

# Nonalcoholic Fatty liver Disease: Correlation of the liver parenchyma fatty acid with intravoxel incoherent motion MR imaging-An Experimental study in rat model

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## TARGET AUDIENCE

This study was focus on non-alcoholic fatty liver disease.

## PURPOSE

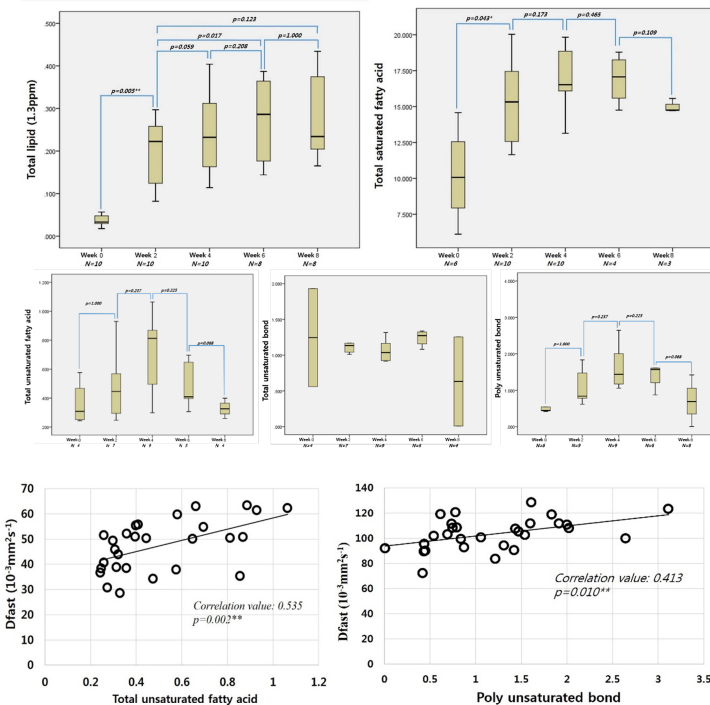
We evaluate the change in liver parenchyma fatty acid using a non-alcoholic fatty liver disease (NAFLD) rat model, depending on the high fat diet feeding period. We also investigate the correlation between each fatty acid and Dfast (capillary perfusion), Dslow (low molecular diffusion coefficients), and Pfraction (pseudorandom blood perfusion).

## MATERIALS AND METHODS

8-week-old, Sprague-Dawley rats were fed a 60% high fat diet for the duration of this experiment. MRI and MRS data were collected every 2weeks for 8weeks from <sup>1</sup>H-proton magnetic resonance spectroscopy (MRS) experiments. All MRI and <sup>1</sup>H MRS experiments were performed on a 3.0T MRI scanner with a 4-channel animal coil. We used a PRESS sequence for localized <sup>1</sup>H-MRS. The diffusion weighted image was obtained using two-dimensional multi-b value spin echo planar imaging (EPI) with multiple b values: 0, 25, 50, 75, 100, 200, 500, 1000 sec/mm<sup>2</sup>. The Dslow, Dfast and Pfraction were estimated with a least-square nonlinear fitting in MatLab (Mathworks, Natick, MA, USA) by fitting the DW signal decay in the region of interest to the IVIM by-compartmental model. For relative quantification, total lipid ((-CH<sub>2</sub>)-n / water), saturated fatty acid, total unsaturated fatty acid (TUSFA), total unsaturated bond (TUSB), and polyunsaturated bond (PUSB) were quantified by separating each peak area of (-CH<sub>2</sub>)-n, -CH<sub>2</sub>-C=C-CH<sub>2</sub>-, =C-CH<sub>2</sub>-C=, and -CH=CH- by -CH<sub>3</sub>. The spearman's correlation coefficient was used to evaluate correlation between each fatty acid and IVIM mapping image with a significance level of p < 0.05.

## RESULTS

The highest mean total lipid concentration was observed in week 8, with the value increasing steadily in preceding weeks. The concentration of total saturated fatty acid gradually increased to its highest value on 6week (16.99±2.99), and then decreased. A significant difference in mean value was observed between week 0 and week 2 (p=0.043), but there were no significant differences in the other experimental periods. The mean concentration of total unsaturated fatty acids, total unsaturated bonds, and poly unsaturated bonds did not differ significantly as the rats were fed the 60% high fat diet. The total lipid had a correlation with Dfast (r=0.333, p=0.012), and significant correlations with r=0.535 and 0.333 were found between total unsaturated fatty acid and Dslow (p=0.002) as well as total unsaturated fatty acid and Pfraction (p=0.030), respectively. The poly unsaturated fatty acid was correlated with Dfast (r=0.413, p=0.010), Dslow (r=0.413, p=0.011), and Pfraction (r=0.346, p=0.028).



## DISCUSSION

The total unsaturated fatty acid and poly unsaturated bond showed positive correlations with Dslow and Pfraction. The Pfraction is defined as the fractional volume of capillary blood flow, while the Dslow represents the true component of diffusion in each imaging voxel. The TUSFA and PUSB had positive effects on blood perfusion point in liver parenchyma.

## CONCLUSION

The NAFLD rat model was completed after 6weeks of a 60% high fat diet. The mean difference in TUSFA, TUSB and PUSB were not significantly affected by the high fat diet. TUSFA and PUSB were correlated with capillary perfusion.

## REFERENCES

[1] Joo, Radiology, 270:131-140 (2014),[2] Guiu, Radiology, 265:96-103 (2012)

**Figure 1.** The mean differences from the fatty acid comparisons of each week's mean quantification. The total lipid and TSFA showed the highest concentrations on week 8 and week 6, respectively. There was no significant mean difference in TUSFA, TUSB, and PUSB for any of the weeks.

**Figure 2.** The correlation coefficient value between IVIM mapping data and TUSFA and PUSB. The TUSFA and PUSB had significant correlations with Dslow and Pfraction. The blood perfusion TUSB and PUSB in the intravascular compartment with volume fraction (Pfraction) is described by the pseudorandom blood perfusion (Dfast), in which the extra vascular compartment is described by the true molecular diffusion (Dslow).