The comparison of Gd-EOB-DTPA enhanced-Magnetic Resonance Imaging and Magnetic Resonance Elastography for the detection and staging of hepatic fibrosis

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Purpose

Liver biopsy is the gold standard for fibrosis staging in clinical diagnosis. However, it is invasive and not well accepted for patients. It is lack of repeatability to trace patient's status after treatment. In addition, liver biopsy is extracted some of local liver parenchyma tissues for pathological analysis, thus it cannot provide the severity of whole liver. It is necessary to develop a non-invasive and reliable method for fibrosis staging. Magnetic resonance elastography (MRE) and Gd-EOB-DTPA enhanced-magnetic resonance imaging (MRI) had been reported to predict liver fibrosis stage. The aim of this study is to compare efficacy of Gd-EOB-DTPA enhanced-MRI and MRE in estimation of hepatic fibrosis stage with histopathologic correlation.

Materials and Methods

The study included 75 patients (63 male and 12 female; mean age: 60±9.9 years) who underwent both MRE and Gd-EOB-DTPA enhanced MRI at 1.5T MRI. The relative enhancement (RE) of liver parenchyma and liver to muscle contrast ratio (CR) were calculated as ($SNR_{hepatobiliary}$ -$SNR_{precontrast}$)/$SNR_{precontrast}$ and ($SI_{hepatobiliary\text{-}liver}$-$SI_{hepatobiliary\text{-}muscle}$)/ ($SI_{precontrast\text{-}liver}$-$SI_{precontrast\text{-}muscle}$). The liver-to-muscle ratio (SNR) and signal intensity (SI) were measured on pre-contrast and hepatobiliary phase of T1 weighted images (Fig.1). The MRE values of liver stiffness were measured on shear-stiffness maps (Fig. 2). The receiver operating characteristic (ROC) analysis and Spearman rank correlation test were used to investigate the performance of MRE, RE and CR for staging hepatic fibrosis. The fibrosis was categorized as F0~F4 according to METAVIR scoring system. The fibrosis group was built as F0~ F1, F2~F3 and F4 which can distinguish mild fibrosis, moderate /severe fibrosis and liver cirrhosis.

Results

Using ROC analysis, the results of MRE and Gd-EOB-DTPA enhanced-MRI in estimation of hepatic fibrosis were shown in Table 1. MRE showed higher sensitivity and specific compared with RE and CR in predication of each fibrosis stage. The sensitivity and specificity of MRE to distinguish fibrosis subgroups ≧F0~F1 (84.4% and 90.9%), ≧F2~F3 (63.6% and 80.6%), and F4 (80.6% and 81.8%) were better than RE (63.6% and 68.8%, 45.2% and 77.3%, 50% and 77.4%) and CR (63.6% and 56.3%, 67.6% and 52.3%, and 81.8% and 45.2%). The area under the receiver operating characteristic (AUC) values of MRE was higher than RE and CR. The ability of MRE for distinguishing mild fibrosis (F0~F1), moderate /severe fibrosis (F2~F3) and liver cirrhosis (F4) was better than different fibrosis stage (F0~F4).

Discussion

In our study, although both MRE, RE and CR showed a significant correlation with hepatic fibrosis staging. MRE showed a better correlation than RE and CR. The stiffness values on MRE were related to abnormal liver structure during a consequence of the pathological changes in hepatic fibrosis. RE and CR indicated the hepatocyte function instead of abnormal liver structure. This might be the reason why RE and CR showed a lower correlation than MRE. According to AASLD treatment guideline, treatment of underlying liver disease should be considered for patients with significant fibrosis (F≧2). Therefore, the diagnosis between mild, moderate/severe, fibrosis and liver cirrhosis is very important. According to our result, the ability of MRE for distinguishing between the subgroups is better than Gd-EOB-DTPA enhanced-MRI.

Table 1. Most Discriminant MRE,RE and CR Cut-off Values at the classification of fibrosis group with METAVIR Scores and Corresponding Sensitivities, Specificities, and Az*

	F0~F1 (Mild Fibrosis)	F2~F3 (Moderate/Severe Fibrosis)	F4 (Liver Cirrhosis)
MRE			
Cut-off value (kPa)	≥ 3.345	≥ 4.240	4.310
Sensitivity (%)	84.4	63.6	80.6
Specificity (%)	90.9	80.6	81.8
Az	0.926	0.702	0.901
RE			
Cut-off value (kPa)	0.755	≤ 0.790	≤ 0.745
Sensitivity (%)	63.6	45.2	50.0
Specificity (%)	68.8	77.3	77.4
Az	0.678	0.589	0.667
CR			
Cut-off value (kPa)	3.925	≤ 3.775	≤ 3.285
Sensitivity (%)	63.6	67.6	81.8
Specificity (%)	56.3	52.3	45.2
Az	0.655	0.602	0.661

*MRE=magnetic resonance elastography, RE=relative enhancement, CR=contrast ratio, Az=area under the ROC curve. All p values <0.05.

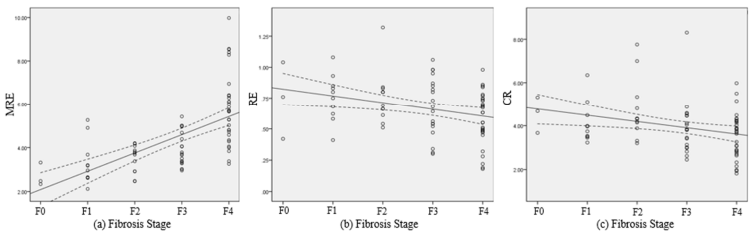

Figure 1. Scatterplots show the relationship between fibrosis stage and (a) MRE stiffness value (r=0.705), (b) RE (r=-0.285) and (c) CR (r=-0.26). All p value <0.05.

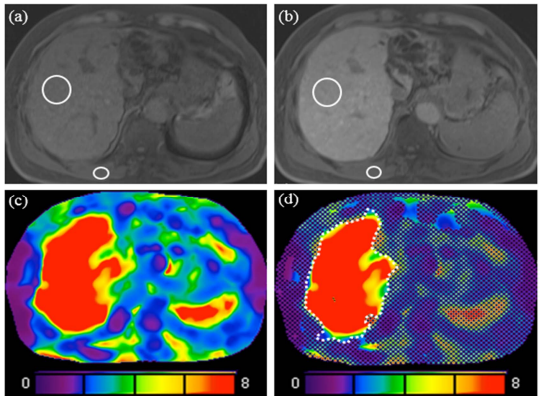

Figure 2. A 69 year-old male underwent Gd-EOB DTPA enhanced MRI and MRE. (a) Pre-contrast phase. (b) Hepatobiliary phase of T1 weighted image. The region of interests (ROIs) were placed on liver parenchyma and para-spinal muscle at pre-contrast and hepatobiliary phase (solid line). (c) MR elastogram. (d) Liver stiffness value was determined by placed a ROI as large as possible in the statistical confidence area (dotted line).

Conclusion

The diagnostic performance of MRE for staging hepatic fibrosis was better than Gd-EOB-DTPA enhanced-MRI. MRE seems to be a promising non-invasive tool for staging and predicating hepatic fibrosis.