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Original research article

Echocardiographic assessment of the left ventricular diastolic function in patients with non-alcoholic liver cirrhosis

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ABSTRACT

Aim: To assess the left ventricular diastolic function in patients with non-alcoholic liver cirrhosis and correlate the degree of diastolic dysfunction to the severity of liver impairment.
Methods: Thirty-five patients with non-alcoholic liver cirrhosis in addition to 16 age- and sex-matched healthy controls were studied. Severity of liver impairment was assessed using the Child-Pugh score. All participants were subjected to echocardiographic assessment using both the conventional and tissue Doppler echocardiography. The left ventricular filling pressure was derived from the transmitral and mitral annular velocities.
Results: Patients with non-alcoholic liver cirrhosis (mean age; 53 ± 6) had significantly higher heart rate compared with the controls (86 ± 6.5 vs 72 ± 4 bpm, $p = 0.04$). Mild degree of left ventricular diastolic dysfunction was detected in 26% of patients using the transmitral diastolic parameters. Compared with controls, the calculated left ventricular filling pressure was statistically significantly higher in patients with non-alcoholic liver cirrhosis (10 ± 3 vs 9 ± 1, $p = 0.002$). Elevated left ventricular filling pressure was detected in only 4 patients. These patients had more advanced form of liver impairment, and were categorized as having normal left ventricular diastolic function based on the mitral inflow indexes.
Conclusions: One fourth of patients with non-alcoholic liver cirrhosis had mild degree of left ventricular diastolic dysfunction using the conventional echocardiographic parameters. Elevated resting left ventricular filling pressure was detected in 11% of patients. The use of multiple parameters to assess the left ventricular diastolic function in patients with liver cirrhosis could unmask cases with pseudonormal pattern.

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Introduction

Liver cirrhosis is a major health problem that is associated with a wide range of cardiovascular abnormalities [1]. In the past 20 years, a number of evidences suggested that cirrhosis regardless of its etiology is associated with the development of hemodynamic changes and major cardiovascular anomalies known as cirrhotic cardiomyopathy [2–5]. This clinical entity has been repeatedly shown to have a negative prognostic impact, especially on the outcome of invasive procedures such as surgery, transjugular intrahepatic portosystemic shunt insertion (TIPS), and liver transplantation [6–9].

Left ventricular (LV) diastolic dysfunction is believed by some authors to be present in every patient with liver cirrhosis [10–13]. The transmitral E/A ratio has been widely used as the only definition criteria for the diagnosis of diastolic dysfunction in most of the previous studies evaluating cardiac function in patients with liver cirrhosis. The present study aimed at assessment of the left ventricular diastolic function in patients with non-alcoholic liver cirrhosis. We hypothesized that due to the U-shaped relation between the mitral inflow indexes and LV diastolic dysfunction [14], it is difficult to differentiate accurately patients with truly normal from those with pseudonormal pattern using these parameters unless the Valsalva maneuver is performed. Since proper performance of Valsalva maneuver might be difficult to achieve in patients with liver cirrhosis due to various neurological and mechanical barriers, we calculated non-invasively the LV filling pressure using the echocardiographic parameters for better assessment of LV diastolic function in these patients.

Methods

Study population

Thirty-five patients with established diagnosis of liver cirrhosis were included in this prospective study. Diagnosis of liver cirrhosis was based on clinical examination, abdominal ultrasonography, and laboratory findings. Severity of liver impairment was assessed using the Child-Pugh score (Table 1).

Table 1 – Child-Pugh classification of severity of liver disease.

Parameter	Points assigned		
	1	2	3
Ascites	Absent	Slight	Moderate
Bilirubin (mg/dl)	≤2	2–3	>3
Albumin (g/dl)	>3.5	2.8–3.5	<2.8
Prothrombin time			
Seconds over control	1–3	4–6	>6
INR	<1.8	1.8–2.3	>2.3
Encephalopathy	None	Grade 1–2	Grade 3–4

INR: International normalized ratio. Total score of 5–6 is considered grade A (well compensated disease); 7–9 is grade B (significant functional compromise); and 10–15 is grade C (decompensated disease).

None of these patients had alcoholic cirrhosis. Sixteen age- and sex-matched healthy subjects were also studied as controls. An informed consent was obtained from all participants. Patients with atrial fibrillation, significant valvular heart disease (more than mild regurgitation or stenosis), coronary artery disease, impaired LV systolic function (ejection fraction <50%), systemic arterial hypertension, diabetes mellitus, mitral annular calcification, and any amount of echocardiographically detected pericardial effusion were excluded from the study. Patients were subjected to full history taking, detailed clinical examination, laboratory investigations, and 12-lead surface electrocardiography. Both patients and controls were subjected to full echocardiographic assessment.

Echocardiography

Examinations were performed with a commercially available Philips IE-33 echocardiographic machine (Philips Medical Systems, Andover, MA) equipped with a tissue imaging and Doppler transducer. Electrocardiographic monitoring was included in all studies. All measurements were averaged over 5 consecutive cycles. The LV cavity size, wall thickness, and ejection fraction (EF) were measured in accordance with American Society of Echocardiography recommendations. The left atrial volume (LAV) was measured using the prolate ellipse method [15].

Assessment of left ventricular diastolic function and filling pressure

Transmitral flow pattern: Peak velocities of early (E) and late (A) diastolic filling, E/A ratio, and deceleration time were derived from Doppler recordings of the mitral inflow at the mitral leaflet tips and repeated with Valsalva maneuver. LV diastolic function was classified accordingly into four groups: normal, impaired relaxation, pseudonormal, and restrictive [16].

Mitral annular velocity: From the apical four chamber view using tissue Doppler imaging (TDI) while placing a 2.5 mm sample volume over the lateral mitral annulus, the early diastolic annular e′ wave velocity was recorded and subsequently E/e′ ratio was calculated. The pulmonary capillary wedge pressure (PCWP) was calculated using the E/e′ ratio. $PCWP = 1.24(E/e') + 1.9$ [17]. Filling pressure was considered elevated with a calculated PCWP of >12 mmHg [18].

Assessment of the stroke volume and cardiac output

Using the zoom mode, the diameter of the left ventricular outflow tract (LVOT) was measured in the parasternal long axis view. The machine then calculated the cross sectional area (CSA) of the LVOT. The velocity time integral (VTI) across the LVOT was then obtained from the apical 5 chamber view using the pulsed wave Doppler. The stroke volume (SV) was then calculated by multiplying the LVOT velocity time integral by the LVOT cross sectional area. The cardiac output (COP) was obtained by multiplying the SV by the heart rate.

Right ventricular (RV) dimensions and systolic function were measured in accordance to the guidelines [19].