

Left Atrial Function by Speckle Tracking in Liver Cirrhosis. A Cross-sectional Study

Estudio transversal de función auricular izquierda mediante speckle tracking en cirrosis hepática

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ABSTRACT

Background: Cirrhotic cardiomyopathy is the systolic and/or diastolic dysfunction of the left ventricle at rest or stress, in the absence of other cardiovascular conditions, and worsens the prognosis after transplant or other liver surgical procedures.

Objective: The aim of the study was to characterize left atrial function with speckle tracking in cirrhotic patients.

Methods: Ninety-nine consecutive patients with liver cirrhosis of different etiology were included in the study. All patients underwent rest echocardiographic evaluation with measurement of left ventricular and atrial function using traditional techniques, three-dimensional measurements and speckle tracking.

Results: Median age was 50.9 years and 40% were men. No alterations of left ventricular systolic function were observed. Twenty-seven percent of patients had diastolic dysfunction and dilatation of the left atrium, the latter with a significant increase according to the Child stage, and left atrial pump function was altered in 29% of cases.

Conclusion: Cirrhotic patients present left ventricular diastolic dysfunction and alterations of left atrial systolic function measured by speckle tracking.

Key Words: Atrial Function/Physiology – Heart Atria/diagnostic imaging - Liver Cirrhosis - Elasticity Imaging Techniques

RESUMEN

Introducción: La miocardiopatía del cirrótico es la disfunción sistólica y/o diastólica del ventrículo izquierdo en reposo o estrés, en ausencia de otras condiciones cardiovasculares que lo explique, y que empeora el pronóstico post trasplante u otros procedimientos quirúrgicos hepáticos.

Objetivo: El objetivo del estudio fue caracterizar la función auricular izquierda con speckle tracking en pacientes cirróticos.

Material y métodos: Se incluyeron 99 pacientes consecutivos con cirrosis hepática de diferente etiología. A todos pacientes se les realizó estudio ecocardiográfico en reposo con medición de la función ventricular y auricular izquierda con técnicas tradicionales, mediciones tridimensionales y speckle tracking.

Resultados: La mediana de edad fue de 50.9 años y 40% de los pacientes fueron hombres. No se observaron alteraciones de la función sistólica del ventrículo izquierdo. El 27% de los pacientes presentó disfunción diastólica y dilatación de la aurícula izquierda, está última con incremento significativo según el estadio Child, y se observaron alteraciones de la función de bomba de la aurícula izquierda en el 29% de los casos.

Conclusión: Los pacientes cirróticos presentan disfunción diastólica ventricular izquierda y alteraciones de la función sistólica de la aurícula izquierda medida por speckle tracking.

Palabras clave: Función Atrial/Fisiología - Atrios Cardíacos/diagnóstico por imagen - Cirrosis Hepática - Diagnóstico por Imagen de Elasticidad

INTRODUCTION

Cirrhotic cardiomyopathy has been defined as the presence of a hyperdynamic state with increased cardiac output at rest, decreased peripheral vascular resistance and splanchnic vasodilation. All this is associated with diastolic dysfunction (DD) in the absence of abnormal left ventricular (LV) systolic function at rest, but with a poor chronotropic and inotropic

response to stress, which leads to heart failure and prolongation of the QT interval. This can affect the prognosis of patients and aggravate the course during surgery, insertion of transjugular intrahepatic portosystemic shunts and liver transplantation. Several studies have shown that after liver transplantation there is improvement in diastolic function, left atrial (LA) function and size, and in the chronotropic

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and inotropic response to stress. The aim of the study was to characterize LA and ventricular function with speckle tracking (ST) in cirrhotic patients.

METHODS

Population

A cross-sectional study was performed including patients of both sexes, from 18 to 70 years of age, 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. Patients were selected consecutively at convenience. Cirrhotic patients with hemoglobin less than 10 g/dL, acute or chronic renal function abnormalities, diabetes, hypertension, ischemic heart disease, significant heart valve disease (with at least moderate degree of severity), diagnosis of permanent cardiac arrhythmia (not including Long QT), thyroid dysfunction, chronic obstructive pulmonary disease, sleep apnea syndrome and/or type I pulmonary hypertension were excluded from the study as well as those with poor acoustic echocardiographic window.

