^{1}H-MRS LINKS ADIPOSE TISSUE FAT COMPOSITION TO LIVER FAT CONTENT IN MEN WITH METABOLIC SYNDROME

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Introduction

The recent epidemic rise in metabolic syndrome/insulin resistance and type 2 diabetes are considered to be a result of a sedentary lifestyle combined with a high caloric diet. Earlier reports have consistently shown a link between a high fat intake, especially saturated fat, and insulin resistance [1]. More recently, the intake of simple carbohydrates, especially fructose, have been suggested to result in insulin resistance [2]. Liver fat content in subjects with metabolic syndrome closely correlates with insulin resistance [3], and is readily measured by ^{1}H-MRS [4]. Adipose tissue is the primary storage site for triglycerdies (fat), and much reasearch has focused on adipose tissue fatty acid composition as a marker of dietary fat composition. Adipose tissue is also implicated in the development of insulin resistance, with impared suppression of lipolysis suggested to result in accumulation of fat in the liver [3]. A non-invasive method for determining adipose tissue fat composition could provide new insights into the pathogenesis of insulin resistance. The objetive of this study was to use ^{1}H-MRS to measure liver fat content and adipose tissue fat composition in male subjects with metabolic syndrome.

Experimental

Twenty-nine male subjects with characteristics of the metabolic syndrome were recruited for the study. All MRI/MRS measurements were performed on a clinical 1.5 T MRI scanner (Avanto, Siemens). Liver spectra were obtained with PRESS, TE/TR = 30/3000ms in free breathing. A T1-weighted gradient echo imaging sequence with selective fat excitation was used to measure waist adipose tissue distribution. Adipose tissue spectra were obtained with PRESS (TE/TR = 135/3000ms) from the dorsal waist subcutaneous area, see localization in Figure 1. Subcutaneous (SAT) and visceral adipose tissue (VAT) were determined by segmentation software (SliceOmatic v4.3). All spectra were analyzed with jMRUI v3.0 using the AMARES algorithm. Liver fat content was determined according to [4]. Three indices of fat composition were obtained from adipose tissue spectra; olefinic/methylene (≈double bonds), diallylic/methylene (≈polyunsaturation) and methylene/methyl (≈saturated fat), see Figure 2.

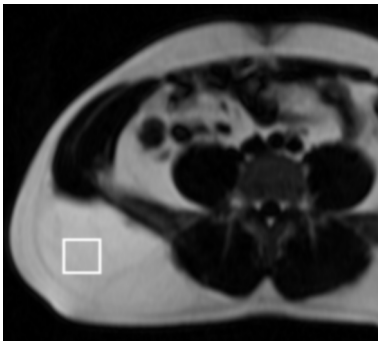
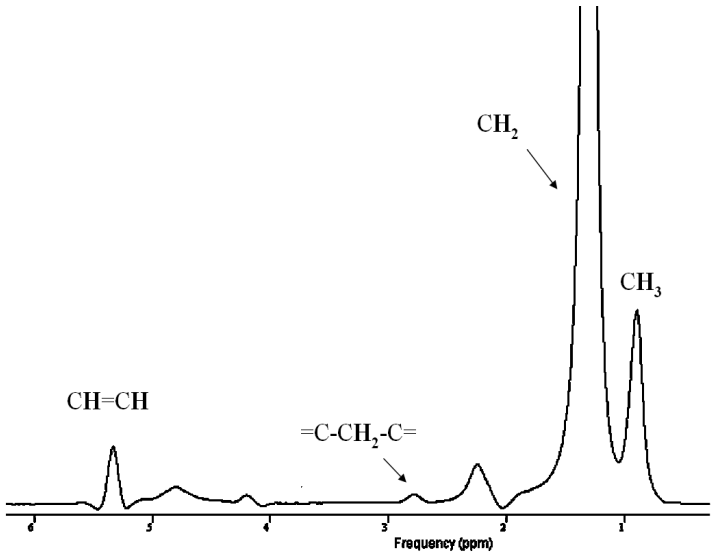


Figure 1. VOI Localization in subcutaneous adipose tissue.



Results

Of the three indices obtained from adipose tissue spectra, the methylene/methyl, an index of saturated fat, correlated negatively with liver fat content ($R = -0.577$, $P < 0.001$). Polyunsaturation (diallylic/methylene) correlated positively with age ($R = 0.492$, $P < 0.007$) and VAT ($R = 0.431$, $P < 0.02$). When corrected for age, the correlation between poly-unsaturation and VAT diminished ($R = 0.373$, $P = 0.08$).

Discussion

The results link low saturated fat content in adipose tissue to a high liver fat content in males with metabolic syndrome. The results may seem contradictory to what is known about dietary influence on insulin resistance. However, they agree with recent studies, which have linked high saturated fat in adipocytes to increased insulin sensitivity [5]. Also, adipose tissue polyunsaturation is known to increase with age [6].

Figure 2. Adipose tissue TE = 135 ms spectrum with fatty acid resonances labeled: olefinic at 5.3ppm (C**H**=C**H**), diallylic at 2.8ppm (=C-C**H$_2$**-C=), methylene at 1.3ppm (C**H$_2$**) and methyl at 0.9ppm (C**H$_3$**).

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