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Noninvasive Detection of Internal Carotid Artery Stenosis: A Head-to-Head Comparison Between Ultrasonography and Magnetic Resonance Angiography

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Background: Color Doppler Ultrasonography (CDUS) and 3D-enhanced magnetic resonance angiography are non-invasive techniques for detecting internal carotid artery (ICA) stenosis. High 2D-echo image resolution and high operator expertise for CDUS, and contrast enhancement magnetic resonance angiography technique with 3D reconstruction postprocessing made both techniques competitive with digital subtraction angiography (DSA).

Aim of the study: to compare CDUS and CEMRA, both at the state of the art technique, with DSA for deteacting and grading severity of ICA stenosis.

Methods: 50 ICA stenosis (20 Males, 30 females) were evaluated. Patients underwent CDUS, CEMRA and DSA in different days and within 30 days of each other. ICA stenosis severity was graded as follows: mild (<40% to ≤70%) and severe (>70% to 100%).

The results obtained by each technique were reported blind.

Results: 38 ICA stenosis were detected with DSA. Of these, 16 were moderate (42%, 95% CI 46 to 58, 22 severe (58%, 95% CI 49 to 67). Conclusively, specificity and diagnostic accuracy were 100%, 91.6% and 94% for CDUS and 94.7% (95% CI 90 to 99), 94% (95% CI 90 to 99) and 94% for CEMRA. Considering stenosis severity, CEMRA identified 14 moderate (36%, 95% CI 21 to 53, p=ns vs DSA and CDUS) and 25 severe (64%, 95% CI 50 to 79, p=ns vs DSA). Conclusively, CEMRA and CEMRA have similar diagnostic efficacy in the detection of ICA stenosis with CDUS having a tendency to understanimstices and CEMRA to overstimaate ICA stenosis severity.

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Real-Time MRI Angioplasty Using Intravascular GuideWire Coils


Background: Direct MRI-guided cardiovascular intervention entails compromises between spatial and temporal resolution. Intravascular guide wire coils (IVGC) may engage and visualize but mid- and distal vessels were not of diagnostic quality. Herein, we describe a new technique to facilitate IVGC in real-time MRI guidance.

Methods: MRI was performed on a GE 1.5T scanner with a custom data reconstruction engine. High-sensitivity phased-array surface coils and in-room coils. In 5 pigs, a 0.9Fr. flexible guide wire coil (Sherpa Wire, Boston Scientific) was advanced into the stenosed ICA. 1.25x2.5mm in-plane resolution. Balloon position, inflation profile, and caliper were visualized without requiring repositioning of the guide wire. 50% endovascular stenosis were crossed with guide wire coil and angioplasty balloon using MRI, which visualized a balloon "waist" and even overexpanded balloon "melting second" during inflation. In 2 swine, balloon trauma to vessel wall was demonstrated using the guide wire coil to obtain high-resolution black blood vessel wall images using a fast spin-echo sequence before and after balloon inflation.

Conclusion: An intravascular loopless guide wire coil sufficiently augments MRI signal to permit wholly MRI-guided catheter tracking, selective angiography, wall imaging, and percutaneous "angioplasty" of medium caliber arteries in swine. Further improvement is necessary for satisfactory human MRI angioplasty.

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Magnetic Resonance Imaging Guided Deployment and Postinterventional Assessment of Endovascular Stents in the Pulmonary Position in Swine

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Background: MRI has been used for quantification of pulmonary flow in patients with pulmonary stenosis (PS) and insufficiency (PI). Recently, endovascular and valved stents have gained wide acceptance in treatment of PS and PI. The aim of the study was to use MRI(1) to guide stent placement in the pulmonary position, and (2) to assess stent morphology and blood flow within the stent lumen after placement.

Methods: The study was performed in a laboratory consisting of a x-ray angiography and a 1.5T short bore MRI unit. In 6 pigs anatomic stents were placed in the pulmonary position using MRI guidance. Image acquisition was performed with a balanced Fast Field Echo (bFFE) and a T1 weighted Turbo Field Echo sequence, which were partially ECG gated. Tracking of the interventional instruments was based on susceptibility and catheters copered with 1% Gadolinium solution. After stent deployment the morphology of the stent and pulmonary artery were assessed using multiphase bFFE. Blood flow volumes within the lumen of the stents were measured using velocity encoded cine (VEC) MRI. The results of the MRI guided intervention were validated with x-ray angiography.

Results: Stent deployment was successful in all animals. In one animal the stent was placed across and in four animals 1-5 mm distal to the pulmonary valve. Measurements of blood flow volumes within the stent lumen showed pulmonary regurgituation flow (31±3.4%) in the animal with the stent placed across the pulmonary valve, but not in animals with a stent placed distal to the pulmonary valve. No complication of the interventional procedure such as stent migration or aneurysms was noted. Postprocedure and morphologic assessment of the stents were confirmed with x-ray angiography.

Conclusions: The results of the study show that MRI can guide stent placement in the pulmonary position. Immediate postinterventional evaluation of the stents was possible using bFFE and VEC MRI. The advantage of this new technique is that it provides simultaneous information about the anatomy and pulmonary morphology of the pulmonary system before and after deployment of the stents.

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Intravascular GuideWire Coil Facilitated Invasive Real-Time Magnetic Resonance Angiography

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Background: Real-time MRI (rtMRI) vascular intervention will require arteriography. We report feasibility of invasive rtMRI catheter-tracking and selective gadolinium (Gd) MR angiography (rtSMRA) facilitated by an intravascular guide wire coil (IVGC).

Methods: rtSMRA used a GE 1.5T scanner and custom reconstruction engine, surface coils and in-room catheters. In 5 pigs, a 0.9Fr. flexible guide wire coil (Sherpa Wire, Boston Scientific) was advanced into the stenosed ICA. rtSMRA was conducted using 30mM Gd hand-injections, saturation-preparation, Cartesian and projection-reconstruction gradient echo sequences.

Results: rtSMRA enabled rtMRI navigation and selective engagement. In 2 and 3 branches were delineated as were parent and branch arteries. Proximal and distal branches were not of diagnostic quality. Conclusions: Tandem catheter movement with an IVGC facilitates accurate navigation and selective arteriography under rtMRI. Advantages of NSMRA over Non-invasive MRI include time-resolved imaging, absence of venous and parenchymal overlap, ability to visualize more distal branches, motion-insensitivity, and ability to perform multiple low-dose contrast injections.