Whole Body MR Angiography at 3.0T on a 32 Channel System: Initial Results

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Background: Recently, multi-channel whole-body 3.0T MR scanners have become available. Multi-channel RF configurations with appropriate array geometry are essential for parallel imaging with higher acceleration factors is considered.
Purpose: To investigate a multi-station high spatial-resolution whole body MR angiography, applying high acceleration factors, on a 32-channel 3.0T MR system
Material and Methods: Ten adult volunteers and six clinical patients with suspected peripheral vascular disease (7M, 9F age: 23-79 years) underwent multi-station whole body contrast-enhanced MR angiography (CE-MRA) on a 32-channel 3.0T MR system (Magnetom TRIO, Siemens). Subjects were positioned supine on the scanner and coil elements were activated in sequential stations, using up to 24 coils per station. The entire body was imaged in four overlapping stations, each with a 500 mm FOV, using a divided two-step contrast injection scheme. Following the 1st injection, the most proximal station (1: neck-chest) was acquired, followed by the most distal station (4: calves). The intermediate two stations (2: abdominal-pelvis & 3: thighs) were acquired following the 2nd injection. Using a high-resolution matrix and generalized autocalibrating partially parallel acquisitions (GRAPPA) with high acceleration factor, sub-millimeter voxels were generated in all four stations: [Station-I: head-neck-upper chest: (matrix: 576 x 383, voxel: 0.9 x 0.8 x 1, GRAPPA x3, scan time: 15s) Station-II: chest-abdomen: (matrix: 576 x 383, voxel: 0.9 x 0.8 x 1.2, GRAPPA x3, scan time: 16s) Station-III: pelvis-thighs: (matrix: 576 x 353, voxel: 0.9 x 0.8 x 0.9, GRAPPA x3, scan time: 22s) Station-IV: calves: (matrix: 640 x 416, voxel: 0.8 x 0.8 x 0.8, GRAPPA x4, scan time: 21s)].
The image quality of the arterial segments, the presence of venous contamination, image noise, artifact, and the presence of arterial stenoses were evaluated by two radiologists independently. The statistical evaluation was performed using a Wilcoxon rank-sum test and kappa coefficient.
Results: The majority of arterial segments (98%) were visualized by whole-body CE-MRA with definition in the diagnostic range thorough out all 4 stations. The comparison of image quality grading between two observers showed no significant difference ($p = 0.57$) and excellent interobserver agreement ($\kappa = 0.81$). Venous contamination, image noise and artifact were minimal, and never interfered with diagnosis. Fifty nine, and fifty five arterial segments with occlusive disease were detected by observer-1 and 2 respectively with excellent interobserver agreement ($\kappa = 0.92$, 95% CI 0.86, 0.96).
Conclusion: Multi-station, high spatial resolution whole body MR angiography is feasible at 3.0T. Using a 3.0T multi-channel RF system with multi-coil technology, effectively support fast parallel acquisition; result in isotropic submillimeter voxels through the whole body. Further clinical studies are required to explore the boundaries of this approach.

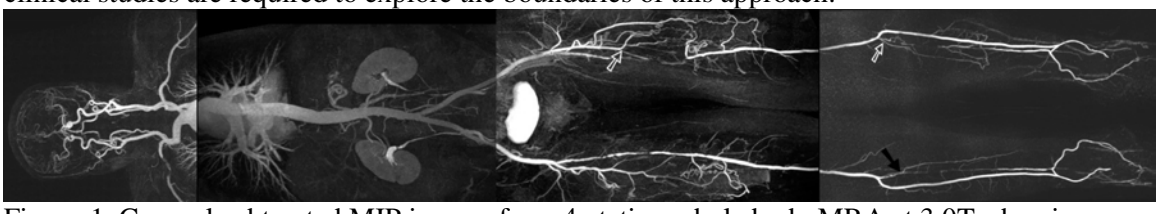

Figure-1. Coronal subtracted MIP images from 4-station whole body MRA at 3.0T, showing segmental occlusion of the left superficial femoral artery (arrow), and bilateral occlusion of the posterior tibial and peroneal artery (arrows). Note the extent of coverage from head to toe, and absence of venous contamination.