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Tissue doppler imaging assessment for left ventricular systolic and diastolic function in patients with different grades of liver cirrhosis

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***Abstract*---**Background: Chronic cardiac disease known as cirrhotic cardiomyopathy dysfunction in cirrhotic patients characterised by altered diastolic relaxation and/or impaired contractile reactivity to stress in the absence of other recognised cardiac diseases.. Aim and objectives: The purpose of the study was to evaluate tissue Doppler the left ventricle's systolic and diastolic characteristics performance in patients with liver cirrhosis. Subjects and methods: Al-Hussien Hospital, Al-Azhar University, did this cross-sectional case-control study, The study included 75 patients with liver cirrhosis and 25 healthy participants. There were four groups created from the study populations: 25 healthy volunteers make up the control group. Patients in Group 1 have Child A liver cirrhosis, while those in Group 2 have Child B cirrhosis. Group 2., Group 3, which consists of patients with Child C liver cirrhosis. Results: A statistically significant higher mean value in patients group compared to control group according to MPI PWD, MPI TDI, MV E/É ratio, DT (ms) and IVRT (ms) with p-value ($p<0.05$ significant); The average values of the EF by Simpson, Average S wave, and EF by M mode all differed significantly. when comparing the sick group to the control group., and MV E/A ratio was seen. A p-value of 0.05 was used to determine this difference. Conclusion: Compared to the control group, patients with

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liver cirrhosis exhibited significantly worse left ventricular systolic and diastolic functioning, and the decompensated patients showed a greater difference than the compensated patients.

***Keywords*---**Cardiomyopathy, Cirrhotic, Electrophysiological abnormalities.

Introduction

Cirrhotic cardiomyopathy, also known as cirrhotic heart disease, is defined by three characteristics: diastolic dysfunction, lowered stress-induced contractile reactivity and electrophysiological anomalies with a prolonged QT interval . Left ventricular diastolic dysfunction (LVDD), one of the three components that cause cirrhotic cardiomyopathy, is a recognised early indicator of cardiac dysfunction in LC patients. 2 In contrast to compensated LC, decompensated LC has a greater rate of LVDD. 3

However, LVDD cannot be detected by an EKG or Child-Pugh scores (ECG).
In fact, the only way to detect LVDD is via echocardiography.[4]

Exercise, pharmacological stress, and volume challenge all limit the increase in cardiac output that is a sign of systolic dysfunction in cirrhotic individuals. In addition, patients with cirrhosis suffer from severe chronotropic incompetence, which is characterised by a markedly diminished cardiac response to exercise as a result of autonomic dysfunction and a decreased sensitivity to sympathetic stimulation. 6 Thickened left ventricular wall, fibrosis, oedema in the subendocardium, and altered collagen structure have all been linked to diastolic dysfunction in cirrhotic individuals, which eventually affects relaxation. 7

The goal of the study was to evaluate the left ventricular systolic and diastolic function of patients with liver cirrhosis using tissue Doppler measures.

Patients and Methods

At Al-Hussien Hospital, Al-Azhar University, a cross-sectional case control research was done. 75 patients with liver cirrhosis participated in the trial, along with 25 healthy volunteers who were matched with the patients' ages and sexes. There were four groups created from the study populations: 25 patients with Child A hepatic cirrhosis make up Group 1. 25 patients with Child B hepatic cirrhosis made up Group 2. 25 individuals with Child C hepatic cirrhosis are in **group 3**. There are 25 healthy volunteers in the control group.

Inclusion criteria: any adult suffering from liver cirrhosis who is older than 18 was included in the trial.

Exclusion criteria: Patients with inherited or acquired heart disorders, those who have diabetes or high blood pressure, those with anaemia or pregnancy who have hyperdynamic circulation, Patients receiving medications that influence heart functioning, such as -blockers, patients with renal or pulmonary disorders,

patients with atrial fibrillation, bundle branch blockers, ischemic heart disease and post cardiac surgery.

