Original Research Article

Cirrhotic cardiomyopathy: Study of cardiac status in patients with liver cirrhosis

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Abstract

Background: Cirrhosis of liver is one of the leading causes of death in the world. Patients may present with features of portal hypertension or with various complications involving kidney and heart like hepatorenal syndrome and cirrhotic cardiomyopathy. Cirrhotic cardiomyopathy is a cardiac condition observed in patients with cirrhosis regardless of the etiologies. It is characterized by the impaired systolic response to physical stress, diastolic dysfunction, and electrophysiological abnormalities especially QT prolongation.
Aim: To study cardiac status in liver cirrhosis with special emphasis on ECG and Echocardiography findings in patients with features suggesting cardiac involvement.
Methodology: This study included 70 patients of liver cirrhosis who had either signs and symptoms of cardiac involvement or an abnormal ECG and Echocardiogram. The data was collected and compiled and studied using standard statistical methods.
Results: The most common ECG changes observed were prolonged QTc interval, low voltage ECG and STT changes. It was observed that none of the patients having prolonged QTc had any hypokalemia or hyperkalemia in our study suggesting that the QTc prolongation in cirrhosis is independent of serum potassium levels and strengthens the theory of potassium channels abnormality

in cirrhosis. The echocardiogram done to assess diastolic and systolic dysfunction correlated well with the severity of the cirrhosis and as the severity of cirrhosis increased, the cardiac dysfunction increased.

Conclusion: ECG and Echocardiography are important noninvasive tools for diagnosis of cirrhotic cardiomyopathy. QT prolongation is an early change and is hallmark of cirrhotic cardiomyopathy. ECG changes are important pointers towards LV dysfunction. It was noted that the cardiac dysfunction was directly proportional to the severity of cirrhosis. One must try to recognize cardiac dysfunction early to prevent grave complications like congestive cardiac failure and hepatorenal syndrome.

Key words

Cirrhosis of Liver, Cirrhotic Cardiomyopathy, QTc interval, Systolic Dysfunction, Diastolic Dysfunction.

Introduction

Cirrhotic cardiomyopathy is a clinical syndrome characterized by impaired contractile responsiveness to stress, diastolic dysfunction and electrophysiological abnormalities in the absence of known cardiac disease. β-adrenergic receptor impairment, the increase in endogenous cannabinoids, the presence of cardiosuppressants such as nitric oxide and inflammatory cytokines are the proposed mechanisms of systolic dysfunction. The activation of cardiac renin-angiotensin system and salt retention play the role in the development of cardiac hypertrophy and impaired diastolic function. QT interval prolongation occurs as a result of the derangement in membrane fluidity and ion channel defect [1]. A lot of patients presenting with early cirrhosis may have cardiac dysfunction which may go unnoticed and lead to life threatening complications. Early identification of cardiac dysfunction is important in improving the overall prognosis in patients of cirrhosis of liver.

Materials and methods

This study was conducted at Department of General Medicine, Dhiraj Hospital, SBKS, Pipariya from January 2018 to October 2019. The study included 70 patients of cirrhosis of liver. All patients with liver cirrhosis admitted in the Department of Medicine and fulfilling inclusion criteria were enrolled for the study after approval from the institutional ethics committee. It was an observational cross sectional study.

Inclusion criteria

- All Ultrasound diagnosed cases with liver cirrhosis with age group above 18 years with one of the additional feature as below
  - Signs and Symptoms suggestive of cardiac dysfunction like Palpitation and Arrythmia, Cardiac dyspnea like Orthopnea, Paroxysmal nocturnal dyspnea, retrosternal chest discomfort suggestive of Ischemic heart disease or any other signs suggestive of heart failure and others.
  - Patient having abnormal ECG in the form of Arrythmias, QT prolongation, Low voltage and others.
  - Patient having Echocardiographic findings suggestive of diastolic dysfunction and systolic dysfunction

Exclusion criteria

- Patients not giving consent.
- Patients with known case of heart disease.
- Patients having Grade 3-4 hepatic encephalopathy.
- Patients with active upper gastrointestinal hemorrhage
- Severe Anemia (Hb<7g/dL), Thyroid disorders, Tuberculosis, ongoing

septicemia and other infectious diseases, Pregnancy.

