Coronary Magnetic Resonance Angiography Depiction of Ameroid Constrictor Position in a Swine Model of Chronic Myocardial Ischemia

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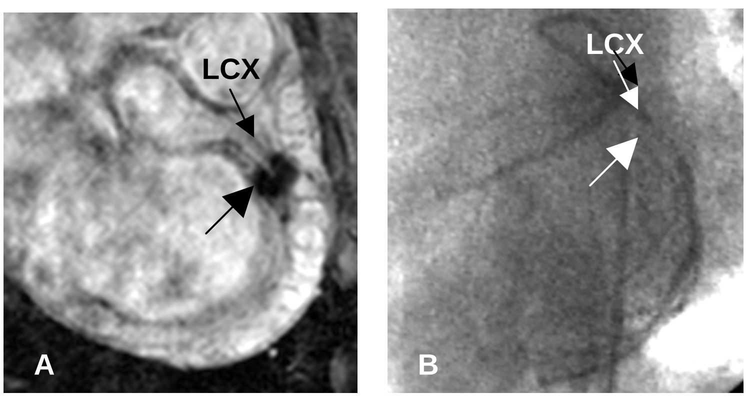
Background: In the ameroid constrictor swine model of chronic myocardial ischemia, visualization of ameroid constrictor position and documentation of coronary artery stenosis has previously required x-ray coronary angiography (XRAY). We studied the utility of coronary magnetic resonance angiography (MRA) to non-invasively characterize ameroid constrictor placement and coronary artery patency in this model.

Methods: A plastic ameroid constrictor (Research Instruments SW, Escondido, CA) was surgically placed around a proximal segment of the left circumflex artery system in 9 Yorkshire pigs (female, 15-20 kg). Three weeks later the animals underwent coronary MRA using a 1.5 T Gyroscan ACS-NT MR system (Philips Medical Systems, Best, NL) equipped with a 5-element cardiac synergy receiver coil. Following animal intubation and initiation of mechanical ventilation under induction of general anaesthesia an ECG-triggered 3D SSFP coronary MRA (TE=3.0ms, TR = 6.0ms, NSA=1) sequence with T2 prepulse and fat saturation was used to image the proximal to mid left coronary artery. Diaphragmatic navigator gating was used to compensate for respiratory motion (5mm gating window, no tracking). Twenty slices with a 3-mm thickness (interpolated to 1.5 mm) were acquired in late diastole (acquisition window 50 ms) with a 270 mm field-of-view and a 270 X 270 matrix (in-plane resolution 1.0 x 1.0 mm). Total scan time was approximately 5 minutes. XRAY with multiple selective injections of the left coronary system in various projections was performed on the same day as coronary MRA. Independent observers reviewed the X-ray angiograms and coronary MRA images. The observers assessed ameroid constrictor position and whether vessel lumen was identified proximal to, distal to, and within the constrictor. In addition, 3D SSFP imaging of a stationary ameroid constrictor after 30 minutes incubation in water was performed to measure early imaged static constrictor lumen size to assess the feasibility of imaging within the constrictor. .



The figure demonstrates an image from an MRA (A) and an image from the corresponding XRA (B). Each image demonstrates a long stenosis (arrow) in the left circumflex artery (LCX) within the ameroid costrictor.

Results: Stationary early ameroid lumen size measured as 2.0 mm by imaging and 2.2 mm by micrometry. Ameroid constrictor position on the proximal left circumflex artery was identified in all animals by both XRAY and coronary MRA. Coronary MRA demonstrated the position of the constrictor as a region of signal loss (Figure A). At the constrictor site, XRAY revealed proximal left circumflex stenosis in 6 animals and occlusion in 3 animals. The left circumflex artery proximal to the constrictor was visualized by coronary MRA in all 6 animals with stenoses, but none with a total occlusion by XRAY. . However, despite application of fat saturation, signal surrounding the coronary artery was not well suppressed. The vessel lumen within the constrictor was visualized by coronary MRA in 3 of 6 animals with stenosis and in none of the animals with occlusion. Among the animals with intra-ameroid vessel occlusion, the distal artery was not visualized by XRAY in 1 animal and was seen only faintly in the other 2 animals. The artery distal to the constrictor was not well visualized by 3D SSFP coronary MRA in any of the animals with stenosis or occlusion.

Conclusions: The finding of poor coronary MRA visualization of the proximal left circumflex artery among those animals with artery occlusion and of the distal artery in all animals suggests a flow-dependency of this technique. Signal surrounding the coronary artery may be attributed to non-fatty pericardial tissue that may be relatively bright using this T2-weighted technique. This observation suggests a potential role for T-1 weighted TFE imaging that would merit further investigation. Accurate MRA determination of early static ameroid constrictor lumen size as well as visualization of lumen within the constrictor in 3 of 6 animals with stenosis suggests some potential for assessing stenosis within the constrictor. These observations demonstrate the feasibility of coronary MRA for demonstration of ameroid constrictor position in a model of chronic ischemia and identify current limitations that merit future study.