Quantification of Hepatic Iron Overload: Usefulness of Echo-Planar Imaging Based Diffusion-Weighted Magnetic Resonance Imaging

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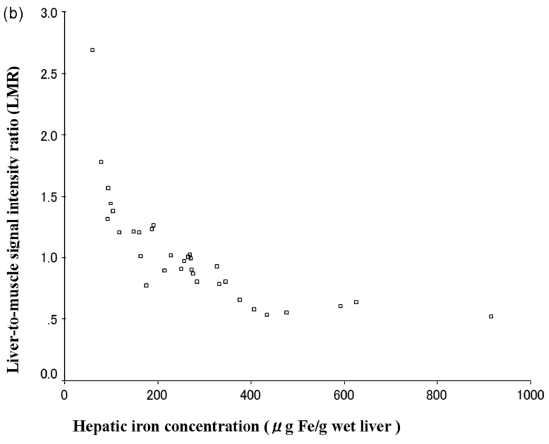
Purpose: MRI is sensitive to tissue iron overload because iron leads to a decline of magnetic resonance signal due to T2-shortening effect related to the paramagnetic properties, and recently has become suitable technique for quantifying hepatic iron overload noninvasively. It is generally accepted that gradient-recalled echo (GRE) sequences are the most sensitive sequence to quantify mild degree of hepatic iron overload. We postulated that EPI sequence might be more superior to GRE sequence for the quantification of more subtle hepatic iron stores, because echo-planar image (EPI) sequence is also sensitive sequence to susceptibility effects or T2-shortning effects. The aim of this study was to assess the usefulness of echo-planar image based diffusion- weighted image (EPI-DWI) for quantifying subtle hepatic iron stores in patients with viral hepatitis.

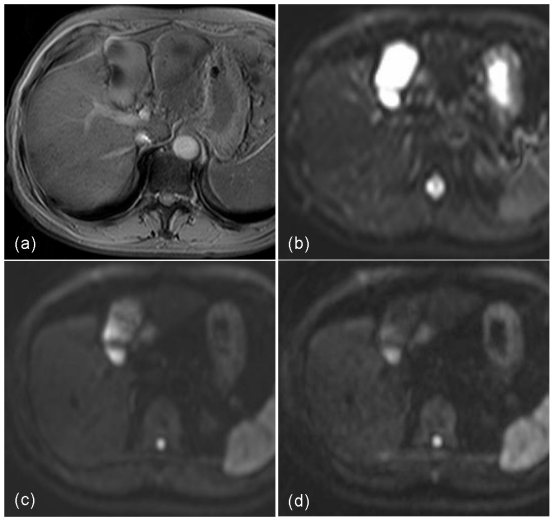
Patients and Methods: The institutional review board approved this retrospective study and waived informed consent. The study examined 34 patients including chronic hepatitis (n = 24) and cirrhosis (n = 10) due to hepatitis B or C virus infection who underwent both hepatic surgery for hepatocellular carcinoma (HCC) and MRI including EPI-DWI (*b*-factors of 0, 500 and 1000 s/mm^2) and T2-weighted GRE sequences. Biochemical assessment for the measurement of hepatic iron concentration (μg/g wet liver) was performed by using Spectrophotometry in all patients. Interobserver agreement of liver-to-muscle signal intensity ratio (LMR) measured by two observers on each sequence was evaluated by Bland–Altman's method (mean bias ± 1.96 standard deviations). Correlation between LMR on each sequence and hepatic iron concentration was assessed by Spearman's rank correlation coefficient.

Results: There was suitable interobserver agreement for each LMR measurement. Interobserver agreement for LMR on DWI (b = 0) was -0.03 ± 0.24 with 95% limits of agreement. EPI -DWI correlated more closely with hepatic iron concentration [Spearman r = -0.91 for b of 0, r = -0.89 for b of 500 and r = -0.85 for b of 1000; P < 0.001, respectively] than did T2-weighted GRE sequence (r = -0.74; P < 0.001).

Conclusion: EPI-DWI might be useful technique for quantifying subtle hepatic iron stores noninvasively in patients with viral hepatitis.



Graphs displays scatterplots of LMR and hepatic iron concentration (μ g/g wet liver) on T2-EPI. Scatterplots for all sequences show inverse linear correlation of LMR with hepatic iron concentration.



MR images on each sequence in 56-year-old man with liver cirrhosis due to C viral infection and with hepatic iron concentration of 592.5 (μg/g wet liver): (a) T2-GRE, (b) T2-EPI, (c) DWI (b = 500), and (d) DWI (b = 1000). EPI-DWI (b), (c), (d) are sensitive to hepatic iron overload and produces definitive decrease in liver signal intensity.