The selected patients subjected to the following:
1- Clear written consent.
2- Full clinical assessment including**:** Full history tacking (including name, age, sex, smoking habit, alcohol, education level, residential area (urban/rural), occupation and drug history). Clinical examination of cirrhotic liver and manifestation of hepatic decompensation including: ascites, lower limb edema and Jaundice. Clinical examination of Cardiomyopathy: Vital Signs: (Blood Pressure - Pulse-Heart Rate), generalized oedema and dyspnea.

3-Routine laboratory investigations including: liver function testing, complete blood count (CBC), erythrocytic sedimentation rate (ESR), and renal function tests, such as blood urea and blood creatinine: serum albumin levels, transaminase levels (including ALT and AST), prothrombin time (PT), and concentration, bilirubin level (Total and direct) and alkaline phosphatase (ALP) Regarding the blood glucose levels after eating and after fasting

4-Ultrasonographic evaluation: The following parameters involved in ultrasonographic evaluation: Liver size, liver texture, splenic size and portal vein diameter.

5- Electrocardiograme (ECG)

6-Echocardiography (ECHO)
Participants performed a comprehensive transthoracic echocardiographic standard echocardiography, tissue collection, a left lateral decubitus posture for assessment.

We adhered to the guidelines for Doppler echocardiography provided by the American Society of Echocardiography. function of the left ventricle during systole.

Evaluation of left ventricular diastolic performance To examine the diastolic function of the left ventricle in the apical four-chamber view, a Doppler beam oriented in the flow direction and a sample volume of 1-2 mm positioned between the mitral leaflets were utilised.

Analytical statistics

Utilizing the statistical programme for social sciences, version 23.0, recorded data was examined (SPSS Inc., Chicago, Illinois, USA). In terms of the quantitative data, mean, standard deviation, and ranges were reported. Qualitative variables were also shown as percentages and numbers. Using the Shapiro-Wilk Test and Kolmogorov-Smirnov tests, data were examined for normality.

Results

Table (1)
Comparison between patients and controls according to demographic data

Demographic data	Patients Group (n=75)	Control Group (n=25)	Test value	p-value
Age "years" Range Mean±SD	 42-74 56.62±10.42	 42-72 55.17±9.87	*t*=-0.610	0.543
Sex Male Female	 45 (60%) 30 (40%)	 16 (64%) 9 (36%)	x^2=0.014	0.906

Using: t=Independent Sample t-test; x^2: Chi-square test;
p-value >0.05 NS

According to the demographic data in this table, there are no statistically significant differences between the groups (p>0.05 non-significant).

Table (2)
Comparison between the study sub-groups regarding laboratory data.

Laboratory data	Sub-Group I (n=25)	Sub-Group II (n=25)	Sub-Group III (n=25)	Control Group (n=25)	Test value	p-value
AST (µl/l)	51.34±17.69*	24.21±4.42†	15.35±2.79†	31.07±6.63‡	*F*=61.053	<0.001**
ALT (µl/l)	81.73±30.58*	101.86±40.73†	85.30±17.11*	28.33±6.73‡	*H*=34.66	<0.001**
PT (s)	15.01±0.91*	17.58±1.16†	21.28±1.89‡	12.28±0.65§	*F*=23.7.9	<0.001**
Creatinine (mg/dl)	0.88±0.27*	1.02±0.23†	1.05±0.19†	0.92±0.20*	*F*=3.215	0.026*
Albumin (g/dl)	3.89±0.31*	3.17±0.20†	2.20±0.33†	4.11±0.29§	*F*=225.24	<0.001**
Hb (g/dl)	13.68±0.97*	12.17±0.78†	12.22±0.84†	13.83±1.18*	*F*=22.355	<0.001**
Bilirubin (mg/dl)	1.73±0.24*	2.52±0.36†	6.94±2.93‡	0.88±0.17§	*H*=82.79	<0.001**
RBS (mg/dl)	130.69±12.67*	117.77±16.50†	112.51±18.82†	116.23±14.62†	*F*=6.249	<0.001**

One way Analysis of Variance test was performed & multiple comparisons between groups through Post Hoc test: Tukey's test

Kruskal–Wallis was performed & multiple comparison between groups through Mann-Whitney test

Means that do not share same symbol are significantly different at p-value (p<0.05).
**p-value <0.05 S; **p-value <0.001 HS*

This table shows statistically significant difference between sub-groups according to laboratory data about AST (µl/l), ALT (µl/l), PT (s), Creatinine (mg/dl), Albumin (g/dl), Hb (g/dl), Bilirubin (mg/dl) and RBS (mg/dl) with p-value (p<0.05 significant).

