ORIGINAL RESEARCH PAPER

Medicine

KEY WORDS: cirrhotic cardiomyopathy, Chronic liver disease, Child Turcotte Pugh Score

ECHOCARDIOGRAPHIC EVALUATION IN PATIENTS WITH CHRONIC HEPATIC PARENCHYMAL DISEASE: A HOSPITAL BASED STUDY

Dr. Ajay Kumar Jha Senior Consultant, Department of General Medicine, Tata Main Hospital, Jamshedpur.

Dr. Sollety Sairam DNB, Department of General Medicine, Tata Main Hospital, Jamshedpur.

Dr. Zaid Mohammed Nafe Senior Registrar, Department of Gastroenterology, Tata Main Hospital, Jamshedpur.

Dr. Sunil Kumar Senior Registrar, Department of General Medicine, Tata Main Hospital, Jamshedpur.

ABSTRACT

Background: The term "cirrhotic cardiomyopathy" was coined to describe impaired contractile responsiveness to stress, diastolic dysfunction, and electrophysiological abnormalities in the absence of known cardiac disease. It has been estimated that as many as 50 % of patients undergoing liver transplantation developed some signs of cardiac dysfunction and about 7–21 % of patients died from heart failure in the post liver transplantation period. **Material And Methods:** A Prospective observational study, conducted at Department of Medicine, Tata Main Hospital, in Jamshedpur of Jharkhand State from Jan 2019- April 2020 on 60 patients of CLD. **Results:** Among 60 patients studied, age groups of 50-59 years have had the greatest number of CLD patients' i.e.,24 (40%) and Males affected more with chronic liver disease i.e., 51 (58%). Most common clinical signs found in our study was ascites i.e., 40 (66.67%) followed by icterus i.e., 37 (61.67%) and majority of the cases were alcohol related CLD i.e., 32 (53.33%) followed by idiopathic CLD i.e., 12 (20.00%). As far as Child Turcotte Pugh score was concerned most patient came under class B i.e., 33 (55.00%) followed by class A i.e., 16 (26.67%). Among 60 cases of CLD, diastolic dysfunction was present in 33 (55 %) CLD patients. Of these, grade I, II & III were seen in 18(30%), 13 (21.67 %) and 02 (3.33%). Patients with End diastolic volume below 90 was 32 (53.33%), patients with End systolic volume was between 38 and 46 (76.67%) and patients with ejection fraction above 60% ejection fraction was 36 (60.00%). Child Turcotte Pugh score (CTP) Class C had most conduction disturbances (QTc interval) above 440 msec i.e., 10 (90.90%) followed by CTP Class B i.e., 22 (66.67%) respectively. **Conclusion:** In patients with chronic liver disease with low E/A ratios, basic manoeuvres that can intensify diastolic dysfunction, should be avoided. Prior to any surgery and other interventional therapies stress should be avoided because it may precipitate cardiac failure. Cirrhotic patients should be subjected to careful cardiac examination.

INTRODUCTION:

Hyper-dynamic syndrome is a well-known clinical condition observed in patients with cirrhosis and portal hypertension and characterized by Increased heart rate, cardiac output and reduced systemic vascular resistance and arterial blood pressure (1-4) characterize this. The main cause of hyper-dynamic circulation in cirrhotic patients is peripheral and splanchnic vasodilatation, due to increased production/ activity of vasodilator factors (such as nitric oxide [NO], carbon monoxide [CO], and endogenous cannabinoids) and decreased vascular reactivity to vasoconstrictors. This leads to a diminished renal blood flow in cirrhotic patients, which in turn stimulates the rennin-angiotensin-aldosterone system (RAAS), sympathetic nervous system, and antidiuretic hormone resulting in renal artery vasoconstriction, sodium retention, and volume expansion (4-6). Earlier before 1960s, it was believed that cardiomyopathy was greatly contributed by alcoholic cardiotoxicity but since last 2 decades it has been clear that cardiac dysfunction is also present in non-alcoholic cirrhosis. In 1953, Kowalski and Abelman observed the elevation of the resting cardiac output, increased stroke volume, normal blood pressure and low systemic vascular resistance in patients with a history of alcoholism, inadequate diet, and liver cirrhosis (1). Later unexpected deaths due to heart failure were reported in the patients following liver transplantation; trans-jugular intrahepatic portosystemic shunts (TIPS) insertion, and surgical portocaval shunts (1). These facts increased the interest in study of the myocardial dysfunction in patients with liver cirrhosis. Liver cirrhosis is associated with increased resting cardiac output (CO), decreased systemic vascular resistance (SVR), reduced myocardial contractility or systolic incompetence, especially under the stress conditions, and increased left ventricular thickness associated with diastolic dysfunction and ECG abnormalities (QTc interval prolongation). The term "cirrhotic cardiomyopathy" was coined to describe impaired contractile responsiveness to stress, diastolic dysfunction and electrophysiological abnormalities in the absence of known cardiac disease (9-12). It has been estimated that as many as 50 % of patients undergoing liver transplantation developed some signs of cardiac dysfunction and about 7–21 % of patients died from heart failure in the post liver transplantation period (13-14).

