Diagnostic Performance of Whole Heart Coronary Magnetic Resonance Angiography in 101 Patients with Suspected Coronary Artery Disease : Effects of Heart Rate on Image Quality and Accuracy

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Purpose: Whole heart coronary MR angiography (MRA) using a navigator-gated 3D steady state free precession can provide noninvasive visualization of all three major coronary arteries without administration of contrast medium. The purposes of this study were to evaluate the diagnostic performance of whole heart coronary MRA for the detection of significant stenoses in the coronary arteries in 101 patients with suspected coronary artery disease, and to determine the effect of heart rate on acquisition time, image quality and diagnostic accuracy.

Methods: One hundred and one patients with suspected coronary artery disease were prospectively evaluated (mean age 65.9± years). A subject specific trigger delay time and an interval of minimal coronary arterial motion were determined by assessing the motion of the RCA on cine MR images. Three dimensional coronary MR images covering the entire heart were obtained with a navigator-gated, steady state free precession sequence with radial k-space sampling (TR/TE=4.6/2.3ms, SENSE factor=2, FOV=280x280x120mm, acquisition matrices= 256x256x80, reconstruction matrices of 512x512x160, reconstructed voxel size of 0.55x0.55x0.75mm). All subjects underwent invasive coronary angiography within two weeks of MR study. All coronary arteries and side branches with a diameter of 1.5 mm or more on coronary angiography were evaluated by two blinded observers, and luminal diameter reduction of 50% or more on quantitative coronary angiography was considered to be significant.

Results: Diagnostic coronary MRA images were successfully obtained in 86 (85.1%) of 101 patients. The averaged heart rate was 71.0/min±12.6 in 86 patients with successful MRA acquisition, and 67.1/min±10.6 in 15 patients without successful acquisition(p=NS). Table 1 summarizes the effects of heart rate on data acquisition time and image quality score. The averaged acquisition time of whole heart coronary MRA was 12.6±4.1 minutes. The acquisition time was significantly shorter in 17 patients with heart rates of < 60/min (10.1±2.5 minutes, $p<0.05$). However, when the patients' subgroups showing heart rates of >60/min were analyzed, the acquisition time was nearly unaffected by heart rate. Excellent image quality score was observed in patients with high heart rates as well as in those with low heart rates. The sensitivity, specificity, positive and negative predictive values, and accuracy of the whole heart coronary MRA for detecting patients having at least one coronary arterial stenosis in 86 patients was 83.8%, 91.8%, 88.6%, 88.2% and 88.4%, respectively. These values in 26 patients with high heart rates (>80/min) were 83.3%, 85.7%, 83.3%, 85.7%, and 84.6%, respectively.

Conclusions: Free breathing whole heart coronary MRA with a navigator-gated steady state sequence can provide an accurate detection of significant stenoses in the coronary arteries. High diagnostic accuracy and image quality score were observed in patients with high heart rate without administration of beta-blockers.

Table 1. The effects of heart rate on data acquisition time and image quality score.

Heart rate (/min)	<60	60-69	70-79	>80	Total
Number of subjects	17	22	21	26	86
Acquisition time (min)	10.1±2.5*	13.8±4.0	13.7±5.1	13.6±3.8	12.6±4.1
Image quality score (1-4)	3.7±0.6	3.8±0.5	3.7±0.6	3.5±0.8	3.7±0.6

* $p<0.05$