Echocardiogram

All studies were performed with VIVID 9 General Electric ultrasound equipment, with two-dimensional cardiac sectorial probe MSS-D (1.5 - 4.5 MHz), as well as three-dimensional cardiac sectorial probe 4D (1.5-4 MHz). EchoPAC software was used to process both myocardial strain by means of two-dimensional ST and three-dimensional images to obtain volumes. The strain in the 3 phases of atrial contraction: reservoir, conduit and booster bump functions were determined (ϵ_s , ϵ_e , ϵ_a) taking the beginning of the QRS as “zero” strain. There are no cut-off values of normality accepted, except those stipulated by Pathan F, D’Elia N et al. Normal Ranges of Left Atrial Strain by Speckle-Tracking Echocardiography: A Systematic Review and Meta-Analysis. *J Am Soc Echocardiogr.* 2017;30:59-70. The images were obtained by 2 echocardiography experts with interobserver variability of less than 2% (kappa 0.82). Variable processing and measurement was performed by a single echocardiography expert blinded to the clinical variables of the patients. The processed images fulfilled the quality requirements established in the international guidelines regarding frame rate and volume rate.

Statistical analysis

Data were analyzed using IBM SPSS Statistics 22 software. Results are presented as median for quantitative variables and as a percentage for categorical variables. Analysis by groups was carried out according to the Child-Pugh classification. Chi-square and Kruskal Wallis tests were used to compare between groups. A two-tailed p value <0.05 was considered to be significant.

RESULTS

Ninety-nine patients were included in the study, with median age of 50.9 years (minimum of 21, maximum of 81) and 40% men. The etiology was: viral in 27 cases, 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. Twenty four patients were classified as A Child-Pugh, 43 as B and 32 as C. Twenty-seven percent of cases presented LA dilatation (15% mild, 4% moderate and 8% severe) in relation to the recommendations for Cardiac Chamber Quantification by Echocardiography in Adults.

All the patients presented normal systolic function. Left ventricular ejection fraction (LVEF) was 66.2% and LV global longitudinal strain was -23%. Diastolic dysfunction was found to be altered in 27% of patients, the pseudonormal pattern being the most frequent with 15% of cases, slow relaxation pattern in 10% and only 2% presenting a restrictive pattern. Seventeen percent of patients presented an increase in LV filling pressures. Regarding LA ST, 13% of the patients showed a decrease of $-20\% \pm 11.1\%$ in mean ϵ_s/ϵ_R (reservoir function), 29.3% presented $12.2\% \pm 5\%$ alteration in pump function and 11% had $9.5\% \pm 4\%$ alteration in the conduit function. When analyzed by Child stage, no differences were found regarding age, gender, etiology, LVEF or LV global longitudinal strain. According to the Child stage, there was progressive increase of LA volume (Figure 1, $p=0.001$) and of the proportion of LA dilatation ($p=0.06$). The rest of the LA function parameters did not show sig-

