The Impact of Dixon Fat Suppression on Liver T1 and DCE Perfusion Quantification

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Target Audience Radiologists, MRI physicists and scientists.

Purpose It has been shown that fat signal affects both T1 and [Gd] concentration estimation from fast GRE acquisition, while water-only images generated with Dixon technique can provide more accurate results[1-3]. The goal of this study is to evaluate the difference in the liver T1 and DCE MRI perfusion parameters measured from non-fat-suppressed in-phase images versus Dixon water-only images in a group of patients.

Methods With institutional IRB approval and written informed consent from patients, TWIST-Dixon technique[4] was used for liver MRI exam of 15 patients (age 18-69, 3 male/12 female)on a clinical 3T scanner. Flip angles of 5°, 10° and 20° was used to measure baseline liver T1. The dynamic pre- and post-contrast images were acquired with the infusion of 0.1mmol/kg Gd-BOPTA. Three sets of images at different time points were obtained in each breath-hold and a total of 18 sets image were obtained post-contrast. Liver perfusion parameter (K^{trans}, Ve, and iAUC) maps and T1 maps were calculated with both TWIST-Dixon in-phase and water-only images respectively using Tissue4D (Siemens, Erlangen, Germany) and MATLAB. Fat signal fraction ($Signal_{fat}/Signal_{in\text{-}phase}$) maps were calculated using MATLAB. The difference ΔX, defined as $X_{in\text{-}phase}$-$X_{water\text{-}only}$, for the measured parameters (T1, K^{trans}, Ve, iAUC) were ploted against fat signal fraction.

Results Figure 1 shows that, in a subject with low fat signal fraction, there was little difference in measured T1 (1069 ms using in-phase images, 1083 ms using water-only images) and K^{trans} (0.082 min^{-1} using both in-phase and water-only images) from either water-only or in-phase images; However, in another subject with high fat signal fraction, the T1 and K^{trans} using in-phase images were 792 ms and 0.223min^{-1}, rather different from 1112 ms and 0.164 min^{-1} respectively using water-only images. Regression analysis shows that the correlation between fat signal fraction and the differences between in-phase and water-only image based result were significant ($P<0.05$) for T1, K^{trans} and iAUC while not for Ve ($P=0.1$) (Figure 2).

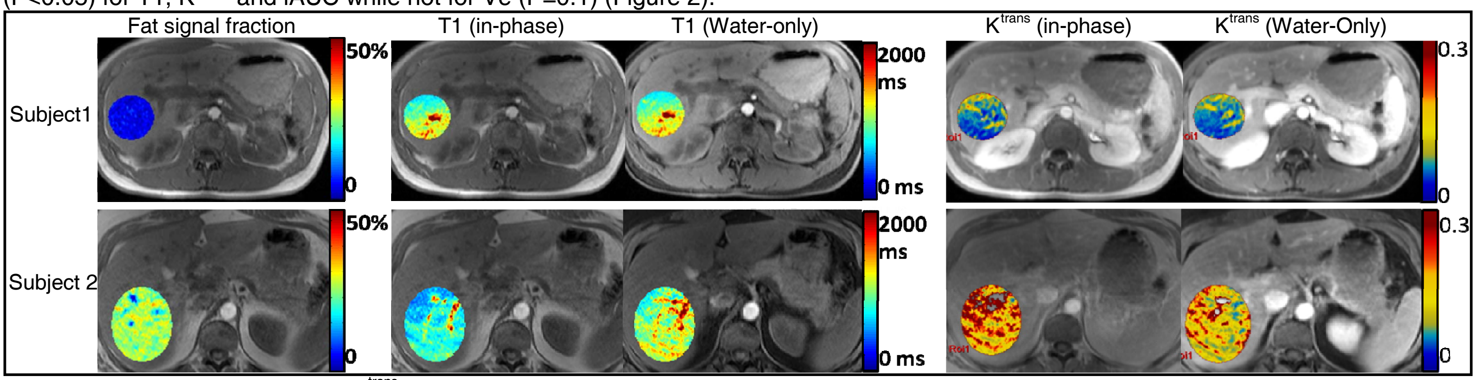

Figure 1. Fat signal fraction , T1 and K^{trans} maps from TWIST-Dixon in-phase and water-only images for two subjects.

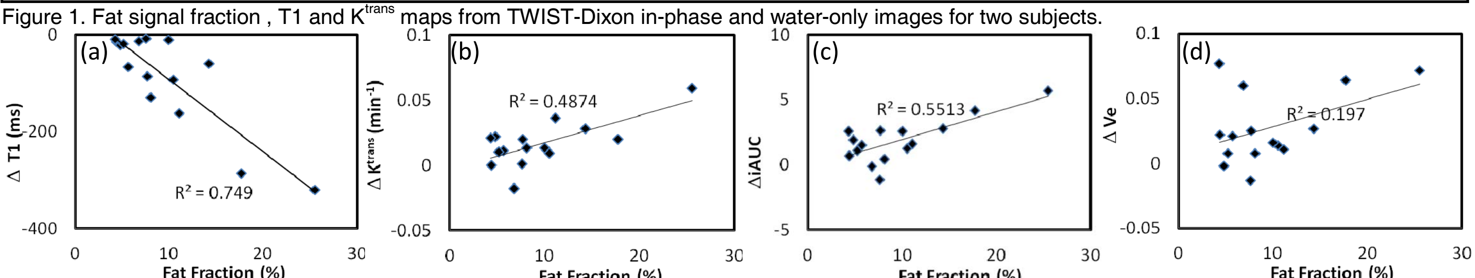

Figure 2. The difference between (a) T1; (b) K^{trans}; (c) iAUC; and (d) Ve derived from in-phase and water-only images versus fast signal fraction.

Discussion In this study, T1 and fat signal fraction values were averaged from the same ROI. In DCE perfusion quantification, image registration and ROI selection were performed separately for in-phase and water-only images, which may contribute to the difference in the perfusion results. Even so, a significant correlation was found between K^{tran} and iAUC differences and the fat signal fraction.

Conclusion Our results show that, in patients with higher liver fat signal fraction, there was a greater divergence between T1 and perfusion parameters measured using Dixon in-phase and water-only images. This result, together with our phantom study results[3], suggests that Dixon fat suppression allows more reliable DCE perfusion quantification.

Reference

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