After obtaining informed consent all the patients were evaluated on the basis of detailed clinical history, systemic examination with laboratory investigations and special emphasis was given on signs and symptoms of cardiovascular dysfunction in all ultrasound diagnosed cases of liver cirrhosis. ECG and transthoracic echocardiography was done. The investigations done as a routine after taking written informed consent were complete blood count, serum electrolytes, renal function tests, liver function tests including liver enzymes such as SGOT (serum glutamic oxaloacetic transaminases), SGPT (serum glutamic pyruvic transaminases) and Serum Bilirubin, PT, INR, Serum total Protein/albumin, Ultrasound Abdomen pelvis, Electrocardiography, 2D echocardiography. Patients were then graded on the basis of the severity using standard Child Pugh scoring system [2, 3].

Cardiovascular evaluation

1. Clinical profile in relation to cardiac dysfunction: Symptoms like cardiac dyspnea, palpitation, chest pain and others are taken into account
2. Electrocardiography: Patients were then evaluated for their electrocardiographic findings.12 lead ECG was done to calculate QT interval manually, and corrected QT (QTC) by using Bazett's formula as

QTC = QT Interval/$\sqrt{RR\ Interval}$

Prolonged QT interval was defined as value > 440 m sec (0.44 sec).

1. Low voltage complexes are defined as a peak to peak QRS amplitude of < 5 mm in limbleads and < 10 mm in the precordial leads.
2. Arrhythmias classified as
    - PACs (an abnormal P wave followed by a normal QRS complex) or
    - VPC (a premature beat arising from an ectopic foci within the ventricles), or
    - Bifascicular block (RBBB plus LAHB or LPHB)
3. Electrocardiographic features were then correlated with the severity of cirrhosis and dyselectrolemia

All the necessary data was collected and compiled in MS excel sheet. Standard statistical analytics were employed like chi square test, P value.

Results

In our study, out of 70 patients, 62 (88.5%) patients had signs and symptoms suggestive of cardiac dysfunction while ECG changes and ECHO findings were present in 58 (82.5%) of patients (**Table - 1**).

Table - 1: Distribution of patients on the basis of inclusion criteria.

	Present	**Absent**	**Total (100%)**
Signs and symptoms suggestive of cardiac dysfunction	62 (88.5%)	8 (11.4%)	70
ECG changes	58 (82.5%)	12 (17.5%)	70
Abnormal ECHO	58 (82.5%)	12 (17.5%)	70

Table - 2: Patients distribution based on Child Pugh Class.

Child Pugh Class	**Frequency**	**Percent**
A	4	5.7
B	38	54.3
C	28	40
Total	70	100

Table - 3: Electrocardiographic findings of the patients (N=70).

ECG Findings	**Patients**	**Percentage (%)**
QT prolongation	20	28.5%
Low voltage	10	14.3%
ST-T changes	5	7.14%
Left ventricular hypertrophy	4	5.7%
Premature atrial and ventricular contractions (PACs and VPCs)	7	10%
Bifascicular Block	6	8.5%
Biventricular Enlargement	6	8.5%
Normal	12	17.1%
	Total (N=70)	100%

Table - 4: Echocardiographic findings.

Echocardiographic findings			**Patients (N=70)**	**%**
A	Systolic dysfunction: Ejection fraction	Hyperdynamic	4	5.7
		Normal	35	50
		Mild	20	28.5
		Moderate	8	11.4
		Severe	3	4.3
B	Diastolic Dysfunction	Grade 0	12	17.14%
		Grade 1	25	35.7%
		Grade 2	26	37%
		Grade 3	7	10%
		Grade 4	0	
C	RWMA	Present	16	22.8%
		Absent	54	77%
D	Chambers	Normal	55	78.5%
		Left ventricular hypertrophy	5	7.14%
		All chambers dialated	10	14.3%

Table - 5: Correlation of Systolic dysfunction with Child Pugh Class (N=70).

