Arterial Enhancement Fraction in Liver Fibrosis and Cirrhosis

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Background and Objective: Liver fibrosis can lead to portal hypertension (scarring distorts blood flow through the liver) or cirrhosis (scarring results in disruption of normal hepatic architecture and liver dysfunction) [1,2]. The accurate diagnosis and staging of hepatic fibrosis and cirrhosis is crucial for prognosis and treatment of liver disease. The current gold standard, liver biopsy, cannot be used for population-based screening, and has well known drawbacks if used for monitoring of disease progression or treatment success. The Hepatic Perfusion Index (HPI) provides a noninvasive measure of the altered hemodynamics in chronic liver disease. HPI has been defined as the ratio of hepatic arterial perfusion to the total hepatic perfusion [3,4], and therefore expresses the relative contribution of arterial in comparison to total blood inflow to the liver. The aim of this study was to show that AEF values correlate with histo-pathological stage of liver fibrosis thus providing a reliable, noninvasive radiological alternative to liver biopsy.

Materials and Methods: After obtaining IRB approval for this HIPAA compliant retrospective study, we evaluated histological findings and AEF of patients who underwent standard tri-phasic liver magnetic resonance imaging (MRI) and liver biopsy between 2005 to 2008. 65 patients underwent MRI and liver biopsy within 12 months of each other. Six patient were excluded due to A) portal vein thrombosis (n=4), B) liver transplantation (n=1) and C) severe right heart failure (n=1) within this time. The mean time between the procedures was 2.5 months (range 0-12 months). The remaining 59 patients (36 male and 23 female; mean age of 50.75 years [range: 26 – 77 years]) were divided into three groups based on the histo-pathologic degree of liver fibrosis or cirrhosis. Group A (n=24) was the normal control group, Group B (n=18) included patients with mild to moderate liver fibrosis while Group C (n=17) consisted of patients with liver cirrhosis. A prototype software (Hepacare, Siemens Healthcare, Erlangen, Germany) was used to calculate AEF. Statistical analysis including Student's t-test and Spearman correlation was performed with SPSS v 9.

Results:

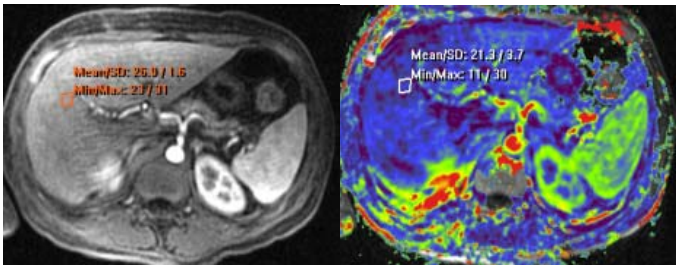

Fig 1: Normal liver with sharp hepatic angle. The corresponding HPI map map shows low hepatic AEF values (blue).

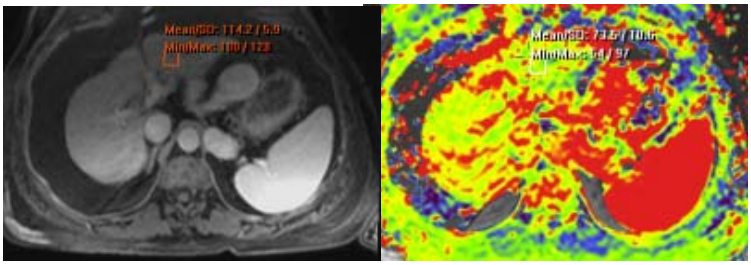

Fig 2: Small contracted cirrhotic liver with high hepatic AEF values depicted in yellow on the HPI map.

The mean AEF of the liver was 26.7±12.4% in Group A, 37.9±16.6 in Group B, and 64.2±18.1% in Group C, respectively. The AEF values differed significantly between Groups A and B (p =0.017) and Group B and C (p=0.001). Furthermore, we determined a high correlation coefficient (r=0.697, P<0.001) between AEF and histo-pathological staging of liver fibrosis or cirrhosis.

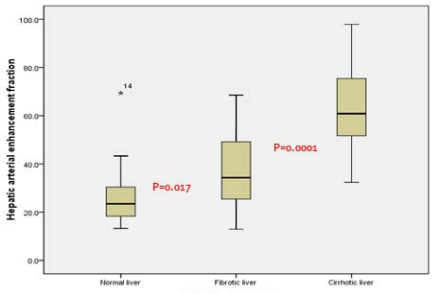

Fig. 3: Mean hepatic AEF by histological group.

Conclusion: The arterial enhancement fraction can be reliable, noninvasive methods to assessment of hepatic fibrosis. While AEF analysis based on triple phase MRI promised to provide a simple solution, the development of diagnostic algorithms that combine different non-invasive modalities with additional genetic/proteomics testing may be needed to improve the diagnostic accuracy.

References: 1. PoveroHistol Histopathol. 2010 Aug;25(8):1075-91 2. Bataller Clin Invest. 2005 Feb;115(2):209-18. 3. Miles Radiology 1993; 188:405-411. 4. Miyazaki Phys Med Biol 2008; 53:5927-5946.