

## Evaluation of Cardiac Function in Patients with Liver Cirrhosis by Conventional and 2-Dimensional Speckle Tracking Echocardiography

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**Abstract: Background:** In our country, there are many studies on cirrhosis, its associated conditions and their effect on cardiac function, but a few studies on evaluation of cardiac function in patients with liver cirrhosis by speckle tracking echocardiography have been done in our country, even outside. Cirrhosis is associated with certain abnormalities in left ventricular (LV) structure and function. Two-dimensional speckle-tracking echocardiography (2D-STE) enables a rapid and accurate analysis of regional LV systolic mechanics in the longitudinal directions. **Objective:** To investigate the systolic function of the left ventricle using 2 Dimensional Speckle-tracking echocardiography in stable, non-alcoholic liver cirrhosis patients with preserved LV ejection fraction. **Material and methods:** A prospective study done in Echocardiography Unit, Cardiology department, El-Hussein University Hospital over a period of one year that included a total of 60 subjects, including 40 cirrhotic patients and 20 healthy individuals, were enrolled. Using 2D-STE, the strain on longitudinal (L) functions of the LV were measured, during the study period from (1/10/2015 to 1/10/2016). All the patients were examined in the left lateral decubitus position. Standard 2D TTE examination were performed with a "Philips iE33 X Matrix "ultrasound machine using "S5-1 "& "X5-1 "matrix array transducers (Philips Medical Systems, Andover, USA) equipped with STE technology, using a multi frequency (1 - 5 MHz). **Results:** In the cirrhotic group, the LS ( $19.98 \pm 7.65$  vs.  $29.50 \pm 5.92$ ,  $p < 0.001$ ) were found to be lower than in the healthy control group. **Conclusion:** LV myocardial contraction was impaired in the longitudinal direction. Using the 2D-STE method for the regional evaluation of the LV, the LV damage can be detected in the subclinical phase in cirrhotic patients.

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**Keywords:** Liver cirrhosis - Cirrhotic cardiomyopathy - Ventricular function - Speckle tracking, echocardiography

### 1. Introduction:

Cirrhosis is known to be associated with structural and functional cardiovascular abnormalities that are termed as cirrhotic cardiomyopathy (CCM). (Yildiz et al., 2005). Further investigations into the cardiovascular complications of cirrhosis have revealed the clinical aspects of CCM. (Rabie et al., 2009). This is a condition comprising a constellation of cardiac abnormalities, which include hypertrophy of the myocardium, leading to a stiff ventricle and hence to diastolic dysfunction, and normal systolic function at rest, with systolic incompetence under conditions of pharmacological or physical stress. (Lee et al., 2007). The pathogenetic mechanisms that underlie this syndrome include the impairment of beta-adrenergic receptor signalling, cardiomyocyte plasma membrane function, intracellular calcium kinetics, and humoral factors such as endogenous cannabinoids, nitric oxide and carbon monoxide. The inflammatory changes in the myocardial structure and the fibrosis that occur in patients with cirrhosis have been demonstrated by studies using cardiac MRI. (Zardi et al., 2010), (Lossnitzer et al., 2010). CCM-related heart failure is the third leading cause of death, following rejection

and infection after transplants (Myers et al., 2000), (Therapondos et al., 2004). Therefore, it is important to evaluate the cardiovascular function in every patient with cirrhosis, especially if the patient is a candidate for any intervention that may affect haemodynamics. The recently developed two-dimensional speckle tracking echocardiography (2D-STE) method has enabled a simple and angle-independent evaluation of the LV deformation in the longitudinal direction. Previous studies have indicated that 2D-STE is more sensitive than conventional echocardiography in detecting subclinical ventricular dysfunction in various clinical disorders. (Leung the presence and severity of cirrhosis and LV function has been investigated in various echocardiographic studies, no studies have investigated the regional function of the LV using 2D-STE in cirrhotic patients. The aim of the present study was to investigate the regional function of the LV myocardium using 2D-STE in stable, non-alcoholic liver cirrhosis patients with preserved LV ejection fraction.

