardiographic abnormalities may vary according to etiology, regional risk factors, and case-mix in different tertiary care settings, underscoring the need for local data[4].

In this context, the present study was designed to systematically evaluate 2D and Doppler echocardiographic changes in patients with chronic liver disease attending a tertiary care center, with particular emphasis on left ventricular systolic and diastolic function, chamber dimensions, and pulmonary artery pressures across Child–Pugh and MELD strata[5]. Increasing severity of liver disease is associated with progressive alteration in echocardiographic parameters consistent with cirrhotic cardiomyopathy[6].

Up to one-third of chronic liver disease patients harbor subclinical cardiac dysfunction that may decompensate during stress, volume shifts, or surgery[7]. Generating center-specific data on the burden and pattern of echocardiographic changes among chronic liver disease patients at a high-volume tertiary hospital in Western India may inform pre-procedural screening protocols and follow-up strategies. The primary objective was to characterize 2D and Doppler echocardiographic parameters, including systolic and diastolic indices and pulmonary pressures, in chronic liver disease patients and to correlate these findings with Child–Pugh class and MELD score.

MATERIAL AND METHODS

The study was conducted in the Department of Cardiology, CPR Hospital, a tertiary care center, over a six-month period from October 2025 to March 2026. Chronic liver disease patients were included if they were aged 18 years or older, had a confirmed diagnosis of chronic liver disease based on clinical, biochemical, and imaging criteria. Patients with known structural heart disease, prior myocardial infarction, significant valvular lesions, congenital heart disease, or documented cardiomyopathy were excluded in order to isolate cardiac changes attributable to chronic liver disease. Additional exclusion criteria comprised uncontrolled systemic hypertension, significant chronic lung disease, current sepsis, or hemodynamic instability.

Ethical approval was obtained from the institutional ethics committee of the tertiary care hospital before initiation of the study, and the protocol was registered at the departmental

level. Eligible patients presenting to the gastroenterology and hepatology services during the study period were screened in liaison with hepatologists, and those fulfilling inclusion criteria were approached consecutively. Written informed consent was obtained from each participant after explaining the purpose, procedures, potential benefits, and risks of the echocardiographic evaluation in a language they understood.

Chronic liver disease status was then documented using standard clinical assessment, routine laboratory investigations, and imaging where required, and each patient was classified according to the Child–Pugh score and MELD score as per established criteria. Demographic data, relevant risk factors, etiology of liver disease, and duration of illness were recorded in a structured case record form in a single sentence-based data capture process. Bedside general and systemic examination focusing on cardiovascular and hepatobiliary systems was carried out and documented in one comprehensive sentence noting vital parameters and major clinical signs.

All patients subsequently underwent standardized non-invasive investigations including 12-lead electrocardiography and transthoracic 2D echocardiography with M-mode and Doppler, covering left ventricular ejection fraction, chamber dimensions, diastolic function indices, and estimation of pulmonary artery pressure, in a single sentence describing the investigation package. No invasive cardiac procedures were performed as part of the study protocol, and echocardiographic measurements were interpreted according to contemporary recommendations for assessment of diastolic function and pulmonary hypertension.

RESULTS

Table 1: Age Group of the Patients

Age and Sex distribution		Frequency	Percent
Age groups	19 to 40 Years	12	26.67
	41 to 60 Years	24	53.33
	61 to 80 Years	9	20
Gender	Male	36	80
	Female	9	20
Total		45	100

The majority of patients were in the 41–60 years age group (53.33%), followed by 19–40 years (26.67%) and 61–80 years (20%), with a total sample size of 45 patients. 36 patients were male (80%) and 9 were female (20%), reflecting a marked male predominance in this chronic liver disease cohort.

