UNENHANCED ECG-GATED FAST SPIN-ECHO MR DIGITAL SUBTRACTION ANGIOGRAPHY (MRDSA) USING SPACE WITH CONSTANT FLIP ANGLE MODE OF FEMORAL ARTERIES

S. Morita[1], S. Kojima[1], M. Hirata[1], M. Suzuki[1], K. Suzuki[1], A. Masukawa[1], and E. Ueno[1]
[1]Department of Radiology, Tokyo Women's Medical University Medical Center East, Arakawa-ku, Tokyo, Japan

INTRODUCTION: Unenhanced electrocardiographically (ECG)-gated fast spin-echo-based magnetic resonance digital subtraction angiography (MRDSA) is reported to obtain hemodynamic information of pulse wave transmission in arteries (1). Variable flip angle fast spin-echo sequence, known as, for instance, sampling perfection with application optimized contrasts using different flip angle evolutions (SPACE), has recently been applied to the ECG-gated fast spin-echo based MR angiography technique (2). It is expected that it can shorten echo-spacing because of non-selective rectangular refocusing pulses as well as variable flip angle. We hypothesized that its reduction of readout duration would be especially effective for MRDSA. However, this had not been evaluated before.

PURPOSE: To compare the image qualities of unenhanced ECG-gated MRDSA using SPACE with constant flip angle mode and conventional half-Fourier single-shot turbo spin-echo (HASTE) sequence.

MATERIALS AND METHODS: Unenhanced ECG-gated MRDSA using SPACE with constant flip angle mode and HASTE of the femoral arteries were prospectively acquired in 10 healthy volunteers at 1.5T MRI. Ten systolic phases with 20 msec incremental time delay starting from the R-wave and two diastolic phases were acquired. The acquisition parameters of SPACE [vs. HASTE] were: TR/effective TE, 2 R-R intervals/45 [vs. 107] msec; flip angle, 120° (constant); bandwidth, 781 Hz/pixel; field of view, 338×380 mm; matrix, 256×190×128; section thickness, 5 mm; slice per slab, 20; echo-spacing, 3.24 [vs. 7.15] msec; echo train length, 109 [vs. 187]; number of shots, 1; parallel imaging, GRAPPA×2; and image acquisition time per 1 phase, 18 R-R intervals. CHESS, MTC, and magnetization restore pulses were used. Sequential frontal MIP images were produced by subtracting each of 10 systolic images from better diastolic image. Relative contrast against the background, the contour sharpness index of the middle superficial femoral artery (SFA) with the best phase image, and the slope of the sequential signal changes of the lower SFA were quantitatively compared using the paired t-test. The overall subjective image quality and sequential appearance changes of the arteries were qualitatively compared by two blinded radiologists using a four-point scale (4, excellent to 1, poor) using the Mann-Whitney's U test.

RESULTS: All quantitative and qualitative analyses of MRDSA using SPACE were significantly better than those of HASTE.

Table 1 Quantitative and qualitative analysis of image quality.

	SPACE	HASTE	*P*-value
Quantitative analysis			
Relative contrast	0.81 ± 0.07	0.48 ± 0.44	0.024
Contour sharpness index	88.7 ± 0.5	82.8 ± 5.7	0.009
Slope of signal changes	0.77 ± 0.24	0.10 ± 0.08	<0.0001
Qualitative analysis			
Overall image quality	3.9 ± 0.3	2.4 ± 0.7	<0.0001
Sequential appearance changes	3.8 ± 0.4	1.2 ± 0.4	<0.0001

Fig.1 Graphs of the average relative contrast changes.

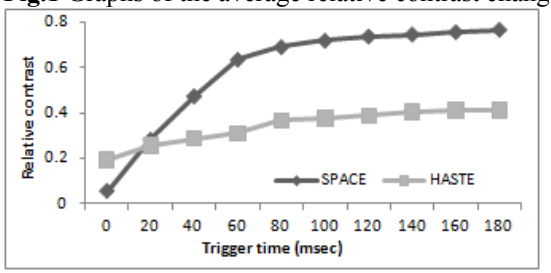
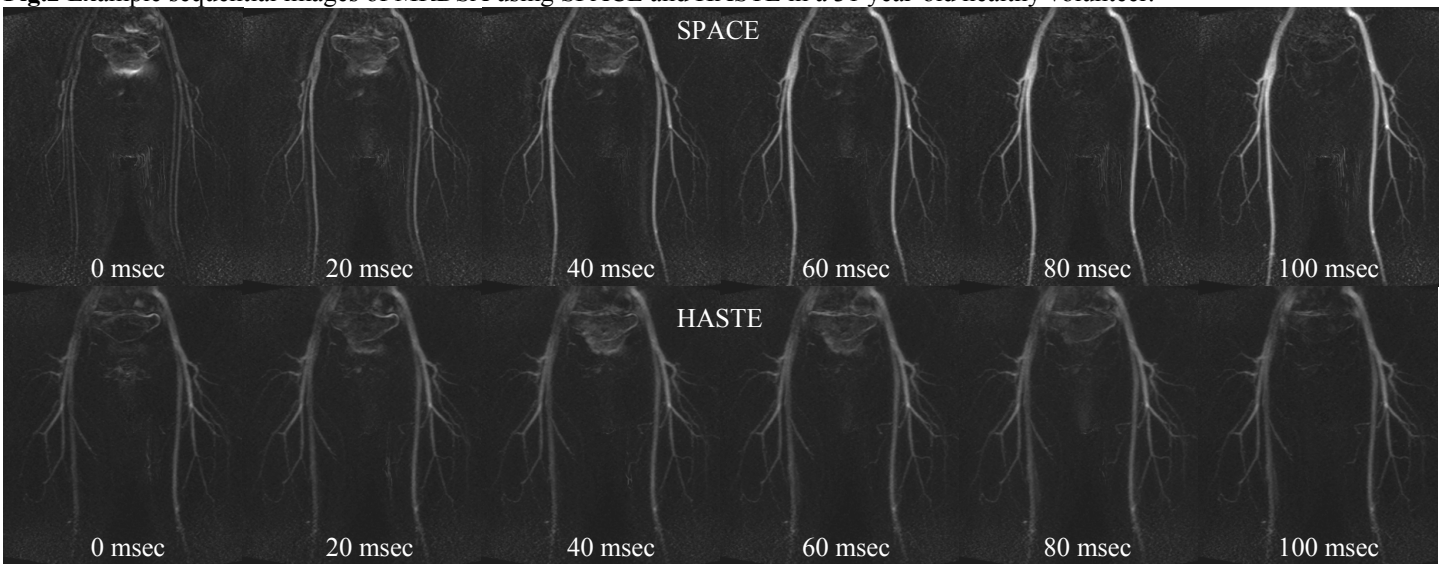


Fig.2 Example sequential images of MRDSA using SPACE and HASTE in a 31 year-old healthy volunteer.



CONCLUSION: Unenhanced ECG-gated fast spin-echo MRDSA using SPACE with constant flip angle mode is superior to the conventional HASTE, and can provide good visual hemodynamic information of arteries.

REFERENCES: (1) Nakamura K, Yamamoto A, et al. ISMRM p1713, 2005. (2) Lim RP, Radiology. 2009;252:874-81.