Is there an effect of Gd-EOB-DTPA on hepatic T2 signal intensity and apparent diffusion coefficient?

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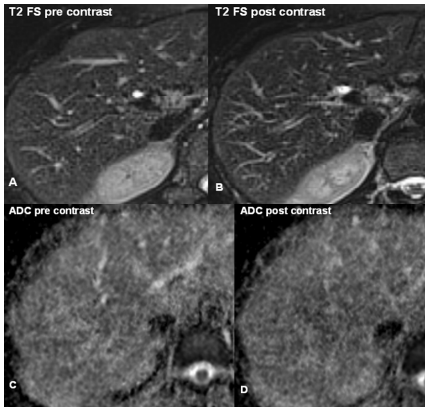
Background: Gadolinium ethoxybenzyldiethylenetriamine penta-acetic acid (Gd-EOB-DTPA) is recently FDA approved liver-specific MR contrast agent which is eliminated roughly in equal proportions via the biliary and renal systems. It has been shown to increase specificity of liver lesion characterization and has demonstrated increased sensitivity in detection of metastatic lesions when images are acquired approximately 20 minutes after contrast injection (in addition to routine dynamic post-contrast acquisition). However, extending routine liver imaging protocol by 20 to 30 minutes is not clinically feasible due to inefficient utilization of resources and increase patient discomfort due to increase in imaging time. One approach to streamline protocol and decrease exam time is to begin the examination by performing T1 pre and dynamic post contrast acquisitions, and acquiring T2 weighted (T2WI) and diffusion weighted (DWI) acquisitions between the equilibrium (~3 min after contrast injection) and delayed phase (~20 minute) acquisitions. However, to implement such a protocol, one must demonstrate that Gd-EOB-DTPA does not significantly affect signal intensity of liver and hepatic lesions on T2WI and DWI.

Purpose: The objective of the study was to compare relative T2 signal intensity and ADC values of the liver parenchyma as well as contrast to noise ratio (CNR) and ADC of focal liver lesions before and after Gd-EOB-DTPA injection.

Material and Methods: In this IRB approved retrospective study, we assessed 30 consecutive patients (11 M,19 F; mean age 58 y) who underwent Gd-EOB-DTPA enhanced imaging of the liver at 1.5T (Magnetom Avanto, Symphony, and Sonata, Siemens Healthcare) and had TWI and DWI performed prior to and after contrast injection. 23 patients received single dose (0.025 mmol/kg) and 7 patients received double dose (0.05 mmol/kg) of Gd-EOB-DTPA. Post-contrast DWI was performed with mean delay of 15 min (range 6-28 min). DWI was performed using axial breath-hold or respiratory-triggered SS EPI sequence (TR/TE 1600-3400/67-82/slice thickness 8 mm/ matrix up to 192x192/ parallel imaging factor 2) with b value of 0, 50, 500 or 0, 50, 500, 1000 s/mm^2, and gradients applied in 3 orthogonal directions. 2 region of interest (ROIs) were placed in the right lobe of the liver on 3 consecutive slices and the ADC values from all 6 ROIs was averaged to generate mean liver ADC for each patient before and after contrast injection. If focal lesion was identified, ADC values were measured before and after contrast injection by placing a large ROI over the lesion.

In 3 patients post-contrast T2WI was not performed. Breath hold axial T2 fat suppressed imaging was performed (TR/TE 3400/123/4mm/256x172) with mean delay of 12 min. (range 5-25 min.). T2 SI of the liver was measured by placing a single ROI in the right and left hepatic lobe on 3 consecutive slices and 6 ROI values were averaged to obtain mean liver T2 SI. ROIs were placed on the right and the left paravertebral muscles on the same slices and averaged. Relative T2SI (rT2) was expressed as: T2 SI liver/muscle prior to and after contrast injection. If a focal liver lesion was detected, contrast to noise (CNR) was calculated as (SI lesion –SI liver)/SI air on baseline and post-contrast acquisitions. Pre and post contrast ADC and rT2 measurements for the liver as well as CNR and ADC of the focal liver lesions were compared using a paired Wilcoxon test and Pearson correlation test. CV (coefficient of variation=SD/mean) was measured for rT2 and ADC of the liver as well as CNR and ADC of the focal liver lesions.



40 year old patient with chronic hepatitis B. **A&B** T2WI pre and post contrast. **C&D** ADC map pre and post contrast. Liver rT2 were 2.91 and 2.95, liver ADC were 1.53 and 1.48 x 10^{-3} mm^2/sec.

Results: There was no significant change in ADC of the liver but significant decrease in liver rT2 values after contrast injection. There was minimal variability in ADC and small variance in rT2 as shown in the **Table**. 12 focal lesions were identified (4 HCC, 2 cholangiocarcinoma, 3 FNH, 2 adenomas, and 1hemangioma) on T2WI and 6 lesions (2 HCCs, 1 cholangiocarcinoma, 2 FNH, 1 adenoma) were identified on DWI. CNR and ADC of the lesions demonstrated minimal variability pre and post contrast. There was excellent correlation between pre and post contrast ADC for liver parenchyma and lesion (r= 0.884 and 0.836 respectively; p<0.05). rT2 and CNR pre and post contrast values also demonstrated excellent correlation (r= 0.940 and 0.984 respectively, p<0.0001)

	Pre-contrast	Post-contrast	P*	CV
Liver ADC (n=30)	1.43 ± 0.23	1.44 ± 0.23	0.365	3.4% ± 4.2%
Lesion ADC (n=6)	1.53 ± 0.19	1.61 ± 0.21	0.295	4.5% ± 3.76%
Liver rT2 (n=27)	1.64 ± 0.90	1.46 ± 0.70	0.032	9.5% ± 8.8%
Lesion CNR (n=12)	22.85 ± 29.6	23.24 ± 31.1	0.505	13.2% ± 10.1%

*Paired Wilcoxon test

Conclusion: ADC values of liver parenchyma and liver lesions are not significantly affected by the use of Gd-EOB-DTPA, and variability in ADC was within expected reproducibility range due to noise. Furthermore, this was consistent with recent work by Gulani et al. that showed post contrast ADC values of the liver approach pre contrast values 5 minutes after contrast injection (using extracellular agents). However, there was mild decrease in liver rT2 after Gd-EOB-DTPA administration but without significant change in lesion CNR. As such, we suggest that Gd-EOB-DTPA liver protocol can be shortened by performing T2WI immediately after the equilibrium phase, followed by DWI.

References:

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