### 2. Material and methods:

Aprospective study done over a period of one year that included a total of 60 subjects, including 40 cirrhotic patients and 20 healthy individuals, were enrolled. Using 2D- STE, the strain on longitudinal (L) functions of the LV were measured, during the study period from (1/10/2015 to 1/10/2016). All the patients were examined in the left lateral decubitus position. Standard 2D TTE examination were performed with a "Philips iE33 X Matrix "ultrasound machine using "S5-1 "& "X5-1 "matrix array transducers (Philips Medical Systems, Andover, USA) equipped with STE technology, using a multi frequency (1 - 5 MHz).

**3. Results:**

The present study included 60 subjects, including 40 cirrhotic patients and 20 healthy individuals, were enrolled.65% of them are males & 35% are females.

Table (1) Demographic and clinical data of the studied sample

Parameter	rs	M ± SD	p
	Control	43.25 ± 5.11	0.054
Age	Patients	46.45 ± 6.29	
	Control	142.00 ± 39.82	0.102
SBP	Patients	128.00 ± 25.24	
	Control	81.75 ± 13.31	0.149
DBP	Patients	76.88 ± 11.59	
	Control	81.00 ± 4.68	0.297
Pulse	Patients	79.35 ± 6.18	

Table (2) Laboratory parameters between control and patients groups

Parameter	rs	M ± SD	P
	Control	8.24 ± 1.01	<
	Patients	6.37 ± 1.58	<b>0.001</b>
Total protein	Control	3.92 ± 0.10	<
	Patients	3.37 ± 0.65	<b>0.001</b>
Albumin	Control	11.00 ± 1.17	<
	Patients	16.33 ± 5.18	<b>0.001</b>
SGPT SGOT	Control	11.45 ± 1.05	<
	Patients	16.95 ± 6.15	<b>0.001</b>
Total bilirubin	Control	1.09 ± 0.13	<
	Patients	1.25 ± 0.43	<b>0.001</b>
S. Creatinine	Control	1.00 ± 0.12	1.000
	Patients	1.00 ± 0.21	
INR	Control	1.20 ± 0.11	0.139
	Patients	1.14 ± 0.14	

Table (3) Conventional echocardiographic parameters between control and patients groups:

Parameter	rs	M ± SD	p
	Control	4.83 ± 0.56	0.059
LVEDD	Patients	5.09 ± 0.46	
	Control	3.12 ± 0.43	0.082
LVESD	Patients	3.33 ± 0.43	
	Control	116.84 ± 36.58	0.169
LVDV	Patients	129.23 ± 19.34	
	Control	31.90 ± 9.94	0.065
LVSV	Patients	35.73 ± 5.82	
	Control	35.50 ± 5.23	0.711
FS	Patients	34.89 ± 6.36	
	Control	67.47 ± 7.66	0.851
EF	Patients	67.79 ± 5.15	
	Control	84.94 ± 28.24	0.073
SV	Patients	99.42 ± 29.33	

Table (4) Doppler echocardiographic and speckle tracking parameters between control and patients groups:

Parameters	rs	M ± SD	p
E wave	Control	0.74 ± 0.13	< <b>0.001</b>
	Patients	0.57 ± 0.13	
A wave	Control	0.64 ± 0.12	
	Patients	0.62 ± 0.14	0.666
	Control	1.17 ± 0.14	
E/A ratio	Patients	0.95 ± 0.24	< <b>0.001</b>
DT	Control	124.45 ± 10.89	
	Patients	135.95 ± 28.93	0.092
IVRT	Control	88.10 ± 8.36	
	Patients	92.75 ± 12.76	0.145
	Control	0.08 ± 0.02	
E'	Patients	0.05 ± 0.01	< <b>0.001</b>
A'	Control	0.09 ± 0.02	
	Patients	0.09 ± 0.02	0.845
	Control	9.15 ± 1.04	
E/E'	Patients	11.14 ± 1.17	< <b>0.001</b>
	Control	- 29.50 ± 5.92	
GLS	Patients	- 19.98 ± 7.65	< <b>0.001</b>

**4. Discussion:**

Cardiac dysfunction has been described in patients with cirrhosis and Cirrhotic cardiomyopathy has been recently described as a condition characterized by impaired contractile response to

stress, diastolic dysfunction and electrophysiological abnormalities, in the absence of known cardiac disease (Alqahtani et al., 2008).

