SIMULTANEOUS R2* AND FAT FRACTION DETERMINATION OF THE LIVER WITH MODULUS AND REAL MULTIPLE GRADIENT-ECHO MRI

N. Ohno[1], T. Miyati[1], E. Ono[1], H. Kasai[2], M. Hara[2], Y. Shibamoto[2], M. Kawano[2], M. Asahi[2], T. Okuaki[3], and T. Yamamoto[4]

[1]Kanazawa University, Kanazawa, Japan, [2]Nagoya City University Hospital, Nagoya, Japan, [3]Philips Electronics Japan, Tokyo, Japan, [4]Kanazawa University Hospital, Kanazawa, Japan

INTRODUCTION:

To evaluate the liver metabolism, T_2*-IDEAL [1, 2] is useful for assessment when there is co-occurrence of hepatic steatosis and iron deposition, but this method is not necessarily implemented in standard MR imagers. Thus, we devised a method for analyzing R_2* (iron content), and fat fraction of the liver tissue simultaneously using modulus and real multiple gradient-echo (MRM-GRE) sequence [3, 4].

METHODS:

On a 1.5-T MRI, modulus images of seven gradient-echoes (2.1, 3.7, 5.3, 6.9, 8.5, 10.1, 11.7 ms) were obtained by MRM-GRE sequence at a time. A real part of the first echo image was also reconstructed to differentiate below and above the 50 percent fat fraction. The fat fraction and R_2* were obtained from the parameters of a theoretically fitted formula with each echo signal. R_2* and fat fraction were measured with MRM-GRE in the phantom (changing fat and iron content, respectively) and the liver in normal volunteers (control group; n=10) and patients with fatty liver (n=5).

RESULTS AND DISCUSSION:

R_2* value of the phantom showed a strongly positive correlation with the actual iron content (Fig. 1), and MRI-derived fat fraction of the phantom was in good agreement with the actual value (Fig. 2). MRI-derived fat fraction in fatty liver was significantly higher than that in the control group (Fig. 3). However, no significant difference in R_2* values was found between fatty liver and control groups. These results show that the MRM-GRE enables to differentiate the causes of signal reduction whether increasing R_2*, i.e., increasing iron content (hemochromatosis) or increasing fat fraction (fatty liver).

CONCLUSION:

The MRM-GRE method makes it possible to simply and accurately assess the fat content and the iron content. The ability to obtain both of them at the same time allows us to optimize the advantages of each and thereby obtain more information about the liver metabolism.

REFERENCES:

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[2] Yu H, et al, Magn Reson Med 2008; 60:1122-1134.
[3] Matsunaga S, et al, Med Imag and Info Sci 2006; 23: 8-10.
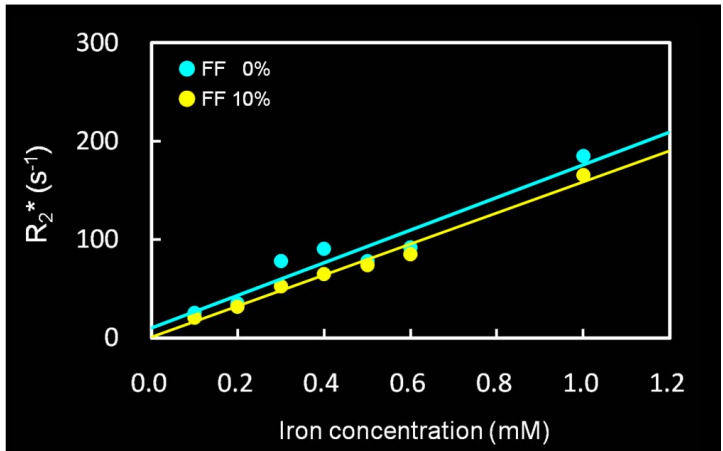[4] Arai N, et al, Jpn J Radiol Technol 2007; 63: 312-318.

Fig. 1. Relation between R_2* and iron concentration for phantom study.
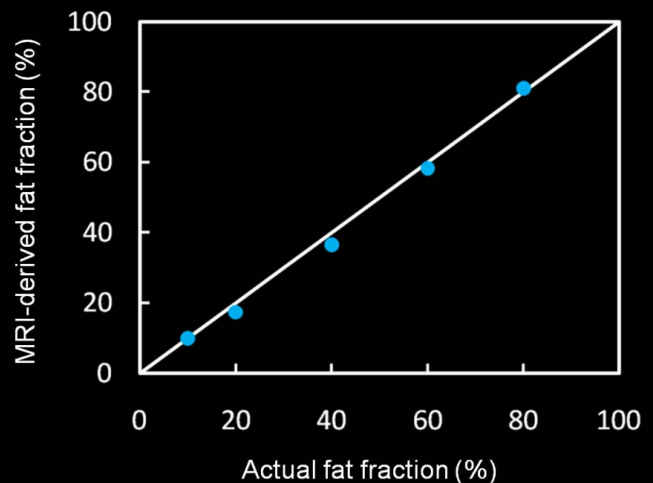

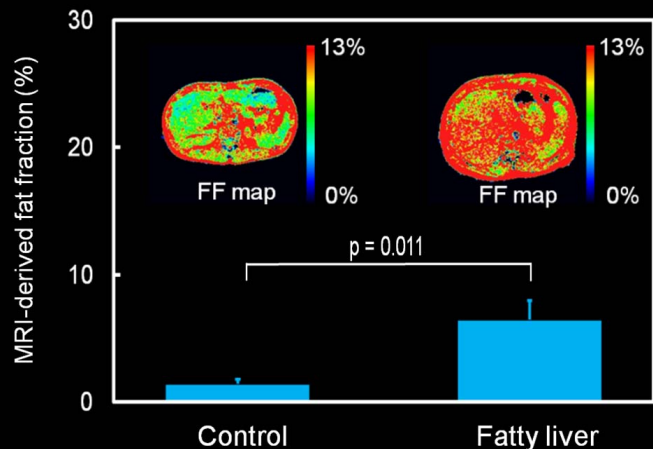Fig. 2. Relation between MRI-derived and actual fat fraction for phantom study.

Fig. 3. MRI-derived fat fractions (FF) in each group for human study.