Hepatic Lipid Quantification with MRS: BMI, T2, and Prandial correlations.

R. D. O'Connor[1], G. Skolnick[2], N. Nejedly[2], A. Bashir[1], and S. Klein[2]
[1]Radiology, Washington University, St. Louis, MO, United States, [2]Geriatrics and Nutritional Science, Washington University School of Medicine, St. Louis, MO, United States

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD), the most common form of chronic liver disease in adults, comprises a range of liver disorders extending from simple hepatic steatosis to end-stage liver disease and also has been associated with obesity and type II diabetes. The ability to diagnose NAFLD while still benign and the capacity to monitor interventions is essential. Currently, MRS is the only non-invasive method to access intrahepatocellular lipid (IHCL) accumulation. Several MRS protocols have been characterized for IHCL quantification, with varying results even for similar approaches. Here, in an effort to establish a reliable and robust assay, we characterize and compare several MRS protocols and conclude on an optimal method.

METHODS

Study Subjects. 5 NAFLD and 5 normal subjects were recruited.
In vivo MRS. After a twelve hour overnight fast, the subjects underwent MRS in a Siemens Avanto 1.5T to quantify their IHCL. For each of the *Te* values listed in Table 1, 10 breath-hold repetitions were acquired with both the standard Siemens PRESS and an optimized PRESS sequence and 20 repetitions from a free breathing navigator version of the optimized sequence. To access intraday variability, the protocols were repeated after removing the subjects from the magnet. The NAFLD subjects also ingested a 1280 high calorie, high fat meal and were reevaluated 2 hours later. To access interday variability, the NAFLD subjects returned within 7 days for reevaluation. Resonance areas were calculated with jMRUI/AMARES and extrapolations to $Te = 0$ were done using non-linear fitting with Sqrt[area] weighting.

RESULTS

The various coefficients of variation (CV) and the *p*-values, calculated via a two-tailed paired *t*-test, are listed in Table 1. Figures 1 and 2 show the correlations between %IHCL and T_2 values and pre- and postprandial evaluation, respectively.

Table 1.

Protocol	*Te* (ms)	CV (%) Intraday	CV (%) Interday	prandial *p*-value
2-Te Siemens	30,50	11.8	12.0	0.84
4-Te Siemens	30,35,40,50	13.0	13.0	0.93
5-Te Optimized	24, 30,35,40,50	4.7	6.9	0.07
5-Te Opt.PACE	24, 30,35,40,50	4.3	6.0	0.023

The results clearly show the necessity of measurements at multiple *Te* values, the importance of the sequence used, the potential variability due to the prandial state, and that an optimized protocol that can achieve a repeatability of 5%.

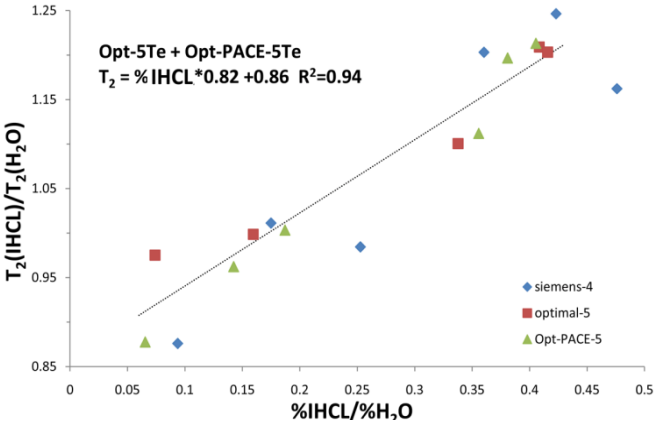

Figure 1. A plot of %IHCL vs the ratio of the T_2's. Only the values from the optimized sequence, including PACE, were used to calculate the line. The strong correlation demonstrates the need to use multiple *Te* values in IHCL MRS protocols.

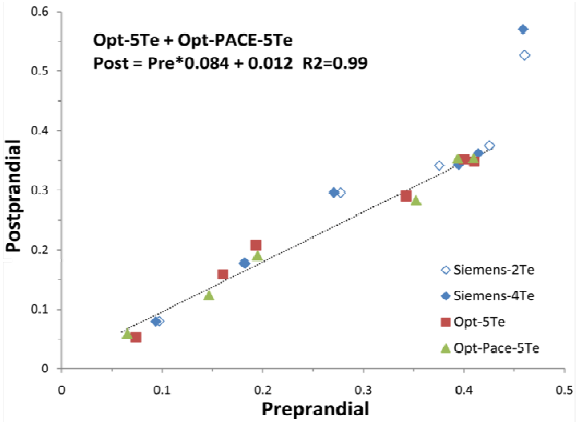

Figure 2. Correlation between pre- and postprandial IHCL values for the protocols using the optimized sequence.

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