Diagnostic value of normalized liver ADC using the spleen as a reference for the diagnosis of cirrhosis

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Introduction

Diffusion weighted imaging (DWI) has shown promise in the detection of liver fibrosis and cirrhosis[1,2]. However, absolute ADC values obtained with DWI are limited by reproducibility and noise contamination[3,4]. The objective of our study was to determine whether the use of the spleen as a reference organ to normalize liver ADC values could improve the diagnostic performance of DWI for diagnosing cirrhosis.

Methods

Patients were included in this retrospective study if they had an MRI performed within 3 months of liver biopsy or transplantation. Patients were excluded (n=17) if pathology demonstrated significant iron deposition (iron grade ≥ 2), or if there was evidence of splenic siderosis (Gamna-Gandy bodies) on T1 weighted in- and out-of-phase imaging. 1.5T MRI included breath-hold DWI (using SS EPI with b-values of 0, 50, and 500 sec/mm^2). Liver and spleen ADC were calculated by measuring signal intensity (SI) on b0 and b500 by placing ROIs in the right hepatic lobe on 3 consecutive slices. Relative liver ADC (rADC) was calculated using the spleen as the reference: rADC = ADCliver/ADCspleen. ADC and rADC values were compared between patients with cirrhosis vs. patients without cirrhosis (fibrosis stages 0-3). A non parametric Mann-Whitney test was used to compare ADC and rADC of cirrhotic vs. non-cirrhotic livers.

Results

19 patients fulfilled the inclusion criteria (13M/6F, mean age 58 y). Absolute liver ADCs for cirrhotic livers (ADC = 1.67 ± 0.26 x 10^{-3} mm^2/sec) were lower than those of non cirrhotic livers, without reaching significance (1.81 ± 0.36 x 10^{-3} mm^2/sec, p=0.33). However, rADC values were significantly lower in cirrhotic vs. non cirrhotic livers: 1.25 ± 0.22 vs. 1.55 ± 0.22 (p=0.02) **(Fig 1, 2)**. Using a cutoff < 1.4, rADC had sensitivity of 78% and specificity of 80% for diagnosing cirrhosis.

Conclusion

Our preliminary data demonstrate the utility of using the spleen as a reference organ to improve the performance of ADC measurement for the diagnosis of cirrhosis, which has important prognostic implications. A low rADC in a morphologically normal appearing liver on conventional MR imaging may potentially serve as a tool for the detection of early cirrhosis.

References

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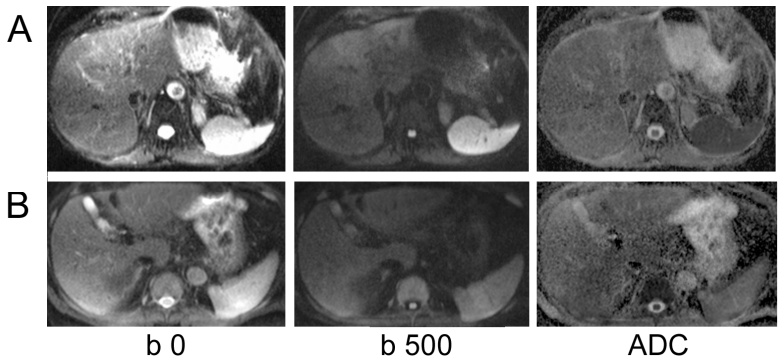

Fig. 1: DWI at b=0, b=500, and ADC maps for two patients: (A) patient with stage 0 fibrosis: liver ADC 1.82x10^{-3} mm^2/sec and rADC 1.83, (B) patient with cirrhosis: liver ADC 2.14x10^{-3} mm^2/sec, rADC 1.02

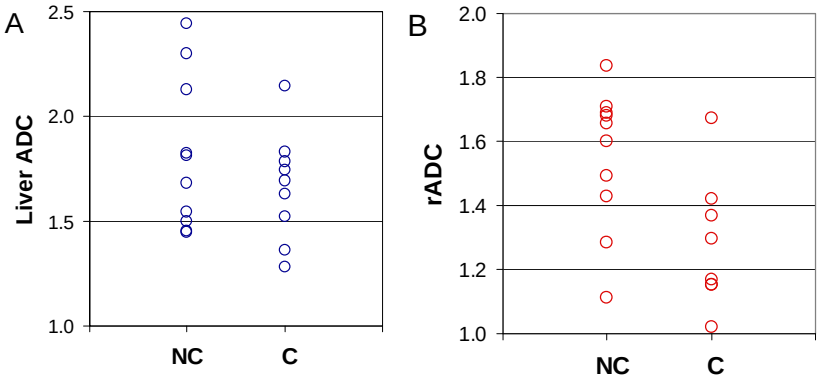

Fig. 2: Distribution of absolute liver ADC (A, x 10^{-3} mm^2/s) and liver ADC normalized to spleen ADC or rADC (B) in 19 patients that have cirrhosis (C) or no cirrhosis (NC). There is a better separation using rADC