Continuously Moving Table Peripheral CE-MRA (TimCT) on a 1.5 T Wide-Bore System in an Obese Population

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Introduction

In recent years, multi-step peripheral contrast-enhanced magnetic resonance angiography (CE-MRA) has been widely established as a clinical routine application. Fast gradient systems and automatic table translation in combination with the Tim (Total imaging matrix) radiofrequency (RF) coil technology facilitate bolus chase MRA from the renal arteries down to the pedal vessels with high image quality and only minor or no venous enhancement. State-of-the-art cylindrical wide-bore scanners (70 cm diameter) are well accepted by claustrophobic patients, and even obese patients can comfortably be examined in most cases. Recently, data acquisition and reconstruction during continuous table movement (TimCT) was introduced [1] which pushes the limits of peripheral MRA. The method enables the acquisition of seamless large FOV data with a significantly streamlined workflow. In the present study, 5 healthy volunteers with normal body weight and 10 obese patients with known peripheral arterial occlusive disease (PAOD) underwent peripheral CE-MRA with continuous table movement on a cylindrical wide-bore magnet.

Methods

All examinations were performed on a 1.5 T cylindrical wide-bore system (Magnetom Espree, Siemens Medical Solutions, Erlangen, Germany) featuring an enlarged bore diameter of 70 cm and a reduced magnet length of 125 cm. The system provides 18 independent RF receiver channels and a matrix of surface RF receiver coils. First, the continuously moving table CE-MRA protocol was optimized with 5 healthy volunteers with a body mass index (BMI) of 20-25. Subsequently, 10 patients with known PAOD and a BMI > 35 were included. Peripheral MRA could not be performed in any of these patients on a conventional 1.5T MR system with a cylindrical bore diameter of 60 cm.

All volunteers and patients underwent continuously moving table peripheral CE-MRA. This method combines 3D coronal slab-selective data acquisition during continuous table movement [2,3] with centric k-space reordering to prevent venous overlay and increased spatial resolution at the distal end of the FOV. Data acquisition was performed with a fast low flip angle T1 weighted gradient echo sequence (FLASH, $\alpha = 24°$, TR/TE = 2.6/1.0 ms, GRAPPA acc. factor 2) with a seamless FOV of 1280x360 mm² and a slab thickness of 126 mm. The acquired voxel size was 1.6x1.2x2.6 mm³ at the proximal end of the FOV and 1.2x1.2x2.1 mm³ at the distal end. 60 slices were reconstructed with a slice thickness of 2.1 mm and an in-plane resolution of 1.3x1.3 mm². The total acquisition time was 77 s. The image quality was evaluated by two radiologists.

Results and Discussion

Although the patients could not be examined on a conventional MR scanner, continuously moving table peripheral CE-MRA was successful in all volunteers and patients on the wide-bore system, providing surface coil image quality (Fig. 1). Total acquisition time and the acquired resolution of the MRA data were equivalent to a conventional multi-step examination. Overall image quality was rated diagnostic in all cases. In contrast to the multi-step approach, continuously moving table data acquisition and reconstruction provides a seamless extended FOV without boundary artifacts between successive stations, which facilitates image reading.

Conclusion

The wide-bore scanner architecture improves not just patient comfort of claustrophobic or obese patients. In a number of cases a 70 cm bore diameter decides whether a patient can be examined at all. Potential imaging limitations of the slightly reduced imaging FOV in the z-direction associated with the overall reduced magnet length of the wide-bore MR system are fully compensated by the continuously moving table technology featuring one seamless large FOV. Furthermore, the workflow introduced with TimCT simplified scan planning.

Fig. 1: Continuously moving table peripheral CE-MRA (FLASH 3D, $\alpha = 24°$, TR/TE = 2.8/1.0, GRAPPA acc. factor 2, FOV 1280x360x126 mm³, voxel size 1.2x1.3x2.1 mm³) of a 70-year-old patient with known PAOD performed on a cylindrical wide-bore MR system. Note: Because of a body weight of 330 lbs, the patient could not be examined on a conventional MR scanner.

References

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