Usefulness of a 3D Dual-Flip-angle T1 mapping technique pre and post Gadoxetic acid administration for the Assessment of Diffuse Liver Disease

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Target audience: Radiologists, physicists and technologists with interest in liver disease.

Purpose: Quantification of hepatic T1 relaxation time before and after Gd-EOB-DTPA has shown utility for evaluation of diffuse liver disease [1]. IR SE remains the standard for T1 relaxometry quantification; however, this technique is too long to be used in clinical practice [2]. Recent advances in MR technology with multichannel receiver coils with acceleration imaging capabilities have allowed the possibility of obtaining maps of magnetic relaxation within a breath hold. The purpose of this study was to assess the diagnostic value of a novel 3D FLASH dual-flip-angle (DFA) T1 mapping sequence with whole liver coverage, used before and after injection of gadoxetic acid (Gd-EOB-DTPA, Primovist/Eovist) for the evaluation of diffuse liver disease.

Methods: Patients who underwent gadoxetic acid-enhanced MRI of the liver at 1.5T (Aera, Siemens) using a 3D-DFA-T1 mapping sequence before and 20 min. post contrast (hepatobiliary phase, HBP) were included in this retrospective IRB approved study. Sequence parameters were: TR/TE 3.6/1.4, FA 2-11°, slice thickness 4 mm, FOV 260 x 260 mm, 256x320, 2 averages, GRAPPA 3. One observer placed 6 ROIs (2 cm^2) in right and left hepatic lobes (in 3 different slices) for measurements of T1 relaxation time (msec). ΔT1(%) was calculated as: [(T1pre-T1post)/T1pre] x100). Baseline, HBP T1 relaxation times and ΔT1 were compared between cirrhotic and non-cirrhotic livers and between Child Pugh A and Child Pugh B+C patients using Mann Whitney U test. Diagnostic performance of ΔT1 to predict cirrhosis was evaluated using ROC analysis. Variability of T1 values across the liver was assessed by calculating coefficient of variation (CV).

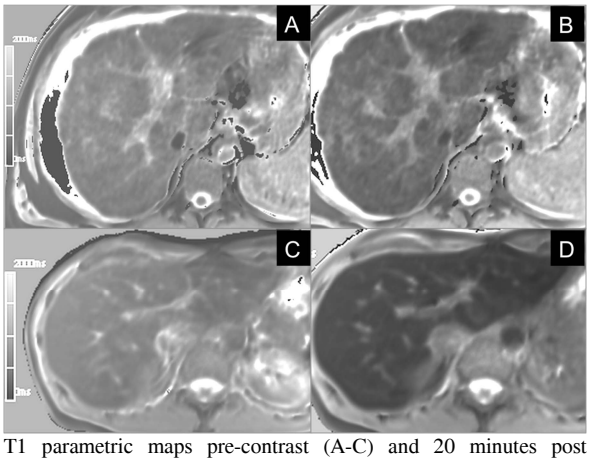
Results: 56 patients (M/F 34/22, mean 62 y) including 19 non-cirrhotic and 37 cirrhotic (Child Pugh scores A=20, B=10, C=7) were evaluated. There was no significant difference between baseline liver T1 for cirrhotic vs. non-cirrhotic patients, while ΔT1 was significantly lower in cirrhotic livers **(Fig.)**. Patients with Child Pugh B+C had significant prolonged T1 relaxation times and lower ΔT1 in comparison with Child Pugh A patients **(Table)**. There was a moderate significant negative correlation between ΔT1 and Child Pugh scores (r -0.5, p <0.0001). AUCs for predicting liver cirrhosis were 0.82 for post-contrast T1 and 0.85 for ΔT1. Cut-off ΔT1 value to distinguish between cirrhotic and non-cirrhotic patients was 64% (sensitivity 78%, specificity 80%). Mean CV for T1 relaxation times within the liver was 12% and 11% for T1 baseline and post-contrast respectively and 17.8% and 16.5% between the right and left hepatic lobes for T1 baseline and T1 post-contrast respectively.

	Non-cirrhotic (n=19)	Cirrhotic (n=37)	p	Child Pugh A (n=20)	Child Pugh B+C (n=17)	p*
T1 pre	608.9 ± 82.6	612.5 ±112.1	0.8	654.1 ± 95.4	563.3 ± 113.1	<0.016
T1 HBP	194.8 ± 40.2	288.4 ± 91.3	<0.001	258.5 ± 82.5	323.6 ± 90.7	<0.045
ΔT1 (%)	67.7 ± 6.4	52.5 ± 13.2	<0.001	60.7 ± 10	42.9 ± 9.5	<0.0045

T1 relaxation times (ms) of the liver and ΔT1(%) before and after gadoxetic acid administration. *p: Child-Pughes A vs B+C

Discussion: Baseline T1 relaxation time for non-cirrhotic livers were in good agreement with literature data at 1.5T (586 ± 39 msec)[3]. In addition, good reproducibility of T1 relaxation values was found across the liver parenchyma and between right and left hepatic lobes. No significant difference was observed in baseline T1 relaxation times between cirrhotic and non-cirrhotic patients, in disagreement with prior data [1, 4]. Significant lower ΔT1 was found for cirrhotic patients in comparison with non-cirrhotic livers in our population. In addition, patients with lower liver function (Child Pugh B and C) had significantly prolonged post contrast T1 relaxation times and lower ΔT1 in comparison with Child Pugh A patients, in agreement with Katsube et al [1]. The signal intensity of the liver parenchyma after gadoxetic acid administration depends on uptake by hepatocytes and biliary excretion [5], therefore quantification of the T1-shortening effect of gadoxetic acid in the liver parenchyma allows indirect assessment of liver function.

Conclusion: 3D T1 mapping sequence with whole liver coverage used before and after gadoxetic acid injection can help detect cirrhosis and evaluate liver function.



T1 parametric maps pre-contrast (A-C) and 20 minutes post contrast (B-D) at HBP in a Child C cirrhotic patient (upper row) and in a non-cirrhotic patient (lower row) demonstrate prolonged post contrast T1 relaxation values and lower ΔT1 in the cirrhotic (323 msec, ΔT1 44%) vs. non-cirrhotic liver (167 msec, ΔT1 67%).

References
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