Table (3)
Comparison between patients and controls according to echocardiographic findings

Echocardiographic findings	Patients Group (n=75)	Control Group (n=25)	Test value	p-value
MPI PWD	0.44±0.04	0.41±0.02	*t*=3.594	<0.001**
MPI TDI	0.52±0.07	0.48±0.03	*t*=2.075	0.041*
EF by Simpson	62.61±7.45	66.48±4.28	*t*=2.460	0.016*
Average S wave	11.55±2.20	12.85±1.30	*t*=2.791	0.006*
EF By M Mode	62.66±7.67	67.02±4.00	*t*=2.715	0.008*
MV E/É ratio	15.27±3.12	5.42±1.05	*t*=15.451	<0.001**
MV E/A ratio	0.77±0.20	1.38±0.12	*U*=14.382	<0.001**
DT (ms)	239.50±19.28	197.04±12.55	*t*=10.290	<0.001**
IVRT (ms)	114.31±13.79	76.78±5.92	*t*=13.174	<0.001**

Using: t=Independent Sample t-test; U=Mann-Whitney test
*p-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS*

This table shows statistically significant higher mean value in patients group compared to control group according to MPI PWD, MPI TDI, MV E/É ratio, DT (ms) and IVRT (ms) with p-value (p<0.05 significant); while EF by Simpson, Average S wave, EF By M Mode and MV E/A ratio was significant decrease mean in patients group compared to control group with p-value (p<0.05 significant).

Table (4)
Comparison between the study sub-groups according to echocardiographic findings.

Echocardiographic findings	Sub-Group I (n=25)	Sub-Group II (n=25)	Sub-Group III (n=25)	Control Group (n=25)	Test value	p-value
MPI PWD	0.42±0.02*	0.44±0.04†	0.45±0.06†	0.41±0.02*	*F*=5.556	<0.001**
MPI TDI	0.47±0.03*	0.51±0.07†	0.54±0.10†	0.47±0.03*	*F*=6.936	<0.001**
EF Simpson	65.21±4.69*	62.76±6.83*	59.83±9.21†	66.47±4.28*	*F*=4.995	0.003*
Average S wave	12.58±1.37*	11.81±2.20*	10.25±2.27†	12.85±1.29*	*F*=10.08	<0.001**
EF M mode	65.59±3.99*	62.79±7.12*	59.60±9.76†	67.02±3.99*	*F*=6.041	<0.001**
MV E/E ′	13.60±4.54*	15.71±1.88†	16.48±1.03†	5.42±1.03‡	*F*=97.85	<0.001**
MV E/A	0.90±0.29*	0.72±0.10†	0.66±0.08†	1.37±0.12‡	*H*=90.0	<0.001**
DT (ms)	230.09±27.63*	243.30±11.64†	244.80±10.64†	197.03±12.54‡	*F*=42.11	<0.001**
IVRT (ms)	103.49±17.60*	117.87±6.91†	121.54±6.14†	76.77±5.92‡	*F*=95.94	<0.001**

One way Analysis of Variance test was performed & multiple comparisons between groups through Post Hoc test: Tukey's test

Kruskal–Wallis was performed & multiple comparison between groups through Mann-Whitney test

Means that do not share same symbol are significantly different at p-value (p<0.05).
**p-value <0.05 S; **p-value <0.001 HS*

This table shows statistically significant difference between sub-groups according to echocardiographic findings about MPI PWD, MPI TDI, EF Simpson, Average S wave, EF M mode, MV E/E ′, MV E/A, DT (ms) and IVRT (ms) with p-value (p<0.05 significant).

