The University Medical Center Mannheim currently operates five MR units (2x 3T equipped with latest Tim technology and with at least 10x32 channel configuration, 1x 1.5T non-Tim system and 2x 1.5T with 76x32 channel configuration). All scanners equipped with Tim technology are equipped with the syngo TimCT-Oncology and syngo TimCT-MRA suites.

Background

Due to a very close cooperation with the departments of vascular surgery and angiography, 8–10 patients with suspected or proven peripheral arterial obstructive vascular disease (PAOD) are examined per week. Because of its non-invasiveness and the good depiction of smallest vessels even with heavy calcification, MR Angiography (MRA) of the lower extremity is considered the most appropriate diagnostic imaging technique for PAOD (Fig. 1). Recent data on the accuracy of 3T MRA of the peripheral arteries in patients with PAOD showed a sensitivity of MRA of 95.3% and a specificity of 98.5% when compared to conventional, invasive DSA [1].

A major disadvantage of conventional large field-of-view (FOV) imaging, such as bolus-chase stepping table MRA, is the complexity of the exam. Three different FOVs have to be planned and examined step-by-step. Thus, images are not acquired as one complete set of data but in several steps. This is error-prone on the one hand and time-consuming on the other hand, in terms of setting up the exam and of actually performing the exam. Afterwards, the images are composed for reading and for demonstration in clinical case conferences. However, the image quality in the overlapping sections of the composed images at the end of the individual FOVs is more likely to be artifact-ridden so that, in the worst case, erroneous interpretation can occur. If MRA images are not composed and are presented as single FOV series, the images are much harder to comprehend for the referring clinical colleagues.

syngo TimCT-MRA advantages

The syngo TimCT-MRA application overcomes these problems by offering a continuous table movement during acquisition of a three-dimensional MRA data set with a continuous z-axis FOV of up to 1200 mm. The single steps of conventional MRA are limited to a FOV.
of 400 to 500 mm depending on the equipment used, which have to be considered manually after the exam. Beyond the easy visualization, TimCT-MRA is beneficial in two other ways. Firstly, due to the ease of planning of the exam without angulation of different slabs and without the need to optimize the overlapping segments. Secondly, whilst the conventional step-by-step approach requires two periods of dead-time (for the table to move without acquiring images and for the contrast agent bolus to travel further through the body), by contrast syngo TimCT is very time-effective since it eliminates these dead-times. The more effective use of the contrast agent enables a reduction in the dose of contrast agent of 20–40%.

**syngo TWIST dynamic information**

Characteristically, up to 50% of patients with PAOD III IV show venous overlay in the calves due to inflammatory hyperemia and side-different flow [1]. Therefore, our protocol is supplemented by an additional dynamic TWIST angiography of the critical calf station after the TimCT-MRA. The syngo TWIST-MRA allows dynamic depiction of the small run-off vessels and collateral vessels. Due to the dynamic nature of the TWIST MRA purely arterial images of the calf vessels can be acquired even in patients with severe inflammation or those with side-different flow.

**TimCT-MRA and TWIST in clinical routine**

The protocol is very simple and – at our institution – includes a syngo TimCT localizer, a vessel scout, the Tim FLASH angiography sequence before and after contrast administration (TR 2.42 ms, TE 1.02 ms, spatial resolution 1.2 x 1.2 x 1.2 mm³) and the TWIST-angiography of the lower legs (TR 2.75 ms, TE 1.02 ms, spatial resolution 1.1 x 1.1 x 1.1 mm) 1–2 minutes after the TimCT-MRA. The examination is performed with a single dose of contrast media (Gadobutrol) for the TimCT-MRA, and with a second administration of a reduced dose of contrast media for the dynamic TWIST-angiography. In order to increase the injected volume and to save on contrast media, at our institution Gadobutrol is diluted with saline 1:1. The dosage of contrast media does not exceed that of a traditional single-dose multi-step MRA.

The images acquired in patients with the syngo TimCT-MRA technique show consistently good image quality (Figs. 2 and 3). In a feasibility study on the image quality of low-dose TimCT-MRA, 393 out of 397 vessel segments showed diagnostic image quality and 213 vessel segments were scored with excellent image quality. Non-assessable segments were only encountered in 4 out of 397 vessel segments (1%). A slight venous overlay occurred in 27% in the lower leg station, not interfering with diagnostic reading, whereas no venous overlay occurred in the pelvis or the thighs [2, 3]. Additional relevant information was found in 64% of the patients with the syngo TWIST-MRA, such as collateral vessels not detectable in the TimCT-MRA due to venous overlay or tissue contrast media enhancement (Fig. 4) [2]. Although the spatial resolution of the syngo TimCT MRA suite (1.2 mm isotropic at 3T with software version syngo MR B15) is currently inferior to the conventional DSA exams (0.3 mm in-plane) and slightly inferior to CT angiography, evaluation of pathologies is nearly equivalent in our experience. A further improvement is the introduction of a higher spatial resolution in the calf station which is available with the latest software version syngo MR B17 allowing 0.7 mm isotropic resolution in the calves.

**Conclusion**

Overall, the syngo TimCT MRA suite is a huge improvement in imaging the lower extremities in a clinical setting as it combines an easy, fast and robust workflow with good clinical results and is applicable to a broad range of patients.

**References**

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