

Steady State Imaging with Blood Pool Contrast Agent MRA in Patients with Critical Lower Limb Ischaemia for Venous Mapping Bypass Graft Assessment - Initial Experience

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Purpose - Patients with peripheral vascular disease may require bypass grafting, however, for this the lower limb veins must be assessed as to their suitability and deep venous thrombosis excluded. Typically this evaluation is performed with duplex ultrasound, a time consuming additional test. We assessed the potential of high resolution steady state imaging with blood pool contrast agent of the lower limbs for evaluation of the venous vasculature when compared with the current standard of duplex ultrasound vein mapping.

Methods – In this ethics committee approved pilot study we recruited patients presenting with critical lower limb ischaemia (Fontaine stage III & IV). Lower limb MRA was performed with blood pool contrast agent (9 ml gadofosveset, ~ 0.03 mmol/kg) using a hybrid dual injection technique with a dynamic MRA initially at the tibial station and subsequent stepping table 3 station bolus chase MRA. Subsequent high spatial resolution steady state gradient echo imaging of the calf and thigh stations was performed in phased array coils with parallel imaging acquisition - for the calf station this employed 0.5 mm³ isotropic resolution and at the thigh either 0.5 mm³ or 0.7 mm³ isotropic resolution depending upon patient size. Imaging was performed at 1.5 T with either a Philips Gyroscan ACS NT (Intera equivalent) or a Siemens Avanto scanner.

On the steady state MRA image quality was assessed on a simple scale. The deep veins were assessed for patency and evidence of DVT. The quality and calibre of the short and long saphenous veins throughout their lengths, sites of division & major tributaries as well as the patency of the deep veins was recorded for each leg, datasets were interactively reviewed on workstations with MPR and MIP.

Patients had duplex venous assessment for the leg in question as per standard protocol in the vascular laboratory with descriptive report.

Superficial leg vein quality in terms of diameter at reference points and any relevant variant anatomy was compared between modalities. With a simple scale of utility the MRI studies were compared to the descriptive duplex reports

Results - 20 patients were recruited. MRI steady state phase image quality was judged as excellent or good in all but one patient who was in severe pain where imaging was severely corrupted by motion artifact. All patients had patent deep veins with no evidence of DVT on either MRI or ultrasound. Superficial vein diameters were consistently assessed as similar calibre to duplex ultrasound. MRA showed more superficial veins, more divisions and more large perforating tributaries than ultrasound.

Discussion - MRA performed well with congruent calibres of veins at measured sites, any minor difference in calibre noted between MRI and ultrasound assessment can be accounted for by the differences in technique - supine with cuffs deflated for MRI, erect with the use of tourniquets to aid venous distension for ultrasound. MRI studies were judged more informative than the descriptive ultrasound reports except for the patient with very poor MRI image quality.

Conclusion - This initial study shows that lower limb MRA performed with blood pool contrast agent and steady state imaging has the potential to obviate additional ultrasound examination in the work-up of patients with lower limb ischaemia who are being assessed for potential vein bypass grafting. The challenge is to ensure consistent image quality in patients with critical ischaemia who can be restless.