Coronary Angiography: The Promise

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Coronary CT angiography (CTA) allows for noninvasive assessment of obstructive coronary artery disease (CAD), and is widely used for ruling out significant CAD in patients who have chest pain symptom. However, coronary calcium substantially attenuates X-ray penetration, causing "blooming" artifacts that obscure the coronary lumen on CTA. Coronary MRA has several important advantages over cardiac CTA, including good delineation of luminal narrowing in the coronary artery even in the segment with heavy calcification. By utilizing the insusceptibility of coronary MRA to calcification, Yonezawa et al recently developed a method for quantifying luminal narrowing on coronary MRA based on the signal intensity profile along the vessel (Radiology 2014, in press). This approach permits a more objective assessment of luminal narrowing in the coronary artery, with sensitivity of 90% and specificity of 80% in detecting >50% stenosis on quantitative coronary angiography by catheter. The capability of visualizing coronary artery without administrating contrast medium is another important benefit of coronary MRA, especially in patients with renal failure. Coronary MRA allows for noninvasive detection of CAD without exposing the patients to radiation. However, it should be noted that the radiation dose of coronary CTA has been consistently reduced. The absence of radiation exposure alone may not justify the use of coronary MRA instead of CTA in the era of sub-mSv coronary CTA. The diagnostic accuracy of coronary MRA has been substantially improved by using parallel imaging technique, SSFP imaging at 1.5T, improved strategies for k-space sampling and high field MR systems (Table 1). Super-resolution (SR) technique has emerged as a method to enhance image resolution and quality and improve diagnostic performance of brain MRI. We recently optimized a dictionary- based SR technique for whole heart coronary MRA, and found that SR processed coronary MRA allows for more accurate detection of significant CAD.

Table 1. The diagnostic accuracy of coronary MRA in multi-center studies.

	Methods	N	Sensitivity	Specificity
Kim WJ, et al *New Engl J Med 2001; 345:1863*	1.5T Gradient echo Target volume	109	88%	58% (consensus reading)
Kato S,et al *JACC 2010 56:983*	1.5T SSFP Whole heart	127	87%	71%
Yang Q, et al *SCMR 2013, ISMRM 2013*	3T(2X Gd) Gradient echo Whole heart	272	91%	80%