Fat-suppressed Non-contrast-enhanced MR Angiography of Thorax: Comparison between Navigator-gated SSFP and Respiratory-gated TSE Imaging

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Introduction: The purpose of this study was to compare two fat-suppressed non-contrast-enhanced 3D MR angiography techniques of the thorax, navigator-gated 3D spectrally fat-suppressed (SPIR) steady-state free precession (SSFP) and respiratory-gated 3D inversion-recovery (IR) turbo spin-echo (TSE), for the vascular signals, image quality, and detection of major branch arteries in the thorax.

Methods: Thirty patients with suspected diseases of thoracic aorta or its major branches (17 men and 13 women; mean age, 58 years) underwent non-contrast-enhanced 3D MR angiography using a 1.5T MR unit. Two MR angiography sequences were performed: navigator-gated 3D SPIR SSFP and respiratory-gated 3D IR TSE. The MR angiography was acquired with high spatial resolution (1.47 x 1.47 x 3 mm), and cardiac-gating and parallel imaging techniques (SENSE = 2). The 3D SSFP imaging was performed with the following imaging parameters: TR 4.2 ms; TE 2.1 ms; flip angle 90 degrees. To suppress respiratory motion artifacts, a k-space weighted navigator-gating technique was used in combination with a prospective respiratory gating with tracking of diaphragmatic movement. The T2-prepared pulse was also used to suppress the background signals. The 3D TSE was acquired with the following parameters: TR one heartbeat; effective TE 90 ms; echo space 6.3 ms; flip angle 90 degrees; 0.85 signal averaging. The respiratory gating was utilized with the bellow sensor, and flow compensation was employed.

Vascular signals, image quality (1: poor – 4: excellent), and detection of the major arteries in the thorax, such as proximal coronary and brachiocephalic arteries, were compared between the two MR angiography sequences.

Results: The navigator-gated 3D SPIR SSFP provided shorter scan time, more homogeneous vascular contrast of the aortic root, and visualized coronary arteries better than did the respiratory-gated 3D IR TSE ($P < 0.01$ for all). However, undesired water suppression of left subclavian artery related to SPIR was seen in the 3D SSFP in seven cases, while MR angiography acquired by the respiratory-gated 3D IR TSE visualized the artery clearly ($P = 0.057$). The image quality was assessed good and identical between the two MR angiography sequences (mean score > 3.55).

Discussion: This study demonstrated that navigator-gated 3D SPIR SSFP provided 3D non-contrast-enhanced MR angiography of the thorax with shorter scan time, more homogenous vascular contrast of the aortic root, and better visualization of coronary arteries than did the respiratory-gated 3D IR TSE. Although the 3D TSE provided good image quality comparable to the 3D SSFP, the 3D TSE was more sensitive to the respiratory motion and the turbulence or high flow at the aortic root. These might lead to the failure of visualization of the proximal coronary arteries by this IR TSE imaging technique. The disadvantage of the 3D SSFP was its inappropriate suppression of left subclavian arterial signal by SPIR, because of its sensitivity to the magnetic inhomogeneity.

In conclusion, both navigator-gated 3D SPIR SSFP and respiratory-gated 3D IR TSE provided non-contrast-enhanced MR angiography of the thorax with good image quality. Because of the shorter scan time, more homogenous vascular signal of aortic root, and better visualization of coronary arteries, the 3D SSFP may be the first choice of non-contrast-enhanced 3D MR angiography of thorax. The 3D TSE imaging can be an alternative to the 3D SSFP when the fat-suppression inappropriately reduces vascular signals or patients complain of left upper extremity ischemia.

References 1. Miyazaki M. JMRI 2000; 12: 776-783. 2. Amano Y. JMRI 2008; 27: 504-509. 3. Francois CJ. AJR 2008; 190: 902-906.