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Original Research

Left atrium function by speckle tracking in cirrhosis

Función de la aurícula izquierda por el rastreo de manchas en la cirrosis

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ABSTRACT. Introduction: Cirrhotic cardiomyopathy, which is defined as systolic and/or diastolic dysfunction of the left ventricle at rest or stress (in the absence of other cardiovascular conditions), worsens prognosis after transplant or other liver surgical procedures. The aim of this study was to characterize left atrial function by speckle tracking in cirrhotic patients. **Methods:** We consecutively included 99 patients with liver cirrhosis of different etiologies. An echocardiographic evaluation with measurement of left ventricular and atrial function was performed using traditional techniques, three-dimensional measurements and speckle tracking. **Results:** The median age was 50.9 years and 40% were men. None had left ventricular systolic dysfunction. Diastolic dysfunction and left atrium enlargement were found in 27%, the latter with a significant increase according to Child Pugh stage. Left atrium pump function showed alterations in 29% of subjects. **Conclusion:** We found left ventricular diastolic dysfunction and alterations in left atrial systolic function measured by speckle tracking in cirrhotic patients.

Key words: Atrial function left, echocardiography, liver cirrhosis.

RESUMEN. Introducción: La miocardiopatía del cirrótico es la disfunción sistólica y/o diastólica del ventrículo izquierdo en reposo o al estrés, en ausencia de otras condiciones cardiovasculares que la expliquen, y que empeora el pronóstico postrasplante u otros procedimientos quirúrgicos hepáticos. El objetivo del estudio es caracterizar la función auricular izquierda con rastreo de manchas en pacientes cirróticos. **Métodos:** Se incluyeron 99 pacientes con cirrosis hepática de diferentes etiologías, de forma consecutiva. A todos se les realizó estudio ecocardiográfico en reposo con medición de la función ventricular y auricular izquierda con técnicas tradicionales, mediciones tridimensionales y rastreo de manchas. **Resultados:** La mediana de edad es 50.9 años, 40% son hombres. No se observaron alteraciones de la función sistólica del ventrículo izquierdo. El 27% presentaron disfunción diastólica y dilatación de aurícula izquierda, esta última con incremento significativo según el estadio Child-Pugh. El 29% presentaron alteraciones de la función de bomba de la aurícula izquierda. **Conclusión:** Se encontró disfunción diastólica del ventrículo izquierdo y alteraciones en la función sistólica de la aurícula izquierda, medida por rastreo de manchas, en pacientes cirróticos.

Palabras clave: Función aurícula izquierda, ecocardiograma, cirrosis hepática.

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INTRODUCTION

Cirrhotic cardiomyopathy has been defined as the presence of an hyperdynamic state with increased cardiac output at rest, decreased peripheral vascular resistance and splanchnic vasodilation. All this is associated with diastolic dysfunction (DD) in patients with preserved left ventricular (LV) systolic function at rest. These patients have a diminished chronotropic and

inotropic response to stress leading to heart failure and QT interval prolongation. This has an impact on prognosis and aggravates the clinical course during surgery, insertion of transjugular intrahepatic portosystemic shunts and liver transplantation. Several studies have shown an improvement in diastolic function, function and size of left atrium (LA), and chronotropic and inotropic response to stress, after liver transplantation. The aim of the study



is to characterize LA and ventricular function with speckle tracking (ST) in cirrhotic patients.

METHODS

Population: This is a cross-sectional study that included patients of both sexes, aged 18 to 70 years, with diagnosis of liver cirrhosis of any etiology, evaluated in the National Institute of Medical Sciences and Nutrition (Mexico), between January 2015 and December 2016. Patient selection was done consecutively at convenience. Cirrhotic patients with diabetes, systemic hypertension, hemoglobin levels less than 10g/dL, acute or chronic renal failure, ischemic heart disease, significant valvular heart disease (at least moderate degree of severity), diagnosis of permanent cardiac arrhythmia (not including Long QT syndrome), thyroid dysfunction, chronic obstructive pulmonary disease, sleep apnea syndrome and/or type I pulmonary hypertension were excluded. Patients with poor acoustic echocardiographic window were eliminated.

Echocardiogram: All studies were performed with VIVID 9 General Electric echocardiography equipment, with two-dimensional sectorial cardiac probe MSS-D (1.5-4.5MHz), as well as three-dimensional sectorial cardiac probe 4D (1.5-4MHz). EchoPAC software was used for processing of myocardial deformation by two-dimensional ST and three-dimensional images for volumetric analysis. The peak strain in the three phases of atrial contraction was determined (ϵ_s , ϵ_e , ϵ_a). LA strain was set to zero at the beginning of the QRS complex (QRS-triggered analysis).

There are no established cut-off values, however, those proposed by Kim et al¹ were taken as reference. Images were obtained by three experts with interobserver variability of less than 2%. Processing and measurement of the variables was performed by a single expert echocardiographer blinded to clinical data. The processed images fulfilled the quality criteria established in international guidelines regarding to frame rate and volume rate.

Statistical analysis: Data was analyzed using the IBM SPSS Statistics 22 software. Results are presented as medians for quantitative variables and as a percentage for categorical variables. Analysis by groups was carried out according to the Child Pugh classification. χ^2 and Kruskal-Wallis tests were used for comparisons between groups. A value of $p < 0.05$ at two tails was considered significant.

