

Does the measurement of liver and vertebral fat content influenced by R2* effect in T2*-IDEAL: A comparison study with

3-point IDEAL and MRS in healthy volunteers

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Introduction

Three-point Dixon IDEAL (iterative decomposition of water and fat with echo asymmetry and least-squares estimation, 3-pt IDEAL) techniques have been used to estimate liver fat content [1]. A multi-echo reconstruction technique, T2*-IDEAL, allows simultaneous measurement of water content, fat content, and T2* [2]. The T2*-IDEAL technique is able to estimate fat-content of liver in the presence of iron overload. The effects of T2* on the signal intensity of fat and water and subsequent fat content calculation on liver and vertebra have not been investigated yet. In this study, we aimed to verify the measurement difference of T2*-IDEAL on signal intensity and fat content of liver and lumbar vertebra compared to the 3-pt IDEAL.

Material and method

This preliminary study enrolled 13 healthy volunteers (7 men, 6 women, 44.1 ± 15.9 years) who were free any hepatic disease or iron deposition-related disease. 3D SPGR sequence was used for sequential acquisitions at three TEs (1.68/3.24/4.80 ms) for 3-pt IDEAL reconstruction with scanning parameters including TR (7.55 ms), matrix (256 × 128), BW (62.15kHz), slice thickness (8mm), slice number (8) and scan time (19 seconds). A multi-echo 3D SPGR sequence with flyback gradient readout was used to acquire six TEs (1.63/4.49/7.35/10.21/13.07/15.93 ms) for T2*-IDEAL reconstruction, with scanning parameters including TR (18.18 ms), slice thickness (8mm), slice/slab number (8). Two sets of images were acquired for T2*-IDEAL reconstruction using matrix size of 256 × 128 and 256 × 224 with a scan time of 9 seconds and 17 seconds, respectively. Three sets of images including fat-only, water-only and fat-fraction images were calculated from aforementioned protocols (Fig. 1). R2* maps were calculated from T2*-IDEAL reconstructions. For comparison, an additional H¹ MRS scan (TE/TR: 30/3000ms, voxel size: 1x1x2cm³) was also performed for fat content estimation. For measurements of fat content and R2* values, five ROIs were placed in the periphery of the right lobe liver parenchyma and another ROI was placed in the marrow of the lumbar vertebra as illustrated (Fig. 1). The H¹ MRS is processed using SAGE (research software of GE, US) for calculating the area of fat peak at 1.3 ppm and the area of water peak at 4.7ppm. Statistical analyses were performed by using SPSS 13.0 (SPSS, Chicago, Ill). Normality of the perfusion parameters was examined using Q-Q plots and Kolmogorov-Smirnov tests. Student t test was used for group comparisons of ADC. Linear regression analysis was used for correlation analysis of liver fat content measured by IDEAL versus MRS. A P value of less than 0.05 was considered as statistically significant.

Results:

The liver fat contents measured by 3-pt IDEAL and T2* IDEAL were significantly correlated with that measured by MRS with a correlation coefficient higher than 0.95 (P < 0.005) (Fig. 2). The R2* value was significantly higher in vertebra (127.98 ± 53.23) than in liver (34.61 ± 14.10) (P < 0.005). The liver fat content (7.03 ± 5.11%) was significantly lower than the vertebral fat content (46.25 ± 8.75%) (P < 0.005) (Fig. 3). In the liver, there was no difference regarding the signal intensity of fat, the signal intensity of water and the fat content measured by 3-pt IDEAL and T2* IDEAL (all P > 0.05). In the vertebra, the signal intensity of fat and water measured by T2* IDEAL was significantly lower than that measured by 3-pt IDEAL (P < 0.005), while the fat content measured by 3-pt IDEAL was in consistent with that measured by T2* IDEAL (all P > 0.05) (Fig. 3).

