Magnetic Resonance Elastography of the Liver: Comparison Between Echo Planar Imaging and Gradient-Echo Sequence

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[Target audience] This presentation will be targeted to audience interested in magnetic resonance elastography (MRE) and liver stiffness measurement.

[Purpose] MRE is a novel functional imaging technique to measure liver stiffness. Spin-echo echo-planar imaging–based MRE with 3D post-processing algorithm (EPI-MRE) is supposed to be less susceptible to hepatic iron deposition and provide more accurate stiffness value than the prototype gradient echo-based MRE with 2D post-processing algorithm (GRE-MRE). The purpose of this study was to compare measured liver stiffness value, inter-rater agreement, and susceptibility to hepatic iron deposition between EPI-MRE and GRE-MRE sequences.

[Methods] We performed liver MRE on a 3-tesla clinical scanner using both sequences in 60 patients with chronic liver disease. The acquisition parameters for EPI were TR/TE = 500/50 ms, continuous sinusoidal vibration = 60 Hz, slice thickness = 4 mm with 1.5-mm spacing, FOV = 40 x 40 cm^2 with matrix = 96 x 96, NEX = 2, parallel imaging factor = 2, number of slices = 7, while those for GRE were TR/TE = 50/20 ms, continuous sinusoidal vibration = 60 Hz, slice thickness = 10 mm, FOV = 35 x 35 cm^2 with matrix = 256 x 80, NEX = 1, flip angle = 23 degree, number of slice = 1. Region of interests (ROIs) were selected in the surface area of the liver on the respective stiffness maps by 2 observers. Liver stiffness was measured as a mean pixel value of the ROI (kPa). The estimated hepatic iron deposition was calculated by placing an ROI on T2* map created from multi-echo gradient echo sequence. The liver stiffness values measured by EPI-MRE and GRE-MRE were compared. Correlation coefficient was calculated to evaluate the inter-rater agreement between the 2 observers. The susceptibility effect on the images were also assessed by referring to the T2* values of the liver.

[Results] The mean difference of the liver stiffness values between EPI-MRE and GRE-MRE was -0.46 ± 0.1 (95% confidence interval: -0.69, -0.22, $p < 0.001$, Figure). The inter-rater agreement of liver stiffness measurements in each sequence was excellent for both EPI 3D MRE ($r = 0.949$) and GRE 2D MRE ($r = 0.944$). There was no significant correlation between estimated hepatic iron deposition and measured stiffness value even in GRE 2D MRE.

[Discussion] 3D MRE can deal with vertically or obliquely propagating shear waves as well as horizontal waves, and thus, provides more precise estimation of the wave propagation than 2D MRE. EPI 3D MRE showed lower values of liver stiffness than GRE 2D MRE in this preliminary study, which is probably because the oblique wave propagation can be corrected in the 3D algorithm.

[Conclusion] EPI 3D MRE shows lower values of liver stiffness than GRE 2D MRE. Both sequences shows excellent inter-rater agreement and comparable susceptibility to hepatic iron deposition.

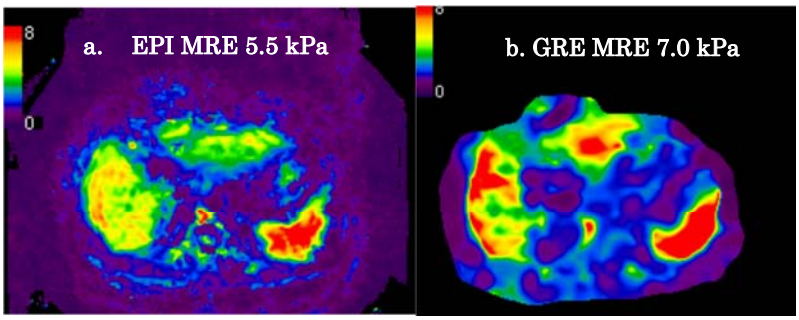

Figure
(a) Liver stiffness value on EPI MRE was 5.5 kPa; (b) Liver stiffness value on GRE MRE was 7.0 kPa, in the same patient.