Echocardiography with conventional as well as deformation imaging modalities extremely helpful in the recognition of these abnormalities. The present study is to identify the prevalence of echocardiographic abnormalities, morbidity, mortality among patients with cirrhosis and their relation to severity of cirrhosis.

AIM AND OBJECTIVES:

To study the prevalence of cardiac changes in patients with chronic liver disease using echocardiography, to assess the cardiac changes in patients with chronic liver disease using echocardiography and to study the morbidity and mortality due to cardiac involvement among patients with chronic liver disease.

MATERIAL AND METHODS:

A Prospective observational study, conducted at Department of Medicine, Tata Main Hospital, in Jamshedpur of Jharkhand State from Jan 2019- April 2020 on 60 patients of CLD.

Sample Size:

Sample size calculation for the study = $Z^2 \times p \times q / l^2$

Z= standard deviation

p= prevalence

q= 1-prevalence
l= relative error

As per previous literature, the prevalence of cardiac involvement among chronic liver patients in India (15), is 20 %, relative error = 10%, and Z=1.96,
Sample size = $(1.96)^2$ x 20x 80 / 10^2
= 3.8416 x 1600 /100
= 6146.56/100
=61.46
Total sample size =60

Outcomes Of The Study:
Echocardiographic measurements such as ejection fraction, diastolic and systolic velocity are the outcomes of the study.

Inclusion Criteria:
Patients who have diagnosis of liver cirrhosis diagnosed by ultrasonography and clinical features with or without upper G.I endoscopy.

Exclusion Criteria:
Patients with known primary cardiac pathology such as ischemic heart disease, congenital heart disease, rheumatic heart disease, pericardial disease and hypertension, patients with disease affecting the heart such as known cases of hypothyroidism and thyrotoxicosis and patients with known diabetes mellitus.

Conventional two-dimensional (2-D) Doppler echocardiography was used in the study. The procedure was done with a 2.5 MHz multiphase array probe in standard parasternal and apical views according to the recommendations of the American Society of Echocardiography (ASE) (16). The ejection fraction was obtained using a modified biplane Simpson's method from apical two and four chamber view. Measurements was made from three consecutive beats and the average of three beats was used for analysis. Doppler recordings of diastolic mitral flow were obtained by using apical four-chamber view and measurements was made by taking an average of two consecutive beats (16). Early [Em] and late [Am] diastolic velocities (trans mitral); Early [Er] and late [Ar] diastolic velocities (trans tricuspid) were obtained. E/A ratios were calculated for both mitral and tricuspid annulus. Pulsed tissue Doppler (M-mode) displays the direction, timing, and synchronicity of the motion of myocardium in the segment selected by the scan line. This technique was used to quantify the segmental movement of the ventricular myocardium as well as diastolic and systolic functions (16). The mitral peak systolic annular velocity (Sm), early diastolic (E tm) and late diastolic annular velocity (A tm) was measured at four different sites at mitral annulus (anterior, inferior, lateral and septal). An average of all the four velocities was taken as mean velocity at mitral annulus. Tricuspid peak systolic annular velocity (St), early diastolic annular velocity (E tr) and late diastolic velocity annular velocity (A tr) was measured at two different sites (lateral and septal). The average of these two velocities were taken as the mean velocity at tricuspid annulus. Other parameters were also measured: left atrial volume (LAV), isovolumetric relaxation time (IVRT) and deceleration time (DT) (16). Peak early diastolic annular velocity (e□) was measured at septal and lateral mitral annulus sites and the average value was calculated. E/e□ ratio was calculated. Left ventricular diastolic dysfunction (LVDD) was graded according to the ASE guidelines (2009). LVDD was defined as: Normal or Grade 0: LAV 1 e□ >8 cm/sec, E/e□ 200 ms; Moderate or Grade II (Pseudo normal): e□ 15, E/A ratio >2 and DT (16).

