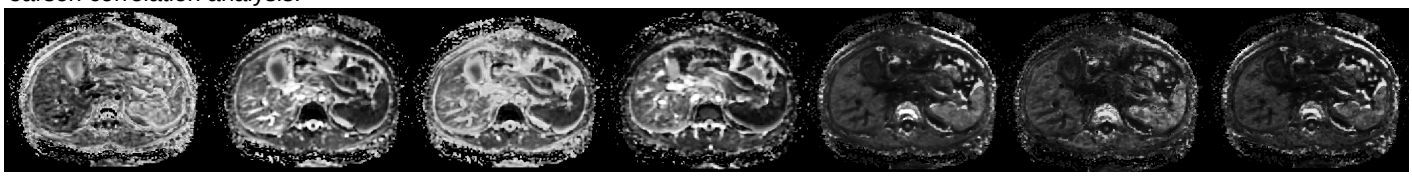
Correlation Study of Quantitative Diffusional Kurtosis Imaging with Serum Indicators in Liver Fibrosis

He Wang[1], Naiyi Zhu[2], Fuhua Yan[2], Guang Cao[1], and Xu Yan[3]

[1]MR Research China, GE Healthcare, Shanghai, China, [2]Department of Radiology, Ruijin Hospital, Shanghai, China, [3]East China Normal University, Shanghai, China

Introduction: Liver fibrosis is a typical complication of chronic liver diseases developing to cirrhosis, with poor prognosis and increased risk of hepatocellular carcinoma. Early diagnosis of liver fibrosis could facilitate early interventions and thus prevent its progression to cirrhosis. Liver fibrosis is associated with progressive restriction of diffusion motion. Recently, MR diffusion tensor imaging (DTI) was found as a potential way to detect the progressive changes in water diffusivities and diffusion anisotropy of liver tissue in liver fibrosis model [1]. Diffusional kurtosis imaging [2] (DKI) is a clinically feasible extension of DTI that enables the characterization of non-Gaussian diffusion by estimating the kurtosis of the displacement distribution, and it has shown promising results in studies of human brain aging and brain tumor characterization, however, limited results were reported on liver diseases. This study is to investigate the clinical feasibility of DKI in evaluating liver fibrosis by comparison with serum fibrosis indicators.

Methods: 44 patients (mean age 32.74 years) with proved liver fibrosis history were enrolled in this study. The liver fibrosis correlated serum indicators such as HBsAg, Alphafetoprotein (AFP), Hyaluronicacid (HA), and laminin (LN) were collected. All subjects underwent DKI scan on a 3.0-T scanner (Signa Hdxt, GE Healthcare, Milwaukee, WI) with the following parameters: FOV=300 x300 mm^2, matrix=128x128, NEX=2, B-value = 0, 100 s/mm^2 (with 25 directions), 200 s/mm^2 (with 25 directions), with respiratory trigger. The low B-values (100, 200) were used instead of high values because non-Gaussian diffusion in liver was mainly induced by microvascular perfusion. DKI post processing was performed offline in MATLAB. All the quantitative results of DKI (FA, MD, Da, Dr, MK, Ka, Kr, shown in Fig.1) were measured in a 3D ROIs which were placed on B0 images covering most parts of the liver, and meanwhile vessels were excluded by setting appropriate thresholds. Afterwards, the DKI results were statistically compared with serum fibrosis indicators by Pearson correlation analysis.



FA MD Da Dr MK Ka Kr

Fig. 1 DKI results: FA, MD, Da, Dr, MK, Ka and Kr

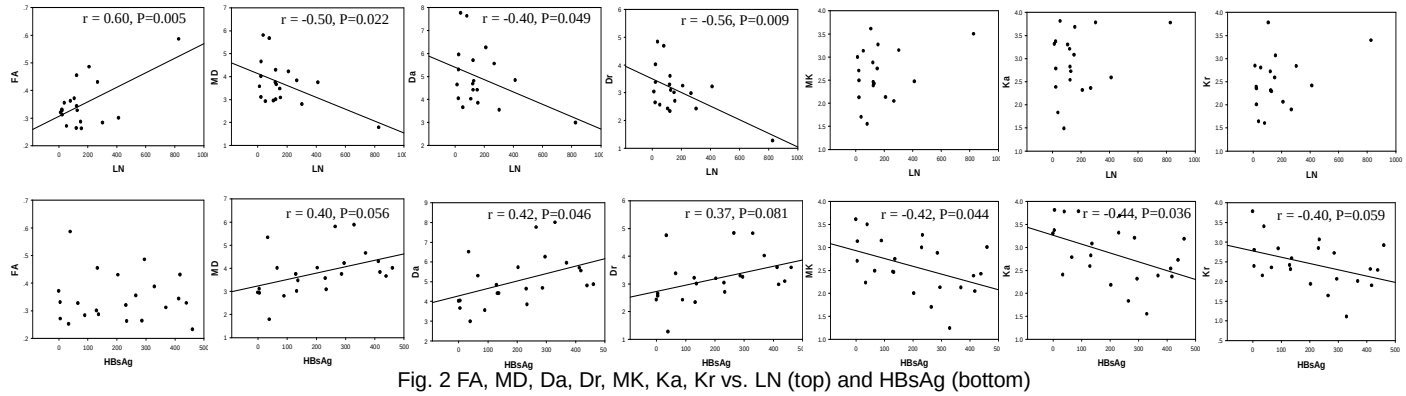


Fig. 2 FA, MD, Da, Dr, MK, Ka, Kr vs. LN (top) and HBsAg (bottom)

Results and Discussion: FA exhibited statistically significant and positive correlation with LN (r=0.60, P=0.005) while MD, Da and Dr exhibited negative correlation with LN (P<0.05). In contrast, no significant linear correlation was observed between kurtosis parameters (MK, Ka, Kr) and LN (Fig. 2 top). In addition, compared with another serum indicator HBsAg, moderate correlations were found in Da, MK and Ka with correlation coefficient of 0.40, -0.42 and -0.44 (P<0.05), respectively. It seemed that kurtosis parameters had stronger correlations with HBsAg than normal diffusion parameters (Fig. 2 bottom). Unfortunately, no other significant linear correlations were found (P>0.05). Longitudinal studies are now required in order to assess if DKI may have future use as a biomarker in clinical trials to evaluate progress of liver fibrosis.

Reference: [1] Cheung JS, et al., JMRI. 2010; 32:1141-48. [2] Jensen JH, et al., MRM. 2005; 53:1432-40