Fresh Blood Imaging (FBI) of Peripheral Arteries: Comparison with 16-Detector Row CT Angiography

K. Nakamura[1], K. Kuroki[1], A. Yamamoto[1], A. Hiramine[1], M. Miyazaki[2], Y. Matsufuji[3]

[1]Radiology, Tobata Kyoritsu Hospital, Kitakyushu, Fukuoka, Japan, [2]Toshiba America Medical Systems, Rolling Meadows, Illinois, United States, [3]Toshiba Medical Systems Co., Fukuoka, Fukuoka, Japan

Purpose

Fresh blood imaging (FBI) is a novel non-contrast enhanced three-dimensional MR angiography technique, which using a physiological signal change of an artery during a cardiac cycle. Recently 16-detecror row CT angiography (CTA) is reported to have high diagnostic ability and an alternative to conventional DSA in the evaluation of aortoiliac and lower extremity arteries. The purpose of this study is to compare FBI with 16-row CT angiography in the evaluation of the infrarenal aorta and lower-extremity arterial system.

Materials and Methods;

This study was approved by the institutional review board, and informed consent was obtained. A total of 13 consecutive patients (10 men [mean age, 72years] and 3 women [mean age, 69 years]) with suspected peripheral arterial diseases underwent both FBI and 16-detector row CT angiography examinations. For data analysis, the arterial vascular system was divided into 23 anatomic segments (infrarenal aorta, right and left common iliac artery, internal iliac artery, external iliac artery, common femoral artery, superficial femoral artery, deep femoral artery, popliteal artery, anterior tibial artery, tibioperoneal trunk, posterior tibial artery, and peroneal artery), which were graded separately for degree of stenosis using a four-point grading system (grade 1, <10% luminal narrowing; grade 2, 10%-49% luminal narrowing; grade 3, 50%-99% luminal narrowing; grade 4, occlusion). On the basis of consensus readings, sensitivity, specificity, and accuracy for detection of stenotic lesions using FBI were calculated, with findings on CTA as the reference standard.

All MR examinations were performed using a 1.5-T clinical imager (EXCELART, Toshiba, Tokyo) using a torso SPEEDER coil. Three-dimensional (3D) half-Fourier FSE acquisition parameters were as follows: TR=3 RR intervals, TEeff =80 msec, TI=190 msec, ETS= 5 msec, matrix=256 x 256, section thickness of 4 mm (interpolated to 2 mm), field of view of 37 x 37 cm, and a total acquisition time of 2-3 minutes. Both diastolic and systolic ECG-triggered 3D data were acquired, the systolic images were subtracted from the diastolic images, and the subtracted images then underwent maximum intensity projection (MIP) processing.

All CTA were examined with a 16-detector row CT scanner (Aquilion 16; Toshiba, Tokyo) with 1-2mm slice thickness and helical pitch of 15. The MIP, multi-planar reformations (MPR), 3D reconstructions as well as axial images were available for analysis of CTA because luminal evaluation is difficult only by MIP images in cases with severe arterial wall calcification.

Results

In all patients, FBI provided diagnostic images comparable with those of CTA. Compared with 16-detector row CT angiography, the sensitivity and specificity of FBI with regard to detection of 50% or greater luminal reduction, which indicated hemodynamically significant stenosis, were 94% and 94%, respectively. Overall diagnostic accuracy was 94%. A typical comparison images for FBI and CTA were shown in Fig. 1. Nine segments which were existed distal to the long severe stenoses or occlusions, demonstrated significantly decreased signal intensity. This was suggestive to possible significant stenoses, otherwise normal or less severe demonstration by CTA. FBI is intrinsically a sensitive technique to arterial flow change during cardiac cycle, the image shows reduced signal intensity when the arterial flow change during cardiac cycle is small. As compared to CTA and DSA, which depict filling of the contrast agent in the vessel lumen, FBI depicts the arterial blood flow difference during diastole and systole. Therefore, FBI provides additional functional information of blood flow during cardiac cycle. Excluded these segments for grading, the sensitivity, specificity, and accuracy of FBI were 97%, 98%, 97%, respectively.

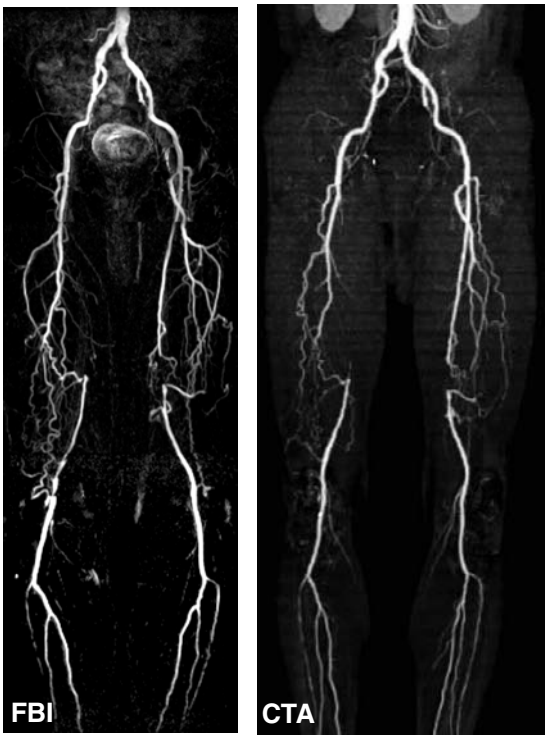

Fig. 1 64 y.o. male with occlusion of bilateral superficial femoral arteries. Coronal MIP image of the entire vascular tree from the distal aorta to the feet obtained with FBI (left) and the corresponding CTA (right).

Discussion

FBI is an accurate and noninvasive alternative to CT angiography for the assessment of aortoiliac and lower extremity arteries in patients with peripheral arterial diseases. The excellent depiction of the vascular territories of the distal aorta and the pelvic and lower limb arteries without contrast materials is suggestive of great potential for the use of FBI in the primary diagnosis of peripheral arterial occlusive disease.

REFERENCES

1] Miyazaki M, Takai H, et al. Radiology 227:890-896, 2003.
2] Willmann JK, Baumert B, et al. Radiology 236; 1083-1093, 2005