Introduction

Time resolved MR Angiography is increasingly being used for body MRA applications as it provides additional functional information as well as seems to be a more robust and rapid technique for clinical use. While several concepts on implementing time resolved or multiphasic MRA have been proposed, we focused in this intraindividual comparison on the potential difference between a standard non-binding Gd-chelate (Gd-DTPA) and a weak protein interacting Gd-chelate (Gd-BOPTA) for abdominal MRA. Previous studies have indicated that Gd-BOPTA exhibits preferential properties for MRA.

Methods

An intraindividual, double blinded randomized, cross-over comparison was performed in five healthy volunteers (4 M, 1 F; age 25-32 years, mean 28 ± 2.3; weight 61-90 kg, mean 70 ± 11.5). The study was performed according to GCP and received a prior IRB approval. All volunteers gave informed consent. Gd-DTPA (Magnevist, Berlex Laboratories, Wayne, NJ) was chosen as the standard compound for MRA. Gd-BOPTA (MultiHance, Bracco, Princeton, NJ) is also a linear, ionic compound, but reveals weak interaction with serum albumin. Both agents were used in a concentration of 0.5 M.

All studies were performed on a 1.5 T clinical MRI system (Magnetom Vision Plus, Siemens Medical Systems, Iselin, NJ) equipped with a resonant echo-planar imaging gradient overdrive (25 mT/m; rt 300 µs) using a phased array body coil with four active elements. Contrast administration was standardized and injected using an MR compatible system ("Tomocart", Bruker Medical Systems, Switzerland). A standardized dose of 0.15 mmol/kg BW was administered at 3 ml/s followed by a saline FLASH of 20 ml. No prior test bolus acquisition was performed and acquisition was started always 10 seconds after start of the administration. A modified 3D fast FLASH sequence with an asymmetric k-space acquisition in the read-out, phase-encoding, and partition directions was used (TR = 3.2 ms, TE = 1.1 ms, flip angle = 40° and a band width of 650 Hertz/pixel). A multiphasic acquisition with five repetitions were acquired after a previous pre-contrast study during breathhold. Acquisition time was 6.4 s for each phase resulting in a total acquisition time of about 32 s. All volunteer studies were performed with a minimum of 48 hours between the subsequent studies.

Post-processing was performed in a blinded fashion for the following quantitative and qualitative analysis.

Qualitative assessment was performed as a blinded reader analysis using a continuous score from +5 (excellent) to -5 (unacceptable). For the read, MIP images after subtraction as well as access to MPR and source images were provided. The reader assessed the overall image quality, homogeneity of contrast, quality of cranial-caudal enhancement, utility of the multiphasic study and the portal-venous enhancement. Quantitative analysis was independently obtained by ROI analysis in the supra- and infrarenal aorta, in a segmental artery of the kidney, and in the portal vein. Dynamic contrast enhancement was calculated from the six temporal data sets per case.

Statistical analysis was performed using the Mann-Whitney (Wilcoxon) W-test as well as the t-test for the quantitative data, kappa-statistic was calculated to compare the different contrast agents.

Results

Qualitative assessment by blind reader found significant (p<0.02) higher scores for overall image quality and cranio-caudal enhancement for Gd-BOPTA and a trend for higher scores (p<0.1) for homogeneity, utility of multiphasic study and portal-venous enhancement. Quantitative analysis confirmed a significant (p<0.02) higher vascular enhancement for Gd-BOPTA at 8.580 vs. 3.939 for Gd-DTPA in aorta. This was also found at the smaller vessels, a significant (p<0.02) benefit was found for Gd-BOPTA (8.340 vs. 2.258). The portal-venous vascular enhancement was found to be higher for Gd-BOPTA.

While this study was designed to compare at a dose of 0.15mmol/kg BW, we believe that the clinical dose range seems to be 0.1 mmol/kg BW - 0.15 mmol/kg BW for Gd-BOPTA.

Conclusion

Gd-BOPTA demonstrated in the intraindividual comparison significant better vascular enhancement characteristics also for multiphasic MRA compared to the conventional Gd-chelate (Gd-DTPA). This agent promises to further improve multiphasic MRA.

Fig. 1a: Multiphasic MIP's every 6 seconds of Gd-DTPA (upper study) and Gd-BOPTA (lower study).

Fig. 1b: Quantitative ROI analysis in the supra- and infrarenal aorta shows higher contrast enhancement for Gd-BOPTA (upper plots) than for Gd-DTPA (lower plots).

References:

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