Data Entry And Analysis:
Data entry was done with Statistical Package for Social Sciences (SPSS IBM) version 21.0. Analysis of data were done with SPSS IBM version 21.0. Both univariate and bivariate analysis was done. Proportions was calculated for qualitative variables and mean with standard deviation was done for quantitative variables. Required tests of significance such as chi square tests and independent t tests was applied. Significance of p value is taken as $p < 0.05$.

RESULTS:
Present study was conducted on 60 patients of chronic liver disease and evaluated echocardiographic findings. Among 60 studies patients, age groups of 50-59 years have the greatest number of CLD patients' i.e.,24 (40%) and Males affected more with chronic liver disease i.e., 51 (58%) (Table 1 and figure 1).

Table 1: Age Distribution Among Stuided CLD Patients

Parameters		Number of patients	Percentage
Age in years	40-49 years	09	15.00%
	50-59 years	24	40.00%
	60-69 years	15	25.00%
	70-79 years	12	20.00%

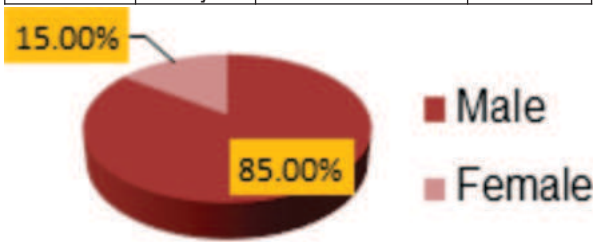

Fig 1: Gender Distribution In Studied Patients

Table 2: Spectrum Of Symptoms At Presentation

Spectrum of symptoms*	Number of patients	Percentage
Generalized weakness	55	91.67%
Abdominal distension	15	25.00%
Blood in vomiting or black stool	20	33.33%
Altered sensorium	03	05.00%

*** Symptoms were overlapping**

Maximum patients show generalized weakness at presentation i.e., 55 (91.67%) followed by blood in vomiting or black stool i.e., 20 (33.33%) respectively (Table 2).

Table 3: Clinical Signs Shown By Selected Patients

Clinical signs*	Number of patients	Percentage
Icterus	37	61.67
Edema	33	55.00
Clubbing	00	00.00
Asterixis	02	03.00
Ascitis	40	66.67

*Clinical signs are overlapping

Most common clinical signs found in our study is ascitis i.e., 40 (66.67%) followed by icterus i.e., 37 (61.67%) (Table 3) and maximum cases were alcohol related CLD i.e., 32 (53.33%) followed by idiopathic CLD i.e., 12 (20.00%) (Fig 2). As far as Child Turcotte Pugh score was concerned most patient came under class B i.e., 33 (55.00%) followed by class A i.e., 16 (26.67%) (Table 4).

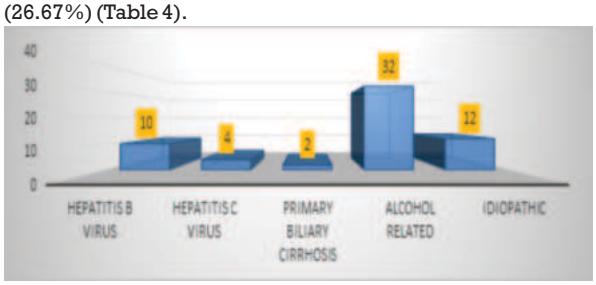

Fig 2: Etiology Of CLD In Selected Patients

Table 4: Child Turcotte Pugh Class

Child Turcotte Pugh Class	Number of patients	Percentage
Class A	16	26.67%
Class B	33	55.00%
Class C	11	18.33%
Total	60	100%

In the selected 60 CLD patients 40 i.e., 66.67% have ascitis and rest 20 i.e., 33.33% have not shown ascites, 20 (33.33%) have varices of any grades (Table 5 and 6) and most patients have QTc interval above 440 msec i.e.,35 (58.33%) (Fig 3).

