Sarcouncil Journal of Medicine and Surgery

ISSN(Online): 2945-3534

Volume- 05| Issue- 07| 2026

Research Article **Received:** 20-05-2026 | **Accepted:** 15-06-2026 | **Published:** 01-07-2026

Echocardiographic Assessment of Right Ventricular Function and Hemodynamic Changes in Patients with Chronic Liver Disease: A Cross Sectional Study in Iraq

Neam Ezzat Abdulmahdi[1], Salam Ayad Jadioo[2] and Salam Qasim Mohammed[3]

[1]M.B.Ch.B., Diploma Echocardiography, Iraqi Ministry of Health, Medical City Complex, Baghdad Teaching Hospital, Baghdad, Iraq.

[2]M.B.Ch.B., C.J.B.A.E.M. (Emergency Medicine), M.R.C.E.M. UK, Iraqi Ministry of Health, Al-Rusafa Health Directorate, Zafaraniya General Hospital, Baghdad, Iraq.

[3]M.B.Ch.B., F.I.B.M.S (INT.MED), C.A.B.M.S (GE&H), Iraqi Ministry of Health, Medical City Complex, Baghdad, Iraq.

Abstract: Background: The worldwide prevalence of cirrhosis is unknown; however, it has been estimated to be between 0.15% and 0.27%. About 25,000 cases of portal hypertension occur for every 100,000 people with non-alcoholic fatty liver disease. Heart is one of the most adversely affected organs in cirrhosis and it increases morbidity and mortality in these patients. The transthoracic echocardiography is the first-line noninvasive screening tool widely available for porto-pulmonary hypertension. Golden standard for the diagnosis of porto-pulmonary hypertension is right heart catheterization. Aim of study: To evaluate the relationship between portal hypertension and echocardiographic abnormalities in patient with underlying liver cirrhosis. Patients and methods: A cross-sectional study that was conducted at Baghdad Teaching Hospital, during a period of nine months from 1st of August 2023 till 1st of May 2024. It included 50 patients diagnosed with liver cirrhosis who were either admitted to the hospital or attending the outpatient clinic of the GIT center. All patients were sent for transthoracic echocardiography with examination, measurements and calculations were done according to guidelines of American society of echocardiography. Results: In this study, 46% were found to have a portosystemic shunt. Patients with positive portosystemic shunt had significantly higher MELD scores, higher VR basil diameter, PASP, PADP, and had significantly lower RV, FAC% and TAPSE when compared to the patients with negative portosystemic shunt. MELD score was significantly higher in patients with CPS grade C compared to those with grade A and grade B. VR basil diameter, PASP, and PADP were significantly increased with increasing severity of disease, while RV FAC% was significantly decreased with increasing severity of disease. There was a positive, significant correlation between the MELD score and RV basil diameter, PASP and PADP, while there was inverse significant correlation with RV FAC% and TAPSE. Conclusion: In Portopulmonary shunt and portopulmonary hypertension are significantly associated with liver cirrhosis with the presence of portal hypertension. Patients with cirrhosis have significant cardiac dysfunction that is evident on echocardiography.

Keywords: Liver cirrhosis, echocardiography, portal hypertension, cardiac, Iraq.

INTRODUCTION

Cirrhosis represents the final stage of chronic liver disease, marked by irreversible architectural disruption, widespread nodules, vascular reorganization, and extensive fibrosis (Sharma A. *et al*., 2023). While the liver initially compensates for injury by forming scar tissue without losing function, repeated insults—such as viral infections, toxins, autoimmune processes, or hereditary conditions—eventually lead to loss of function and cirrhosis (Scaglione, S. *et al*., 2015). In advanced stages, liver transplantation remains the only definitive treatment, though early intervention targeting the underlying cause may halt or even reverse progression (Çelik, Z. 2022).

Etiology and Classification

Cirrhosis arises from diverse chronic liver disorders. In developed countries, hepatitis C virus (HCV), alcohol-related liver disease, and nonalcoholic steatohepatitis (NASH) dominate, whereas hepatitis B virus (HBV) and HCV are more prevalent in developing regions (Zhai, M. *et al*., 2021). Other causes include genetic disorders (e.g., Wilson disease, hemochromatosis), autoimmune hepatitis, vascular conditions such as Budd-Chiari syndrome, and cryptogenic cirrhosis of uncertain origin (Scaglione, S. *et al*., 2015). Classification is based on morphology—micronodular, macronodular, or mixed—or etiology, which encompasses viral, toxic, autoimmune, cholestatic, vascular, and metabolic categories (Goodman, Z. D. 2018; Akram, U. I. M. *et al*., 2023).

Prevalence and Burden

Despite its significant global impact, cirrhosis remains under-recognized compared to other chronic diseases. Estimates suggest a prevalence between 0.15% and 0.27%, though many cases go undiagnosed. Importantly, more than half of cases are potentially preventable through control of diabetes, reduction of alcohol misuse, and management of viral hepatitis (Ginès, P. *et al*., 2021).

