SINGLE DOSE LARGE ANATOMICAL COVERAGE CONTRAST-ENHANCED PERIPHERAL MRA USING A NOVEL BROADBAND DIGITAL MR ARCHITECTURE: INITIAL EXPERIENCE

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Introduction

High dose contrast-enhanced MR angiography (CE-MRA) is losing attractiveness due to advances in MR hardware and software as well as complications associated with gadolinium-based contrast agents when using double or triple dose regimens in patients with severely impaired renal function[1-3]. The purpose of this study was to investigate the feasibility of single dose (0.1 mmol/kg) CE-MRA of the peripheral vessels with improved anteroposterior (AP) coverage and higher spatial resolution using a new fully digital channel-independent MR platform with improved signal-to-noise (SNR) coils.

Material and methods

6 patients (1M/5F; mean age: 29.2±15.0 years) underwent CE-MRA of the aortoiliac and lower extremity arteries using a novel fully digital channel independent 1.5T MR platform (Ingenia, Philips Medical Systems, Best, The Netherlands) with the anterior surface and integrated posterior coil arrays. A single dose (0.1 mmol/kg) of gadobutrol (Gadovist, Bayer Schering Pharma, Berlin, Germany) of contrast agent was administered. For comparison, 6 patients (3M/3F; mean age: 79±9.0 years) underwent CE-MRA of the aortoiliac and lower extremity arteries using a standard 32-channel 1.5T MR platform (Achieva, Philips Medical Systems, Best, The Netherlands) with peripheral vascular coils. A double dose (0.2 mmol/kg) of contrast agent was administered. Imaging parameters are listed in the table. Images were analyzed subjectively by assessing diagnostic image quality on a 3-point scale (non-diagnostic [=0], some artefacts but diagnostic [=1], or good quality [=2]) and objectively by measurement of vessel to background and contrast in source images in 5 named vessel segments per depicted field-of-view (FOV).

	Parameters	Abdomen	Upper legs	Lower legs
Ingenia	FOV / AP coverage [mm]	450 / 150	450 / 150	450 / 150
	TR/TE/flip/SENSE factor	3.3/1.2/20/4x	3.3/1.2/20/4x	3.9/1.4/20/4.5x
	Acquired resolution [mm^3]	1.1x1.2x2.8 [3.7]	1.1x1.3x2.4 [3.4]	0.9x0.9x0.9 [0.73]
	Acquisition time (s)	16.9	18.1	58.6
Intera	FOV / AP coverage [mm]	471 / 112	471 / 90	471 / 105
	TR/TE/flip/SENSE factor	3.7/1.2/35/2	4.3/1.3/40/2	3.9/1.3/30/2
	Acquired resolution [mm^3]	1.3x1.4x2.8 [5.1]	1.2x1.5x2.0 [3.6]	1.1x1.1x1.5 [1.8]
	Acquisition time	18.9	22.7	41.3

Results

All datasets in patients were acquired successfully. In total 13 FOVs were depicted using the Ingenia system and 18 FOV using the Intera system. It was possible to simultaneously improve AP coverage to a standard value of 150 mm, which was up to 68% higher compared to the standard imaging protocol, while at the same time improving spatial resolution (up to 2.5x better). Administered contrast volumes ranged between 6-12 mL on Ingenia and 10-20 ml on Intera. This amounted to a reduction of approximately 50% in the standard dose used. All datasets acquired on both systems were considered diagnostic. Mean subjective image quality score was 1.92±0.28 for Ingenia (image example in figure 1) and 1.89±0.32 for Intera (p=N.S.). Vessel to background contrast ratio was uniformly high and ranged between 32.1-59.3 (mean±SD: 43.7±9.3) for Ingenia and 35.1-55.0 (mean±SD: 41.5±7.6) for Intera (p=N.S.).

Conclusions

The intrinsically higher SNR of the new fully digital Ingenia system was invested to improve 1) anteroposterior coverage, 2) acquisition resolution, and 3) to reduce contrast agent dose from a double to a single dose. At the same time good image quality was preserved, both by subjective and objective image quality measures. We therefore conclude that highly accelerated single dose multistation CE-MRA is feasible with good diagnostic quality and similarly high vessel to background contrast when leveraging the intrinsically higher signal-to-noise ratio of a fully digitized MR imaging system.

Figure 1. Single dose CE-MRA of runoff vessels using the new fully digital MR architecture. Note high vessel to background despite low contrast dose and higher spatial resolution compared to the conventional imaging protocol (also see table).

References

1. Leiner et al. JMRI 2009;30:1357-63.
2. Maki et al. JMRI 2009;30:1085-92.
3. Ersoy et al. AJR 2008;190:1675-84.
4. Prince et al. JMRI 2009;30:1298-1308.