Clinical Comparison of the Hybrid Peripheral Magnetic Resonance Angiography Technique versus Sequential Stepping-Table Approach

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Introduction

Lower extremity contrast enhanced peripheral MR angiography (pMRA) is used routinely to triage patients with peripheral vascular disease to percutaneous intervention or surgery. A sequential stepping-table 3-station technique (bolus-chase) is routinely used for pMRA, risking either poor enhancement of run-off vessels or venous contamination. The purpose of our study was to evaluate the efficacy of a "hybrid" dual timing/dual injection pMRA technique with separate preceding calf acquisition and compare it to a conventional bolus-chase pMRA technique.

Materials and Methods

155 consecutive patients underwent pMRA on a 1.5 T scanner (Magnetom Quantum, Siemens Medical Systems, Malvern, PA) using a 3D gradient echo pulse sequence (TR/TE: 3.5/1.2, α: 25°) and dedicated peripheral vascular coil. Angiographic correlation was available in 61 patients. The first 34 patients underwent bolus chase pMRA with a single 2 ml Gad-DTPA timing run followed by an automated sequential, 3-station bolus chase, stepping-table technique. Bolus-chase infusion was a graduated single infusion of Gad-DPTA: the first 20 ml at 2 ml/s followed by the remaining 28-40 ml (maximum weight based dose 0.3 mmol/kg) at 0.8 ml/s. The next 121 patients underwent hybrid pMRA with 2 separate axial timing runs centered in the calves and pelvis. Calf single-station MRA was performed first with the infusion of 20 ml Gad-DPTA at 2 ml/s. Subsequently, pelvis-thigh stepping-table MRA was carried out with a second injection of Gad-DPTA: 20 ml at 2 ml/s followed by 10-16 ml (maximum weight based total 0.3 mmol/kg) at 0.8 ml/s. Two independent observers reviewed source partition, MIP and volume-rendered data. Arterial vessels were divided into 29 anatomic segments per patient and the most severe stenosis per segment was graded by 10% increments. Qualitative measures of venous contamination and diagnostic confidence per station were made. Digital subtraction angiograms were assessed separately in a similar fashion for lesion severity by anatomic segment.

Results

Sensitivity, specificity, and accuracy for the hybrid technique were 95%, 95% and 95% versus 85%, 93% and 91% for the bolus-chase technique. Venous contamination in the calves was significantly more severe for bolus-chase pMRA. Diagnostic quality of the calf vessels was rated significantly higher with the hybrid technique. All p values were significant ($p < 0.05$).

Conclusion

While increasing exam length slightly, the addition of a second timing run and separate calf acquisition significantly reduces venous contamination and increases diagnostic confidence. This fact coupled with its higher spatial resolution and diagnostic image quality make the hybrid approach preferable to conventional bolus-chase, stepping-table techniques.