***Corresponding Author:** Neam Ezzat Abdulmahdi

DOI- https://doi.org/10.5281/zenodo.21098681

Complications

Cirrhosis leads to a wide spectrum of complications, including portal hypertension, ascites, variceal hemorrhage, jaundice, splenomegaly, spontaneous bacterial peritonitis, hepatocellular carcinoma, hepatorenal syndrome, hepatopulmonary syndrome, and hepatic encephalopathy. These complications significantly increase morbidity and mortality, underscoring the importance of early detection and management (Hayward, K. L., & Weersink, R. A. 2020).

Portal Hypertension

Portal hypertension, defined as elevated pressure within the portal venous system, is a major consequence of cirrhosis. Clinically significant disease occurs when the hepatic venous pressure gradient exceeds 10 mmHg. Causes are classified as prehepatic (e.g., portal vein thrombosis), intrahepatic (e.g., cirrhosis, schistosomiasis), or posthepatic (e.g., Budd-Chiari syndrome, constrictive pericarditis). Its complications mirror those of cirrhosis, including variceal bleeding, ascites, bacterial peritonitis, hepatorenal syndrome, and porto-pulmonary hypertension (Alhaddad, O. *et al*., 2025).

Porto-Pulmonary Hypertension (PoPH)

PoPH is a distinct disorder recognized by the World Health Organization, defined as pulmonary arterial hypertension in association with portal hypertension (Alhaddad, O. *et al*., 2025). Its pathophysiology remains incompletely understood but involves vasoconstriction, endothelial dysfunction, abnormal angiogenic signaling, and portosystemic shunting that exposes pulmonary vessels to harmful mediators (Raevens, S. *et al*., 2021). Diagnosis is challenging due to nonspecific symptoms such as exertional dyspnea, fatigue, and syncope. Right heart catheterization remains the gold standard, supported by echocardiography and imaging studies (Galiè, N. *et al*., 2016). Early recognition is vital, as PoPH significantly worsens outcomes in cirrhotic patients.

Aim of the Study

To evaluate the relationship between portal hypertension and echocardiographic abnormalities in patient with underlying liver cirrhosis.

PATIENTS AND METHOD

This was a cross-sectional study that was conducted at Baghdad Teaching Hospital, during a period of nine months from 1st of August 2023 till 1st of May 2024.

The study included 50 patients diagnosed with liver cirrhosis who were either admitted to the hospital or attending the outpatient clinic of the GIT center. They were informed about the nature of the study and written consent was obtained from them.

Exclusion Criteria

- ✓ Patients with chronic systemic hypertension or diabetes mellitus.
- ✓ Patients with previous cardiac disorders.
- ✓ Anemic patients with hemoglobin < 9 g/dL.
- ✓ Patients with chronic renal, respiratory or thyroid diseases.

A questionnaire was applied to all enrolled patients to collect the needed information which filled by the researcher. It included questions to gather the following information:

- Age and gender
- Causes of cirrhosis.
- Child Pugh Score: It was designed to predict mortality in cirrhosis patients. The original scoring system used five clinical and laboratory criteria to categorize patients: serum bilirubin, serum albumin, ascites, neurological disorder, and clinical nutrition status. The scoring system was modified later by Pugh *et al*, substituting prothrombin time for clinical nutrition status. Additionally, they introduced variable points for each criterion based on increasing severity (as shown in Table1) (Tsoris, A., & Marlar, C. A. 2019)

Table 1: Child-Pugh score of liver cirrhosis severity

Parameter		Score		
		1	2	3
Hepatic Encephalopathy		None	Grade 1 and 2	Grade 3 and 4
Ascites		None	Slight	Moderate
S. Bilirubin (µmol/L)		< 34	34 – 51	> 51
S. Albumin (g/l)		> 35	30 - 35	< 30
PT	Seconds prolonged	< 4	4 – 6	> 6
	INR	< 1.7	1.7 – 2.3	> 2.3

Publisher: SARC Publisher

Then the grading was based on the score as follows:

- **Child's A (Good hepatic function):** Score of 5 – 6.
- **Child's B (Moderately impaired hepatic function):** Score of 7 – 9.
- **Child' s C (Advanced hepatic dysfunction):** Score of 10 – 15.

Model for end-stage liver disease (MELD) score: It was initially developed to predict survival following transjugular intrahepatic portosystemic shunt was subsequently found to be accurate predictor of mortality amongst patents with end-stage liver disease. It based on three biochemical variables that are readily available, reproducible, and objective. These include: serum bilirubin, serum creatinine, and the international normalized ratio (INR) of prothrombin time.

Parameters in MELD scoring system are:
MELD= 3.78 x ln [S. bilirubin (mg/dl)] + 11.2 x ln [INR] + 9.57 x ln [S. Cr (mg/dl)] + 6.43.(14)
All patients were sent for transthoracic echocardiography with examination, measurements and calculations were done according to guidelines of American society of echocardiography, BRAUNWALD text of cardiology by using Phillips and GE VIVID e95 authorized by the Iraqi MOH. The following parameters were obtained:

- Left atrial diameter in systole.
- Left ventricular end diastolic diameter.
- Left ventricular end systolic diameter.
- Right atrial diameter in systole.
- Right ventricular diameter in diastole.
- Mitral valve flow and tissue velocities (E, A, E/A, E', A', E'/A', E/E').
- Tricuspid valve inflow and tissue velocities (E, A, E/A, E', A', E'/A', E/E') and Tricuspid annular plane systolic excursion (TAPSE).
- Pulmonary artery-to-right ventricular pressure gradient in diastole to estimate RV and pulmonary artery diastolic pressure.
- RV to RA pressure gradient in systole to estimate RV and pulmonary artery systolic pressure.
- LV ejection fraction.
- Pulmonary vascular resistance (PVR) using the following equation

PVR=[TRV/TVI(RVOT)*10] +0.16.
Agitated saline was given to all patients to assess the presence of shunt.

