Non-enhanced MR angiography of the uterine vessels; optimization of the sequence parameters

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Introduction:

MR angiography (MRA) of pelvic vessels, including uterine vessels, is not only applicable for various vascular disorders but also useful for surgical planning. Time-spatial labeling inversion pulse(Time-SLIP) technique is an emerging technique of arterial spin labeling, and permits detailed angiography of both arteries and veins. Non-enhanced MRA with Time-SLIP can be basically performed with either 3D balanced steady state free precession (SSFP) technique or fast advanced spin-echo technique (FASE), which utilizes 3D half-Fourier spin-echo sequence with ECG-triggering. In both techniques, the optimization of inversion time (TI) is essential for obtaining contrast between arteries and veins. The purpose of this study is to evaluate the difference of depiction and contrast of the uterine vessels in different inversion time in optimization of TI in non-enhanced MRA utilizing Time-SLIP.

Materials and Methods:

Our study subject consisted of eight normal healthy volunteers (age; 21-28, mean24). All MR examinations were performed with 1.5T scanner (Excelart Vantage, Toshiba) with a multi-channel phased array coil. Nonenhanced Time-SLIP MRA was performed utilizing both SSFP (TR 4.3 ms, TE 2.2 ms, FA 120) and FASE (TR 3815 -6965 ms, TE 80 ms) acquisitions under ECG-gating with three different TIs (1200ms, 1500ms, 1800ms), employing parallel imaging with a reduction factor of two. FOV was 300 - 350 mm for FASE and 320 -350 mm for SSFP. The matrix was 256 x 256, slice number was 60 and slice thickness was 1.5 mm. All MRA images were independently evaluated by two radiologists. The readers rated the depiction of the uterine arteries and veins, and the contrast between these vessels of the both side of the pelvic wall, using a 4-point scale; 0 as none, 1 as poor, 2 as moderate, 3 as excellent. The results of visual assessments were statistically analyzed utilizing ANOVA test, with p-value less than 0.05 as statistically significant.

Results and Discussion:

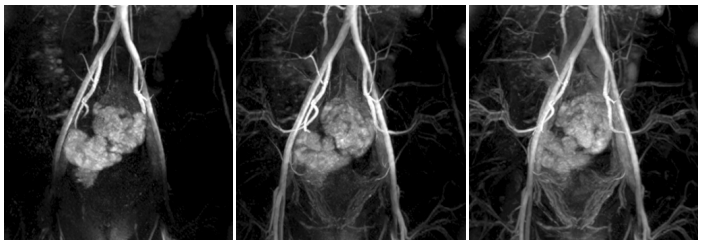
The results of the averaged score of visual assessment for both techniques were summarized in the table 1 and 2. The neighboring boxes with bold character mean statistically significant. In FASE technique, TI of 1200ms most frequently failed to depict the uterine arteries. The longer TI provided better depiction of the uterine veins, but did not significantly improve the depiction of the arteries and contrast between arteries and veins. In SSFP, the longer TI tended to provide better depiction of the arteries, vein and the contrast between them with best contrast. The difference of contrast between arteries and veins in FASE and SSFP could be an intrinsic contrast effect of SSFP (T2/T1 of blood) and the effective TE selected in FASE. In addition, the TI time difference between SSFP and FASE provides difference in contrast between arteries and veins.

Table1. FASE sequence

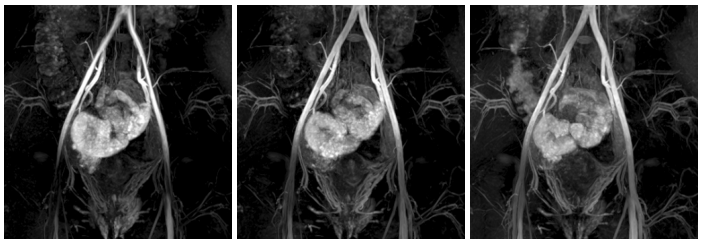
TI	1200ms	1500ms	1800ms
Arteries	0.72±1.21	1.13±1.41	1.16±1.09
Veins	**0.13±0.34**	**1.19±0.36**	**2.06±0.31**
Contrast	0.81±1.28	1.34±1.42	1.31±1.12

Table 2. SSFP sequence

TI	1200ms	1500ms	1800ms
Arteries	0.78±0.75	**1.06±1.03**	**1.78±0.98**
Veins	**1.69±0.36**	**2.31±0.36**	**2.63±0.34**
Contrast	1.06±1.01	**1.13±0.95**	**1.36±0.96**



FASE TI=1200ms TI=1500ms T1=1800ms



SSFP TI=1200ms TI=1500ms T1=1800ms

Conclusion:

With FASE technique, the difference of contrast between arteries and veins dose not significantly differ, although images with longer TI tend to show better depiction of the uterine veins. T1 of 1200ms may be suboptimal for depicting vessels. With SSFP, TI of 1800ms may provide best depiction of the both arteries and veins, and contrast between them with best contrast

References: 1) Kanazawa H and Miyazaki M. ISMRM p140, 2002. 2) Ito K, et al., AJR 178:343-348, 2002. 3) Yui M, et al., ISMRM p2121, 2004.