Temporally-resolved Pulmonary MRA with GRAPPA at 3 Tesla

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Introduction:

Temporally-resolved, contrast-enhanced MRA (CEMRA) using ultrashort TR [1,2] has been successfully implemented in the pulmonary circulation and thoracic aorta. With this technique, spatial resolution is sacrificed in order to improve temporal resolution. Parallel imaging techniques [3] can improve spatial resolution while maintaining satisfactory temporal resolution, however this may result in significant reduction in signal to noise ratio (SNR) at 1.5T. With the availability of high field 3T whole body MRI scanners for clinical use, the SNR lost due to parallel imaging may be regained. Therefore, it may be possible to combine parallel imaging techniques with MRA at 3T, without any significant loss in SNR. This has the potential to produce detailed high quality images of the pulmonary vasculature, while maintaining the acquisition speed.

Purpose:

To evaluate the feasibility of temporally-resolved pulmonary MRA at 3T using GRAPPA and to compare the findings at 3T vs 1.5T in a small group of patients.

Materials and Methods:

5 normal volunteers and a group of patients, with suspected cardiovascular disease, underwent pulmonary MRA on a 3.0 T whole body MRI scanner (Trio, Siemens Medical Systems, Erlangen, Germany) using a cardiac phased array coil (Siemens Medical Systems, Erlangen, Germany). A multi-phase, partial Fourier 3D FLASH pulse sequence (TR/TE/Flip = 2.0 ms/0.8 ms/10-15^{o}, matrix = 180 x 320, 36 partitions, voxel size = 1.6x1.2x4.0mm^{3}) was used. GRAPPA acceleration factor of 2, with 24 reference lines, was also used. 10-12 sequential measurements, each lasting approximately 3 seconds, were acquired during suspended respiration. 15 ml of Gadolinium-DTPA was injected @ 5.0 ml/sec. Both the MR acquisition and contrast injection were started simultaneously. Images were subtracted in-line and there was automatic maximum intensity projection (MIP) post-processing.
A second group of patients underwent conventional temporally-resolved pulmonary MRA (TR/TE/flip angle: 1.7/0.8/15) on a 1.5T Siemens Sonata, using similar scanning parameters. This group was compared to the patient group at 3T.
Images were assessed qualitatively by 2 observers. The number of lobar, segmental and subsegmental branches visualized was noted. Conspicuity of each branch vessel was scored on a scale of 1-5. In the patient studies, the presence of any abnormality was noted.

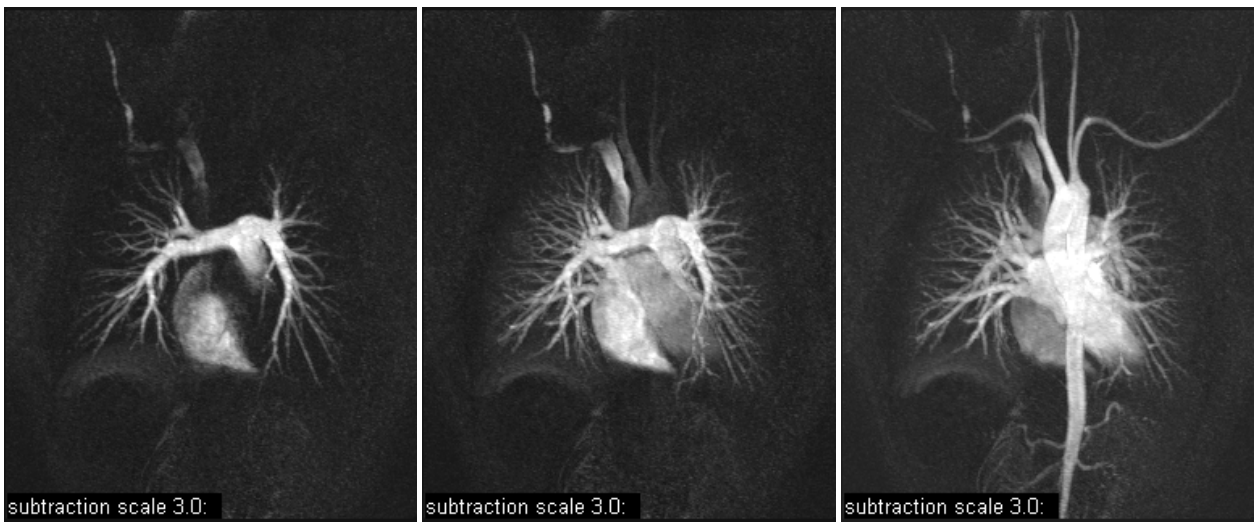

Figure 1: Three consecutive MIP from contrast enhanced pulmonary MRA exam acquired in a volunteer. The SNR provide by the 3.0 T scanner allows for high frame rate acquisition through the use of parallel imaging, and high spatial resolution.

Results:

Pulmonary MRA at 3T with GRAPPA was successful in all patients and volunteers. The number of branch vessels visualized was higher at 3T compared to 1.5T. Conspicuity scores were higher at 3T compared to 1.5T. All the abnormalities were detected in both the 1.5T and 3T patient groups.

Conclusion:

Temporally-resolved pulmonary MRA at 3T using GRAPPA is feasible and can produce more detailed images of the pulmonary vasculature compared to conventional MRA at 1.5T. Parallel imaging with MRA may be better suited to the 3T platform because of the less marked effect on SNR.

References:

[1] Finn JP, et al. Radiology 2002.
[2] Carr JC, et al. Academic Radiology 2002
[3] Sodickson, et al. MRM 1997