Contrast Enhanced MR Angiography of the Pulmonary Circulation at 3.0T: Initial Experience with a Phased Array Coil.

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Background

Although whole-body 3.0T imaging systems are now being installed world-wide, experience to date is very limited for non-neurological applications. The promise of MR angiography (MRA) at 3.0T is that the higher available signal and lower background signal can be traded for speed and /or increased spatial resolution. The challenges to large field-of-view (FOV) MRA at 3.0T include increased sensitivity to magnetic susceptibility effects, increased RF power deposition and the lack of optimized phased array coils for body imaging. The purpose of this study was to implement both time-resolved contrast-enhanced MRA and high-resolution contrast-enhanced MRA of the lungs using a whole-body 3.0T system and an eight-element phased-array body coil.

Method

Six normal adult volunteers and one patient with stable heart failure underwent contrast-enhanced MRA at 3.0T. All studies were carried out on a whole body 3T MR system (Siemens Medical Solutions, Malvern, PA), using an 8-channel receive system and a phased array body coil with 8 elements. Time-resolved MRA was implemented using a 5 ml bolus of Gd contrast, as previously described at 1.5T [1], but with the following changes: the RF pulse duration was increased from 400 msec to 600 msec, increasing the minimum TR to 2.2 msec at a bandwidth of 1200 Hz per pixel; the number of partitions was increased to 20; the pixel size was decreased to 1.5 mm x 1.1 mm on a 220 x 320 matrix and parallel imaging with an acceleration factor of 2 was employed. The true temporal resolution for dynamic MRA was 1.8 seconds per 3D dataset. For high resolution MRA, a 30 ml infusion of Gd at 2 ml/sec was used with the following image acquisition parameters; FOV 380 mm, matrix 420 x 640, partition thickness 1.1-1.3 mm, TR=3.2 msec, and parallel imaging with an acceleration factor of 2. Two phases of enhancement were captured, each during a 22 second breath-hold.

Results

Representative results are shown in figures 1 and 2. When compared to previously published results at 1.5T, resolution for comparable acquisition times were increased by a factor of 2-4, while maintaining good overall image quality. The high-resolution images resulted in visualization of second-order, subsegmental pulmonary artery branches. In two subjects, residual contrast in the left innominate vein caused local susceptibility artifact on the first-phase, high-resolution images; an effect which is more pronounced than has previously been reported at 1.5T. In one subject, excessive right-left undersampling of k-space resulted in overfolding artifact and some degradation of image quality.

Conclusions

Initial results suggest that, with the use of low-SAR RF pulses, parallel acquisition strategies, and phased-array receiver coils, contrast-enhanced MRA of the lungs at 3.0T can provide dynamic, functional imaging with superior performance to1.5T. For non-time-resolved MRA, spatial resolution comparable to multi-slice CT is feasible. Further clinical evaluation is warranted.

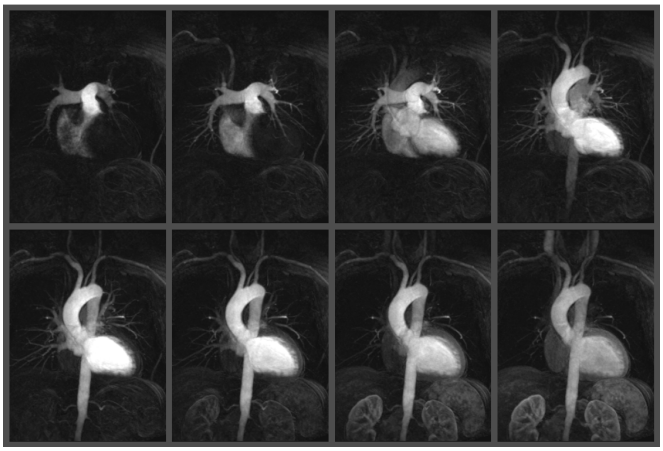

Fig.1: Time-resolved contrast-enhanced MRA of the lungs at 3T. Temporal resolution is 1.8sec per MIP projection.

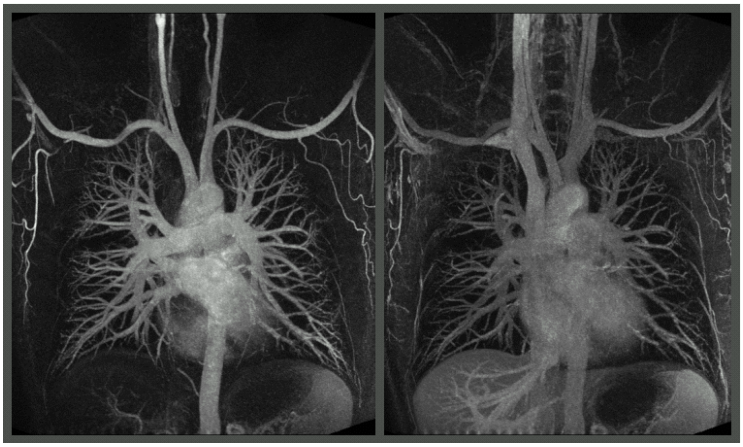

Fig. 2: High-resolution MRA of the lungs with nearly isotropic resolution during breath-hold of 22 sec.

References

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