Child Pugh Class versus Systolic dysfunction			**p-value**
Child Pugh Class	**Systolic dysfunction**		
	Absent	**Present**	
A	4	0	0.003
B	23	15	
C	6	22	
Total	33	37	

As shown in the **Table - 2**, out of total of seventy patients of cirrhosis, four patients (5.7%) belonged to Child Pugh Class A category, thirty eight (38) patients (54.3%) belonged to Child Pugh Class B category and rest 28 patients (40%) belonged to Child Pugh Class C category.

Out of 70 patients, most common abnormality found on ECG was QTc prolongation which was found in 20 (28.5%) patients. 12 (17.1%) patients had normal ECG. The second most common abnormality found in 10 (14.3%) patients was low voltage ECG. Other findings were Left

ventricular hypertrophy in 4 (5.7%) patients, ST-T changes in 5 (7.14%) patients and Arrythmias in 13 patients. The most common rhythm abnormality was Premature atrial and ventricular contractions found in 7 (10%) patients, followed by Bifascicular block in 6 (8.5%) patients and biventricular enlargement in 6 (8.5%) patients respectively (**Table - 3**).

Table - 6: Correlations of Diastolic dysfunction with Child Pugh Class (N=70).

Child Pugh Class versus Diastolic dysfunction			**p-value**
Child Pugh Class	**Diastolic dysfunction**		
	Absent	**Present**	
A	2	2	0.7
B	8	30	
C	5	23	
Total	15	55	

In present study, low voltage complexes and QT prolongation was found maximum in patients belonging to child pugh class A, while all the patients having ST-T changes in ECG belonged to child pugh class B. Also, Arrhythmias and biventricular enlargement were found maxiumum in patients belonging to child pugh class B. Arrhythmias were also found in patients belonging to child pugh class C (**Table - 4**).

In our study, four echocardiographic parameters were taken , where systolic dysfunction was assessed by ejection fraction. 35 (50%) out of 70 patients had no systolic dysfunction whereas 20 (28.5%) patients had mild, 11.4% had moderate and 4.3% patients had severe LV systolic dysfunction. Diastolic dysfunction was found in 58 patients out of which 25 (35.7%) patients had grade 1, 26 (37%) patients had grade 2, 7 (10%) patients had grade 3 diastolic dysfunction. Regional wall motion abnormality was found in 16 (22.8%) patients. 55 (77%) patients had normal cardiac chambers, while all the chambers were found to be dilated in 10 (14.3%) patients (**Table - 5**).

In present study, no patients belonging to child pugh class A had systolic dysfunction. Out of 38 patients in Child pugh class B, systolic dysfunction was found in 15 patients(39.4%) , while amongst 28 patients in Child pugh class C, 22(78.5%) had systolic dysfunction (**Table - 6**).

While comparing severity of liver disease with diastolic dysfunction, it was found that in Child Pugh class A, 2 out of 4 patients had diastolic dysfunction (50%); in Child Pug class B, 30 out of 38 patients had diastolic dysfunction (78.9); in Child Pug class C, 23 out of 28 patients had diastolic function (82.1). (**Table - 7**).

Discussion

Signs and symptoms which may be suggestive of cardiac dysfunction may include palpitation and arrhythmias, dyspnea, pericardial effusion, signs of hyperdynamic circulation which was 88.5% of patients (**Table - 1**). The severity of the cirrhosis in the present study was assessed by categorising them into CHILD PUGH CLASS. Most of the patients in our study had cirrhosis belonging to Child Pugh Class B 38 patients (54.3%) and 28 patients (40%) Class C category. In a study conducted by P. Punekar, et al. [4], in which; out of 100 patients of cirrhosis there were 43 patients(43%) in Child Pugh Class A, 45 (45%) in Child Pugh Class B and 12 patients (12%) in Child Pugh Class C category (**Table - 2**).