Administrative approvals were granted from Baghdad Teaching Hospital and the scientific Committee in College of Medicine / Baghdad University.

All analyses were performed using SPSS version 26.0 (IBM Corp.). Kolmogorov–Smirnov and Shapiro–Wilk tests were used to determine the presence of a parametric distribution, and they confirmed that the data were normally distributed. Therefore, the significance of the difference between different means (quantitative data) was tested using the students-t-test for the difference between two independent means, or the ANOVA test for the difference between more than two means. The significance of the difference of different percentages (qualitative data) was tested using the Pearson Chi-square test (X^2-test) with the application of Yate's correction or Fisher Exact test whenever applicable. Pearson correlation was calculated for the correlation between two quantitative variables with its t-test for testing the significance of correlation. The correlation coefficient value (r) is either positive (direct correlation) or negative (inverse correlation) with values <0.3 representing no correlation, 0.3-<0.5 representing weak correlation, 0.5-<0.7 moderate strength, and>0.7 strong correlation. A level of P-value less than 0.05 was considered significant.

RESULTS

Portosystemic Shunt

Out of the 50 patients, 23 (46%) were found to have a portosystemic shunt, while the remaining 27 (54%) had no portosystemic shunt as shown in (Figure 1).

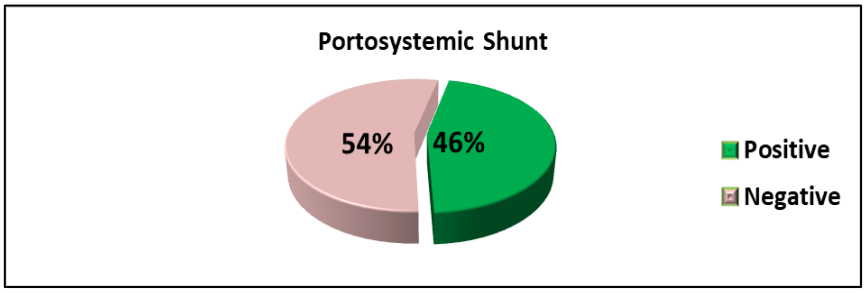

Figure 1: Incidence of portosystemic shunt among the studied patients

Publisher: SARC Publisher

This study found no significant association between portosystemic shunt and CPS grade (P= 0.525). On the other hand, the MELD score was significantly different according to portosystemic shunt status. Patients with positive portosystemic shunt had significantly higher MELD scores when compared to the patients with negative portosystemic shunt (16.48 vs 13.52, P= 0.042). As shown in (Table 2).

Table 2: Comparison of Child-Pugh and MELD scores according to portosystemic shunt

Variable	Portosystemic Shunt		P – Value *
	Positive	Negative	
Child-Pugh Score			
Grade A	5 (50.5)	5 (50.0)	0.525
Grade B	12 (40.0)	18 (60.0)	
Grade C	6 (60.0)	4 (40.0)	
*Significant difference between percentages using Pearson Chi-square test at 0.05 level.			
MELD Score	16.48 ± 5.36	13.52 ± 3.55	0.042

*Significant difference between two means using Student t-test at 0.05 level.

The comparison of echocardiographic parameters according to portosystemic shunt status revealed that patients with portosystemic shunt compared to those who had negative portosystemic shunt had significantly higher VR basil diameter (36.61 mm vs 33.74 mm, P= 0.017), PASP (35.04 mmHg vs 24.44 mmHg, P= 0.001), and PADP (18.09 mmHg vs 12.74 mmHg, P= 0.001), and had significantly lower RV FAC% (0.46 vs 0.049, P= 0.001) and TAPSE (20.04 mm vs 22.44, P= 0.001). Other echocardiographic parameters showed no significant difference according to portosystemic shunt status as illustrated in (Table 3).

Table 3: Comparison of echocardiographic parameters according to portosystemic shunt

Echocardiographic Parameters	Portosystemic Shunt		P - Value*
	Positive Mean ± SD	Negative Mean ± SD	
RV Basil Diameter (mm)	36.61 ± 4.6	33.74 ± 3.55	0.017
RV FAC (%)	0.46 ± 0.06	0.49 ± 0.03	0.014
TAPSE (mm)	20.04 ± 2.01	22.44 ± 1.39	0.001
TV E/A	1.1 ± 0.32	1.62 ± 0.51	0.195
PASP (mmHg)	35.04 ± 6.69	24.44 ± 4.03	0.001
PADP (mmHg)	18.09 ± 4.99	12.74 ± 2.29	0.001
PVR (wood)	2.07 ± 0.77	2.85 ± 0.52	0.509

*Significant difference between two means using Student t-test at 0.05 level.