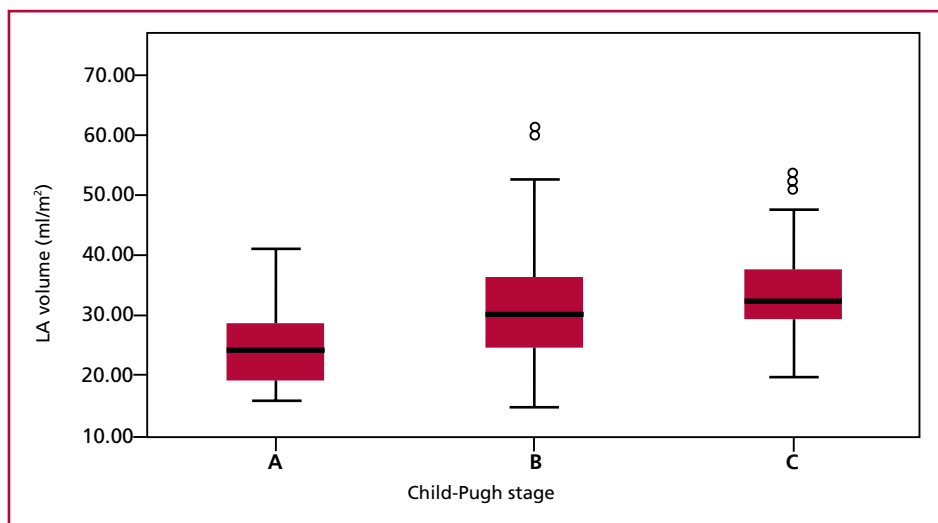


Table 1. Indexed LA volume by Child-Pugh stage, $p<0.05$

Table 1. Echocardiographic characteristics of the population

CHARACTERISTIC	TOTAL (n=99)	Child A (n=24)	Child B (n=43)	Child C (n=32)
Age, 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 strain	-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 (εs/ εR)	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 (εa/ εCD)	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 (εe/ εCD)	23.3 (5.9-47.9)	22.6	24	22.8
LA conduit function alteration	11%	3 (12%)	5 (11%)	3 (9%)
ε contraction index	43.2 (15.8-79.7)	41.3	44.2	43.4

* p<0.05. LVEF: Left ventricular ejection fraction. LV: Left ventricular. LA: Left atrial. R: Reservoir. CD: Conduit

nificant differences in the analysis by groups. The echocardiographic characteristics are summarized in Table 1.

DISCUSSION

Cirrhotic cardiomyopathy is a newly recognized entity in patients with all-cause liver cirrhosis (2-12). Initially, cardiac changes were attributed to the effects of alcohol, however, in the 1980's (11,13,15), deaths were reported due to heart failure after liver transplantation, transjugular stent insertion in intrahepatic portosystemic shunts and surgical procedures for portocaval short circuits. Cirrhotic cardiomyopathy is considered to be LV dysfunction (either due to abolished contractile response to stress and/or altered diastolic relaxation), and electrophysiological alterations in the absence of another cardiac disease, in patients with cirrhosis. In our study, we observed that systolic function (both 3D LVEF and LV strain) was preserved. This data is similar to that reported by Sampaio et al. (16) where only 9.2% of patients had LVEF <55%. The absence of this dysfunction in our population can be explained by two reasons: the measurements used (LVEF-3D and LV strain) and the absence of decompensated subjects, the latter included in other studies. Regarding diastolic function, we found that 27% of patients had abnormalities, which coincides with LA dilatation. 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 this study consists of a small sample, it could be thought that the majority of patients with cirrhosis do not have cirrhotic cardiomyopathy, which coincides with Sampaio et al., who reported 16% of DD. One of the most recently incorporated measures in echocardiography is the measurement of LA function. Sampaio et al. found

that the reservoir function was diminished and the pump function remained normal; in our study we observed that the reservoir function was only decreased in 13% of the patients and the pump function was altered in 29%. This can be explained by our greater proportion of DD, which can be related to altered LA systolic function.

Limitations

The limitations of our study are: (1) the cross-sectional nature of the study excludes it as a test of causality or prognosis, (2) it is a single-center study with a small sample, (3) no measurements of cardiac biomarkers were performed to stratify the degree of myocardial dysfunction by another method, (4) not performing measurements under stress could decrease the proportion of alterations, and finally (5) no invasive measurements were carried out to confirm the increase in filling pressures.

CONCLUSIONS

In our population of cirrhotic patients we observed LV diastolic dysfunction and alterations of LA systolic function. The incorporation of new echocardiographic techniques for the LA could help to identify cirrhotic patients with worse prognosis after liver transplantation.

Ethical considerations

The study was evaluated and approved by the institutional Ethics Committee

Conflicts of interest

None declared.

(See authors' conflicts of interest forms on the website/ Supplementary material).

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