Comparison of MR Elastography and DWI for Assessment of Hepatic Fibrosis

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Introduction: Hepatic fibrosis and cirrhosis have classically been diagnosed by liver biopsy, an invasive and expensive procedure with a small but significant risk of complications. Noninvasive methods for assessment of hepatic fibrosis are desirable, not only for initial diagnosis but also to follow disease progression and response to therapeutic interventions. MR elastography (MRE) has been validated as a tool for noninvasive assessment of hepatic fibrosis in independent studies[1]. More recently diffusion-weighted imaging (DWI) has also been evaluated as a potential technique for noninvasive assessment of hepatic fibrosis, and inverse correlation between ADC values and severity of fibrosis has been demonstrated[2]. In this study we examine the correlation between stiffness values measured with MRE and ADC values measured with DWI in 29 patients with known or suspected hepatic fibrosis.

Methods: Clinically indicated MR elastography was performed in 29 patients with known or suspected hepatic disease. DWI was performed with b=100 in 24 of these patients and with b=600 in 29 patients. MRE was performed using a passive driver placed over the anterior abdomen vibrating at 60 Hz. Propagating shear waves were imaged with a modified phase contrast pulse sequence with TR/TE 100/25ms, flip angle 25, matrix 256x96, slice thickness 8mm, FOV 32-42 cm. MR elastograms were generated from the acquired wave images using a local frequency estimation inversion algorithm. DWI was performed as a breath-held acquisition with the following parameters: TR/TE 2000-2400/40-75ms, matrix 128x128, slice thickness 7-8mm, 2-3 NSA, parallel imaging with acceleration factor 2, and b values of 0 and 100 and/or 600. Four slices were acquired for MRE data, and 12-20 slices for DWI data. 4-8 large regions of interest were drawn on magnitude images and transferred to the elastograms to generate average hepatic stiffness values for each patient. An equivalent number of ROI's in similar locations were drawn on the b0 images and then transferred to ADC maps to generate ADC data.

Results:

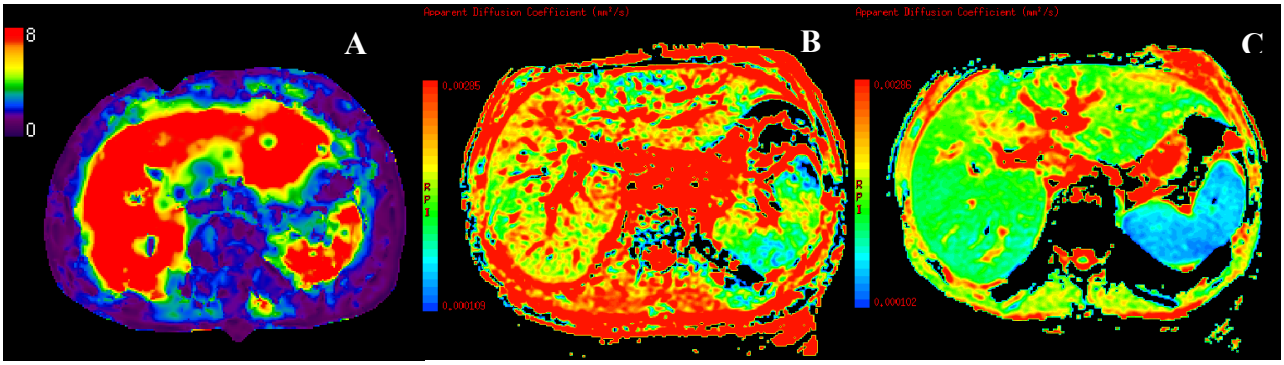
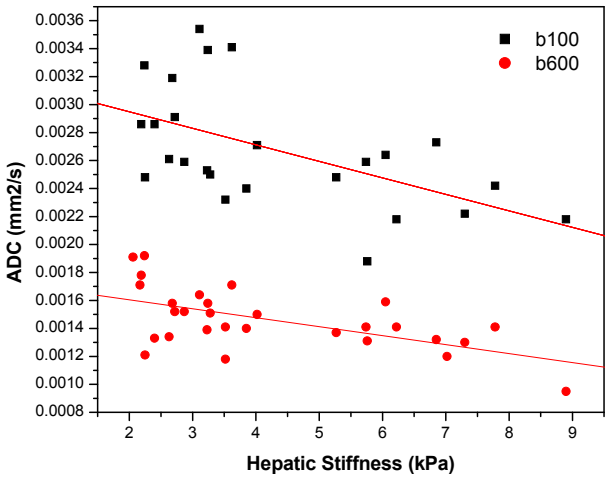


Fig. 1. MR elastogram (A), and b100 (B) and b600 (C) ADC maps in a patient with cirrhosis and diffusely increased hepatic stiffness.



Data were obtained from 19 female and 10 male patients with average age 54 years (20 – 75). Imaging findings were negative in 6 patients, 11 patients had evidence of cirrhosis, 4 patients had one or more hepatic masses suspicious for hepatocellular carcinoma, 2 patients had fatty infiltration, and one patient had portal vein thrombosis. Hepatic stiffness values ranged from 2.2 – 8.9 kPa with average 4.2 kPa (normal range is < 2.9 kPa). ADC values for both b100 and b600 acquisitions were linearly related to stiffness values measured by MRE. Linear fit of ADC versus hepatic stiffness yielded slightly better fit of b600 data: R = -0.59, p = 0.0008 versus R = -0.55, p = 0.004 for b100 data.

Discussion: Linear correlation between ADC values and hepatic stiffness measured by MRE was demonstrated at both low and intermediate b values. The range of variation in stiffness values is larger than that of ADC values for this group of patients, suggesting that MRE may be more sensitive to smaller variations in hepatic stiffness; however, larger studies are needed as well as correlation with hepatic biopsy.

References: [1] Yin et al, Clin Gastroenterol Hepatol 2007; 5:1207, [2] Lewin et al, Hepatology 2007; 46:658