Table (5)

Comparison of patients who received compensation against those who did not, as revealed by echocardiographic findings

Echocardiographic findings	Compensated (n=75)	Decompensated (n=25)	Test value	p-value
MPI PWD	0.42±0.02	0.45±0.05	*t*=4.296	<0.001**
MPI TDI	0.48±0.03	0.53±0.09	*t*=4.195	<0.001**
EF by Simpson	65.21±4.72	61.30±8.21	*t*=2.933	0.004*
Average S wave	12.58±1.38	11.04±2.37	*t*=3.975	<0.001**
EF by M mode	65.59±3.99	61.20±8.63	*t*=3.456	<0.001**
MV E/É ratio	13.60±4.54	16.10±1.56	*t*=2.693	0.008*
MV E/A ratio	0.91±0.29	0.70±0.10	*U*=3.541	<0.001**
DT (ms)	230.39±27.63	244.06±11.04	*t*=2.404	0.018*
IVRT (ms)	103.50±17.60	119.72±6.74	*t*=4.487	<0.001**

Using: t=Independent Sample t-test; U=Mann-Whitney test
*p-value >0.05 NS; *p-value <0.05 S; **p-value <0.001 HS*

This table shows statistically significant higher mean value in compensated group compared to decompensated group according to EF by Simpson, Average S wave, EF by M mode and MV E/A ratio with p-value (p<0.05 significant); while MPI PWD, MPI TDI, MV E/É ratio, DT (ms) and IVRT (ms) was significant decrease mean in compensated group compared to decompensated group with p-value (p<0.05 significant).

Table (6)

LV systolic dysfunction distribution among patients group

LV systolic dysfunction	No.	%
Yes	7	9.3%
No	68	90.7%
Total	75	100%

This table shows that there were LV systolic dysfunction was 7 patients (9.3%).

Table (7)

LV diastolic dysfunction distribution among patients group

Sub-Groups	Total	LV diastolic dysfunction	
		No.	%
Child A	25	8	32.0%
Child B	25	16	64.0%
Child C	25	25	100.0%
Total	75	49	65.3%

This table shows that there were LV diastolic dysfunction was 49 patients (65.3%), out of them 8 patients (32%) in Child A; 16 patients (64%) in Child B and 25 patients (100%) in Child C.

Discussion

Al-Hussien Hospital, part of Al-Azhar University, served as the site of this cross-sectional case-control study. 75 patients with liver cirrhosis participated in the trial, along with 25 healthy volunteers who were matched with the patients' ages and sexes.

There were four groups created from the study populations: Group 1 consists of 25 patients with Child A hepatic cirrhosis. Group 2 consists of 25 patients with Child B hepatic cirrhosis. 25 individuals with Child C hepatic cirrhosis are in group 3. There are 25 healthy volunteers in the control group. According to demographic data, The present investigation showed that there was no statistically significant difference between groups. (p>0.05 non-significant). The current study can be supported by **Ashmawy et al., [8]** sought to assess the left ventricular function in cirrhotic liver patients utilising tissue Doppler imaging. 30 of the 90 people with liver cirrhosis had Child A, 30 had Child B, and 30 had Child C cirrhosis., participated in this cross-sectional case-control study. In addition, 45 healthy volunteers served as the study's control group. According to demographic information, According to the study, Between the groups, there was no statistically significant difference. AST (l/l) levels from the study's subgroups' laboratory data were compared, and it was discovered that there were statistically significant differences between them. ALT (µl/l), PT (s), Creatinine (mg/dl), Albumin (g/dl), Hb (g/dl), Bilirubin (mg/dl) and RBS (mg/dl) with p-value (p<0.05 significant).In agreement with the current study **Ashmawy et al., [8]** revealed that there was a statistically significant difference in the kid grade subgroups. A, B, and C as regard laboratory data including AST, ALT, PT, Creatinine, Albumin, Hb, Bilirubin and RBS.The same results were reported by **Hassan & Elden, [9]** who demonstrated that the differences between the subgroups were statistically significant