These changes may be attributable to the excessive mechanical overload due to the hyperkinetic circulation. This interpretation is based on the assumption of a direct relationship between an increased haemodynamic load and LV enlargement which, however, might be altered in these patients as a result of the activation of neurohormonal and autocrine growth factors. Volume overload leading to the activation of neurohormones, including noradrenaline, angiotensin, and aldosterone, has been implicated in cardiac hypertrophy and fibrosis, resulting in structural remodelling through increased collagen accumulation in the interstitium (Wong et al., 2010).

Diastolic relaxation is impaired primarily because of the stiffening and/or hypertrophy of the LV, leading to decreased compliance and higher diastolic pressures compared to the controls. Diastolic dysfunction occurs before systolic dysfunction and may progress to systolic dysfunction. Some authorities contend that some degree of diastolic dysfunction by simple echocardiography is not sufficient to differentiate true CCM patients from general cirrhotic patients (Moller et al., 2001).

Although myocardial dysfunction is observed in the early phases of cirrhosis, the LVEF may remain within normal limits because of the increase in the LV twist brought about by the increase in the LV preload and end-diastolic volume, and the decrease in the afterload. For these reasons, when evaluating myocardial function using the 2D-STE method, the presence of CCM may be assessed during the subclinical stage in cirrhotic patients with preserved EF (Sengupta et al., 2008).

Echocardiography is an easily accessible imaging technique and the most widely used method to evaluate the cardiac function. Although several echocardiographic abnormalities have been described in cirrhosis, Conventional echocardiographic methods are frequently unable to detect abnormalities at rest and have limitations.

On the other hand, Newer echocardiographic techniques may identify patients with functional impairment more accurately than conventional methods, newer echocardiographic modalities like tissue Doppler imaging are mandatory when evaluating diastolic function as conventional Doppler measures are highly dependent on loading conditions. (Kasner et al., 2007).

Also Because of myocardial architecture, subendocardial fibres are most susceptible to damage and longitudinal left ventricular function is the first to be affected in the presence of myocardial disease, Several limitations – like image artefacts and

dependence on insonation angle are acknowledged when using tissue-Doppler. Newer speckle-tracking derived strain may overcome some of these limitations resulting in better reproducibility (Poulsen et al., 2005).

Our finding, is in concordance with the results of Refik study that included 38 cirrhotic patients and 37 healthy individuals, were enrolled. Using 2D-STE, the strain (S) and systolic strain rate (SRS) values belonging to the radial circumferential, and Global longitudinal functions of the LV were measured and the Results revealed that In the cirrhotic group, the global longitudinal strain and strain rate ( $20.57 \pm 2.1$  vs.

$28.7 \pm 43.1$ ,  $p < 0.001$ ) values were found to be lower (Refik et al., 2014).

And the results in concordance with the result of Francisco study that included 109 hospitalized and ambulatory patients with cirrhosis and 18 healthy controls. Detailed echocardiographic evaluation was performed including tissue Doppler and speckle-tracking analysis. The results showed that Peak systolic longitudinal strain (PLS) was lower in patients. Ejection fraction was similar in patients and controls. Based on mitral- flow pattern, DD was present in 44 patients (40.4%) (Francisco Sampaio et al., 2013).

Also in concordance with the results of Sunil which revealed that Left ventricular diastolic dysfunction is commonly associated with advancement of hepatic dysfunction while systolic function is maintained till advanced hepatic failure. Peak early diastolic wave velocity, deceleration time and  $E/e'$  ratio for left ventricular diastolic dysfunction are accurately assessed by pulsed tissue Doppler imaging (Sunil Dadhich et al., 2014).

### Conclusion:

Cirrhosis is associated with subclinical LV systolic dysfunction. In cirrhotic patients with early subclinical heart disease, myocardial dysfunction involves the left ventricle, and leads to impairment of systolic function. The two-dimensional speckle tracking Echocardiography technique appears to be a sensitive tool for early detection of LV asymptomatic dysfunction in subjects with liver cirrhosis.

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