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 suprarenal, juxtarenal, 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, MultiHance⁶, 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 suprarenal, juxtarenal, 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>
<thead>
<tr>
<th>CM</th>
<th>Suprarenal</th>
<th>Juxtarenal</th>
<th>Infrarenal</th>
<th>Suprarenal</th>
<th>Juxtarenal</th>
<th>Infrarenal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gd-BOPTA</td>
<td>37.0±13.4</td>
<td>44.3±17.4</td>
<td>48.3±11.9</td>
<td>32.5±12.2</td>
<td>39.9±16.6</td>
<td>44.2±11.6</td>
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<tr>
<td>Gd-DTPA</td>
<td>37.1±14.0</td>
<td>39.9±13.3</td>
<td>40.6±12.0</td>
<td>32.9±13.8</td>
<td>35.9±13.0</td>
<td>36.4±12.2</td>
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<tr>
<td>p-values</td>
<td>0.972</td>
<td>0.173</td>
<td>0.052</td>
<td>0.850</td>
<td>0.186</td>
<td>0.051</td>
</tr>
</tbody>
</table>

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.