Table 2. Presenting Symptoms and Clinical Sign of the Patients

Symptoms and Signs		Frequency	Percent
Presenting Symptoms	Generalized weakness	39	86.67
	Abdominal distension	22	48.89
	Hematemesis	12	26.67
	Malena	10	22.22
	Altered Sensorium	5	11.11
Signs	Pallor	32	71.11
	Icterus	28	62.22
	Ascites	24	53.33
	Edema Feet	23	51.11
	Loss of Axillary and Pubic hairs	4	8.89
	Gynecomastia	2	4.44
	Asterixis	2	4.44
	Spider Naevi	1	2.22
	Breast Atrophy	1	2.22

Generalized weakness was the most common presenting symptom (86.67%), followed by abdominal distension (48.89%), hematemesis (26.67%), malena (22.22%), and altered sensorium (11.11%). Pallor (71.11%) and icterus (62.22%) were common clinical signs, while ascites (53.33%) and pedal edema (51.11%) were also frequently observed; less common findings included loss of axillary and pubic hair (8.89%), gynecomastia (4.44%), asterixis (4.44%), spider naevi (2.22%), and breast atrophy (2.22%).

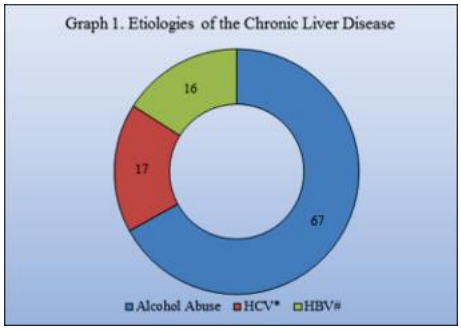
Table 3. Distribution of Patients According to MELD Score and Child Pugh's Score

Scire Grading of CLD		Number	Percentage
MELD score	<9	15	33.33
	10-19	22	48.89
	≥20	8	17.78
Child Pugh's Score	A	19	42.22
	B	19	42.22
	C	7	15.56
Total		100	100.0

According to MELD score, 33.33% patients were having MELD <9, 48.89% having MELD 10–19, and 17.78% having MELD ≥20. Nearly two-thirds of the cohort fell into the intermediate or high MELD strata, reflecting moderate to severe hepatic dysfunction in many patients. As per the Child–Pugh class distribution, with 42.22% of patients in class A, 42.22% in class B, and 15.56% in class C. Most patients had compensated or moderately decompensated cirrhosis, while a smaller subset had advanced decompensation.

Etiologies of the Chronic Liver Disease

Etiologies show that with alcohol abuse accounting for 67% of cases, hepatitis C virus infection for 17%, and hepatitis B virus infection for 16%, in a total of 45 patients. This underscores alcohol as the predominant cause of chronic liver disease in this cohort, with viral etiologies contributing to about one-third of cases.



*Hepatitis C virus, # Hepatitis B virus

Duration of Alcohol Consumption

Alcohol consumption duration shows that among 30 alcohol-related cases, showing that 16.67% had consumed alcohol for ≤10 years, 63.33% for 11–20 years, 16.67% for 21–30 years, and 3.33% for 31–40 years. This indicates that most alcohol-related chronic liver disease developed after a prolonged intake ranging from 11 to 20 years.

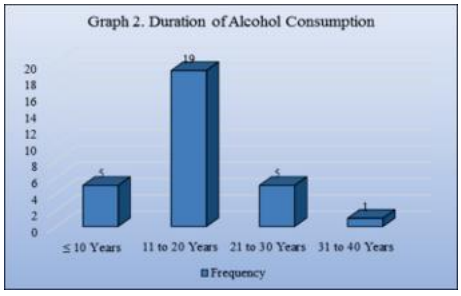


Table 4. ECG Findings in Patients:

ECG Finding	Frequency	Percent
Normal	23	51.11
Ischemic Changes	9	20
Low voltage complex	9	20

Old AWMI*	2	4.44
Old IWMI#	2	4.44
Total	45	100

* Old Anterior Wall Myocardial Infarction, # Old Inferior Wall Myocardial Infarction

ECG findings shows normal tracings in 51.11% of patients, ischaemic changes in 20%, low voltage complexes in 20%, old anterior wall myocardial infarction in 4.44%, and old inferior wall myocardial infarction in 4.44%. This pattern indicates that nearly half of the patients had ECG abnormalities, including evidence of ischaemia or prior myocardial injury, which may influence peri-procedural cardiac risk.

