Peripheral Contrast-Enhanced MR Angiography at 3.0T Using a Dedicated 36-Element Peripheral Phase Array Coil

K. Nael[1], M. Krishnam[1], A. Ton[1], G. Laub[2], S. G. Ruehm[1], and J. Finn[1]
[1]Radiological Sciences, David Geffen School of Medicine at UCLA, Los Angeles, CA, United States, [2]Siemens, Los Angeles, CA, United States

Purpose: To investigate a peripheral contrast-enhanced MR angiography (CE-MRA) protocol at 3.0T, applying a dedicated multi-channel array coil and highly accelerated parallel acquisition.
Material and Methods: 10 volunteers and 20 patients with peripheral vascular disease underwent multi-station peripheral CE-MRA on a 32-channel 3.0T MR system (Magnetom Trio, Siemens Medical Solutions). Subjects were positioned supine, feet-first in the magnet bore and a 36 element phased array coil was used to cover the entire peripheral vascular territory encompassing the feet. Three sequential stations with 500 mm field of view, and 100 mm overlap were acquired, resulting in cranio-caudal (z) coverage of 1300 mm using a fast 3D GRE sequence (TR/TE: 2.7/1ms; FA 20º; bandwidth 720Hz/pixel, slice thickness 1mm; 104 partitions; matrix 512x 384). By applying generalized autocalibrating partially parallel acquisitions (GRAPPA) algorithm **(1)** with an acceleration factor of 4 in phase encoding direction, high spatial resolution 3D data sets were acquired over the entire peripheral arterial tree with acquired isotropic voxel dimension of 1 x 1 x 1 mm³ during 20s for each station. Following an initial measurement of contrast transit time to the abdominal aorta and calves, the peripheral CE-MRA was performed using a two phase contrast injection scheme **(2)**. A total dose of 0.15 mmol/kg Gadopentetate dimeglumine (Magnevist, Schering AG, Berlin, Germany) was infused in 2 separate injections at a rate of 1.2 ml/s followed by 30 ml of saline at the same rate. Following the first contrast injection (40% of the volume), the data for the calves-feet (station III) was acquired. The two proximal stations (I & II) were acquired following the second injection of the remaining contrast volume (60%). After acquiring the data for the abdomen-pelvis (station I), the table was automatically moved (table repositioning time: 4s) to station II, to image the thigh arteries. The phase encoding order was linear for the station I and III, and elliptical-centric for station II. The entire 3D volume from each station was reconstructed in collapsed MIP algorithm. The image quality, presence of venous contamination, image noise, and artifact were evaluated by 2 radiologists independently. Assessment of arterial disease for 540 arterial segments was performed, and findings were correlated with conventional catheter angiography in 8 patients. Wilcoxon test, kappa, and Spearman rank correlation coefficient (Rs) was used for statistical analysis.
Results: All studies were yielded high diagnostic image quality with excellent interobserver agreement (κ =0.86; 95% CI: 0.71, 0.96). Venous contamination, image noise and artifact were minimal, and never interfered with diagnosis. One hundred eleven arterial segments with significant stenoses (>70%) were detected by both observers with excellent interobserver agreement (κ =0.84; 95% CI: 0.76, 0.90). There was a significant correlation between CE-MRA and conventional angiography (Rs =0.92 and 0.94 for reader 1 and 2, respectively) for the assessment of the degree of stenosis.
Conclusion: Peripheral CE-MR angiography is feasible and promising at 3.0T. Higher available SNR at 3.0T in combination with multi-coil technology, effectively support fast parallel imaging; result in acquisition of isotropic high spatial resolution voxels for evaluation of peripheral vasculature. Further clinical studies are required to explore the boundaries of this approach.

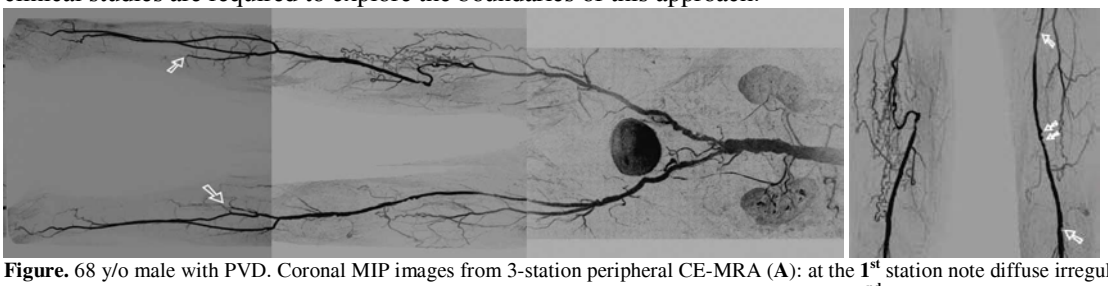

Figure. 68 y/o male with PVD. Coronal MIP images from 3-station peripheral CE-MRA (**A**): at the **1st** station note diffuse irregularity of the abdominal aorta and multiple ulcerative plaques in the bilateral common iliac arteries. At the **2nd** station, there is segmental occlusion of right superficial femoral artery, and multi-focal tandem significant stenoses along the left superficial femoral artery (arrows in **B**). The **3rd** station shows proximal occlusion of the bilateral posterior tibial arteries (arrows in **A**).

References:
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