In the present study, there was a significant association between CPS grades and the cause of liver cirrhosis, as more than half of patients with alcoholic liver injury were in CPS grade C (54.5%, P= 0.009), while CPS grades were not significantly associated with patients' age and gender (P ≥ 0.05), It was clear that the mean MELD score was significantly different according to CPS grades, Multiple comparisons showed that the mean MELD score was significantly higher in patients with CPS grade C compared to those with grade A and grade B (22.40 vs 10.90 and 13.70, respectively with P= 0.001). Further, patients with CPS grade B had significantly higher mean MELD scores compared to those with grade A (13.70 vs 10.90, P= 0.001) as shown in (Table 4).

Table 4: Comparison of age, gender, and etiology of liver cirrhosis according to Child-Pugh grades

Patients' characteristics	Child-Pugh Score			P- Value*
	Grade A No. (%)	Grade B No. (%)	Grade C No. (%)	
Age Group (Years)				
< 35	4 (30.8)	7 (53.8)	2 (15.4)	0.334
35 – 44	1 (7.1)	8 (57.1)	5 (35.8)	
≥ 45	5 (21.7)	15 (65.2)	3 (13.1)	
Gender				

Publisher: SARC Publisher

Male	6 (17.1)	23 (65.8)	6 (17.1)	0.452
Female	4 (26.7)	7 (46.7)	4 (26.7)	
Etiology of Cirrhosis				
Nonalcoholic steatohepatitis	4 (33.3)	7 (58.3)	1 (8.3)	0.009
Alcoholic Liver Injury	0 (0)	5 (45.5)	6 (54.5)	
Viral Hepatitis	1 (6.7)	11 (73.3)	3 (20)	
Autoimmune	0 (0)	5 (100)	0 (0)	
Others	5 (71.4)	2 (28.6)	0 (0)	
MELD Score	10.90 ± 1.96	13.70 ± 2.95	22.40 ± 5.54	0.001

*Significant difference between percentages using Pearson Chi-square test at 0.05 level.

The comparison of echocardiographic parameters according to CPS grades revealed that VR basil diameter, PASP, and PADP were significantly increased with increasing severity of disease, while RV FAC% was significantly decreased with increasing severity of disease. Other echocardiographic parameters showed no significant difference between CPS grades as illustrated in (Table 5).

Table 5: Comparison of Echo parameters according to Child-Pugh grades

Echocardiographic Parameters	Child-Pugh Score			P- Value*
	Grade A No. (%)	Grade B No. (%)	Grade C No. (%)	
RV Basil Diameter (mm)	31.6 ± 3.62	34.87 ± 3.51	39.1 ± 3.9	0.001
RV FAC (%)	0.51 ± 0.02	0.48 ± 0.04	0.43 ± 0.07	0.001
TAPSE (mm)	21.9 ± 1.37	21.57 ± 1.71	20.1 ± 3.14	0.096
TV E/A	1.27 ± 0.06	1.52 ± 0.47	1.11 ± 0.42	0.701
PASP (mmHg)	25.5 ± 4.27	28.37 ± 5.76	36.01 ± 5.28	0.016
PADP (mmHg)	13.1 ± 3.07	14.13 ± 3.21	20.5 ± 5.72	0.001
PVR (wood)	1.32 ± 0.36	2.93 ± 0.81	2.49 ± 0.79	0.561

*Significant difference between more than two means using ANOVA-test at 0.05 level.

In the Pearson correlation analysis, there was a positive, significant correlation between the MELD score and RV basil diameter (r= 0.532, P= 0.001), PASP (r= 0.627, P= 0.001) and PADP (r= 0.683, P= 0.001) while there was inverse significant correlation with RV FAC% (r= - 0.705, P= 0.001) and TAPSE (r= - 0.572, P= 0.001) as shown in (Table 6).

Table 6: Correlations of the MELD score with clinical characteristics and echocardiographic parameters

Variable	MELD Score	
	r	P – Value *
Age (Years)	- 0.022	0.88
RV Basil Diameter (mm)	0.532	0.001
RV FAC (%)	- 0.705	0.001
TAPSE (mm)	- 0.572	0.001
TV E/A	- 0.092	0.524
PASP (mmHg)	0.627	0.001
PADP (mmHg)	0.683	0.001
PVR (wood)	0.268	0.067

*Correlation is significant at the 0.05 level.

DISCUSSION

Portosystemic Shunt

In comparison to Spengler *et al* study, a different result published, in which portosystemic shunt was observed in 54.8% of 217 patients with end stage liver disease, while the remaining 45.2% had no shunt (Spengler, E. K. *et al*., 2017) . Two hundred twenty-two patients with cirrhosis were evaluated in Nardelli *et al* study, in which 63.5% of them found to have a portosystemic shunt (Nardelli, S. *et al*., 2021). Moreover, Simón-Talero *et al* study found a shunt of any size was observed in 60% of patients (Simón-Talero, M. *et al*., 2018), and Praktiknjo *et al* study found that only 30% of the

Publisher: SARC Publisher

patients were with a portosystemic shunt (Praktiknjo, M. *et al*., 2020). The presence of shunt leads to the reduction of arterial oxygen saturation, especially when the blood of portal vein is of low oxygen saturation (Porres-Aguilar, M. *et al*., 2013).

