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Meeting abstract

1043 High spatial and temporal resolution MRA of the entire peripheral vascular system using a new 3D time-resolved MRA technique (TWIST)

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Introduction

Bolus-chase magnetic resonance angiography (MRA) protocols covering the entire peripheral vasculature must be considered as the state of the art technique and imaging modality of first choice in patients suffering from peripheral arterial disease (PAD). However, even if technically perfect, standard MRA techniques only provide morphologic information whereas digital subtraction angiography as the standard of reference provides additional information on flow. To overcome these limitations at least for the infrapopliteal arteries hybrid MRA techniques combining time-resolved MRA of the lower legs and bolus chase MRA for the pelvis and upper legs have been introduced. The results of hybrid MRA are encouraging but until now spatial resolution is scarified in dynamic MRA to improve the temporal resolution. Additionally, dynamic information about arterial filling and venous enhancement is only available for in the infrapopliteal vessels. Therefore our study aimed to develop a triple injection scan protocol for dynamic, high-resolution, isotropic MRA of the entire peripheral vascular system applying a recently developed time-resolved 3D MRA sequence (TWIST).

Methods

Twenty patients (mean age 64) with clinically documented PAD underwent contrast-enhanced MRA collecting dynamic 3D data sets at three consecutive, slightly overlapping stations (Figure 1). All imaging was performed on a 1.5 T system with Tim technology (Avanto, Siemens, Medical Solutions, Erlangen, Germany). Two flexible phased array coils and a dedicated peripheral vasculature coil were used for signal reception. 25 consecutive T1w 3D datasets were acquired in coronal planes following automatically injection of 5 cc Gadovist at 3 cc/sec for each station using the TWIST sequence. The TWIST sequence divides the k-space into a central region (A) and a peripheral region (B). While region A is completely sampled for all data sets region B is undersampled by a factor of n. Parallel acquisition (GRAPPA, acceleration factor 2) was applied and spatial resolution and coverage were adapted for each station: Abdominal/pelvic station: (slices 80; spatial resolution 1.3 × 1.3 × 1.3 mm^3; temporal resolution true/interpolated 4.5/2.3 s); thighs: (slices 64; spatial resolution 1.3 × 1.3 × 1.3 mm^3; temporal resolution true/interpolated 3.9/2.0 s); lower limbs: (slices 64; spatial resolution 1 × 1 × 1 mm^3; temporal resolution true/interpolated 3.9/2.0 s). Reconstruction times were evaluated for all data sets. The MRAs were evaluated by two experienced radiologist in consensus and all significant stenoses (>50%) as well as all vessel occlusions were recorded. All patients underwent digital subtraction angiography within 24 – 48 hours of the MRA exam, which served as the standard of reference.

Results

All exams could successfully be performed; no technical or reconstruction problems occurred. A total number of

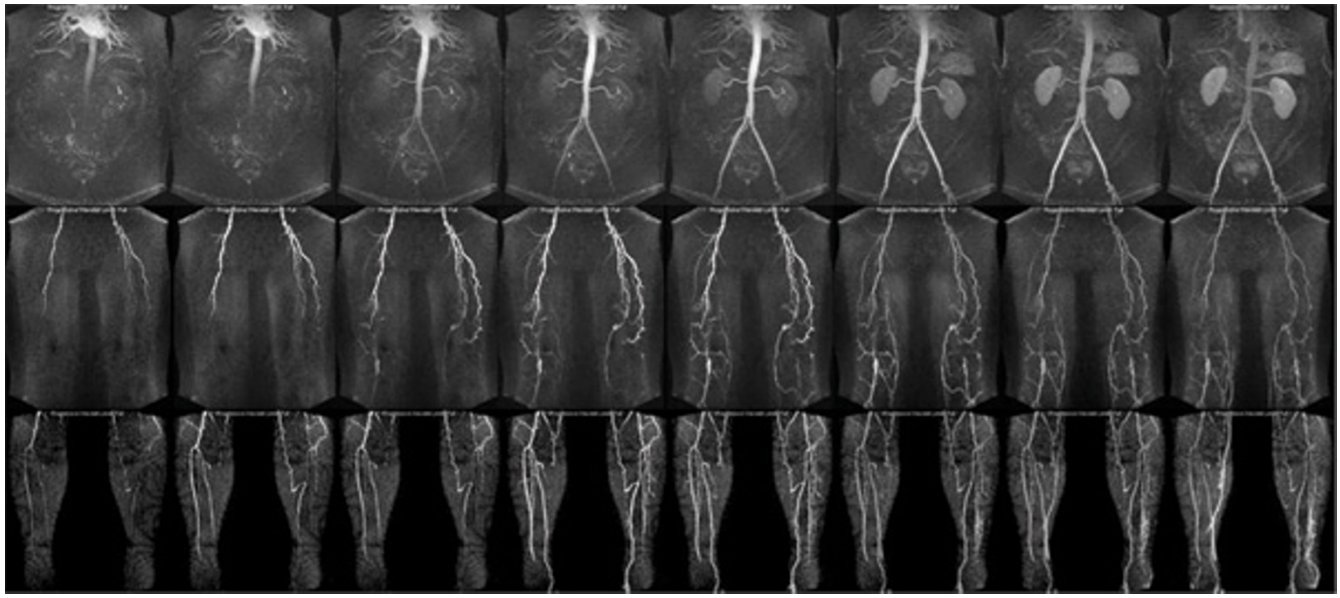

Figure 1
83 y male old patient with PAD. Multiple stenoses and occlusions of the upper and lower limb arteries can be depicted.

up to 2000 images per station were reconstructed in about 6 minutes. Due to the dynamic data acquisition venous overlay did not hamper the assessment of the arterial system in any station. The number of evaluable segments on the MRA data sets was equal to DSA. Significant stenoses (> 50%) as well as occlusions were correctly characterized in all cases using DSA as the standard of reference.

Discussion

The triple TWIST protocol is a robust and reliable technique for MRA of the peripheral arterial system. Compared to other MRA protocols it provides important advantages: 1. perfect arterial opacification of all vessels without any timing issues; 2. no venous overlay in the entire peripheral vascular system; 3. functional information combined with high resolution morphologic information. Hardware improvements will definitely further reduce the reconstruction time in the near future and this approach may become the state of the art imaging protocol for MRA in PAD patients.