Prospective Comparison of IVIM DWI, MR Elastography and Transient Elastography for the detection of liver fibrosis in HCV. Initial results.

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Target audience: Radiologists and physicists interested in applications of quantitative liver MRI.

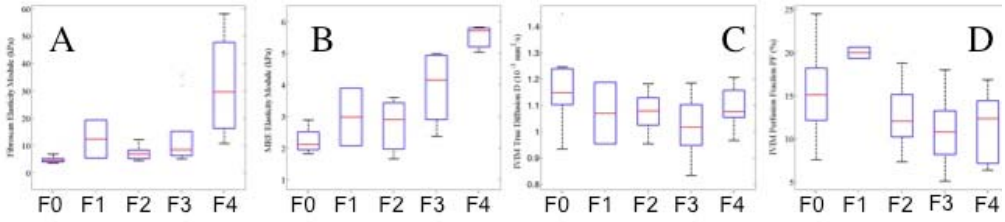
Purpose: Liver fibrosis is characterized by excessive collagen deposition and scarring, which lead to changes in mechanical properties as well as water diffusion and blood perfusion in liver parenchyma. Mechanical properties can be measured with MR elastography (MRE)[1] and transient elastography (Fibroscan, TE); diffusion and perfusion can be assessed using intravoxel incoherent motion (IVIM) with multiple b-value DWI. The purpose of this study is to report our initial experience using IVIM DWI, MRE and TE for the prospective detection of liver fibrosis in HCV.

Methods: 40 subjects (age 51 ± 14 y, M/F 29/11, including 9 healthy volunteers and 31 HCV patients with liver fibrosis assessed with histopathology (within 90 days of MRI) were enrolled in this IRB approved prospective study. All subjects underwent 1.5T exam with IVIM DWI using 16 b values (0-800). 16/40 subjects underwent MRE and 30/40 subjects underwent TE on the same day as the MRI. MRE data were processed using MRE Quant software (Mayo Clinic) by placing ROIs in the right liver lobe and measuring the average stiffness value from stiffness map. For IVIM data, ROIs were placed in the right liver lobe and the mean signal intensity decay was used to estimate D (true diffusion coefficient), PF (perfusion fraction), D* (pseudo diffusion coefficient) and ADC (calculated with all 16 b values) using Bayesian fitting method. The value retained for TE stiffness was the median of 10 successful measures. A Mann-Whitney test was performed to assess differences in IVIM parameters (D, PF, D* and ADC) and liver stiffness (LS measured with MRE and TE) according to fibrosis stage.

	F0-F1 vs. F2-F4	F0-F2 vs. F3-F4	F0-F3 vs. F4
D (n=40)	**0.016**	0. 054	0.83
PF (n=40)	**0.005**	**0.023**	0.37
D* (n=40)	0.21	0.32	0.62
ADC (n=40)	0.39	0.21	0.49
LS MRE (n=16)	**0.04**	**0.005**	**0.004**
LS TE (n=30)	**0.002**	**0.001**	**0.005**

Comparison of different groups according to fibrosis stages (METAVIR F0 to F4). P values are bolded when significant

Results: METAVIR fibrosis stage distribution observed in 31 patients was F0 (n=2), F1 (n=2), F2 (n=8), F3 (n=11), F4 (n=8). Healthy subjects were assigned F0 (Table). Significant differences were observed between all subgroups using Fibroscan and MRE. Differences were less marked using DWI, which shows significant differences in D or PF depending on the subgroup considered. The distribution of relevant parameters in each group is illustrated in the figure.



Boxplot distribution for liver stiffness (LS) measured with FibroScan (A), LS measured with MRE (B), IVIM true diffusion D (C) and perfusion fraction PF (D). As fibrosis liver stiffness increases (A and B), D and PF decrease (C, D)

Discussion: Our initial results show that IVIM, MRE and TE have potential for liver fibrosis detection, and that LS (measured using MRE or TE) shows better discrimination between groups than IVIM parameters, especially for detection of cirrhosis. Similar observations were made in a previous study comparing MRE and DWI for fibrosis detection[2]. However, PF could also be a useful parameter for the discrimination of early stages of fibrosis. We are in the process of recruiting more patients, and in analyzing different combinations (e.g. IVIM combined with MRE) for the assessment of liver fibrosis.

Conclusion: In our initial results, liver stiffness, measured using MR elastography or transient elastography, and perfusion fraction, measured with IVIM diffusion weighted imaging, are sensitive to early changes occurring in liver fibrosis and correlate with histologic findings.

References

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