

Intraindividual Comparison of Static, High Resolution and Dynamic 4D Contrast Enhanced Magnetic Resonance Angiography of the lower legs

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Introduction: Contrast enhanced MR Angiography (CE MRA) is continuously replacing diagnostic Digital Subtraction Angiography in clinical routine. However, the visualization of the crural arteries remains difficult due to their small caliber and difficulties in contrast agent bolus timing. Therefore, the purpose of this study was to intraindividually compare dynamic (4D) CE MRA and high resolution, static CE MRA of the crural arteries in patients with severe peripheral arterial occlusive disease (PAOD).

Materials and Methods: 92 patients (23 female; 69 male; mean age: 70.0 years) were included in this IRB approved trial. After providing written informed consent, all patients underwent run off MRA (1.5T) of both lower extremities for suspected peripheral arterial occlusive disease. First, a static CE MRA (3D GRE, TR/TE: 3.3/1.2ms; FA: 25°; FoV: 420mm, Matrix: 384 x 384; slice thickness: 1 mm; 80 slices; acquisition time: 21s) of the lower legs was acquired after the application of 0.1 mmol/kg bodyweight gadobenate dimeglumine. Then, a 4D CE MRA (3D GRE, TR/TE: 3.0/1.2ms; FA: 25°; FoV: 420mm, Matrix: 256 x 256; slice thickness: 1 mm; 72 slices; 15 phases; acquisition time per phase: 3,28) of the lower legs was acquired after the application of 0.05 mmol/kg bodyweight gadobenate dimeglumine.

Two independent radiologists evaluated the images for image quality and presence, number and severity of stenoses. Image quality was assessed on a five point scale from 1 excellent to 5 non-diagnostic. In addition, the presence of venous opacification was assessed on a 5 point scale from 1 no venous opacification to 5 venous enhancement stronger than arterial enhancement. Severity of stenoses was evaluated on a 5 point scale (1: no stenosis; 2: diameter stenosis below 51%; 3: 51% to 70%; 4: 71% to 99%; 5: occlusion). In addition, stenoses were classified in non-significant (grades 1, 2 and 3) and significant (4 and 5). Interobserver variation as assessed by a Cohen's kappa statistic.

Results: Median image quality of the static MRA images was rated as fair (3) while 4D MRA images were rated as good (2) from both observers. Venous opacification was rated influential on diagnosis in 40% of cases in static MRA, and in 3% in 4D MRA. The Cohen's kappa statistic revealed a significant almost complete agreement of 0.88 for static and of 0.92 for 4D MRA.

Conclusion: State of the art 4D MRA of the lower legs for suspected PAOD provides excellent image quality without venous overlay, an artefact that severely influences diagnostic quality in static MRAs. In addition, it is user independent proven by a Cohen's kappa of 0.92. 4D MRA of the lower legs should be employed in all patients undergoing CE MRA for suspected PAOD.

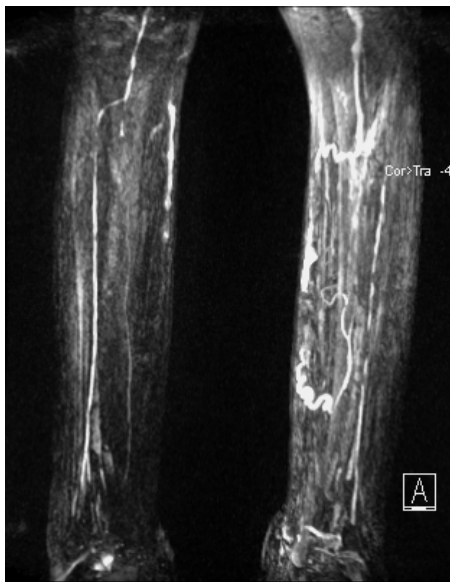


Figure 1: Static, high resolution CEMRA of a 58-years old female patient with suspected paod. Sever motion artefacts and venous overlay limit the diagnostic accuracy.

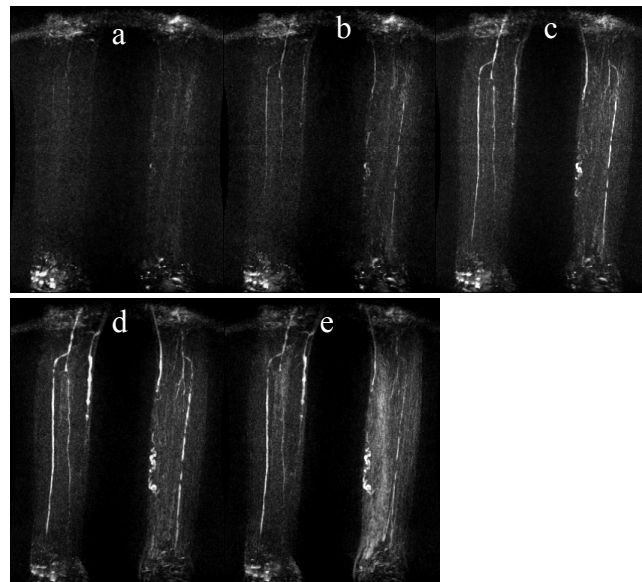


Figure 2: 4D CEMRA of the same patient shows arrival of the contrast agent in the arteries (a, b), complete depiction of the arteries with early venous enhancement (c,d) and wash out (e). All arteries can be assessed.