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"One-stop-shop" cardiac MRI at 3.0T for the detection of coronary artery disease

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Magnetic resonance imaging; coronary artery disease

We present "one-stop-shop" cardiac MRI findings in a 58-year-old male patient with suspected coronary artery disease (CAD) who was scheduled for a primary diagnostic invasive coronary angiography. The patient was instructed to refrain from any beverage or foods containing caffeine, and antianginal medication within 24 hours before the MRI study.

The study was performed on a 3.0T whole-body clinical scanner (MAGNETOM Tim Trio, Siemens Healthcare, Erlangen, Germany) equipped with a 12-element cardiac coil. The "one-stop-shop" cardiac MRI procedure consisted of four major protocols performed in the following order: 1) cine imaging for assessment of left ventricular function; 2) adenosine gadolinium first-pass imaging for assessment of stress perfusion; 3) coronary MRA for assessment of coronary artery anatomy; and 4) delayed enhancement MRI for assessment of myocardial infarction.

After localizer sequences, a FLASH sequence was used for cine imaging. The following sequence parameters were used: TR/TE/flip-angle = 5.00 ms/2.44 ms/13°. The short-axis views were distributed to cover the entire left ventricle and two long-axis views (four- and two-chamber views) were also acquired. Adenosine was then administered intravenously at 140 µg/kg/min with the heart rate and blood pressure monitored. After 3 min of the adenosine infusion, an intravenous bolus injection of 0.05 mmol/kg gadolinium contrast material (Magnevist, Schering, Berlin, Germany) was administered into an antecubital vein on the opposing arm with the use of a power injector (Spectris, Medrad, Indianola,

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Pennsylvania) at a rate of 4 ml/s, followed by a 20 ml saline flush at 4 ml/s. A SR-Turbo-FLASH sequence was used for perfusion imaging with the following parameters: TR/TE/flip-angle = 2.38/1.14/12°, FOV = 270×360 mm², matrix = 94×192, spatial resolution = 2.9×1.9×10 mm³, GRAPPA factor = 2, TI = 100 ms, and the number of slices = 3. Whole-heart coronary MRA with additional slow infusion of contrast material (0.15 mmol/kg at 0.3 ml/sec) was acquired after perfusion imaging. A navigator-gated, electrocardiography-triggered, fat saturated, segmented 3D fast low-angle shot sequence [1,2], with the following image parameters was used: TR/TE/flip-angle = 3.0/1.4/20°, readout bandwidth = 610 Hz/pixel, voxel size = 1.3 × 1.3 × 1.3 mm³ interpolated to 0.65 × 0.65 × 0.65 mm³, GRAPPA factor = 2, inversion prepulse delay = 200 ms. Delayed enhancement images were acquired by phase sensitive inversion recovery sequences after coronary MRA for viability study.

The total examination time was 33 min. Acquisition time of whole-heart coronary MRA procedure was 9.1 min with a navigator acceptance rate of 34%. Data reformation and analysis were performed on a commercially available workstation (Leonardo, Siemens Healthcare, Erlangen, Germany). Figure 1 shows “one-stop-shop” cardiac MRI images at 3.0T from the 58-year-old male patient with suspected CAD.

This work shows the feasibility of a comprehensive protocol “one-stop-shop” for cardiac MRI at 3.0T. It is possible to complete the cine imaging, perfusion imaging, coronary MRA, and delayed enhancement imaging in a single study within 35 minutes. The major advantage of this approach is that it offers functional studies for the detection of ischemia, tissue characterization for the detection and quantification of myocardial infarction as well as luminal assessment of the coronary arteries in a single noninvasive and radiation free test. This may be extremely useful for better selecting patients to undergo an invasive procedure.

The authors of this manuscript have certified that they comply with the Principles of Ethical Publishing in the International Journal of Cardiology [3].

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Figure 1.

“One-stop-shop” cardiac MRI images at 3.0T from a 58-year-old male patient with suspected CAD. Perfusion image (A) demonstrates perfusion defects in the mid anteroseptal and inferoseptal segments. Coronary MRA images (B and C) show significant stenoses in the left anterior descending coronary artery (LAD) and right coronary artery (RCA). Delayed enhancement image (D) does not show subendocardial hyperenhancements. Coronary angiography images (E and F) confirm significant stenoses in the LAD and RCA.