

Hepatic Fibrosis by Chronic Viral Hepatitis: Segmental Localization of Degree of Fibrosis Using Double Contrast Material-Enhanced MRI

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Background

During the generation of hepatic fibrosis, the atrophy-hypertrophy complex of the liver induces contour changes, including atrophy of the right lobe (RL) and medial segment (MS), hypertrophy of the caudate lobe (CL) and lateral segment (LS). Gadolinium chelates display a delayed distribution into fibrotic tissue, thereby causing delayed enhancement of hepatic septal fibrosis during T1-weighted imaging. Superparamagnetic iron oxides (SPIOs) accumulate within the reticuloendothelial cells of the liver, causing T2 and T2* shortening, thereby decreasing the signal intensity of the background parenchyma in the cirrhotic liver. Based on a gradient-echo T1-weighted sequence with a longer echo time, it is possible to directly visualize reticular fibrosis and regenerating nodules on the double contrast material-enhanced MRI (DC-MRI). We hypothesized that direct visualization of reticular fibrosis would enable us to evaluate geographic differences in fibrotic changes and their associations with the atrophy-hypertrophy complex of different lobes and segments in cirrhotic livers. Because the hepatitis B virus is usually associated with macronodular cirrhosis and the hepatitis C virus is usually associated with micronodular cirrhosis, we also hypothesized that the distribution of hepatic fibrosis would differ depending on the type of viral infection which might be related to the recently reported differing prevalence of the fibrosis-induced gross morphologic signs between the two types of viral infection.

Purpose

To identify the geographic differences in hepatic fibrosis arising from chronic B or C virus-induced hepatitis and their associations with the morphologic changes of the atrophy-hypertrophy complex with use of DC-MRI.

Materials and Methods

MR imaging was performed with a 3 T unit (Signa EXCITE; GE Medical Systems, Milwaukee, WI, USA) or 1.5 T unit (Magnetom Avanto; Siemens, Erlangen, Germany). After multiphasic gadopentetate dimeglumine (Magnevist; Bayer HealthCare)-enhanced dynamic imaging, ferucarbotran (8 μ mol iron/kg of Resovist; Bayer HealthCare) was intravenously administered as the second contrast agent of SPIO. After 10 minutes, a gradient-echo sequence (TR/TE, 134/10 msec; flip angle, 35° or TR/TE 196/10 msec, flip angle 30° depending on MRI vendor) was added for post-SPIO T2*-weighted imaging. Twenty-two consecutive patients with cirrhosis with chronic hepatitis C virus infection (C-viral group) and 35 randomly selected cirrhotic patients with chronic hepatitis B virus infection (B-viral group) were subjected to a retrospective analysis. The fibrosis grade of RL, CL, MS, and LS of the liver were visually assessed using a 5-grade scale on DC-MRI. The presence of cirrhotic morphologic signs (expansion of gallbladder fossa and the formation of a right posterior hepatic notch) was assessed in the livers of each viral group.

Results

The CL was relatively spared from hepatic fibrosis compared to the RL or MS in the C-viral group ($p=0.005$), whereas all lobes were similarly affected in the B-viral group ($p=0.221$). The right posterior hepatic notch was more frequent in patients with intersegmental differences in fibrosis between the RL and CL ($p<0.001$). All 8 patients with more advanced fibrosis of the MS, as compared to the LS, had signs of an expanded gallbladder fossa (100%), whereas 40 (82%) of the remaining 49 patients with homogeneous fibrosis had the same signs ($p=0.327$).

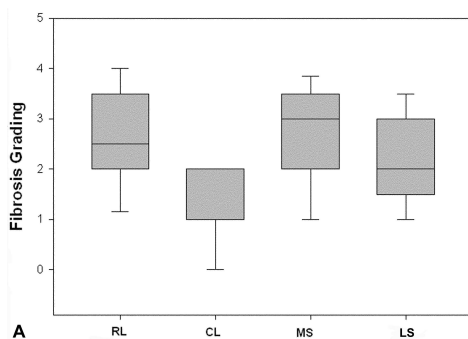


Fig. A. Box plots showing segmental fibrosis grading in C-viral group. Caudate lobe shows significantly low fibrotic grade distinguished from other segments.

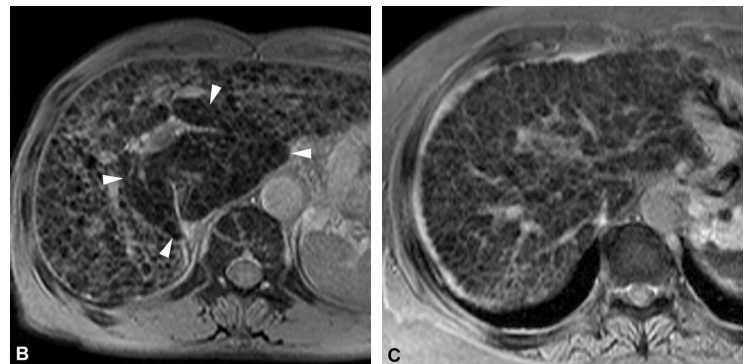


Fig. B. 60-year-old man with C-viral induced cirrhosis. Double contrast material-enhanced gradient echo (196/10) T2*-weighted image obtained by 1.5 T unit depicts diffuse hyperintense reticulations in the entire liver except the area of hypertrophic caudate lobe (arrowheads).

Fig. C. 60-year-old woman with B-viral induced cirrhosis. Double contrast material-enhanced gradient echo (196/10) T2*-weighted hepatic MR image obtained by 1.5 T unit depicts homogeneous reticular fibrosis involving the entire liver without any evidence of caudate lobe hypertrophy.

Conclusion

DC-MRI demonstrated the geographic or intersegmental differences of hepatic fibrosis in the C-viral group distinguished from the B-viral group showing no remarkable variations among the different hepatic segments. The relative lack of fibrosis in the CL and the more advanced fibrosis in the RL causes a right posterior hepatic notch especially in the patients with chronic C-viral hepatitis, whereas expansion of the gallbladder fossa is not closely related to the intersegmental differences in hepatic fibrosis regardless of the sorts of the viruses.