This study revealed that patients with positive portosystemic shunt had significantly higher MELD scores when compared to those with negative shunt (P= 0.042), while no significant association was observed between portosystemic shunt and patients' age, gender, etiology of cirrhotic liver and CPS grade ($P \geq 0.05$). The results published in Spengler *et al* study contradicted the current one, as the found that portosystemic shunt was significantly associated with etiology of the of liver cirrhosis and age of the participants (P<0.05), while no significant relation observed between the shunt and the higher MELD scores (P= 0.07) (Spengler, E. K. *et al*., 2017). In the same regard, Silvia Nardelli and their colleagues reported that patients with positive portosystemic shunt and those with negative shunt were similar in age, gender, cause of cirrhosis, and CPS grade, but not MELD score, which was more impaired in patients with positive portosystemic shunt, with no significant association between them (P = 0.02) (Nardelli, S. *et al*., 2021). Similarly, Matsumoto *et al* study demonstrated that no significant association exist in Child-Pugh stage between patients with shunt and those without, also there was no significant relation between the shunt and the etiology of the disease (P>0.05) (Matsumoto, Y. *et al*., 2016).

Difference reported above can be related to the different sample size and study design, added to that, the causative agents lead to cirrhosis, represented by infection, alcohol, autoimmune hepatic diseases and the presence of other comorbid conditions.

Although the burden and underlying causes of chronic liver disease and cirrhosis vary worldwide, they are a major cause of morbidity and mortality. Regardless of the pattern and etiology, cirrhosis is characterized by severe scarring of the liver tissue with collagen deposition, architecture distortion and failed function, and is related to life-threatening complications as portal hypertension, ascites, variceal bleeding, hepatic encephalopathy, and cardiac (Asrani, S. K. *et al*., 2019). Outcome of cirrhotic patients are of great clinical importance. So, the above-mentioned scores for assessment of mortality and a specific etiology of chronic liver disease have been utilized (Lopez-Delgado, J. C. *et al*., 2016).

This study found that patients with portosystemic shunt compared to those with negative portosystemic shunt had significantly higher RV basil diameter, PASP, and PADP, and had significantly lower RV FAC% and TAPSE (P<0.05). Other echocardiographic parameters showed no significant difference. This is consistent with Karabulut *et al* study, who demonstrated that right ventricular diastolic dysfunction has higher rate among patients with chronic liver diseases, with the resultant hypertrophy and dilatation of the right heart chambers (Karabulut, A. *et al*., 2006). In Zhang *et al* study, different findings were observed. They reported that RV basal diameter and thickness were significantly higher in patients with cirrhosis. Parameters of RV systolic function (TAPSE, RV FAC%, s') were similar between the cirrhotic and non-cirrhotic groups (P>0.05). The PASP was significantly higher in patients with cirrhosis (Zhang, K. *et al*., 2019). Obviously, the portosystemic shunt is related to severity, as demonstrated in Talwalker *et al* study, in which a high proportion of shunts among patients with moderate and severe portopulmonary hypertension (71% and 87%, respectively), while in contrast; lower proportions were observed in mild portopulmonary hypertension and controls (33% and 25%, respectively P < 0.01) (Talwalkar, J. A. *et al*., 2011).

In the present study, there was a significant association between CPS grades and the cause of liver cirrhosis, as more than half of patients with alcoholic liver injury were in CPS grade C (P<0.05), while CPS grades were not significantly associated with patients' age and gender ($P \geq 0.05$). An agreement observed in Mesropyan *et al* study, in which both CPS grades and etiology of liver diseases were significantly related. They observed that cirrhotic liver diseases was significantly higher in patients with alcoholic liver diseases of CPS grade, but differed in that CPS grade was significantly related to the age of the participants. Furthermore, multiple comparisons in this study showed that mean MELD score was significantly higher in patients with CPS grade C compared to those with grade A and grade B. Further, patients with CPS grade B had significantly higher mean MELD scores compared to those with grade A (P<0.05). In the same concern, Mesropyan and colleagues reported that mean MELD score was significantly increased as the grade of GPS of the cirrhotic patients

Publisher: SARC Publisher

increased, as in GPS grade C was the highest and GPS B was higher than GPS grade A (P<0.05) (Mesropyan, N. *et al*., 2022).

All the above-mentioned studies demonstrated a high diagnostic performance of mapping parameters to discriminate between different cirrhosis classes. But the differences among them might be explained by the fact that for the calculation of clinical scores of liver disease severity different laboratory and clinical markers are used. On the one hand, it may decrease the specificity of these markers, as changes outside the liver and comorbidities, which are not primary related to liver disease, contribute to the final score. Moreover, it might be attributed to the fact that patients in the study sample were recruited from inpatient wards and patients who were attending the outpatient clinic reflecting that patients with more severe disease are more likely to seek medical attention and their sample size and the design of each study performed.

