

Multiple flip angle measurement to quantify hepatic uptake of gadoxetic acid in MRI

Alexander Ciritsis¹, Daniel Truhn¹, Nils Krämer¹, and Christiane K. Kuhl¹

¹Department of Diagnostic and Interventional Radiology, RWTH University Hospital Aachen, Aachen, NRW, Germany

Clinical Relevance statement

MRI based measurement of hepatic function using Gd-EOB-DTPA can enhance diagnosis and treatment. We demonstrated that an absolute quantification of the hepatic Gd-EOB-DTPA uptake is possible.

PURPOSE

Gadoxetic acid (Gd-EOB-DTPA) is excreted via the liver and the kidney, about 50% each. To measure the hepatic function, recent research has relied on semi-quantitative measurements of signal intensities. This study describes a method to quantitatively assess the hepatic amount of Gd-EOB-DTPA based on T1-shortening.

MATERIAL AND METHODS

Seven patients were scanned at 1.5 T using a gradient echo sequence (TR=9.4 ms; TE=4.6ms) with five different flip angles (4°; 10°; 16°; 25°; 30°). 7 ml 0.5 M Gd-EOB-DTPA (= 3.5 mmol) were administered intravenously. The sequence was acquired in one breath-hold for each flip angle, respectively. T1-relaxation time was measured in five regions of interest in liver parenchyma before and 20 minutes after contrast medium injection. Using a least squares fit of the theoretical MR signal, T1-values were derived and the concentration of contrast agent in the liver tissue was calculated. A contrast agent calibration curve was measured in phantoms. After liver volumetry, the total amount of Gd-EOB-DTPA was calculated.

RESULTS

T1 was 601 ms before (Fig. 1) and 200 ms (Fig. 2) after Gd-EOB-DTPA administration, respectively. The concentration of Gd-EOB-DTPA in the liver parenchyma 0.52 μmol per ml liver tissue. A liver volume of 1502 ml resulted in a total hepatic Gd-EOB-DTPA uptake of 0.78 mmol which represents 22% of the Gd-EOB-DTPA given intravenously.

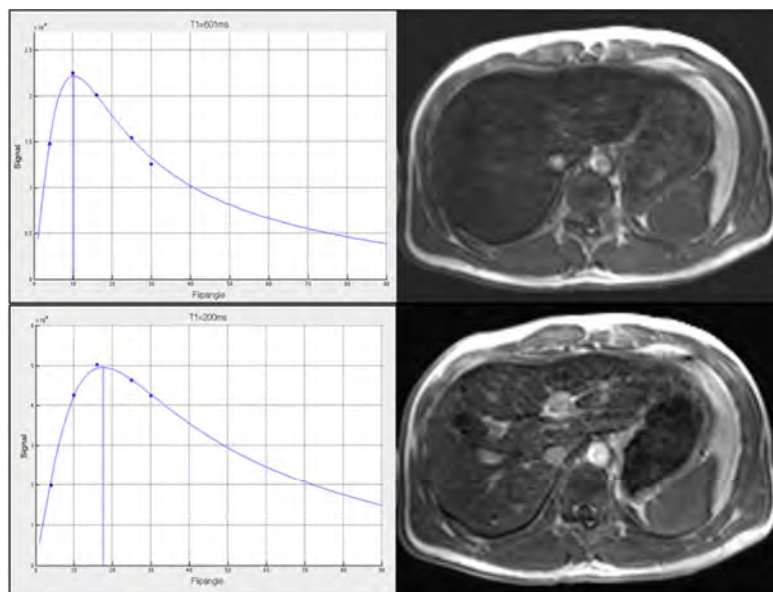


Fig.1

Right: The liver was scanned with GRE sequences applying different flip angles before (upper row) and 20 min after (bottom row) Gd-EOB-DTPA administration.

Left: Signals for different flip angles. The blue line marks the calculated signal function from which T1 values were derived (before: T1 = 601ms; after: T1 = 200ms).

CONCLUSION

The proposed method enables to quantify the amount of Gd-EOB-DTPA contrast agent which is taken up by the hepatocytes. Our uptake fraction of Gd-EOB-DTPA is in good agreement with values found in literature. This method may contribute to a more accurate quantitative MRI measurement of the liver function in different volumes of interest.

REFERENCES

1. Sourbron, S., et al., Combined quantification of liver perfusion and function with dynamic gadoxetic acid-enhanced MR imaging. *Radiology*, 2012. 263(3): p. 874-83.
2. Dahlqvist Leinhard, O., et al., Quantifying differences in hepatic uptake of the liver specific contrast agents Gd-EOB-DTPA and Gd-BOPTA: a pilot study. *Eur Radiol*, 2012. 22(3): p. 642-53.