

MAGNETIC RESONANCE ELASTOGRAPHY: INFLUENCE OF THE PORTAL VENOUS FLOW ON THE LIVER STIFFNESS

Simon CHATELIN ^a, Raoul POP ^b, Céline GIRAUDEAU ^b, Elodie BRETON ^a, Khalid AMBARKI ^c, Jonathan VAPPOU ^a

^a ICube, CNRS UMR 7357, University of Strasbourg, Strasbourg, France

^b Institute for Image-Guided Surgery, IHU-Strasbourg, Strasbourg, France

^c Siemens Healthcare SAS, Saint Denis, France

Abstract

Background: This presentation aims not only to present the base concepts of Magnetic Resonance Elastography (MRE), but also to present a specific *in vivo* application to link the liver elasticity measurement to the hepatic vascular flow (as described below).

Aims: The invasive measurement of the hepatic venous pressure gradient (HVPG) is still considered as the reference method to assess the degree of Portal Hypertension (PH) [Boleslawski *et al.* 2012]. Even though previous studies have shown that the liver stiffness (LS) measured by elastography could predict PH in patients with chronic liver disease [Ipek-Ugay *et al.* 2016] the mechanisms behind remain today poorly understood. The main reason is that the LS is not specific to PH and is also influenced by concomitant pathologies, such as cirrhosis [Bavu *et al.* 2011; Ferraioli *et al.* 2012]. PH is also source of a substantial diversion of portal venous blood to the systemic circulation, bypassing the liver [Berzigotti *et al.* 2013]. This study focuses on this effect of PH.

Methods: We propose to generate and control the portal venous flow (PVF) (to isolate the modifications in the PVF as single effect of PH) in two pigs and then to quantify its implications on LS by an original combination of MRE and 4D-Flow Magnetic Resonance Imaging (MRI), respectively. A catheter balloon is progressively inflated in the portal vein (Fig.(A)) and the following parameters are quantified in a 1.5T MRI scanner (AREA, Siemens Healthcare, Erlangen, Germany): (1) the peak flow (PF) and the peak velocity magnitude (PVM) (4D-Flow, Fig.(B)); (2) the LS μ (MRE, Fig.(C)).

Results: A strong correlation appears between both the PVM, PF or the LS and the inflation state of the balloon. Moreover, the comparison of LS with PVM or PF highlights a strong correlation of these parameters with the possibility of identifying linear relationships (Fig.(D)).

Conclusions: These results are thought to give indications about how LS can be affected by PH. Otherwise, this study provides unprecedented information for the mechanical modeling of the liver (including mechanical properties and vascular flows) dedicated to computer-assisted surgery.

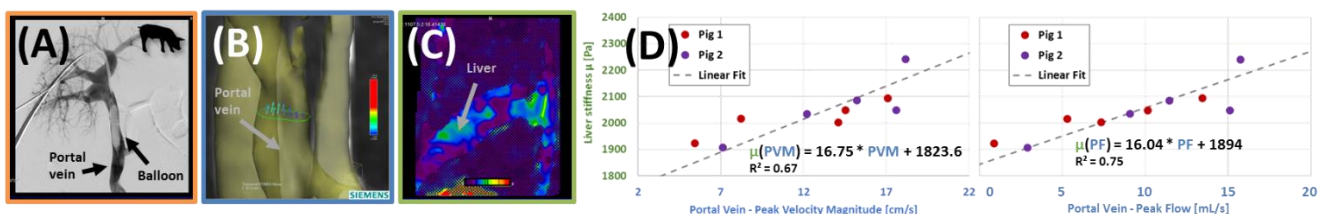


Fig. A catheter balloon is successively inflated in the portal vein (A). The flow (B) and mechanical (C) parameters are successively measured. LS is shown as correlated to PVM and PF (D).

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Keywords: portal venous flow, liver stiffness, portal hypertension, 4D-flow MRI, Magnetic Resonance Elastography

Corresponding author: Simon CHATELIN, schatelin@unistra.fr