Effect of conventional gadolinium contrast agents on IDEAL based hepatic fat-fraction measurements

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Target audience – Radiologists & scientists with an interest in hepatic fat fraction measurements using MRI methods.

Purpose

Recently Hernando et al[1] studied the effect of a hepatocyte-specific contrast agent (Eovist/Primovist, Bayer Pharmaceuticals) on IDEAL based fat fraction measurements[2]. Previously Yokoo et al[3] investigated the effect of an extracellular gadolinium based contrast agent on hepatic fat quantification, using in- and opposed-phase imaging with different flip angles. However, we are not aware of previous work that investigated the effect of more widely used conventional gadolinium-based contrast agents on quantitative hepatic fat-fraction (HFF) measurements using a multi echo gradient echo technique (IDEAL)[2], which prompted us to explore this at 1.5T.

Methods

Population - 22 consecutive patients (14 males & 8 females) with a mean age of 55 years (range 18-86 years) referred for liver MRI, were imaged at 1.5 T (MR450W, GE Healthcare, Waukesha, Wisconsin, USA). Indications for MRI were: HCC follow-up (5), cirrhosis / HCC surveillance (6) and characterisation of focal liver lesions (12). *MR Technique* - Patients were examined using a chemical-shift encoded water-fat MRI sequence (IDEAL-IQ) with a low flip angle (8°), both before and after administration of a conventional gadolinium-based contrast agent (Gadovist®, Gadobutrol, Bayer Schering Inc., USA. Dose: 0.1mmol/kg). The timings of the post-gadolinium HFF acquisition relative to gadolinium administration were recorded for each patient. Imaging parameters were as follows: 3D axial slab, TR/TE1 = 17.1/7.1, matrix = 224x192, 40x32cm field of view, 10mm slices with 5mm overlap. *Analysis* - Circular ROIs (20 cm^2 area) were defined on the pre-gadolinium images using OsiriX (version 5.5.2, Pixmeo, Berne, Switzerland). ROI's were placed in the right lobe on 5 consecutive but non-overlapping slices, avoiding large vessels and focal liver lesions. Subsequently, the ROI's were copied to the matching locations on the post-gadolinium images. HFF values were averaged across slice locations and the resulting dataset pairs (pre- vs. post-gadolinium) were compared using a Bland-Altman analysis. The distributions were formally assessed to confirm normality (using a Shapiro-Wilk's test) and a paired Student's T-test was applied to detect any significant difference in the datasets (using the R programming language, version 3.1.1, The R foundation for statistical computing, Vienna, Austria). A p-value <0.05 was defined as statistically significant.

Results

The population HFF values pre- and post-gadolinium were 8.58±4.42 (range: 2.1-14.3%) and 8.43±4.45 (range: 2.2-15.2%) respectively, the difference was not statistically significant (p=0.452). Gadolinium was administered intravenously 4min. 3sec. (SD 1min. 4sec) before the post-gadolinium HFF measurement. The pre- and post- contrast HFF values were similar (Fig 1.): bias of 0.15% and the 95% limits of agreement (-1.63 to 1.92%).

Discussion

This study shows that low (8°) flip angle HFF measurements based on IDEAL[2], are not significantly influenced by a conventional gadolinium-based contrast agent. This confirms the findings of Hernando et al.[1] and Yokoo et al.[3] that post-contrast HFF measurements are valid using the appropriate parameters for both dual and multi echo techniques. These results allow for examination time reduction by performing the HFF acquisition in the interval between the dynamic phase and delayed phase imaging post-gadolinium.

Conclusion

This study shows no statistically significant difference between hepatic fat fraction measurements, based on the IDEAL technique, performed pre- and post- intravenous administration of conventional gadolinium chelates.

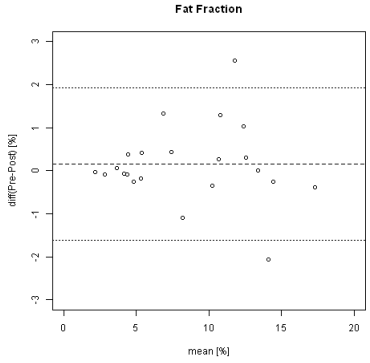

Figure 1: Bland-Altman scatterplot comparing hepatic fat fraction pre- and post-gadolinium

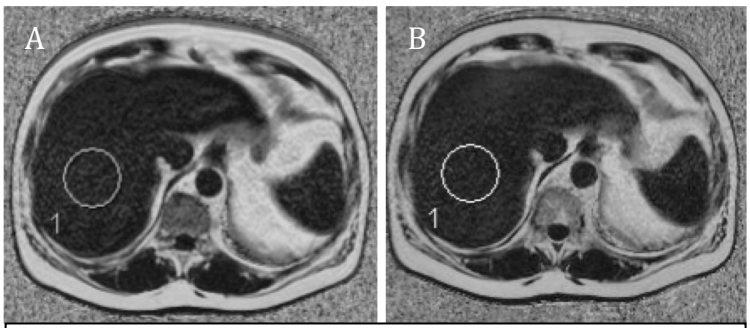

Figure 2: ROIs placed in the right lobe on a "fatfrac" processed image on (A) pre – HFF 7% and (B) post i.v. gadolinium – HFF 6%.

References

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