EVALUATION OF LIVER STIFFNESS IN CONSTRICTIVE PERICARDITIS

Bogdan Dzyubak[1], Eric R. Fenstad[2], Jae K. Oh[1], Eric E. Williamson[1], James Glockner[1], Phillip M. Young[1], Richard L. Ehman[1], Philip A. Araoz[1], and Sudhakar K. Venkatesh[1]

[1]*Radiology, Mayo Clinic, Rochester, Minnesota, United States,* [2]*Cardiovascular Diseases, Mayo Clinic, Rochester, Minnesota, United States*

Background. Constrictive pericarditis (CP) results in reduced pericardial compliance, ventricular interdependence, and right heart failure. Patients with CP may develop liver failure due to chronic venous congestion which leads to fibrosis and cirrhosis if CP is untreated. Chronic venous congestion ± fibrosis may lead to increased liver stiffness. Magnetic Resonance Elastography (MRE), a phase-contrast technique which quantitatively measures tissue stiffness based on the speed of externally-induced acoustic waves propagating in tissues [1], was used to evaluate whether patients with CP have increased hepatic stiffness.

Methods. In this prospective study we recruited patients with suspected CP and underwent 2D transthoracic echocardiography, cardiac MRI, and liver MRE. An automated segmentation algorithm [2] was used to process MRE images and calculate the mean liver stiffnesses, in kilopascals (kPa). A t-test with $\alpha = 0.05$ was performed between stiffness values of patients with positive and negative CP findings based on MRI. The correlation of liver stiffness with right atrial pressure (RAP) was also calculated.

Results and Discussion. Sixteen patients met inclusion criteria with a mean ± SD age of 53±20years. Nine patients (56%) had CP based on MRI findings (Table 1). Mean liver stiffness was significantly higher in patients with CP compared to those without CP (3.52 kPa vs. 2.27; p=0.03; Figure 1). The optimal liver stiffness cutoff for detecting CP was 2.17 kPa (89% sensitivity, 71% specificity). Stiffness had a positive correlation (r=0.699) with RAP (Figure 2). Additionally, liver stiffness was significantly higher in patients with abnormal septal motion on MRI, inferior vena cava plethora, and in patients with echo findings of CP. Examples of elastograms for patients with and without CP are shown in Figure 3.

Variable	% N pos.	Liver Stiffness (kPa)	% N neg.	Liver Stiffness (kPa)	P value
MRI positive for CP	56	3.52	44	2.27	0.03
Pericardial Thickening on MRI	69	3.27	31	2.31	0.14
Pericardial Delayed Enhancement	75	2.85	25	3.33	0.52
Abnormal Septal Motion	56	3.52	44	2.27	0.035
Echo positive for CP	50	3.56	50	2.38	0.046
Pericardial Effusion on MRI	69	2.97	31	2.96	0.98
Inferior Vena Cava Plethora Echo	44	3.74	56	2.37	0.018

Table 1: **Mean liver stiffness in patients grouped according to MRI and Echo findings**

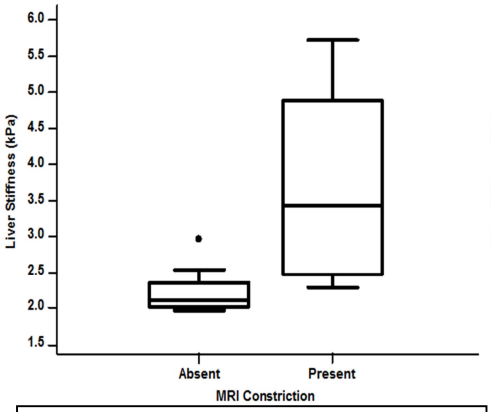

Figure 1: **Stiffness distributions of patients with and without MRI features of CP** (significantly different at p<0.05)

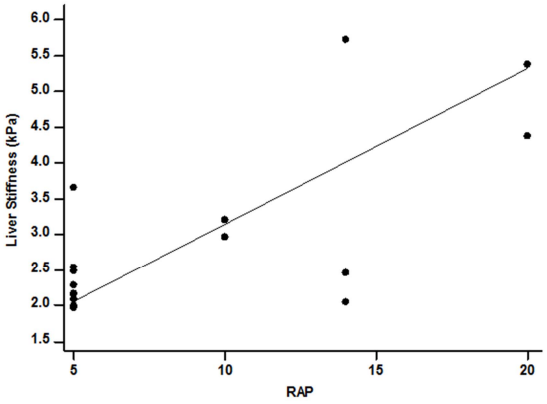

Figure 2: **Correlation of liver stiffness with right atrial diastolic pressure** (r = 0.699)

Conclusions. Constrictive pericarditis was found to be associated with increased liver stiffness. The increased stiffness is most likely secondary to chronic hepatic venous congestion and/or fibrosis. MRE is useful for noninvasively assessing effects on liver in patients with CP. Findings warrant further investigation regarding prognostic significance of increased liver stiffness in CP.

References. 1) Venkatesh and Ehman. Magn Reson Imaging Clin N Am. 22(3):433-46, 2014. (2) Dzyubak et al., JMRI 38: 371-379, 2013.

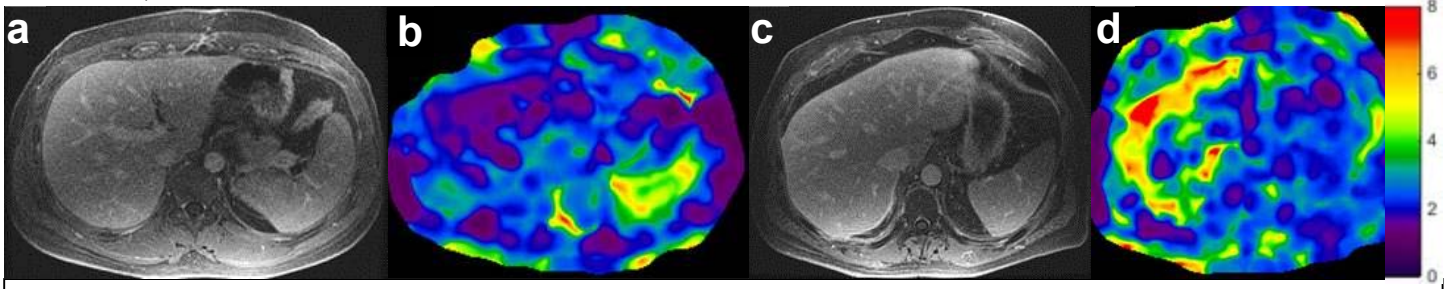

Figure 3: **Examples of cases with and without CP**. Images (a) and (b) are MRI magnitude and stiffness maps for a patient without CP. Images (c) and (d) are the corresponding images for a patient with constrictive pericarditis. The liver stiffness is elevated in the patient with CP to 5.7 kPa as compared to 2.5 kPa in the patient without CP.