ECHO Findings (Structural)

Structural 2D ECHO findings show normal studies in 71.11% of patients, chamber enlargement in 8.89%, pericardial effusion in 8.89%, left ventricular diastolic dysfunction in 6.67%, hyperdynamic flow in 4.44%, and pulmonary hypertension in 2.22%. These data show that, although most chronic liver disease patients had structurally normal hearts, a significant minority exhibited cirrhotic cardiomyopathy features and volume-related changes.

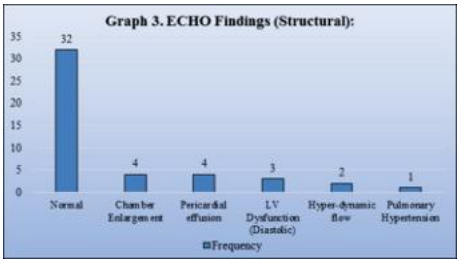


Table 5. Echo Findings (Functional)

Echo Findings	Mean	Std. Deviation
LV EF* (%)	62.35	13.16
LV in Diastole (mm#)	45.18	3.05
LV systole (mm)	28.06	2.71
Left Atria (mm)	32.88	4.54
LV PWT@ (mm)	10.05	1.13
IVS (mm)	9.82	1.03

Left Ventricular Ejection Fraction, # millimetre, @ left ventricle posterior wall thickness

2D ECHO parameters show as mean left ventricular ejection fraction 62.35 (13.16)%, LV end-diastolic dimension 45.18 (3.05) mm, LV end-systolic dimension 28.06 (2.71) mm, left atrial size 32.88 (4.54) mm, LV posterior wall thickness 10.05 (1.13) mm, and interventricular septal thickness 9.82 (1.03) mm. These indices collectively suggest preserved global systolic function with relatively normal chamber dimensions and wall thicknesses in the majority of patients.

Table 6. Doppler Echo Findings

Doppler Echo	Mean	Std. Deviation
Mean PAP*	20.52	2.41
Mean EDT#	223.55	13.32
Mean E / A Ratio@	1.03	0.12

*Pulmonary Artery Pressure, #E-wave deceleration time, @Early€ to Late(A) velocity ratio

Doppler findings show mean pulmonary artery pressure 20.52 (2.41) mmHg, E-wave deceleration time 223.55 (13.32) ms, and E/A ratio 1.03 (0.12). This profile is compatible with overall normal to mildly altered diastolic filling and pulmonary pressures in most cases.

Table 7. Child Pugh's Score and Echo Findings

ECHO Findings	Score A		Score B		Score C		P value
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
LVEF (%)	57.12	18.88	65.70	3.22	67.40	2.41	0.002
LV in Diastole (mm)	44.24	2.69	45.26	2.98	47.60	3.04	0.002
LV in Systole (mm)	27.38	3.21	27.98	2.27	30.20	0.41	0.001
Left Atria (mm)	34.02	3.50	32.00	4.97	32.20	5.41	0.099
LVPWT (mm)	9.90	1.19	10.00	1.07	10.60	1.06	0.115
IVS (mm)	9.93	0.95	9.65	1.19	10.00	0.65	0.356

Mean LVEF and LV cavity dimensions (both diastolic and systolic) increase progressively from Child–Pugh class A to C, with statistically significant p values (LVEF p = 0.002, LV diastolic dimension p = 0.002, LV systolic dimension p = 0.001), whereas left atrial size, LV posterior wall thickness, and interventricular septal thickness do not differ significantly between classes. This indicates that worsening liver disease severity is associated with measurable changes in LV size and ejection fraction, but not with appreciable alterations in atrial size or wall thickness.