In the present work, comparison of echocardiographic parameters according to CPS grades revealed that RV basil diameter, PASP, and PADP were significantly increased with increasing severity of disease, while RV FAC% was significantly decreased with increasing severity of disease. Other parameters showed no significant difference between CPS grades. This was in agreement to the results of Nirmal *et al* study, in which they found that cardiac dysfunction was directly correlated with severity of liver cirrhosis according to CPS criteria, thereby suggesting that possible cardiac changes were due to cirrhosis (Nirmal, A. *et al*., 2021). The results of Balde *et al* study contradict the current one, they observed that 93.3% of patients with CPS Grade C had mild echocardiographic parameters changes, while 6.7% of the remaining with CPS Grade C had moderate PAH. Although this association between CPS and PAH was not significant (P>0.05) (Balde, J. *et al*., 2016), which was in accordance with the results of Abd-El-Aziz *et al* study, in which there was no significant difference in echocardiographic parameters among subgroups of CPS (Abd-El-Aziz, T. A. *et al*., 2010). In Zaki *et al* study, the RV basil diameter was significantly higher in groups of patients with CPS A, B, and C when compared with the normal group. On the other hand, the RVFS% was significantly lower in groups of patients with CPS A, B, and C.

TAPSE and T-E velocity failed to show significant difference in any of the study groups compared with the normal group (Zaki, E. R., & El Deen, N. M. B. 2017).

Dilated splanchnic vasculature is a hallmark of cardiac dysfunction in the cirrhotic population, which happens in the context of a circulatory failure. A hyperdynamic circulation compensates for the circulatory dysfunction in the early stages of cirrhosis. Subsequently, when portal hypertension and liver disease worsen, there is a gradual vasodilatation that lowers the effective arterial blood volume and triggers the sympathetic nervous system and the renin-angiotensin-aldosterone system (Agrawal, S. *et al*., 2019). The heart chambers may dilate because of these circulation changes, and functional cardiac alterations may start. Elevated norepinephrine levels lead to β-adrenergic receptor dysfunction (Nirmal, A. *et al*., 2021).

Correlations of MELD Score with ECHO Parameters

In the Pearson correlation analysis in this study, there was a positive, significant correlation between MELD score and RV basil diameter (r= 0.532, P= 0.001), PASP (r= 0.627, P= 0.001) and PADP (r= 0.683, P= 0.001) while there was inverse significant correlation with RV FAC% (r= - 0.705, P= 0.001) and TAPSE (r= - 0.572, P= 0.001).

In contrary, Zhan and other co-authors reported in their study that MELD score correlated non-significantly with the RV basal diameter, TAPSE, PASP, and RA active emptying fraction in patients with end-stage liver cirrhosis (Zhang, K. *et al*., 2019). Similarly, Kumar and other co-authors concluded that cirrhotic patients had impaired cardiac function, mainly present as cirrhotic cardiomyopathy and diastolic dysfunction, and the extent of dysfunction was correlated with the MELD score. Hence, MELD scoring system can be used to predict risk of occurrence of cardiac dysfunction in cirrhosis (Kumar, A. *et al*., 2022).

The relationship between the severity of liver disease and cirrhotic cardiac dysfunction is controversial. Although some studies have shown no direct relationship between the degree of liver dysfunction and extent of changes in cardiac function, others reported the most pronounced cardiac dysfunction in patients with higher MELD score, The MELD scoring system was designed to provide a more accurate assessment of liver disease and takes into account renal insufficiency, the etiology of cirrhosis (Li, X. *et al*., 2014).

Publisher: SARC Publisher

Clinical Characteristics

This study reported that the most common etiology for cirrhosis was nonalcoholic steatohepatitis (24%), followed by alcoholic liver injury (22%), hepatitis B virus (16%), and autoimmune (10%). Concerning Child-Pugh score (CPS), 20% of patients had CPS grade A, 60% had grade B, and 20% had grade C. Mean MELD score was 14.88 ± 5.20 with a range of 8 to 29), and levels of MELD score were as follows: ≤ 10 in 14% of patients, 11 – 20 in 76%, and > 20 in 10% of the enrolled patients.

In Behera *et al* study, the most common cause of cirrhosis was alcohol which was responsible for cirrhosis in 41.4% of patients with hypertension. It was followed by cryptogenic and hepatitis cirrhosis (15.6 and 13.28% respectively). NASH-related cirrhosis of the liver was seen in 7.82% of patients. About 5.8% of patients belonged to Child class A, 443.7 % to Child class B, and 56.2% to Child class C (Behera, S. K. *et al*., 2023). The etiology of cirrhosis in Krishnan *et al* study was hepatitis C virus (HCV) in 21%, hepatitis B in 15.1%, alcohol abuse in 29%, HCV and alcohol abuse in 1.1%, nonalcoholic steatohepatitis in 2.2% and autoimmune hepatitis in 3.8% of patients (Krishnan, A. *et al*., 2022). Concerning CPS in Nirmal *et al* study, more than half of participants had grade I score (56%), grade II observed in 63.6% and 7.3% of participants had grade III (Nirmal, A. *et al*., 2021).

