Renal MRA at 3.0T with 0.1mmol/kg Gadolinium - Interindividual Comparision to Renal MRA at 1.5T with Full Dose of Gadolinium

H. J. Michaely[1], H. Kramer[1], K-P. Lodemann[2], O. Dietrich[1], M. F. Reiser[1], and S. O. Schoenberg[1]

[1]Institute of Clinical Radiology, Ludwig-Maximilians University Munich, Grosshadern-Campus, Munich, Germany, [2]Bracco-ALTANA Pharma, Konstanz, Germany

Background

Clinical high-field scanners have become increasingly available. Due to the high signal-to-noise ratio (SNR) of 3.0T scanners and due to the improved background suppression at 3.0T the contrast agent efficacy is increased compared to 1.5T[1]. Theoretically a reduced amount of contrast agent should be sufficient for good opacification of the vessels with good contrast to the background. The aim of this study was therefore to compare state-of-the art renal MRA at 3.0T with 0.1mmol/kg body weight (BW) Gd-BOPTA to renal MRA at 1.5T with 0.2mmol/kg BW gadobutrol.

Material and Methods

In this prospective study 15 consecutive patients examined at 1.5T (Siemens Avanto) and 15 consecutive patients examined at 3.0T (Siemens Tim Trio) were included. The patients were referred to the MR-exam to either rule out renovascular hypertension or to evaluate renal transplant dysfunction. At both field strengths one body matrix and the spine matrix were used for signal reception. At 3.0T a higher spatial resolution was realized in a shorter acquisition time by using a higher readout bandwidth and parallel imaging factor 3. The exact sequence parameters at both field strengths can be found in table 1. At 1.5T a flat bolus of 15ml gadobutrol (Gadovist®, Schering) was applied at 2ml/s. For an average patient this amount of contrast agent equals a Gd-dose of 0.2mmol/kg BW. At 3.0T a flat bolus of 15ml Gd-BOPTA (Multihance, Bracco-ALTANA Pharma) was administered at 2.5ml/s. For an average patient this equals a dose of 0.1mmol/kg BW. At both field strength, a 30ml saline-chaser at the same flow rate as the contrast agent was used. Timing was done with a testbolus technique. Image quality was rated by two radiologists in consensus on a 4 point ordinal scale (4-very good, 3 good, 2 moderate, 1 poor-non diagnostic). The criteria included vessel conspicuity, visible noise, and presence of artifacts. SNR (SNR) was measured in a phantom measurement to avoid errors associated with the conventional SNR measurement in images acquired with parallel imaging. T-tests were used for statistical analysis.

Results

All MRA measurements were diagnostic. The median score for 3T-MRA and 1.5T MRA was 4. The number of visible small vessels was equal to 1.5T but the vessel conspicuity was better at 3T. Fine structure such as fibromuscular changes could be demonstrated better at 3T (Figure 2) than at 1.5T (Figure 1, different patients). The image noise and artifacts were equally perceivable at both field strengths. The contrast between opaquified vessels and background was rated equally good for both field strengths (median 4). The SNR was significantly ($p < 0.05$) higher at 3T (17.8) than at 1.5T (13.4).

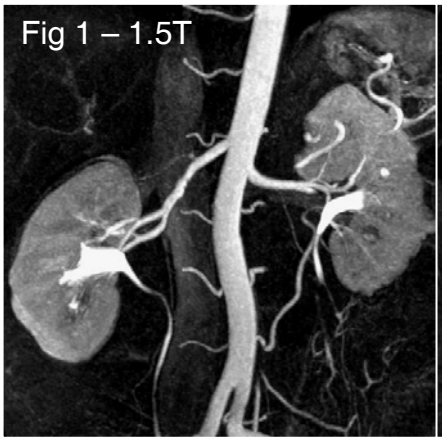
Conclusion

This interindividual renal MRA study proves that at 3T renal MRA with bisected amount of Gadolinium achieves at least an equal image quality compared to a 1.5T renal MRA with the full dose of contrast agent. In addition, at 3T the spatial resolution and coverage could be increased, the scan time decreased with a still significantly higher SNR. The different relaxivities[1] of the contrast agents are a potential confounding factor even though at 3.0T the relaxivity difference becomes less important.

References

1. Rohrer M, Bauer H, et al. *Invest Radiol.* 2005

	1.5T MRA	3.0T MRA
TR / TE [ms]	3.77 / 1.39	3.14 / 1.1
Flip angle [°]	25	23
Bandwidth [Hz/Px]	350	510
Matrix	512 x 80%	512 x 80%
FOV [mm²]	400 x 87%	400 x 81%
Phase Oversampling [%]	0	8
Voxel size [mm³]	0.8	0.65
Spatial resolution [mm³]	1 x 0.8 x 1	0.9 x 0.8 x 0.9
Scan time [s]	26	18
Partitions	80	96
Parallel imaging	GRAPPA factor 2	GRAPPA factor 3



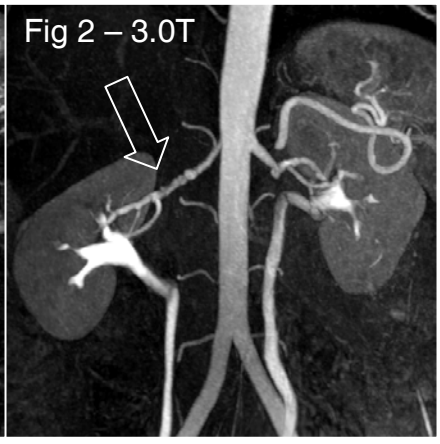


Table 1 – Overview of the relevant sequence parameters for the MRA sequences at 1.5T and 3.0T (Siemens Avanto and Siemens Tim Trio)