

Diagnostic Accuracy of Different Image Postprocessing Methods for the Detection of Coronary Artery Stenoses by Using Contrast Enhanced Coronary MRA at 3.0T

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Introduction: Contrast enhanced 3T whole heart coronary MR angiography (CMRA) is a reliable method for the detection and exclusion of hemodynamically significant coronary stenosis and has shown high accuracy in recent single center trial¹. Whole heart coronary MR angiography has been introduced as a method that can provide visualization of long segments of all coronary arteries with a single 3D acquisition². With the improvements in spatial resolution, particularly along the z-axis, it is possible to postprocess whole heart CMRA images by using advanced methods such as MIP, curved MPR, and 3D VRT.

Purpose: To retrospectively evaluate the diagnostic accuracy of contrast enhanced 3T whole-heart CMRA for detection of hemodynamically significant (50%) stenoses by using various image postprocessing methods with an optimized protocol using a 32-channel cardiac coils.

Methods and Materials: The analysis used data from previous studies, use of which had been approved by the Institutional Review Board. Data sets for 80 patients were evaluated. For image acquisition an ECG-triggered, navigator-gated, inversion-recovery prepared, segmented gradient-echo sequence was used at 3T (Trio, Tim; Siemens, Germany) with an acceleration factor of three in the phase-encoding direction using GRAPPA reconstruction. Imaging parameters included: voxel size 0.55x0.55x0.65 mm³ (interpolated from 1.1x1.1x1.3 mm³), TR/TE = 3.3/1.5 msec, flip angle = 20°, bandwidth = 700 Hz/pixel, TI=200 msec. Contrast agent (0.15 mmol/kg body weight, MultiHance, Bracco, Italy) was intravenously administered at a rate of 0.3 ml/sec. Three independent investigators evaluated the data sets for the presence of stenoses with diameter reduction of 50% or more, by using either exclusively axial source images, free thin-slab maximum intensity projection (MIP, 3-5 mm thick), prerendered curved MPRs, or prerendered three-dimensional volume rendered reconstruction (VRT). The likelihood of coronary artery stenosis on CMRA was graded according to the following scale: 1, absent; 2, probably absent; 3, possibly present; 4, probably present; and 5, definitely present. The diagnostic performance of each evaluated postprocessing method for the detection of significant coronary artery stenosis (sensitivity, specificity, positive predictive value, negative predictive value, and accuracy) were calculated on a per-segment basis using invasive x-ray coronary angiography as reference standard. The significance of differences in diagnostic performance between the different postprocessing methods was tested using the chi-square test.

Results: Overall, 78 coronary artery stenoses were present. Accuracy for detecting stenosis were 87% for transverse, 93% for thin slab MIP, 88% for curve MIP, 86% for VRT. Diagnostic accuracy was significantly higher for thin slab MIP than for axial, curved MIP, and VRT. Example images are shown in Fig 1.

Conclusion: The evaluation of contrast enhanced 3T whole heart coronary MR angiography with interactive image display methods, especially interactive thin-slab maximum intensity projection, permits higher diagnostic accuracy than evaluation of prerendered images (curved MPR, or VRT images). Interactive evaluation of contrast enhanced 3T whole heart CMRA data sets on a workstation should thus be the preferred way of interpretation.

Reference: 1. Yang Q, et al. J Am Coll Cardiol, 54: 69-76, 2009. 2. Weber OM, et al. Magn Reson Med 2003; 50: 1223-8.

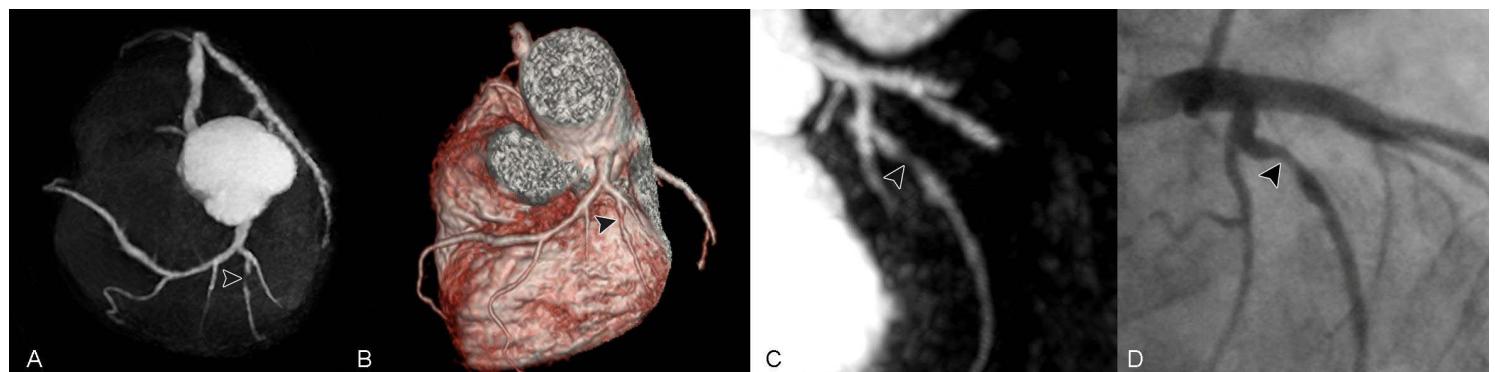


Figure 1. Comparison of different image postprocessing methods in one patient. (A) Visualization of stenosis (arrow) in an oblique thick slab MIP. (B) Visualization of stenosis (arrow) in VRT. (C) Visualization of stenosis (arrow) in thin slab sliding MIP. Significant stenosis of the obtuse marginal branch was confirmed by conventional coronary angiogram (D).