Table 5: Ascitis Status In Selected Patients

Ascitis status	Number of patients	Percentage
Present	40	66.67%
Absent	20	33.33%
Total	60	100%

Table 6: Variceal Status In Selected Patients

Variceal status	Number of patients	Percentage
Present	20	33.33%
Absent	40	66.67%
Total	60	100%

Fig 3: Conduction Disturbances In Selected Patients

Among 60 studied cases of CLD, diastolic dysfunction was present in 33 CLD patients with grades I, II & III were 18, 13 and 02 i.e., 30%, 21.67% and 03.33% respectively (Table 7), patients with End diastolic volume below 90 was 32 (53.33%) (Table 8), patients with End systolic volume below 38 was 46 (76.67%) and patient's with ejection fraction above 60% ejection fraction was 36 60.00% (Table 9).

Table 7: Diastolic Dysfunction In Selected CLD Patients

Diastolic dysfunction		Number of patients	Percentage
Present	Grade I	18	30.00%
	Grade II	13	21.67%
	Grade III	02	03.33%
Absent		27	45.00%
Total		60	100%

Table 8: End Diastolic Volume In Selected Patients

End diastolic volume	Number of patients	Percentage
Above 90	28	46.67%
Below 90	32	53.33%
Total	60	100%

Table 9: End Systolic Volume In Selected Patients

End systolic volume	Number of patients	Percentage
Above 38	14	23.33%
Below 38	46	76.67%
Total	60	100%

Table 10: Ejection Fraction In Selected Patients

Ejection fraction	Number of patients	Percentage
Above 60	36	60.00%
Below 60	24	40.00%
Total	60	100%

CTP class C had most conduction disturbances (QTc interval) above 440 msec i.e., 10 (90.90%) followed by CTP Class B i.e., 22 (66.67%) respectively (Table 11). Most CLD cases with diastolic dysfunction seen in class A i.e., 13 (81.25%) (Table 12) and end diastolic volume above 90 was found mostly in CTP Class A i.e., 08 (50.00%) followed by CTP Class B 16 (48.48%) respectively (Table 13). End systolic volume above 38 found in CTP classes A, B & C were in 02 (12.50%), 04 (12.12%) & 08 (72.72%) and below 38 in 14 (87.50%), 29 (87.88%) & 03 (27.28%) respectively and CTP Class B had more cases with ejection fraction below 60 i.e., 17 (51.51%) followed by Class C i.e., 10 respectively (Table 15).

Table 11: Child Turcotte Pugh Class V/s Conduction Disturbances

Qtc interval	Child Turcotte Pugh Class			
	Class A	Class B	Class C	Total
Above 440 msec	03 (18.75%)	22 (66.67%)	10 (90.90%)	35 (58.33%)
Below 440 msec	13 (81.25%)	11 (33.33%)	01 (09.10%)	25 (41.67%)
Total	16	33	11	60
p- value	The chi-square statistic is 16.0597. The p-value is 0.000326. The result is **significant** at $p < 0.05$.			

Table 12: Child Turcotte Pugh Class v/s Diastolic Dysfunction

Diastolic dysfunction	Child Turcotte Pugh Class			
	Class A	Class B	Class C	Total
Present	13 (81.25%)	11 (33.33%)	09 (81.81%)	33 (55.00%)
Absent	03 (18.75%)	22 (66.67%)	02 (18.19%)	27 (45.00%)
Total	16	33	11	60
p- value	The chi-square statistic is 13.9103. The p-value is 0.000954. The result is significant at $p < 0.05$.			

