Fresh Blood Imaging (FBI) of Peripheral Arteries: Interobserver and Intraobserver Reproducibility Study

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PURPOSE;

Fresh blood imaging (FBI) is a novel non-contrast enhanced three-dimensional MR angiography technique (1). We reported that FBI at 1.5T offered an excellent diagnostic capability for the detection of significant stenosis with a sensitivity and specificity comparable to CT angiography (CTA) (2). The purpose of this study is to assess the inter-observer and intra-observer agreement in the interpretation of FBI for the aortoiliac and lower extremity arteries.

MATERIALS and METHODS;

This study was approved by the institutional review board. A total of 23 patients (age 55-100 (mean 73.2 +- 11.7), 16 male, 7 female) with suspected peripheral arterial diseases underwent non-contrast FBI examination. Three board certified radiologists participated in this study, who had different experiences in analyzing FBI images; radiologist A with hundreds cases of experience, radiologist B with less than 50 cases, and radiologist C with less than 10 cases. 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 (grade 1, <10% luminal narrowing; grade 2, 10%-49%; grade 3, 50%-74%; grade 4, 75-99%; grade 5, complete occlusion; and grade 6, non-diagnostic).

All MR examinations except one case were performed at a 1.5-T clinical imager (EXCELART VantageTM powered by Atlas, Toshiba, Tokyo) using a combination of an Atlas SPEEDER body and an Atlas SPEEDER spine coil. One MR examination was performed at a 3T-clinical imager (Vantage TitanTM 3T, Toshiba, Tokyo). After diastolic and systolic ECG-triggered 3D data were acquired, the system automatically performed that the systolic images were subtracted from the diastolic images, and the subtracted images then underwent a maximum intensity projection (MIP) processing.

Each radiologist interpreted the 23 cases in a random order without patients' history using a clinical PACS workstation, SYNAPSE (Fuji medical Co., Tokyo). Stenosis grading was conducted by a visual estimation of vessel diameter reduction at the point of maximum stenosis compared to the nearest distal healthy segment, and was performed using MIP and source images if necessary. A second analysis was performed a period of two weeks later to reduce memory bias.

Cohen's Kappa statistic (k) was used to assess the agreement in categorical stenosis grading by radiologists.

RESULTS;

Analysis of inter-observer agreement found moderate to substantial agreement (k=0.644 – 0.761) (Table 1). Analysis of intra-observer agreement was substantial (radiologist A k=0.827, radiologist B k=0.800, radiologist C k=0.922) (Table 2).

Radiologists with less experience in FBI analysis tended to misinterpreted the signal decrease of the left common femoral artery or proximal superficial femoral artery due to B1 inhomogeneity as a "real" stenosis. Some of the leg arteries were evaluated as "non-diagnostic", because the signal of such arteries was somewhat decreased especially in middle to distal leg region, which was not thought suitable for precise evaluation.

Table 1 Inter-observer variation

	Radiologists A and B	Radiologists A and C	Radiologists B and C
1st reading	0.734	0.722	0.761
2nd reading	0.644	0.723	0.680

Table 2 Intra-observer variation

	Radiologist A	Radiologist B	Radiologist C
k value	0.827	0.800	0.922

DISCUSSIONS;

FBI shows the moderate to substantial inter- and intra-observer agreement for the assessment of aortoiliac and lower extremity arteries, with which FBI is thought to be clinically acceptable for the evaluation of peripheral arterial diseases. B1 inhomogeneity may degrade the arterial demonstration especially at the left common femoral to proximal superficial femoral arteries; therefore, it is recommended to radiologists about the typical pattern of artifacts to avoid the diagnostic error (3). Use of a dielectric pad may resolve this issue. FBI using 3T-MRI with B1 correction can resolve the problem of inferior demonstration of distal leg arteries in 1.5 T-FBI (4).

CONCLUSIONS;

In this study, both the interobserver and the intrabserver reproducibility of FBI for peripheral arteries were clinically acceptable.

References;

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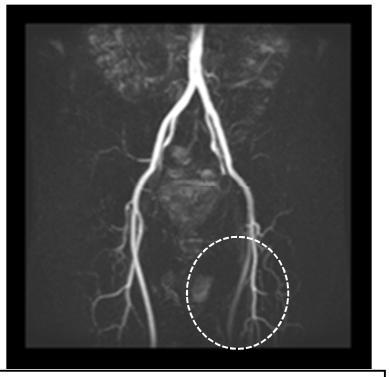

Fig.1 Typical example of the artifact due to B1 homogeneity (FBI of pelvic region) Left superficial femoral artery shows low signal due to B1 inhomogeneity, which was misdiagnosed as a stenosis by a radiologist with less experiences of FBI analysis.