Table 7. Child Pugh's Score and Doppler Echo Findings

Doppler ECHO Findings	Score A		Score B		Score C		P value
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	
PAP (mmHg)	19.76	2.43	20.19	1.74	23.60	1.55	0.000
EDT (ms)	227.86	7.74	220.58	17.19	220.00	9.82	0.021
E/A Ratio	1.00	0.08	1.06	0.15	1.03	0.05	0.085

Mean pulmonary artery pressure and E-wave deceleration time vary significantly across Child–Pugh classes (PAP p = 0.000, EDT p = 0.021), while the E/A ratio remains statistically similar between groups (p = 0.085). This suggests that progression of liver disease correlates with rising pulmonary pressures and subtle diastolic filling changes, although overall transmitral filling ratio remains largely preserved.

DISCUSSION

In the present study, chronic liver disease predominantly affected middle-aged adults, with 53.33% of patients in the 41–60-year age group and 80% being male, reflecting a clear male predominance. Similar demographic patterns have been reported by Pradeep MN et al.[8], who noted that 56.7% of their CLD cohort were aged 41–60 years and 83% were male, and by an Indian tertiary-care series Punekar P et al. [4] where males comprised nearly 75–80% of cirrhotic patients, largely attributed to higher alcohol consumption among men.

With respect to clinical presentation, generalized weakness (86.67%) and abdominal distension (48.89%) were the predominant symptoms in the current cohort, while pallor (71.11%), icterus (62.22%), ascites (53.33%), and pedal edema (51.11%) were the most frequent signs. Punekar P et al. [4] reported fatigue in 82% and abdominal distension in 60% of cirrhotic patients, with ascites present in about 58% and pedal edema in 46%, values closely paralleling the current series. Similarly, Nirmal A et al. [7] observed ascites in 52% and peripheral edema in 48% of their cirrhosis cohort undergoing echocardiographic evaluation.

In terms of disease severity, 48.89% of patients in the present study had an intermediate MELD score of 10–19, and 17.78% had MELD ≥20, while Child–Pugh classes A and B each comprised 42.22% and class C 15.56%. Nirmal A et al. [7] reported that approximately 60% of their sample were Child–Pugh B or C, with higher grades correlating with greater frequency of cardiac dysfunction. A cross-sectional study by Ewid M et al.[9] on echocardiographic assessment in cirrhosis similarly found that 56% of patients belonged to Child–Pugh B/C, and cardiac dysfunction increased significantly with advancing Child–Pugh class. By contrast, in an earlier study by Karagiannakis DS et al. [6] did not demonstrate a strong association between 2D echo changes and Child–Pugh class, possibly due to stricter exclusion of decompensated cases or reliance only on resting parameters.

Alcohol was the dominant etiology in this study, accounting for 67% of cases, with hepatitis C and B responsible for 17% and 16%, respectively. This is consistent with a study by Nirmal A et al. [7] where 62% of cirrhotics had alcoholic etiology, and with Pradeep MN et al. [8] who reported alcohol as the cause in 63.3% of CLD patients undergoing echocardiography. A more recent observational study by Alvi A et al. [10] also identified alcohol as the leading cause in nearly two-thirds of CLD admissions, though with a rising contribution of metabolic and viral etiologies. The predominance of alcohol in the present cohort is therefore in line with stud by Karagiannakis DS et al. [6] and may have specific implications for cirrhotic cardiomyopathy, as alcohol exerts direct myocardial toxicity in addition to hemodynamic effects of cirrhosis.