Table 13: Child Turcotte Pugh Class Vs End Diastolic Volume

End diastolic volume	Child Turcotte Pugh Class			
	Class A	Class B	Class C	Total
Above 90	08 (50.00%)	16 (48.48%)	04 (36.36%)	28 (46.67%)
Below 90	08 (50.00%)	17 (51.52%)	07 (63.64%)	32 (53.33%)
Total	16	33	11	60
p- value	The chi-square statistic is 0.5844. The p-value is 0.746613. The result is not significant at $p < 0.05$			

Table 14: Child Turcotte Pugh Class vs End Systolic Volume

End systolic volume	Child Turcotte Pugh Class			
	Class A	Class B	Class C	Total
Above 38	02 (12.50%)	04 (12.12%)	08 (72.72%)	14 (23.33%)
Below 38	14 (87.50%)	29 (87.88%)	03 (27.28%)	46 (76.67%)
Total	16	33	11	60
p- value	The chi-square statistic is 18.371. The p-value is 0.000103. The result is significant at $p < 0.05$.			

Table 15: Child Turcotte Pugh Class Vs Ejection Fraction

Ejection fraction	Child Turcotte Pugh Class			
	Class A	Class B	Class C	Total
Above 60	09 (56.25%)	17 (51.51%)	10 (90.90%)	36 (60.00%)
Below 60	07 (43.75%)	16 (48.49%)	01 (09.10%)	24 (40.00%)
Total	16	33	11	60
p- value	The chi-square statistic is 5.4624. The p-value is 0.06514. The result is not significant at $p < 0.05$.			

DISCUSSION:

Our study shown age group of 50-59 years have the greatest number of CLD. Majority of the cases belonged to age group of 46-55 years (47.29%), followed by 56-65 years (22.97%). Present study found Males were affected more with chronic liver disease i.e., 51 (58%). Our study reported maximum patients had generalized weakness as presentation during admission followed by abdominal distension, hematemesis, and melena. **In addition,** most common clinical signs were ascites followed by icterus. Among 60 cases of CLD, diastolic dysfunction was present in 33 (55 %) CLD patients. Of these, grade I, II & III were seen in 18(30%), 13 (21.67 %) and 02 (3.33%). Patients with End diastolic volume below 90 was 32 (53.33%), patients with End systolic volume was between 38 and 46 (76.67%) and patients with ejection fraction above 60% ejection fraction was 36 (60.00%).

Studies	Ascites status
Present study	Ascites (66.67%)
Venu AH et al (22) (2019)	Mild ascites (53.3%)
Mallik S et al (17) (2018)	Ascitis (45.71%)
Chandey M et al (19) (2020)	Ascitis (80.0%)

Studies	QTc interval above 440 msec
Present study	58.33%
Chandey M et al (19) (2020)	62.35%
Kini R et al (20) (2017)	50.00%

CONCLUSION:

In patients with chronic liver disease, we should be aware of the risk of myocardial diastolic dysfunction. In patients with low E/A ratios, basic manoeuvres that can intensify diastolic dysfunction, such as a high sodium diet, fluid overload, exercise and hepato-toxic drugs should be avoided. Moreover, prior to any surgery and other interventional therapies stress should be avoided because it may precipitate cardiac failure. Cirrhotic patients should be subjected to careful cardiac examination. To corroborate these findings and their association with the progression and severity of cirrhosis, further studies with a bigger sample size and serial evaluation of cardiac function are needed.

