"Between weeks" reproducibility of 3.0 Tesla Magnetic Resonance Spectroscopy for measuring hepatic fat content

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Introduction:

Hepatic steatosis is characterized by increased hepatic fat content. Hepatic steatosis is present in about one third of the general population in Western countries. This condition is associated with a variety of disorders, including obesity, diabetes mellitus, hepatitis and drug toxicities. Invasive liver biopsy is the reference standard for histopathological assessment of hepatic steatosis. The utility of liver biopsy is limited because of its invasiveness, sampling errors, complications and inter-observer variability. Proton magnetic resonance spectroscopy (^{1}H-MRS) has proven to be a very sensitive non-invasive method to detect hepatic fat content and has shown to correlate with liver biopsy results. ^{1}H-MRS could also be suitable to determine hepatic fat content and follow up patients in clinical trails. However in longitudinal studies knowledge of reproducibility over time is necessary and so far no conclusive data are presented in the literature. Therefore the purpose of this study was to investigate "between weeks" reproducibility of 3.0T ^{1}H-MRS to measure hepatic fat content (HFC).

Patients and methods:

In this study we included 24 subjects: Six healthy subjects, 12 obese subjects and six subjects with familial hypobetalipoproteinemia (FHBL). Obesity and FHBL are conditions associated with increased hepatic fat content. We included these subjects to cover a broad spectrum of hepatic fat content. To study "between weeks" reproducibility all subjects were scanned at baseline and after four weeks. All ^{1}H-MRS measurements were performed in fasting condition on a 3.0T Philips Intera scanner. A voxel of 20 x 20 x 20 mm was positioned in the right hepatic lobe (figure 1). Spectra were acquired using a PRESS sequence with TE/TR 35/2000 ms and 64 signal acquisitions during free breathing. We evaluated the liver [1]H-MR spectra by using jMRUI software (figure 2). A ratio from the [1]H-MR spectra was calculated and defined as the total fat peak versus the reference H_2O peak. Calculated peak areas of water and fat were corrected for T2 relaxation and converted to a weight fraction representing % hepatic fat content. Reproducibility of both ^{1}H-MRS measurements was assessed by means of the Bland-Altman method and Repeatability Coefficient which allows calculating the 95% limits of agreement. Furthermore we calculated the Intraclass Correlation Coefficient and Coefficient of Variation. Difference between both ^{1}H-MRS scans was studied using the Wilcoxon Signed Rank test.
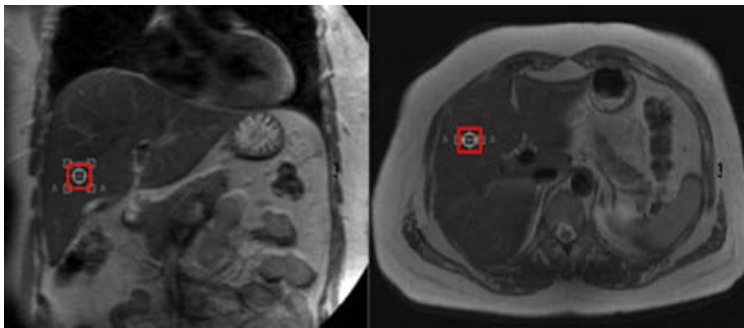

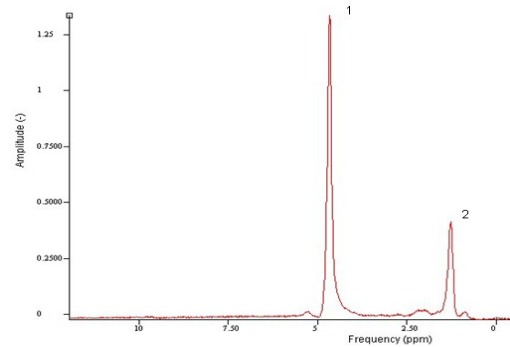*Figure 1*: voxel position in a liver at a coronal (left) slice and axial (right) slice

Figure 2: [1]H-MR spectrum of subject with increased hepatic fat content. 1) reference H_2O peak at 4.65 ppm, 2) increased total fatty acid peak at 1.3 ppm

Results:

Mean hepatic fat content in the first ^{1}H-MRS measurement (6.8% HFC) did not significantly differ from the second ^{1}H-MRS measurement (7.0% HFC), p=0.391. In figure 3 and 4 these results are represented in a scatter plot of both measurements and a Bland-Altman plot to show the limits of agreement between both measurements. The Coefficient of Variation between both scanning sessions was 9.5% and the Repeatability Coefficient was 1.3% HFC. The Intraclass Correlation Coefficient was 0.998 (p<0.001), indicating that these measurements are very reproducible.
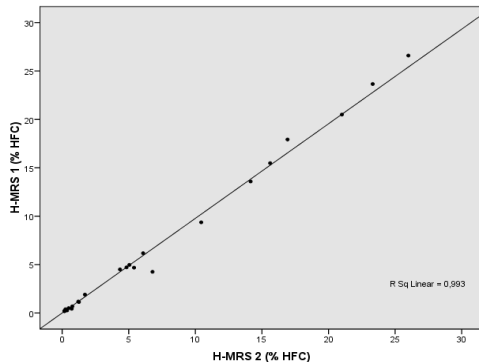

Figure 3: "between weeks" reproducibility of ^{1}H-MRS measurements
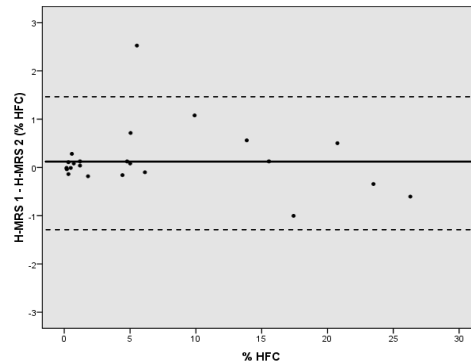

Figure 4: Bland-Altman plot representing 95% limits of agreement

Conclusion:

In this study we showed that "between weeks" reproducibility of 3.0T ^{1}H-MRS to measure hepatic fat content is highly reproducible in a spectrum varying from low to high hepatic fat content. "Between weeks" reproducibility displays an acceptable variation of 9.5%. Assessment of "between weeks" reproducibility is essential to detect abnormal variation in longitudinal studies. From our data it can be concluded that normal variation in a single subjects is lower than 1.3% HFC. Therefore 3.0T ^{1}H-MRS is very suitable to measure hepatic fat content in consecutive measurements in clinical practice.