NON-CONTRAST ENHANCED MRA OF UTERINE ARTERY USING TIME-SLIP: EVALUATION OF OPTIMAL BBTI

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Target Audience: Clinical radiologists and technician who are interested in non-contrast-enhanced MRA or gynecological imaging.

Introduction:

Time-spatial labeling inversion pulse (time-SLIP) is one of the well-known technique for the non-invasive acquisition of angiogram of the artery.In this technique, both factors of arterial visualization and background suppression are important for good visualization of MRA image. Black Blood Inversion Time (BBTI) defines these two factors, i.e., a time delay for the tagged blood flowing into the imaging region and the degree of signal recovery of background tissues(1). There have been some reports on non-contrast-enhanced MRA of renal artery or hepatic vessels(2). As for uterine artery, it should be considered the distance from aortic artery and there are two vessels that reach the uterus bilaterally. In addition, feasible parameters for 3T machine different from 1.5T magnet are also required because of elongation of T1. We aimed to evaluate the reasonable BBTI for obtaining non-contrast-enhanced MRA of uterine artery using time-SLIP technique at 3.0-T.

Materials and Methods

19 women of reproductive age (range 21-47 y.o. average 31 y.o.) were recruited for the study. MR studies were performed using 3.0-T MR system (Toshiba Medical Systems, Tochigi, Japan), equipped with a pair of 4 by 4 phased array coils placed at both front and back of the abdomen. MR images were obtained during without bleeding of menstruation. No pre-medication was given to any subjects before examination. Non-contrast-enhanced MRA using 3D true SSFP imaging sequence with fat saturation using short time inversion recovery was performed in the coronal plane with the following parameters: TR/TE/FA = 4.8 ms/2.4 ms/120, slice thickness/gap=5/0mm, number of slices = 22, number of averages = 1, field-of-view = 350 mm × 200 mm, matrix size=256×128, number of acquisition = 2(tag on/off). The final images were reconstructed into an apparent spatial resolution of 0.7mm×0.7mm×5mm. BBTI = 1200, 1400, 1600, 1800 were set for comparison. A respiratory triggering and ECG-gating was not used. A non-selective inversion-recovery pulse was placed on the abdomen, which could approximately cover the lower abdomen. Then, the second tag was placed on the aorta as long as possible in a coronal plane with 60 mm thickness. The tag-on/off subtraction images were made from tag-on and tag-off images and then, minimum intensity projection image (MinIP) were made from the subtraction images.

Fig.1 Quantitative analysis

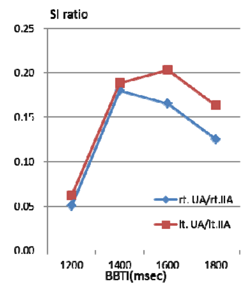
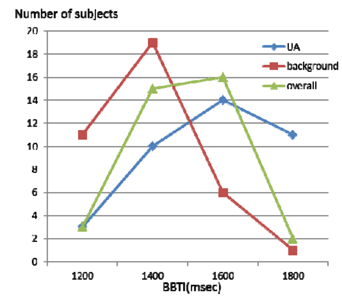


Fig.2 Qualitative analysis



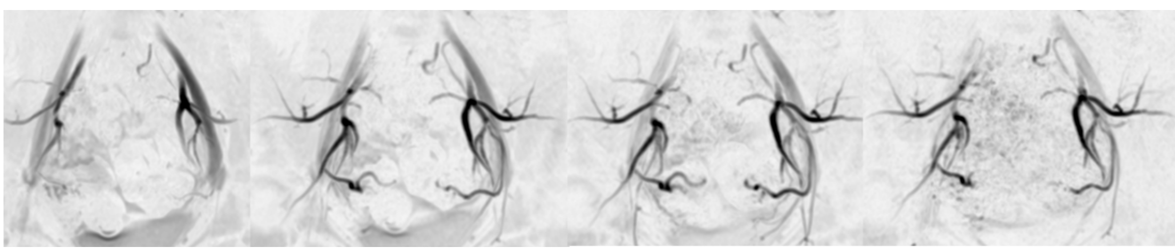
1, Quantitative evaluation

The signal of uterine artery (UA) at parametrium of the uterus after divergence from internal iliac artery (IIA) was measured on the subtraction images. The signal of UA was normalized by dividing by the signal of IIA on the tag-on image.

The signal of background was represented by the signal intensity of intestines between bilateral IIA.

2, Qualitative evaluation

The visualization of UA, degree of background suppression and over all image quality was rated(score 1-4) by two radiologists.



BBTI=1200 BBTI=1400 BBTI=1600 BBTI=1800 : Uterine arteries were recognized longest at BBTI=1400-1600, signal intensity of the pelvic intestines was best suppressed at image with BBTI=1200-1400msec.

Results: The relative signal intensity of UA/IIA were shown on figure 1 and was significantly higher in the images with BBTI=1400-1600 in bilateral. There was no significant difference in the signal of background (intestine). The results of qualitative analysis were shown on figure 2. There were significant differences among four BBTIs for the visualization of UA, degree of background suppression and over all image quality. Images with BBTI=1400-1800 were better than those with BBTI=1200 for arterial visualization, but the background was well suppressed in images with BBTI=1200-1600.

Discussion and Conclusion:

The optimal BBTI for visualizing uterine arteries by time-SLIP technique were between 1400-1600msec. considering the qualitative and quantitative analysis of arterial and background signals.

Ref.(1) Miyazaki M, Lee VS. Radiology. 2008;248(1):20-43. (2) Shimada K, et al. J Magn Reson Imaging. 2009;29(5):1140-6.