Electrocardiographic abnormalities were present in nearly half of patients: 51.11% had normal ECGs, while 20% each showed ischemic changes and low-voltage complexes, and 4.44% had evidence of old anterior or inferior wall myocardial infarction. In the Healthcare Bulletin hospital-based study by Alvi A et al. [10], ECG abnormalities were even more frequent, documented in 68.5% of CLD patients, with prolonged QTc in 21.9% and low-voltage QRS in 9.6%. A systematic review by Izzy M et al. [1] also concluded that QTc prolongation and low QRS voltage may affect up to 50% and 10–15% of cirrhotics, respectively, often correlating with disease severity.

On structural echocardiography, 71.11% of patients had a normal study, whereas chamber enlargement and pericardial effusion were each seen in 8.89%, LV diastolic dysfunction in 6.67%, hyperdynamic flow in 4.44%, and pulmonary hypertension in 2.22%. In contrast, a study by Nirmal A et al. [7] found cardiac dysfunction in 51 of 150 cirrhotic patients (34%), with diastolic dysfunction in 69% of those affected and higher prevalence in advanced Child–Pugh classes. Another tertiary-care Indian study by Pradeep MN et al. [8] reported that over 50% of CLD patients had at least one echocardiographic abnormality, including increased chamber dimensions, wall thickness, or estimated pulmonary pressure. The lower proportion of overt structural changes in the present cohort may be due to reliance on conventional 2D and Doppler indices without tissue Doppler or strain imaging, which are more sensitive for early diastolic dysfunction.

Functional parameters in this study showed a mean LVEF of 62.35±13.16%, with LV end-diastolic and systolic dimensions of 45.18±3.05 mm and 28.06±2.71 mm, respectively, indicating preserved global systolic function in most patients. These values are similar to those reported by Nirmal A et al. [7], who found mean LVEF around 60–65% across Child–Pugh classes despite diastolic abnormalities. The systematic review by Ewid M et al. [9] also highlighted that many cirrhotic patients maintain normal resting LVEF, with dysfunction unmasked only under stress or by advanced imaging.

Finally, the present study demonstrated that LVEF and LV cavity dimensions increased significantly from Child–Pugh A to C (LVEF $p=0.002$; diastolic and systolic dimensions $p=0.002$ and $p=0.001$), while left atrial size, LV wall thickness, and interventricular septal thickness did not differ significantly across classes. Mean PAP and E-wave deceleration time also rose with worsening Child–Pugh class ($p=0.000$ and $p=0.021$, respectively), whereas E/A ratio remained comparable. These gradients support the concept that advancing liver disease is associated with progressive cardiac remodeling and subtle diastolic impairment, in agreement with Nirmal A et al. [7], who reported a significant correlation between cardiac dysfunction and severity of cirrhosis, and with meta-analytic study by Izzy M et al. [1] showing higher prevalence of LVDD in Child–Pugh B/C patients. However, the absence of marked changes in wall thickness contrasts with some longitudinal data indicating increased interventricular septal thickness over time in CLD, suggesting that structural remodeling may be less advanced in this cross-sectional, relatively small cohort.

CONCLUSION

In the present study, most patients have preserved resting left ventricular systolic function, with a mean ejection fraction of 62.35%, and relatively normal chamber dimensions on conventional echocardiography. Nevertheless, a substantial proportion shows structural and functional abnormalities compatible with early cirrhotic cardiomyopathy, including chamber enlargement, pericardial effusion, diastolic dysfunction, and mildly elevated pulmonary artery pressures. Echocardiographic alterations become more pronounced with increasing Child–Pugh class.

Doppler indices reveal subtle diastolic filling abnormalities, with changes in E-wave deceleration time but preserved E/A ratio across severity strata, suggesting early diastolic involvement before overt dysfunction appears on standard measures. Routine echocardiographic and Doppler evaluation is recommended in all moderate-to-severe chronic liver disease patients, especially Child–Pugh B/C or MELD ≥ 10, to detect subclinical cirrhotic cardiomyopathy and guide peri-procedural risk stratification.

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