3.0T High Spatial Resolution CE-MRA of the Pulmonary Circulation: Initial Experience with a 32-Channel Phased Array Coil Using a High Relaxivity Contrast Agent

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Purpose: To evaluate the technical feasibility of high spatial resolution contrast-enhanced MRA (CE-MRA) with highly accelerated parallel acquisition at 3.0 Tesla (3T) using a 32-channle phased array coil, and a high relaxivity contrast agent.

Materials and Methods: Ten adult healthy volunteers (5 male, 5 female, age: 21-66) underwent high spatial resolution CE-MRA of the pulmonary circulation. Imaging was performed at 3T using a 32-channel phase array coil. After intravenous injection of 0.1 mmol/kg of Gadobenate Dimeglumine (Gd-BOPTA, Multi-Hance, Bracco Diagnostic Inc. Princeton, NJ) at 1.5ml/s, high spatial resolution CE-MRA of the pulmonary circulation was acquired in coronal plane, using a fast gradient-recalled echo (GRE) sequence (TR/TE:3/1.2ms FA:18°, BW: 590 pixel/Hz, matrix: 448 x 416). Generalized autocalibrating partially parallel acquisitions (GRAPPA) algorithm **(1)** was integrated into the sequence with an acceleration factor of 3 in phase encoding direction and an acceleration factor of 2 in slice encoding direction. By selecting 144 partitions with a thickness of 1 mm, CE-MR angiography of the entire pulmonary circulation was performed during a 20s breath-hold with acquired isotropic voxel dimension of 1 x 1 x 1 mm^3. The presence of artifact, noise, and image quality of the pulmonary arterial segments were evaluated independently by two radiologists. Due to known effects of parallel imaging on non-uniformity of noise distribution across the field of view, Phantom measurements were performed to assess the signal-to-noise ratio (SNR) **(2)**. Statistical analysis of data was performed by using Wilcoxon rank-sum test and two-sample Student t-test. The interobserver variability was tested by kappa coefficient.

Results: All studies were of diagnostic quality as determined by both observers. The pulmonary arteries were routinely identified up to 5th order branches, with definition in the diagnostic range and excellent interobserver agreement (κ =0.84; 95% CI: 0.77, 0.90). Phantom measurements showed significantly lower SNR ($p < 0.01$) using GRAPPA (20.2 ± 18.8) compared to measurements without parallel acquisition (58 ± 49.4).

Conclusion: The described 3T CE-MRA protocol in addition to high T1 relaxivity of Gadobenate dimeglumine **(3)** provides sufficient SNR to support highly accelerated parallel acquisition (GRAPPA x 6), resulting in acquisition of isotopic (1 x 1 x 1 mm^3) voxels over the entire pulmonary circulation in 20 seconds.

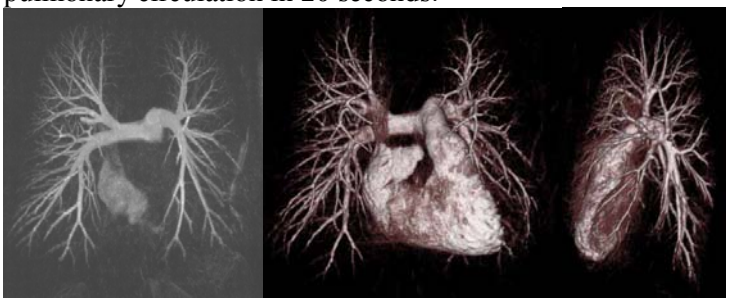

Figure. Coronal thin (20 mm) Maximal intensity projection **(A)** & coronal and sagittal volume rendered **(B & C)** from high resolution CE-MRA in a healthy volunteer, depicting the entire pulmonary circulation with isotropic voxel sizes (1 x 1 x 1 mm^3) during 20s breath-hold.

References:

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