In our study, out of 70 patients, most common abnormality found on ECG was QTc prolongation which was found in 20 (25.7%) patients. The second most common abnormality found in 10 (14.3%) patients was low voltage complexes. In a study conducted by Dr.Harsh Vardhan Tevethia, et al. [5], 25% patients had QT interval prolongation, followed by low

voltage complexes which were found in 21.8% of patients in the study. Other findings were Left ventricular hypertrophy in 4 (5.7%) patients, ST-T changes in 5 (7.14%) patients and Arrythmias in 13 patients. The most common rhythm abnormality was Premature atrial and ventricular contractions found in 7 (10%) patients, followed by Bifascicular block in 6 (8.5%) patients and biventricular enlargement in 6 (8.5%) patients respectively (**Table - 3**). Josefsson, et al. [6] reported several supraventricular arrhythmias in cirrhotic patients, such as atrial and junctional premature beats, atrial flutter or fibrillation, sinus tachycardia or bradycardia. Pre-transplant evaluation of cirrhotic patients also revealed atrioventricular conduction defects, such as complete or incomplete right or left bundle branch block and intraventricular blocks. It was noted that none of the patients with prolonged QTc had any hypo or hyperkalemia. A prolonged QT interval, found incidentally by Kowalski, et al. [7], is the electrophysiologic hallmark of cirrhotic cardiomyopathy. It represents the most common electrocardiographic finding in patients with liver cirrhosis appearing in half of cirrhotic patients [8]. (**Table - 3**).

Amongst 70 patients, diastolic dysfunction was found in 58 (82.9%), most being grade 1 (35.7%), and Grade 2 (37%) (**Table - 4**). A study done by Achecar and A. Gonzalec-Tallon [9], in 2011 showed that 50% of cirrhotic patients had left ventricular diastolic dysfunction. Prevalence of diastolic dysfunction was 51% in a study done by A. Salari, A. Shafaghi, M. Ofoghi, A. Saeidinia and F. Mansour-Ghanaeiin in 2013 [10]. Systolic dysfunction was assessed on the basis of grading of ejection fraction. In a study conducted by Pozzi, et al. [11] mean ejection fraction was 63.4% (normal) which was similar to the results in our study where ejection fraction was normal. Out of 38 patients in Child pugh class B, systolic dysfunction was found in 15 patients, while amongst 28 patients in Child pugh class C, 22 had systolic dysfunction. None of the patients of Child Pugh class A had systolic dysfunction (Table - 5). Above results suggests systolic dysfunction increases according to the severity of cirrhosis which is consistent to the study conducted by P. Punekar [12] where 3 out of 12 patients had evidence of systolic dysfunction. While comparing severity of liver disease with diastolic dysfunction, it was found that in Child Pugh class A, 2 out of 4 patients had diastolic dysfunction (50%); in Child Pug class B, 30 out of 38 patients had diastolic dysfunction (78.9); in Child Pug class C, 23 out of 28 patients had diastolic function (82.1). The diastolic dysfunction too was proportional to the severity of cirrhosis (**Table - 6**). As per the study conducted by Moller S, et al. in 2016, the presence of diastolic dysfunction averages about 50% in cirrhotic patients [13].

Conclusion

Early identification of cardiac dysfunction is important in improving the overall prognosis in patients of cirrhosis of liver. ECG and Echocardiography are important noninvasive tools for diagnosis of cirrhotic cardiomyopathy. QT prolongation is an early change and is hallmark of cirrhotic cardiomyopathy. Low voltage ECG and STT changes seen on ECG along with arrhythmias are important pointers towards LV systolic and diastolic dysfunction. It was noted that the cardiac dysfunction was directly proportional to the severity of cirrhosis. One must try to recognize cardiac dysfunction early to prevent grave complications like congestive cardiac failure and hepatorenal syndrome in cirrhosis of liver.

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