Table-moving Contrast-Enhanced MRA of the Lower Extremities in Patients with Arterial Occlusive Disease: Its Diagnostic Accuracy and Reliability in Comparison with IA-DSA

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Purpose
Table-moving 3D-enhanced MRA is now widely used in the evaluation of arterial occlusive disease of lower extremities. However, it is known that there are some problems and limitations. The purpose of this study is to evaluate the usefulness of table-moving 3D-enhanced MRA of the lower extremity in comparison with IA-DSA.

Materials & methods
Fifty-nine patients (54 men and 5 women; mean age 70 years) with arterial occlusive disease of the lower extremities were examined. One patient had been treated by bypass graft surgery and 11 (8 men and 3 women; mean age 68 years) patients were treated with metallic stent placement. One to 7 (mean:2.7) stents were placed in each patient. In total 30 metallic stents (12 Palmaz stents, 5 Easy Wallstents and 13 SMART stents) were used. All patients underwent table-moving 3D-enhanced MRA and IA-DSA within one month. All MR imaging was performed on a 1.5 T superconducting MR system using moving table methods. MRA of three consecutive different stations from abdomen to ankle was obtained with automatically moving bed procedure. We used peripheral vascular phased array coils or combination of body coil and body array coils (body coil from abdomen to thigh and body array coils in calf). We used SPGR (TR=5.3, TE=1.1, FA=40deg, FOV=400mm, Matrix = 256x160, slab/partitions = 94-150/18-30, ZIP=4) with sequential view order. Acquisition time of each station varied from 18 to 29 sec. Total acquisition time of three stations was within 2 min. 15-20ml of Gd-DTPA was injected intravenously at a speed of 1ml/sec. The contrast injection was followed immediately by a 20ml saline flush at 1ml/sec. Timing examination had been performed before MRA data acquisition to determine the delay time. For subtraction technique, images were also obtained before the Gd-DTPA injection. MRA was obtained by Maximum Intensity Projection (MIP).

These images and IA-DSA were read in a blind fashion by two radiologists. Contrast of Arteries and veins was evaluated in each station. The degree of demonstration of veins was divided in 3 categories. a) no venous overlay, b) mild venous overlay :arterial demonstration was not disturbed, c) moderate to severe overlay: arterial demonstration was disturbed.

To evaluate the assessment of stenotic degree, arteries were divided into 9 segments (distal abdominal aorta, common iliac A., external iliac A., superficial femoral A., Popliteal A. on both sides). In a patient with bypass graft, each bypass graft was counted as one segment. In this study arteries in lower leg were excluded, because of high rate of venous overlay. In total 372 arterial segments were investigated. Each segment was assessed for patency according to the following schema; a) patency (stenosis less than 50%), b) mild stenosis (stenosis 50-74%), c) severe stenosis (stenosis 75-99%) and d) occlusion (100%). Each segment was categorized on the basis of its narrowest position.

Results
In the first and second stations (from abdominal aorta to popliteal A.), contrast of arteries was good. No venous overlap was noticed in the first station. In the second station, 46 cases (77.9%) showed no venous overlap. 11 cases showed mild venous overlap and 2 cases (3.4%) showed moderate venous overlay. In the third station, 31 cases (52.6%) showed no venous overlap, 17 (28.8%) showed slight venous overlap and 11 (18.6%) showed moderate to severe venous overlay.

In one patient treated with bypass graft surgery, bypass graft was well demonstrated on CE-MRA. On the other hand, arterial segment treated with metallic stent placement were not clearly demonstrated. In all arterial segments treated with Palmaz stent placement, no signal was observed. The stented vessels treated with Easy Wallstents or SMART stents showed the signals within the stented vessels. The lumen treated with stents were demonstrated as slightly to moderately stenosed. Very slow flow such as native artery in case with bypass graft was much better demonstrated on 3D-enhanced MRA than on IA-DSA.

In comparison with IA-DSA, 335 segments (94.3%) on enhanced MRA were correctly classified. The sensitivity, specificity and accuracy for detecting hemodynamically significant stenosis (stenosis more than 50%) of CE-MRA were 95.2%, 90.6%, 91.6%, respectively. When 17 arterial segments with metallic stent placement were excluded, 335 out of 355 arterial segments (94.3%) were correctly classified and the sensitivity, specificity and accuracy for detecting hemodynamically significant stenosis of CE-MRA were 95.2%, 96.0%, 95.8%, respectively. 13 segments were overestimated and 6 were underestimated with only for one category difference. The length of stenotic lesion was accurately demonstrated on CE MRA. In 3 cases, the length of occlusion were smaller on CE-MRA than on IADSA. In these cases, length of occlusion were well correspond to CE-MRA. Therefore, the length of occlusion was overestimated on IA-DSA, due to dilution of contrast material or slow flow.

Conclusion
Evaluation of the stenotic degree on CE-MRA up to trifurcation was highly accurate in comparison with IA-DSA. The degrees of stenosis on CE-MRA were close to IA-DSA except for the arterial segments treated with metallic stent placement. In this study, one of the most significant limitations of CE-MRA was overlap of veins, especially in calf (the 3rd station). This sometimes impaired the demonstration of arteries in the lower leg. Therefore, 2 or 3-phase injection should be considered.

We believe that 3D-enhanced MRA of the pelvis is reliable and it could be used as a screening or follow-up examination.

References