RESULTS

Ninety-nine patients were included, with a median age of 50.9 years (minimum of 21, maximum of 81) and 40% were men. The etiology was viral in 27, cryptogenic in 18, primary biliary cirrhosis (PBC) in 16, PBC/ autoimmune hepatitis (AIH) in 6, AIH in 13, nonalcoholic fatty liver in 10 and alcoholic in 9 subjects. 24 patients were in Child Pugh stage A, 43 in stage B and 32 in stage C. LA enlargement was found in 27% (15% mild, 4% moderate and 8% severe). All patients had normal systolic function. Left ventricle ejection fraction (LVEF) median was 66.2% and LV global longitudinal deformation was -23%. DD was identified in 27% of patients. A pseudonormal transmitral flow pattern was the most prevalent (15%), followed by slow relaxation in 10% and only 2% with restrictive pattern. 17% of patients presented an increase in LV filling pressures. Regarding LA ST strain analysis, the mean ϵ_s/ϵ_r (reservoir function) was 41.3% with 13% patients displaying lower values. 29.3% and 11% of patients presented alterations in pump and conduit function, respectively. When analyzed by Child stage, no differences were found regarding age, gender, etiology, LVEF or LV global longitudinal deformation. LA volume was progressively larger in relation to Child Pugh stage (Figure 1, $p = 0.001$) and a larger

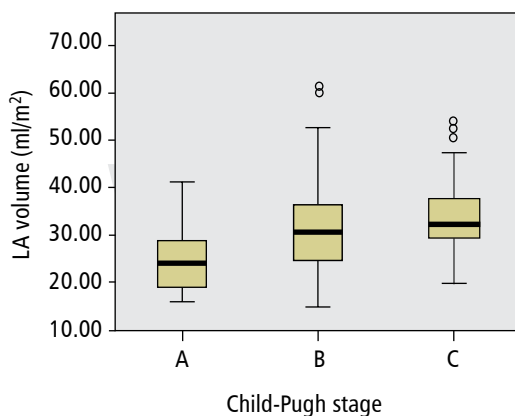


Figure 1:

Indexed volume of LA by Child-Pugh stage, $p < 0.05$.

proportion of LA enlargement was observed in more advanced stages ($p=0.06$). Other LA function parameters did not show significant differences in group analysis. Echocardiographic characteristics are summarized in *Table 1*.

DISCUSSION

Cirrhotic cardiomyopathy is a newly recognized entity in patients with liver cirrhosis of any cause.²⁻¹² Initially, cardiac changes were attributed to the effects of alcohol, however, in the 1980's,^{11,13-15} reports of deaths due to heart failure after liver transplantation, transjugular stent insertion and intrahepatic portosystemic shunts were made. Cirrhotic cardiomyopathy is defined as LV dysfunction (either due impaired contractile response to stress, and/or altered diastolic relaxation) and electrophysiological alterations, in the absence of cardiac disease, in patients with cirrhosis. In this study, we observed a preserved systolic function (both 3D LVEF and LV strain). This data is similar to that reported by Sampaio et al¹⁶ where only 9.2% subjects had LVEF <55%. The absence of LV systolic dysfunction in our population can be explained by two reasons: the measurements

used (LVEF-3D and LV strain) and the absence of decompensated subjects, which have been included in other studies. We found LV diastolic dysfunction and LA enlargement in 27% of patients. At this point it is striking that even a large number of patients with advanced clinical stages (Child Pugh B or C) have normal systolic and diastolic function. Even though our study sample was small, we can assume that the majority of patients with cirrhosis do not have cirrhotic cardiomyopathy, which agrees with Sampaio et al., whose population had a 16% prevalence of DD. One of the most recently incorporated measures in echocardiography is the measurement of left atrial function. Sampaio et al reported that reservoir function declines and pump function remains normal in this group of patients. In our study it was observed that reservoir function was only decreased in 13% of patients and pump function was found altered in 29%. This may be due to our greater DD prevalence, which strongly correlates with LA dysfunction. Our study limitations were: (1) its cross-sectional nature, which does not allows to establish causality or prognosis (2) it was performed in a single center with a small sample, (3) cardiac biomarker measurements for

Table 1: Echocardiographic characteristics of the population.

Characteristic	Total (n = 99)	Child A (n = 24)	Child B (n = 43)	Child C (n = 32)
Age in years	50.9 (21-81)	48.5	53	49.9
Male sex	40%	13 (54%)	13 (30%)	16 (50%)
LVEF (3D)	66.2 (56-77)	65.4	66.6	66.3
LV global longitudinal deformation	-23 (-29.8, -17.1)	-22.4	-22.7	-23.9
Increase in LV filling pressures	17%	3 (12%)	6 (14%)	8 (25%)
Diastolic dysfunction	27%	7 (29%)	9 (21%)	11 (35%)
LA volume (mL/m ²)	31.1 (15-61.2)	25.3	31.8	36.7*
LA dilatation	27%	4 (16%)	12 (28%)	11 (35%)
LA reservoir function (ϵ_s/ϵ_R)	41.3 (19.9-87.8)	39	43.5	40.1
LA reservoir function alteration	13%	4 (16%)	5 (11%)	4 (12%)
LA pump function (ϵ_a/ϵ_{CD})	18 (4.2-51.2)	16.4	19.4	17.3
LA pump function alteration	29%	11 (45%)	10 (23%)	8 (25%)
LA conduit function (ϵ_e/ϵ_{CD})	23.3 (5.9-47.9)	22.6	24	22.8
LA conduit function alteration	11%	3 (12%)	5 (11%)	3 (9%)
E contraction index	43.2 (15.8-79.7)	41.3	44.2	43.4

LVEF = left ventricle ejection fraction; LV = left ventricle; LA = left atrium. * $p < 0.05$.

degree of myocardial dysfunction stratification were not included, (4) not performing a stress test could underestimate our findings and finally (5) invasive measurements to confirm increase in LV filling pressures were not done. In conclusion, our population of cirrhotic patients showed LV diastolic and LA systolic dysfunction. Incorporating new echocardiographic techniques for LA function analysis could help identify cirrhotic patients with a worse prognosis after liver transplantation.

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No conflict of interest to declare.

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