Feasibility of pulmonary CE-MRA at 3.0T compared to 1.5T

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Introduction:

MRI has proven to be useful for the detection of lobar and segmental pulmonary emboli (1). For accurate detection of emboli in pulmonary arteries with magnetic resonance angiography (MRA), it is essential to have a selective arterial phase without venous overlay. To obtain clinically useful MR images, very short scan durations are necessary because of the short arteriovenous window in the pulmonary vascular bed (2-4 seconds) (2) and the difficulties with scanning in breath hold in dyspnoeic patients. Recently, 3.0 T systems have become available. At this field strength, higher signal to noise ratio (SNR) is theoretically beneficial because it offers the possibility to use a higher spatial or temporal resolution scanning protocol compared to 1.5T. This might enable more reliable detection of pulmonary embolism. The purpose of this study was to investigate the feasibility of real-time pulmonary CE-MRA at a 3.0 T system in comparison to 1.5 T.

Methods:

4 healthy volunteers were imaged twice: once at 1.5T, and once at 3T (Intera/Achieva, Philips Medical Systems, Best, The Netherlands). Imaging parameters at 1.5T were: TR/TE/FA 2.8ms/0.87ms/12°. The highest possible parallel imaging factor (SENSE x4) was used. Acquired voxel size was 2.0x2.0x6.0 (slices interpolated to 3.0mm); 80 slices were acquired to cover the entire thorax. Six consecutive 3D volumes were obtained, each lasting 3.8 sec. Imaging parameters at 3.0T were: TR/TE/FA 1.01ms/0.38ms/8°. Because the surface body coil at 3.0T has 6 elements, 6-fold acceleration was used. Acquired voxel size and number of slices was identical. 24 consecutive 3D volumes were obtained, each lasting 1.0 sec. In both protocols imaging was started concurrently with injection of contrast medium (5.0 mL/s).

Results:

In all volunteers 3-4 selective arterial phases could be obtained at 3T, while at 1.5T only 1 arterial phase was obtained (Figures 1 and 2). There was no noticeable subjective reduction in signal to noise ratio. With both imaging protocols the main pulmonary arteries as well as the lobar, segmental and most of the subsegmental arteries were visualized in all subjects.

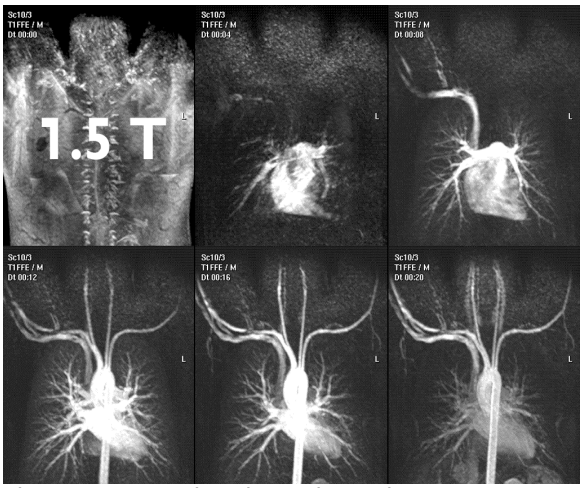

Figure 1. Successive phases in a volunteer at 1.5 T. Note that there is only 1 selective arterial phase (top right).

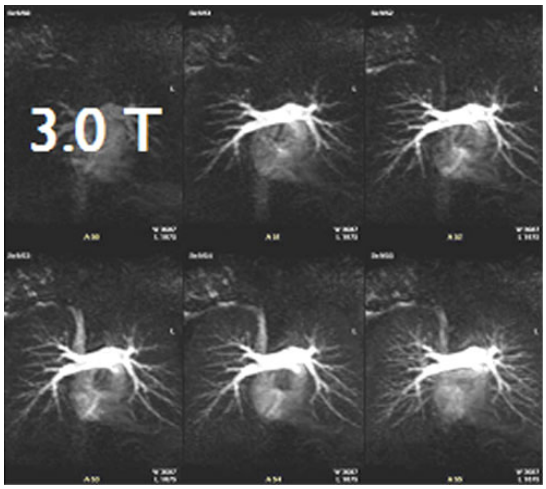

Figure 2. Successive phases in a volunteer at 3.0 T. There are 4 selective arterial phases before venous enhancement occurs.

Conclusions:

True real-time pulmonary CE-MRA is possible at 3.0T with a temporal resolution of 1.0 second per imaging volume. This is a significant improvement over existing protocols where dynamic phases typically last between 3-6 seconds (2,3).

References:

1. Meaney et al. NEJM 1997;336:1422-7
2. Fink et al. JMRI 2004;19:202-8
3. Carr et al. Acad Radiol 2002;9:1407-18