with child grades A, B, and C as regard laboratory data including AST, ALT, Albumin and Bilirubin.In the current study Comparison between patients and controls according to echocardiographic findings According to MPI PWD, MPI TDI, and other metrics, there was a statistically significant greater mean value in the patient group compared to the control group.MV E/É ratio, DT (ms) and IVRT (ms) with p-value (p<0.05 significant); A significant drop in mean values for EF by Simpson, The patient group's average S wave, EF by M mode, and MV E/A ratio were noted contrasted with the control group, with a p-value of 0.05. In Harmony with the current study **Ashmawy et al., [8]** a statistically significant difference was reported higher mean value in patients group compared to control group according to MPI PWD, MPI TDI, MV E/É ratio, DT (ms) and IVRT (ms) with p-value (significant at 0.05); The mean EF by Simpson, Average S wave, EF by M mode, and MV E/A ratio between the sick group and the control group could be clearly distinguished from one another (p0.05).

Therefore, compared to the control group, patients with liver cirrhosis had considerably worse LV systolic and diastolic function. Also, **Hassan & Elden, [9]** reported that by conventional echocardiography, even if the EF via M-mode increased significantly (P=0.004) in cirrhotic group versus control group, there was insignificantly increased LV end-diastolic dimensions, LV end-diastolic

volume, and EF by 2D. Regarding diastolic function by conventional parameters, there were statistically higher significant values of E, A, and deceleration time in cirrhotic group versus normal one. There was a significant lower TDI systolic velocity and LV global longitudinal strain (GLS) % for assessment of LV systolic function beside LV diastolic dysfunction assessed by TDI in the cirrhotic group versus control.

Furthermore, Comparison between the study sub-groups according to echocardiographic findings in According to echocardiographic data on MPI PWD, Average S wave, MPI TDI, EF Simpson, and EF M mode, the current study demonstrated that there were statistically significant differences between sub-groups. , MV E/E ′, MV E/A, DT (ms) and IVRT (ms) with p-value ($p<0.05$ significant).This comes in agreement with **Ashmawy et al., [9]** who disclosed that the Child score for the severity of liver disease increased as a result of these LV dysfunctions. Because the results of the MPI PWD, MPI TDI, EF Simpson, Average S wave, and EF M mode echocardiographic subgroups varied statistically significantly from one another, MV E/E ′, MV E/A, DT (ms) and IVRT (ms).In addition, **Hassan & Elden, [9]** reported that all three groups had normal LV dimensions according to traditional echo settings. both the left ventricle's internal diastole and its internal systole measurements but increased (especially LV end-diastolic dimension and EF by M-mode) in class C (group III), indicating hyperdynamic function especially in group III, and by TDI, there was an increase in Sa in group III but lowered systolic function in STE.

Also, the study by **Rani et al., [10]** reported that Echocardiographic alterations were statistically significant ($p <0.05$) in cirrhotic patients related with Child-Pugh scoring based disease severity.

Based on the Child-Pugh classification criteria, groups of cirrhotic patients were separated into groups that receive compensation (Child-Pugh class A) those who don't, too (Child-Pugh class B and C). 11 According to EF by Simpson's Average S wave, the current investigation found that the mean value in the compensated group was statistically significantly greater than that in the decompensated group, EF by M mode and MV E/A ratio with p-value ($p<0.05$ significant); while MPI PWD, MPI TDI, MV E/É ratio, DT (ms) and IVRT (ms) was significant decrease mean in compensated group compared to decompensated group with p-value ($p<0.05$ significant).The current study showed that there were LV systolic dysfunction was 7 patients (9.3%). Also, we found that there were LV diastolic dysfunction was 49 patients (65.3%), out of them 8 patients (32%) in Child A; 16 patients (64%) in Child B and 25 patients (100%) in Child C. This indicates that as liver cirrhosis severity increases the prevalence of were LV diastolic dysfunction, means a positive correlation exist.