CONCLUSION

- ✓ In Portopulmonary shunt and portopulmonary hypertension are significantly associated with liver cirrhosis with the presence of portal hypertension.
- ✓ Patients with cirrhosis have significant cardiac dysfunction that is evident on echocardiography.

REFERENCES

1. Sharma A, Nagalli S. “Chronic liver disease.” StatPearls [Internet]: StatPearls Publishing. (2023).
2. Scaglione, S., Kliethermes, S., Cao, G., Shoham, D., Durazo, R., Luke, A., & Volk, M. L. "The epidemiology of cirrhosis in the United States: a population-based study." *Journal of clinical gastroenterology* 49.8 (2015): 690-696.
3. Çelik, Z. "Çanakkale Onsekiz Mart Üniversitesi Tıp Fakültesi hastanesi'ne başvuran karaciğer sirozlu hastaların etiyolojik, demografik özellikleri ve laboratuar parametrelerinin değerlendirilmesi." (2022).
4. Zhai, M., Long, J., Liu, S., Liu, C., Li, L., Yang, L., & Shu, B. "The burden of liver cirrhosis and underlying etiologies: results from the global burden of disease study 2017." *Aging (Albany NY)* 13.1 (2021): 279.
5. Goodman, Z. D. "Liver Biopsy Diagnosis of Cirrhosis." *Diagnostic Methods for Cirrhosis and Portal Hypertension*. Cham: Springer International Publishing, 2018. 17-31.
6. Akram, U. I. M., Priya, B., Rumela, U. D. “Cirrhosis and its Complication: other Clinical Complications Except Aclf and Critical Illness.” . *Archives of Clinical and Biomedical Research*. 7 2023: 382-6.
7. Ginès, P., Krag, A., Abraldes, J. G., Solà, E., Fabrellas, N., & Kamath, P. S. "Liver cirrhosis." *The Lancet* 398.10308 (2021): 1359-1376.
8. Hayward, K. L., & Weersink, R. A. "Improving medication-related outcomes in chronic liver disease." *Hepatology communications* 4.11 (2020): 1562-1577.
9. Alhaddad, O., Elsabaawy, M., Eissa, M., Abdelhafeez, R., Rewisha, E., & Waked, I. "Expansively splenic reflective foci: A case-based résumé." *Arab Journal of Gastroenterology* 26.3 (2025): 311-313.
10. Savale, L., O’Callaghan, D. S., Magnier, R., Le Pavec, J., Herve, P., Jais, X., & Sitbon, O. "Current management approaches to portopulmonary hypertension." *International Journal of Clinical Practice* 65 (2011): 11-18.
11. Raevens, S., Geerts, A., Devisscher, L., Van Vlierberghe, H., Van Steenkiste, C., & Colle, I. "Recent advances in the approach to hepatopulmonary syndrome and portopulmonary hypertension." *Acta Gastro-Enterologica Belgica* 84.1 (2021): 95-99.
12. Galiè, N., Humbert, M., Vachiery, J. L., Gibbs, S., Lang, I., Torbicki, A., & Hoeper, M. "2015 ESC/ERS guidelines for the diagnosis and treatment of pulmonary hypertension: the joint task force for the diagnosis and treatment of pulmonary hypertension of the European Society of Cardiology (ESC) and the European Respiratory Society (ERS): endorsed by: Association for European Paediatric and Congenital Cardiology (AEPC), International Society for Heart and Lung Transplantation (ISHLT)." *European heart journal* 37.1 (2016): 67-119.
13. Tsoris, A., & Marlar, C. A. "Use of the Child Pugh score in liver disease." (2019).