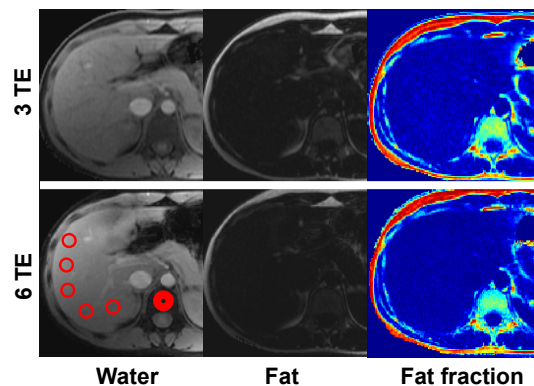


Fig. 1. Illustrations of water and fat images and fat content map.

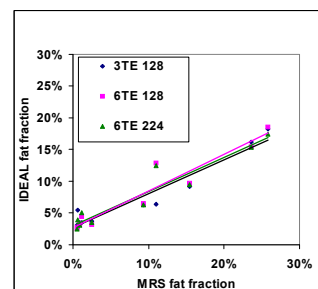


Fig. 2. Correlations between IDEAL versus MRS in liver fat content.

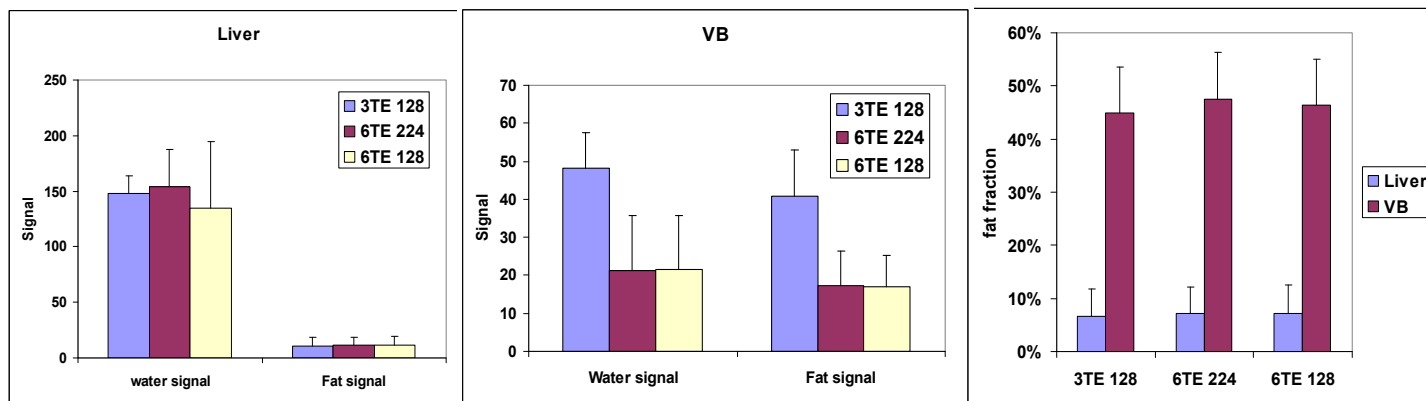


Fig. 3. Signal intensity of water, fat and fat fraction of the liver and vertebra (VB) measured by 3-pt IDEAL (3TE) and T2* IDEAL (6TE).

Discussion & Conclusion: Our results show that both 3-pt IDEAL and T2* IDEAL as suitable as MRS in measurement of fat content in both liver and vertebra. The higher R2* value of the vertebra is responsible for the lower signal intensity of both fat and water than the liver on T2* IDEAL. Our study suggests that T2* IDEAL is superior to 3p-IDEAL by providing more information of R2* effect, allowing either larger spatial coverage or higher resolution without compromising the fat content measurement. In conclusion, T2*-IDEAL is at least as good as 3-pt IDEAL and MRS in fat measurements in both liver and vertebra disregarding the R2* effect.

Reference: [1] Hyeonjin K, et al, MRM, 59:521(2008). [2] Huanzhou Yu, et al, JMRI, 26:1153(2007).