However, **Bhuin & Mohanty, [12]** reported that the prevalence cardiac dysfunction in nonalcoholic cirrhosis were 37 patients (52.9%) had systolic dysfunction, while 57 patients had diastolic dysfunction (81.4 percent). Our findings were supported by **Hassan & Elden, [9]** who shown a link between LV systolic failure and the severity of liver cirrhosis.

Conclusion

Standard Doppler echocardiography can detect right and left ventricle diastolic failure, while tissue Doppler is more capable of identifying diastolic dysfunction. and provides a more accurate assessment of filling dynamics. Compared to the control group, patients with liver cirrhosis exhibited significantly worse left ventricular systolic and diastolic performance., and this difference was more prominent in decompensated patients than in compensated patients.

References

Ashmawy MM, Younis HA, Elbaset MA, Rahman H, Ashmawy AM, Shawky ME, Et al. Evaluation of cardiac function in patients with liver cirrhosis using tissue Doppler study. The Egyptian Journal of Internal Medicine, 2018; 30(3), 115-120.

Bernardi M and Caraceni P. Pathogenesisof ascites and hepatorenal syndrome: alteredhaemodynamics and neurohumoral systems. In:Gerbes, A, Beuers, U, Jüngst, D, Pape, G, Sackmann, M. and Sauerbruch, T. (eds), FalkSymposium 117. Hepatology 2000. Symposium inHonour of Gustav Paumgartner, Munich, 6–8 May2000. Dordrecht: Kluwer Academic Publishers, (2001); pp.185–203.

Bhuin S, Mohanty R. Evaluation and correlation of cardiovascular dysfunction in nonalcoholic cirrhotic patients with its severity. JOURNAL OF EVOLUTION OF MEDICAL AND DENTAL SCIENCES-JEMDS, 2017; 6(73), 5200-5204.

Carvalheiro F, Rodrigues C, Adrego T, Viana J, Vieira H, Seco C, et al. Diastolic dysfunction in liver cirrhosis: prognostic predictor in liver transplantation? Transplant Proc. 2016;48:128–131.

Falletta C, Filì D, Nugara C, Di Gesaro G, Minà C, Baravoglia CM, et al. Diastolic dysfunction diagnosed by tissue Doppler imaging in cirrhotic patients: prevalence and its possible relationship with clinical outcome. Eur J Intern Med. 2015;26:830–834.

Hassan AA, Elden NB. Assessment of left ventricular functions and its correlation to the severity of liver cirrhosis caused by hepatitis C virus by different echocardiography modalities (two-dimensional speckle-tracking echocardiography study). Al-Azhar Assiut Medical Journal, 2019; 17(2), 154.

Huang CH, Wu LS, Jeng WJ, Cheng YF, Ko YS, Sheen IS, et al. In HCV-related liver cirrhosis, local pulse wave velocity increases and in decompensated patients correlates with poorer survival. Plos one, 2019; 14(3), e0212770.

Pozzi M, Carugo S, Boari G, Pecci V, De Ceglia S, Maggiolini S, et al. Evidence offunctional and structural cardiac abnormalities in cirrhotic patients with andwithout ascites. Hepatology 1997;26:1131-7

Rani K, Zaman B, Bai K. Echocardiographic Alterations in Liver Cirrhosis. Drug Resistant TB and Bone Marrow Stem Cells, 2021; 32(3), 172-176.

Ruiz-del-Árbol L, Serradilla R. Cirrhotic cardiomyopathy. World J Gastroenterol. 2015; 21: 11502–11521.

Suryasa, I. W., Rodríguez-Gámez, M., & Koldoris, T. (2021). The COVID-19 pandemic. *International Journal of Health Sciences*, *5*(2), vi-ix. https://doi.org/10.53730/ijhs.v5n2.2937

Wiese S, Hove JD, Bendtsen F, Møller S. Cirrhotic cardiomyopathy: pathogenesis and clinical relevance. Nat Rev GastroenterolHepatol. 2014;11:177–186.

Wong F, Girgrah N, Graba J, Allidina Y, Liu P, Blendis L. The cardiac response to ex-ercise in cirrhosis. Gut 2001;49:268-75.