Contrast-enhanced MR angiography of the renal arteries: blinded multicenter crossover comparison of 0.1 mmol/kg gadobenate dimeglumine (Gd-BOPTA) and 0.2 mmol/kg gadopentetate dimeglumine (Gd-DTPA)

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Synopsis: Thirty-four patients underwent two identical contrast-enhanced MRA exams of the renal arteries. Gd-DTPA at 0.2 mmol/kg was used for one exam and Gd-BOPTA at 0.1 mmol/kg for the other. The CM were administered in randomized order at 2 ml/s. Qualitative evaluation by two independent blinded assessors revealed no significant differences in image quality between the two exams. Quantitative evaluation at regions-of-interest on the supra-, juxta- and infrarenal aorta revealed similar values for signal-to-noise and contrast-to-noise ratios. A trend towards increasing SNR and CNR on descending the aorta was apparent after 0.1 mmol/kg Gd-BOPTA but less so after 0.2 mmol/kg Gd-DTPA.

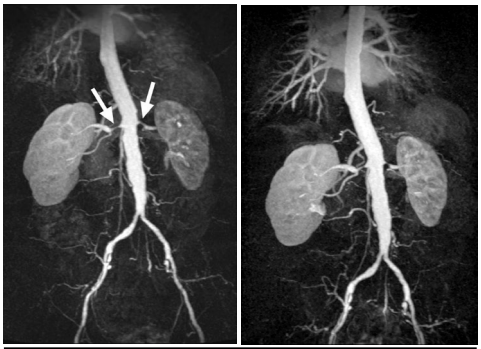
Background/Purpose: Conventional gadolinium contrast agents such as Gd-DTPA are routinely employed at a dose of 0.2 or 0.3 mmol/kg BW for contrast-enhanced MRA of the renal arteries (1). Gadobenate dimeglumine (Gd-BOPTA, MultiHance®, Bracco Imaging SpA, Milan, Italy) is a gadolinium contrast agent whose T1 relaxivity *in vivo* (r1=9.7 mmol•$L^{-1}s^{-1}$) is approximately twice that of Gd-DTPA due to a capacity for weak and transient interaction with serum albumin (2, 3). Unlike the situation with Gd-DTPA and other conventional agents, a Gd-BOPTA dose of 0.1 mmol/kg BW appears optimal for contrast-enhanced MRA of the abdominal aorta and renal arteries (4). The present intra-individual crossover study was performed to determine conclusively whether Gd-BOPTA at 0.1 mmol/kg can be considered equivalent to Gd-DTPA at 0.2 mmol/kg for contrast-enhanced MRA of the renal arteries.

Methods and Materials: Thirty-four patients at 3 centers underwent two identical renal MRA exams at 1.5 T separated by >48 hours but <12 days. The randomized order for CM administration was Gd-BOPTA/Gd-DTPA in 18 patients and Gd-DTPA/Gd-BOPTA in 16 patients. A phase-encoded 3D-spoiled breath-hold sequence (TR/TE/FA=<5/<2/45°, FOV=32-36 cm, 2 mm slices (n=32), 1x1x2 mm spatial resolution and acquisition time=<30 sec) was used after test bolus injection and calculation of time delay. Two blinded, independent readers qualitatively assessed randomized subtracted MIP images from each exam for diagnostic quality. A 3-point scale (diagnostic information poor=0, moderate=1, adequate=2) was applied to each of 9 vessel segments covering the abdominal aorta and left and right renal arteries to give an overall quality score between 0 and 18. Quantitative assessment (vessel SNR, vessel-muscle CNR) of unsubtracted source images was performed at ROIs placed on the supra-, juxta-, and infrarenal aorta and psoas muscle.

Results: No significant qualitative differences between 0.1 mmol/kg Gd-BOPTA and 0.2 mmol/kg Gd-DTPA were noted by either reader (reader 1: Gd-BOPTA=15.15, Gd-DTPA=15.23; p=0.94; reader 2: Gd-BOPTA=16.77, Gd-DTPA=17.01; p=0.46). The order of treatments likewise produced no differences: readers 1 and 2 reported quality scores of 14.4±4.2 and 16.7±2.3, respectively, when Gd-BOPTA was the first CM, and 15.2±1.8 and 16.6±1.6, respectively, when Gd-DTPA was the first CM. The scores when Gd-BOPTA and Gd-DTPA were the second agents were 16.0±3.0 and 15.3±2.9, respectively (reader 1), and 16.9±2.0 and 17.4±1.4, respectively (reader 2). Quantitative evaluation revealed no differences in mean SNR and CNR although increasing SNR and CNR on descending the aorta was seen with Gd-BOPTA (Table 1).

Table 1. Comparison of SNR and CNR values in the abdominal aorta after Gd-BOPTA and Gd-DTPA

CM	SNR			CNR		
	Suprarenal n=33	Juxtarenal n=33	Infrarenal n=18	Suprarenal n=33	Juxtarenal n=33	Infrarenal n=18
Gd-BOPTA	37.0 ± 13.4	44.3 ± 17.4	48.3 ± 11.9	32.5 ± 12.2	39.9 ± 16.6	44.2 ± 11.6
Gd-DTPA	37.1 ± 14.0	39.9 ± 13.3	40.6 ± 12.0	32.9 ± 13.8	35.9 ± 13.0	36.4 ± 12.2
p-values	0.972	0.173	0.052	0.850	0.186	0.051



MRA of the abdominal aorta and renal arteries of a 60-year-old woman after 0.1 mmol/kg Gd-BOPTA (left) and 0.2 mmol/kg Gd-DTPA (right). Stenoses (arrows) of both the right and left proximal renal arteries are depicted on both MIP images.

Discussion/Conclusion: The image quality observed after 0.1 mmol/kg Gd-BOPTA was similar to that observed after 0.2 mmol/kg Gd-DTPA. A tendency towards improved SNR and CNR with 0.1 mmol/kg Gd-BOPTA on descending the aorta may be related to a tighter and more compact contrast agent bolus (1, 5). The possibility to acquire similar diagnostic information with half the dose may impact positively on clinical routine.

1. Leung DA, et al. MR angiography of the renal arteries. Radiol Clin North Am 2002; 40:847-865.
2. Cavagna FM, et al. Gadolinium chelates with weak binding to serum proteins. A new class of high-efficiency, general purpose contrast agents for magnetic resonance imaging. Invest Radiol 1997; 32:780-796.
3. de Haën C, et al. Gadobenate dimeglumine 0.5 M solution for injection (MultiHance): Pharmaceutical formulation and physicochemical properties of a new magnetic resonance imaging contrast medium. J Comput Assist Tomogr 1999; 23 (suppl. 1):161-168
4. Kroencke TJ, et al. Gadobenate dimeglumine – enhanced magnetic resonance angiography of the abdominal aorta and renal arteries. Am J Roentgenol 2002; 179:1573-1582.
5. Völk M, et al. Renal time-resolved MR angiography: quantitative comparison of gadobenate dimeglumine and gadopentetate dimeglumine with different doses. Radiology 2001; 220:484-488.