Publisher: SARC Publisher

14. Emenena, I., Emenena, B., Kweki, A. G., Aiwuyo, H. O., Osarenkhoe, J. O., Iloeje, U. N., & Akinti, O. M. "Model for end stage liver disease (MELD) score: a tool for prognosis and prediction of mortality in patients with decompensated liver cirrhosis." *Cureus* 15.5 (2023).
15. Spengler, E. K., Hunsicker, L. G., Zarei, S., Zimmerman, M. B., & Voigt, M. D. "Transjugular intrahepatic portosystemic shunt does not independently increase risk of death in high model for end stage liver disease patients." *Hepatology communications* 1.5 (2017): 460-468.
16. Nardelli, S., Riggio, O., Turco, L., Gioia, S., Puzzono, M., Bianchini, M., & Schepis, F. "Relevance of spontaneous portosystemic shunts detected with CT in patients with cirrhosis." *Radiology* 299.1 (2021): 133-140.
17. Simón-Talero, M., Roccarina, D., Martínez, J., Lampichler, K., Baiges, A., Low, G., & Botella, E. R. "Association between portosystemic shunts and increased complications and mortality in patients with cirrhosis." *Gastroenterology* 154.6 (2018): 1694-1705.
18. Praktiknjo, M., Simón-Talero, M., Römer, J., Roccarina, D., Martínez, J., Lampichler, K., & Stangl, F. "Total area of spontaneous portosystemic shunts independently predicts hepatic encephalopathy and mortality in liver cirrhosis." *Journal of hepatology* 72.6 (2020): 1140-1150.
19. Porres-Aguilar, M., Gallegos-Orozco, J. F., Garcia, H., Aguirre, J., Macias-Rodriguez, R. U., & Torre-Delgadillo, A. "Pulmonary vascular complications in portal hypertension and liver disease: a concise review." *Revista de gastroenterologia de Mexico* 78.1 (2013): 35-44.
20. Matsumoto, Y., Hidaka, H., Matsunaga, K., Kubota, K., Yamane, K., Inoue, T., & Koizumi, W. "Three-dimensional computed tomography of portopulmonary venous anastomoses in patients with esophageal varices before treatment." *Hepatology Research* 46.6 (2016): 559-564.
21. Asrani, S. K., Devarbhavi, H., Eaton, J., & Kamath, P. S. "Burden of liver diseases in the world." *Journal of hepatology* 70.1 (2019): 151-171.
22. Lopez-Delgado, J. C., Ballus, J., Esteve, F., Betancur-Zambrano, N. L., Corral-Velez, V., Mañez, R., & Javierre, C. "Outcomes of abdominal surgery in patients with liver cirrhosis." *World journal of gastroenterology* 22.9 (2016): 2657.
23. Karabulut, A., Iltumur, K., Yalcin, K., & Toprak, N. "Hepatopulmonary syndrome and right ventricular diastolic functions: an echocardiographic examination." *Echocardiography: A Journal of Cardiovascular Ultrasound and Allied Techniques* 23.4 (2006): 271-278.
24. Zhang, K., Braun, A., von Koeckritz, F., Schmuck, R. B., Teegen, E. M., Cuspidi, C., & Tadic, M. "Right heart remodeling in patients with end-stage alcoholic liver cirrhosis: speckle tracking point of view." *Journal of Clinical Medicine* 8.9 (2019): 1285.
25. Talwalkar, J. A., Swanson, K. L., Krowka, M. J., Andrews, J. C., & Kamath, P. S. "Prevalence of spontaneous portosystemic shunts in patients with portopulmonary hypertension and effect on treatment." *Gastroenterology* 141.5 (2011): 1673-1679.
26. Mesropyan, N., Kupczyk, P. A., Dold, L., Praktiknjo, M., Chang, J., Isaak, A., & Luetkens, J. A. "Assessment of liver cirrhosis severity with extracellular volume fraction MRI." *Scientific Reports* 12.1 (2022): 9422.
27. Nirmal, A., Agrawal, G., Kumar, S., Acharya, S., Dafal, A., & Bhushan, D. "Echocardiographic Assessment of Cardiac Function in Liver Cirrhosis: A Cross-sectional Study." *Journal of Clinical & Diagnostic Research* 15.5 (2021).
28. Balde, J., Rao, N. K., Ballala, K., Samanth, J., Shetty, K. R., Patil, N., & Varghese, G. "Echocardiographic abnormalities in cirrhosis & their correlation with severity of cirrhosis using Child-Pugh score among patients in a tertiary care hospital." *Indian Journal of Medical Research* 144.6 (2016): 935-937.
29. Abd-El-Aziz, T. A., Abdou, M., Fathy, A., & Wafaie, M. "Evaluation of cardiac function in patients with liver cirrhosis." *Internal Medicine* 49.23 (2010): 2547-2552.
30. Zaki, E. R., & El Deen, N. M. B. "Relation of right ventricular dysfunction to the severity of hepatic cirrhosis by different echo modalities using speckle-tracking echocardiography." *Al-Azhar Assiut Medical Journal* 15.1 (2017): 7-14.
31. Agrawal, S., Kumar, S., Gabhane, V., Acharya, S., & Wanjari, A. "Electrocardiography and Echocardiography Correlation in Patients of Left Ventricular

Publisher: SARC Publisher

Hypertrophy." *Journal of Clinical & Diagnostic Research* 13.12 (2019).

32. Kumar, A., Bansal, T., Bery, A., & Sood, A. "Prevalence of cardiac dysfunction in cirrhosis and its relation with Meld score." *Indian Journal of Clinical Medicine* 12.1-2 (2022): 6-11.
33. Li, X., Yu, S., Li, L., Han, D., Dai, S., & Gao, Y. "Cirrhosis-related changes in left ventricular function and correlation with the model for end-stage liver disease score." *International Journal of Clinical and Experimental Medicine* 7.12 (2014): 5751.
34. Behera, S. K., Behera, P., Behera, J. R., & Behera, G. "Study of Cardiac Dysfunction in Portal Hypertension: A Single-Center Experience From Eastern India." *Cureus* 15.12 (2023).
35. Krishnan, A., Woreta, T. A., Vaidya, D., Liu, Y., Hamilton, J. P., Hong, K., & Ma, M. "MELD or MELD-Na as a predictive model for mortality following transjugular intrahepatic portosystemic shunt placement." *Journal of clinical and translational hepatology* 11.1 (2022): 38.

Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Abdulmahdi, N. E., Jadioo, S. A. & Mohammed, S. Q. "Echocardiographic Assessment of Right Ventricular Function and Hemodynamic Changes in Patients with Chronic Liver Disease: A Cross Sectional Study in Iraq." *Sarcouncil Journal of Medicine and Surgery* 5.7 (2026): pp 1-10.

Publisher: SARC Publisher