Optimized Whole-Body 3D MR angiography with suprapopliteal venous compression: a feasibility study

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Synopsis:
The purpose of the study was to assess whether the transient venous compression (60 mmHg) using external air pressure at the mid-femoral level in combination with a high resolution gradient recall echo sequence for the lower extremities improve the delineation of calf vessels and reduces venous overlay in 3D whole-body MRA. Venous compression was well tolerated by all study participants and yielded significantly higher quantitative and qualitative results compared to standard WB-MRA. The outlined strategy suggest that mid-femoral venous compression should be incorporated into multi-station protocols of the lower extremities for improved delineation of calf arteries without disturbing venous overlap.

Introduction:
Whole-body MRA (WB-MRA) has been shown to be both sensitive and specific in the detection of significant arterial disease (1,2). Reflecting the arrival of the contrast bolus at least 30 seconds prior to data collection, evaluation of the lower extremity arteries can however be hampered by venous contamination. In addition, restricted spatial resolution limits delineation of small collaterals or assert graft vessel patency in patients with peripheral arterial disease. A desired increase in spatial resolution requires lengthening of the acquisition time thereby intensifying venous enhancement. The purpose of the study was to evaluate a venous compression technique (3) employed at the level of the mid thigh to reduce venous enhancement in order to increase scan time and spatial resolution for better display of the lower extremity arteries.

Methods:
5 healthy volunteers and 10 patients with angiographically documented peripheral arterial occlusive disease were included in the study. Contrast-enhanced whole body MRA (5 consecutive 3D FLASH data sets, Gadovist®, Schering, Berlin, Germany) was performed on a 1.5 T MR scanner (Siemens, Magnetom Sonata) with the subjects placed on a moving table platform (AngioSURF). Whole body MRA was performed on three occasions per participant with a time interval of at least 24h between examinations. Different protocols were used: 1. standard protocol using standard parameters (matrix: 256) for the distal two data sets (TA: 0:27 min); 2. higher spatial resolution (matrix: 512) for distal two stations (TA: 1:02 min), and 3. the same protocol as in 2 but with constant venous compression (60 mmHg) at the mid-femoral level during the entire exam. Quantitative and qualitative evaluation of image data was performed in consensus by two radiologists.

Results:
Compared with the standard whole body MRA technique, the “high resolution” protocols enabled better visualization of lower limb arteries (Fig. 1). However, due to a longer data acquisition time, venous overlay was significantly increased, if the compression technique was not used. With the compression technique a substantial decrease of venous enhancement resulting in a superior image quality with higher diagnostic confidence for the assessment of crural arteries was present.

Discussion:
Whole body MRA performed with venous compression results in significant delay of venous overlay. It thus permits longer acquisition times with increased spatial resolution.

References:

Fig. 1: Images show DSA (a) and the two distal stations of standard (b), high resolution (HR, c), and HR with venous compression (d) AngioSURF exams of 68yo woman with PAD and multiple plaques. Note considerable venous contamination on c and bright vessel signal in d.