REFERENCES

1. Kowalski HJ, Abelmann WH. The cardiac output at rest in Laennec's cirrhosis. The Journal of clinical investigation. 1953 Oct 1;32(10):1025-33.
2. Claypool JG, Delp M, Lin TK. Hemodynamic studies in patients with Laennec's cirrhosis. The American journal of the medical sciences. 1957 Jul;234(1):48.
3. Murray JF, Dawson AM, Sherlock S. Circulatory changes in chronic liver disease. The American journal of medicine. 1958 Mar 1;24(3):358-67.
4. Møller S, Henriksen JH. Cardiovascular complications of cirrhosis. Postgraduate medical journal. 2009 Jan 1;85(999):44-54.
5. Solà E, Ginès P. Renal and circulatory dysfunction in cirrhosis: current management and future perspectives. Journal of hepatology. 2010 Dec 1;53(6):1135-45.
6. Martell M, Coll M, Ezkurdia N, Raurell I, Genescà J. Physiopathology of splanchnic vasodilation in portal hypertension. World journal of hepatology. 2010 Jun 27;2(6):208.
7. LIMAS CJ, GUIHA NH, Lekagul O, COHN JN. Impaired left ventricular function in alcoholic cirrhosis with ascites: ineffectiveness of ouabain. Circulation. 1974 Apr;49(4):755-60.
8. Regan TJ, Levinson GE, Oldewurtel HA, Frank MJ, Weisse AB, Moschos CB. Ventricular function in noncardiacs with alcoholic fatty liver: role of ethanol in the production of cardiomyopathy. The Journal of clinical investigation. 1969 Feb 1;48(2):397-407.
9. Caramelo C, Fernandez-Muñoz D, Santos JC, Blanchart A, Rodriguez-Puyol D, López-Novoa JM, Hernando L. Effect of volume expansion on hemodynamics, capillary permeability and renal function in conscious, cirrhotic rats. Hepatology. 1986 Jan;6(1):129-34.
10. Ingles AC, Hernandez IS, Garcia-Estan JO, Quesada TO, Carbonell LF. Limited cardiac preload reserve in conscious cirrhotic rats. American Journal of Physiology-Heart and Circulatory Physiology. 1991 Jun 1;260(6):H1912-7.
11. Lee SS, Marty J, Mantz J, Samain E, Braillon A, Lebrec D. Desensitization of myocardial -adrenergic receptors in cirrhotic rats. Hepatology. 1990 Sep;12(3):481-5.
12. Møller S, Henriksen JH. Cirrhotic cardiomyopathy. Journal of hepatology. 2010 Jul 1;53(1):179-90.
13. Zardi EM, Abbate A, Zardi DM, Dobrina A, Margiotta D, Van Tassell BW, et al. Cirrhotic cardiomyopathy. J Am Coll Cardiol. 2010; 56:539–549. [PubMed: 20688208].
14. Myers RP, Lee SS. Cirrhotic cardiomyopathy and liver transplantation. Liver Transpl. 2000:S44–S52. [PubMed: 10915191].
15. Sidmal PS, Prashanthkumar BG, Shekarappa KC. Pattern of diastolic dysfunction in alcoholic and non-alcoholic cirrhotic portal hypertensive patients with or without ascites in rural population in South India. Int J Res Med Sci 2015;3:2316-22.
16. Nagueh SF, Appleton CP, Gillebert TC, et al. Recommendations for the evaluation of left ventricular diastolic dysfunction by echocardiography. J Am Soc Echocardiogr 2009;22:107-133.
17. Mallik S, Sarkar K, Rahman M, Haldar SN. Clinical and Etiological Study on Chronic Liver Diseases. hypertension.;2:5-7.
18. Satish G, Bharath S, Aparna P, Vinay K. Study of Cardiac Function in Alcoholic Cirrhotic Patients. International Journal of Contemporary Medical Research, Volume 6 | Issue 8 | August 2019. ISSN (Online): 2393-915X; (Print): 2454-7379 | ICV: 98.46 | .
19. Chandey M, Mohan G, Kaur J, Vaid A. Cardiovascular dysfunction in patients of cirrhosis of liver. International Journal of Advances in Medicine | January 2020 | Vol 7 | Issue 1 Page 39.
20. Ratnakar Kini p. a study of cardiac dysfunction and conduction disturbances in non alcoholic cirrhotic patients. International Journal of Scientific Research, Volume-6 | Issue-9 | September-2017 | ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46.
21. Keshav R, Mitra JK, Topno M, Bhardwaj A. A study on cardiac dysfunction using echocardiography in cirrhotic patients of Jharkhand. INDIAN JOURNAL OF APPLIED RESEARCH, Volume-9 | Issue-4 | April-2019 | PRINT ISSN No 2249-555X.
22. Venu AH, Muralidhar C. A study to assess the echocardiographic changes among chronic liver disease in a tertiary care center. International Journal of Advances in Medicine. 2019 Nov;6(6):1.