Robustness of a hybrid magnitude/complex method for liver fat quantification in the presence of a hepatobiliary contrast agent

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Target Audience
Clinical radiologists; abdominal MR radiologists

Purpose
Quantification of hepatic lipid content is an important emerging technique which holds promise for staging the disease as well as assessing response to treatment. The contrast agent gadoxetate (Eovist/Primovist, Bayer) is being increasingly used for structural and functional assessment of the liver, and adding lipid quantification sequences to these examinations may provide important, complementary metabolic information. In order to provide efficient clinical workflow, it would be advantageous to be able to perform lipid quantification after contrast administration, since there is typically a 20-minute waiting period between contrast administration and the acquisition of the final post-contrast sequences. The purpose of this study was to assess the reproducibility of hepatic fat fraction measurements obtained using a hybrid magnitude/complex MRI method in the presence and absence of gadoxetate.

Methods
The local institutional review board approved this prospective study. Abdominal MRI examinations from 10 consecutive subjects were performed on a 3 T MR system (Skyra, Siemens Healthcare) prior to and at 15-20 minutes post-injection of 10 mL of gadoxetate intravenously. The imaging method was a 3D technique with: FA 4°, TR 8.9 ms, first TE 1.23 ms, 6 echoes collected with ΔTE 1.23 ms. Single voxel spectroscopy (high-speed T2-corrected multiecho – HISTO) was performed prior to contrast administration using a 20x20x20 mm³ voxel placed in the liver, avoiding large vessels, and five echoes were collected (TE 12-72 ms) to perform T2 correction. A cubic ROI was chosen on the image data sets to co-localize with the spectroscopy (SVS) voxel.

The details of the image reconstruction method are reported in a separate abstract. Briefly, the image reconstruction includes T2*-correction, multi-fat-peak modeling, and provides separate solutions for the R2* values of fat and water. It uses a two-point Dixon method with flexible echo measurement does not add to the total examination time.

Results
Results of the regression analysis are shown in Figure 1. There was excellent correlation between the PDFF values measured post-contrast compared with both SVS (R² = 0.98, slope = 0.96, intercept = 0.11, p < 0.001) and the pre-contrast MRI method (R² = 0.97, slope = 0.99, intercept = -0.23, p < 0.001). The slope was not significantly different from 1 and the intercept not significantly different from 0 for either comparison. The Wilcoxon signed-rank test showed no statistically significant difference between the post-contrast measurement and either pre-contrast measurement (p > 0.2 for both comparisons).

Representative fat fraction images from one patient are shown in Figure 2, with PDFF of 8.6% measured after contrast administration by the MRI method, and 9.4% measured after contrast administration by the MRI method.

Discussion
The addition of lipid quantification to contrast-enhanced MR abdominal examinations would likely provide an efficient evaluation of hepatic metabolism, particularly if this could be accurately obtained following IV contrast administration without adding scan time to each individual patient. Our results demonstrate a very strong agreement between the PDFF measured after contrast administration using the MRI method and both pre-contrast measurements.

Conclusion
The PDFF measured after contrast administration agreed well with both pre-contrast PDFF measurements. Fat quantification can be performed accurately using this MRI-based method after administration of gadoxetate during the period spent waiting for the 20-minute delayed image, so that this measurement does not add to the total examination time.

References