

Effect of dose bisection at 3.0T on contrast-enhanced magnetic resonance angiography of the renal arteries

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Synopsis:

Aim of the study was to intra-individually compare two doses of gadolinium for contrast-enhanced enhanced three-dimensional Magnetic Resonance Angiography (CE-MRA) in patients suspected of renal artery stenosis. 22 patients underwent MR imaging of the renal arteries at 1.5T (0.2 mmol/kg) and 3.0T (0.1 mmol/kg). Random consensus readout was performed. While mean image quality did not show any statistically significant differences between the two doses and field strength SNR and CNR values were statistically significant different with the greater dose at 1.5T as compared to the lower dose at 3.0T. Further dose studies for optimized renal CE-MRA are warranted.

Introduction:

Three-dimensional contrast-enhanced magnetic resonance angiography (CE-MRA) has been established as a safe, robust, and reliable technique for detection and grading of renal artery pathologies (1). The technique is based on the bright display of gadolinium in the renal arteries on fast gradient echo sequences acquired during a single breath-hold. Recently, growing numbers of MR systems operating at field strength of 3.0T has been observed. Inherent to MR imaging at 3.0T is increased signal and higher spatial resolution. Thus, lower contrast doses for CE-MRA of the renal arteries might be possible. In this study, we aimed to evaluate a bisected dose of gadolinium at 3.0T in comparison to a full dose of gadolinium for the display of the renal arteries and the detection of significant stenosis.

Methods:

Institutional review board approval was granted and patients signed informed consent before enrollment. 22 patients (14 men, 8 women; mean age, 66.5 years) with clinically suspected secondary arterial hypertension due to renal artery stenosis or fibromuscular dysplasia (FMD) underwent two MR angiographic examinations of the renal arteries separated by 24 hours on a respective whole-body 1.5T scanner (Magnetom Sonata) and 3.0T MR system (Magnetom Trio, both machines Siemens Medical Solutions, Erlangen, Germany) in random order using dedicated multi-channel phased array coils. A phase-encoded three-dimensional spoiled breath-hold pulse sequence was employed characterized by the following parameters: For the examination at 1.5T, a dose of 0.2 mmol/kg bodyweight of gadodiamide (Omniscan™, GE Healthcare, Princeton, NJ) was applied, and a dose of 0.1 mmol/kg gadodiamide was used for CE-MRA at 3.0T. Two radiologists blinded to the particular dose assessed all image data in consensus for renal artery disease as well as for image quality on a five-point Likert-type scale. Quantitative evaluation (vessel signal-to-noise ratio, SNR, and vessel-muscle contrast-to-noise ratio, CNR) was performed by an additional radiologist.

Results:

Five renal artery stenoses were detected with both techniques. Mean image quality did not show any statistically significant differences between the two doses and field strength, respectively. However, SNR and CNR values showed statistically significant difference with the greater dose at 1.5T as compared to the lower dose at 3.0T (125.7 vs. 112.3; 64.2 vs. 59.7; both $p < 0.05$). Intraparenchymal 2nd and third grade branches were better visualized with the higher dose at 1.5T.

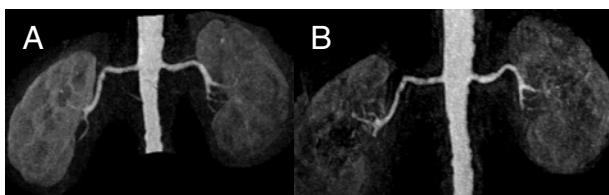


Figure 1: 67 yo male. Maximum Intensity Projections (MIP) of 3D CE-MRA images at 1.5T (A) with 0.2 mmol/kg of gadodiamide and at 3.0T with 0.1 mmol/kg gadodiamide

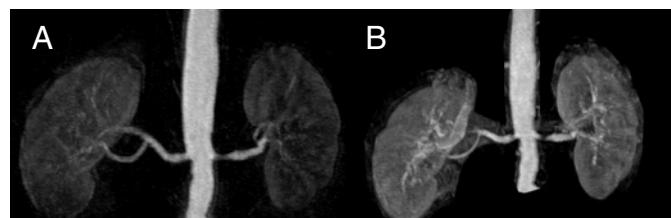


Figure 2: 77yo female patient with arterial hypertension and left renal artery stenosis displayed at 1.5T (A) and 3.0T (B)

Discussion:

CE-MRA techniques of the renal arteries at 1.5T is currently not without its limitations (2). Hence, the search for optimized imaging alternatives or technical refinements at higher field strength is necessary. Against this background CE-MRA at 3.0T with an bisected dose of contrast material cannot be recommended as standard of reference, especially when dealing with intraparenchymal branches. Nevertheless, further analysis of optimal doses at 3.0T is deemed necessary.

References:

1. Schoenberg SO, et al. Nephrol Dial Transplant 2003;18:1252-1256
2. Vasbinder GBC, et al. Ann Int Med 2004;141:674-682