

Quantification of liver steatosis in morbidly obese patients: comparative performance of low-field open MRI and Steatotest

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Background Quantification of intrahepatic fat represents an important challenge in disease management for morbidly obese patients. Liver biopsy is often problematic with associated risks and limited volume of coverage. Alternate techniques include serum tests such as Steatotest(1) and MRI fat quantification(2). However, the diagnostic performance of Steatotest and MRI in steatosis grading have not been compared. Moreover, obese patients are often difficult to examine in conventional MRI systems (60-70 cm bore size and 1.5 or 3.0T field strength), and it may be necessary to examine these patients in open magnets at low field strengths. Therefore, we compare the diagnostic performance of Steatotest and low-field strength open MRI for hepatic steatosis grading in a cohort of morbidly obese patients.

Methods Nineteen patients (16 females, 3 males, median 41 years, range 24-64 years) were enrolled on the basis of prescription of bariatric surgery with associated hepatic biopsy. Informed consent was obtained. MRI acquisition was performed in a 1.0T open bore MRI system (Philips Healthcare, Best, The Netherlands). A multiecho gradient echo sequence was used, with a field of view of 41 × 45cm and three 10-mm thick contiguous slices. Fourteen echoes evenly spaced from 3.4ms to 48.3ms were acquired with a flip angle of 10°. Data processing was carried out with a numerical fitting procedure, using fat and water proton densities obtained using the in-out-in paradigm (3) as starting values. The data from each echo was weighted by its corresponding signal to noise ratio. The fit function included separate T2* values for the water and the fat compartments. The fat compartment was modeled as a generic fat spectrum with six resonances of fixed chemical shift and amplitudes(4). The fat and water proton densities derived from the fit were used to express a proton density fat fraction (PDFF) in percent. These measurements were compared to the Steatotest. The reference examination was the steatosis grade according to the Brunt classification at histopathological examination of liver biopsy. Statistical analysis was performed with receiver operating characteristic (ROC) analysis.

Results Proton density fat fraction (PDFF) was found to vary with the steatosis grade determined by histology. PDFF values of 7.7±6.5% (n=6), 10.0±4.4% (n=8), 15.5±10.8% (n=3) and 27.7±6.7% (n=2) were obtained for patients with histological steatosis grades 0, 1, 2 and 3, respectively (figure 1). The receiver operating characteristic for the detection of advanced steatosis (histology grade ≥2) yielded an area under the curve of 81% (p<0.05). By comparison, the area under the ROC curve obtained

with Steatotest was 52% (n.s.), significantly lower than the AUROC for PDFF (p < 0.05 using the DeLong method for comparing ROC curves). At a threshold of 14.25%, a sensitivity of 80% and a specificity of 86 % were obtained (positive / negative predictive values: 67% / 92%) for PDFF.

Discussion/Conclusion Although the results presented

here need to be validated on a larger sized cohort, the determination of the fat fraction at 1.0T MRI in an open field system yielded, under our experimental conditions, a better grading of liver steatosis than the serum Steatotest. Results were in agreement with those obtained at higher field strengths(5), indicating a potential usefulness of

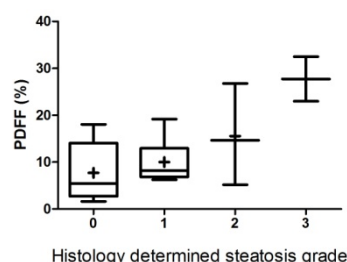


Fig. 1: Proton density fat fraction (PDFF) obtained at the different histologically-determined steatosis grades. PDFF determined at 1.0T in an open system is seen to increase with steatosis grade.

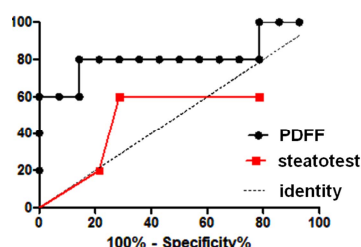


Fig. 2: ROC curves for the determination of severe steatosis by PDFF (black circles) or Steatotest (red squares). The PDFF performance is better than that of Steatotest for the determination of steatosis.

PDFF measurements for steatosis estimations on morbidly obese patients requiring open bore systems.

References

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