

T1 mapping on gadoxetate disodium enhanced MRI in patients with primary sclerosing cholangitis (PSC)

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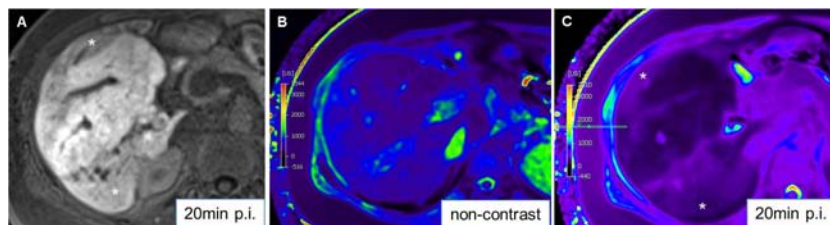
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Target audience: Clinical radiologists performing hepatobiliary imaging.

Purpose: Primary sclerosing cholangitis is a chronic cholestatic liver disease of unknown etiology, characterized by diffuse fibrosing inflammation and obliteration of bile ducts. Complications include the development of cholangitis, biliary cirrhosis and cholangiocarcinoma¹. Gadoxetate disodium is a liver specific contrast agent which shows an uptake by hepatocytes and subsequent biliary excretion of 50%². Further, biliary contrast excretion is known to be delayed in patients with PSC and impaired liver function³. The purpose of the study was to assess the value of T1 mapping of the liver on gadoxetate disodium enhanced MRI in patients with PSC for evaluation of liver function, and to determine a possible correlation with severity of disease.

Methods: 40 patients (27 males, 13 females; mean age 43 years) with confirmed diagnosis of PSC who underwent gadoxetate disodium enhanced hepatic MRI on a 1.5T system were included in this prospective IRB-approved study. T1 mapping of the whole liver was performed using a 3D spoiled gradient echo sequence with flip angles (5°, 15°, 20°, 30°) before (TP1), and approximately 16 minutes (TP2) and 142 minutes (TP3) after i.v. contrast injection. T1 values were measured by placing ROIs in each liver segment on identical positions of the corresponding datasets and compared (Wilcoxon Test). Mean T1 changes (TP1-TP2; TP1-TP3) were calculated and correlated with liver functions tests (Spearman), which were obtained within 24 hours of the MRI scan.

Results: Significant changes of T1 relaxation times between non-enhanced and gadoxetate disodium enhanced MRI could be observed in all liver segments ($p < 0.0001$), regarding both post-contrast imaging time points (TP1 and 2). Mean T1 value prior to contrast injection was 613ms (range 444-781ms), and after contrast injection 222ms (TP2; range 105-505ms) and 228ms (TP3; range 105-454ms), respectively, corresponding with a T1 decrease of 37% (TP2; range 15-80%) and 38% (TP3; range 15-91%). A significant correlation at early hepatocyte phase imaging with serum bilirubin ($p = 0.0007$), cholinesterase ($p = 0.0007$) and GOT ($p = 0.0005$) could be appreciated ($r = -0.49, 0.49$ and -0.50 , respectively)



25 year old female patient with confirmed diagnosis of PSC. Post contrast T1w VIBE (A) depicts areas of reduced signal (*) intensity consistent with focal confluent fibrosis. Corresponding T1 maps before (B) and 20 minutes after (C) contrast injection.

Discussion: On a segmental level, T1 relaxation times significantly decreased on gadoxetate disodium enhanced MRI in patients with PSC. Regarding the whole liver, the decrease of T1 relaxation times significantly correlated with bilirubin, cholinesterase and GOT, whereof fluctuations during the course of the disease are common. These findings may be useful for dynamic evaluation and follow-up of patients, as well as for guidance of biopsies. Future directions of study may also include the value of T1 mapping regarding assessment of early and small bile duct PSC as well as a possible improvement of tumor detection.

Conclusion: T1 mapping of the liver in PSC may serve as a useful method to assess liver function and probably indirectly severity of the disease on a global as well as on a segmental level.

References:

1. Weismuller TJ, Wedemeyer J, Kubicka S, et al. The challenges in primary sclerosing cholangitis – aetiopathogenesis, autoimmunity, management and malignancy. *J Hepatol* 2008;48 Suppl 1: S38-57.
2. van Montfoort JE, Stieger B, Meijer DK, et al. Hepatic uptake of the magnetic resonance imaging contrast agent gadoxetate disodium by the organic anion transporting polypeptide Oatp1. *J Pharmacol Ex Ther* 1999;290(1):153-157.
3. Ringe KI, Hinrichs J, Merkle EM, et al. Gadoxetate disodium (Gd-EOB-DTPA) in patients with primary sclerosing cholangitis (PSC) An analysis of hepatobiliary excretion kinetics. *J Magn Reson Imaging* 2013; in press.