Comparison of Two Types of Fat-suppressed Black-blood MR Imaging for Fat, Myocardial and Flow signals Suppression and Cardiac Structure Visualization: Black-Blood Fast STIR and Black-blood CHESS MR Imaging

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Introduction
Black-blood fast spin-echo (FSE) imaging technique using a section-noselective / section-selective inversion-recovery pulse pair and cardiac gating is effective for suppressing the vascular signal and flow artifact and provides good T2-weighted contrast images of the thorax and cardiovascular structures. The possible disadvantage of this black-blood T2-weighted FSE is the bright fat signal inherent in FSE imaging. This bright fat signal may obscure the high intense lesions surrounded by adipose tissues and enhance the respiratory artifact. Fat-suppression techniques combined with black-blood T2-weighted FSE may overcome these problems. The purpose of this study was to compare two black-blood fat-suppressed MR imaging techniques, black-blood fast short inversion-time inversion-recovery (STIR) and black-blood chemical shift selective fat-saturated (CHESS) FSE, for suppression of fat, myocardial, and flow signals and for visualization of cardiac structures.

Methods
Black-blood fast STIR and black-blood CHESS FSE imagings were performed in 20 cases with various cardiovascular and intrathoracic disorders using a 1.5 T MR unit. The imaging parameters were a repetition time; 2 cardiac cycles, an effective echo time; 85 msec, an echo train length; 20, an echo space 6.53 msec, a bandwidth; 31.3 kHz, an imaging matrix; 256x128, a field-of-view; 40x40 cm, one excitation, and a 5 or 7 mm section thickness with a 2-5 mm gap. The inversion time of 150 msec was applied to black-blood fast STIR, while CHESS pulse was set immediately before the selective RF pulse in black-blood CHESS FSE. Fat and myocardial signals, flow artifact, signal ratio of the myocardium to the left ventricular cavity were quantitatively assessed using a region-of-interest technique and visualization of cardiac structures were assessed using scoring system (1: poor visualization – 5: excellent visualization). The signals of fat and myocardium, and signal ratio of the myocardium to the ventricular cavity of black-blood fast STIR were compared between the two black-blood fat-suppressed MR imagings.

Results
The mean value +/- SD of fat and myocardial signals, signal ratio of the myocardium to the ventricular cavity, and flow artifact were 9.78 +/- 3.80, 12.54 +/- 5.15, 3.37 +/- 1.08, and 3.27 +/- 1.70 in black-blood fast STIR, while they were 42.93 +/- 29.69, 26.3 +/- 16.44, 5.78 +/- 3.58, and 3.44 +/- 1.19 in black-blood CHESS FSE imaging. The fat signal (p< 0.0001), myocardial signal (p< 0.005), and signal ratio of the myocardium to the ventricular cavity (p<0.013) were significantly lower in black-blood fast STIR than in black-blood CHESS FSE imaging. There was no significant difference in the flow artifact between the two black-blood fat-suppressed MR imaginings (p= 0.59). The mean visualization score of cardiac structures was 3.6 in black-blood fast STIR and 3.7 in black-blood CHESS FSE and there was no significant difference in this visualization score of cardiac structures was found between the two black-blood fat-suppressed MR imaging techniques (p=0.66). When the scores in black-blood fast STIR were equal to or higher than those in black-blood CHESS T2-weighted FSE, no tendency was found in these scores and the signal ratio of the myocardium to the ventricular cavity. On the other hand, the signal ratios were higher in black-blood CHESS FSE than in black-blood fast STIR in all 6 cases with the higher visualization scores in black-blood CHESS FSE.

Discussion
Black-blood fast STIR could provide the homogeneous suppression of fat and myocardial signals without any significant effect on the vascular flow. Although CHESS was not useful for reducing the fat signal because of magnetic inhomogeneity of thoracic region, black-blood CHESS FSE provided higher signal ratio of the myocardium to the ventricular cavity. In conclusion, black-blood fast STIR was useful for suppressing both fat and flow signals, while black-blood CHESS FSE can be recommended as an additional technique for visualization of cardiac structure if the lower signal ratio of the myocardium to the ventricular cavity of black-blood fast STIR is considered to make the heart morphology ambiguous.

References