Body MRA in the era of CTA - Is it still the imaging modality of choice?

Stefan G Ruehm

The status of conventional catheter angiography as gold standard is increasingly challenged by non-invasive cross-sectional imaging modalities such as CT and MRI. Each modality has its advocates, and over time each will continue developing, making it more successful in the diagnosis of vascular diseases.

The main premise that has guided the shift to CT angiography (CTA) and MR angiography (MRA) has been patient’s safety. Invasive catheter angiography will certainly prevail for therapeutic approaches while diagnostic imaging will almost exclusively depend on non-invasive techniques.

CTA utilizes the use of x-rays in combination with computerized image analysis of. Beams of x-rays pass from a rotating X-ray source through the body from several different angles creating cross-sectional images. These images are calculated by a computer and provide a three-dimensional picture of the body region under investigation.

MRA employs pulse sequences in combination with frequency antennas for luminal angiography based on the motion of blood relative to its surrounding tissue or the presence of contrast agent within the vessel lumen. Prerequisite for high quality MRA is the use of short repetition times enabled by powerful gradients in combination with high resolution imaging coils.

Compared to catheter angiography, which relies on the insertion of a catheter into the arterial or venous system, MRA and CTA are more patient-friendly. Both CTA and MRA are able to provide accurate diagnostic information for therapeutic decision making.

Regarding the contrast agent, CTA uses iodine-based contrast agent while MRA requires gadolinium. There is a minimum risk of allergies with CTA and in patients with kidney disorders both CT and MRI contrast agent may be contraindicated. When comparing quantities of contrast volumes typically administered, CTA requires 80 to 150 ml, while MRA requires only 10 to 30 ml of gadolinium –based contrast agent.

High radiation doses to which patients are exposed undergoing CT has raised concerns regarding the widespread use of CTA. Therefore radiologists have developed increased interest to perform MRA studies as an alternative.

When comparing both techniques, the interpretation of CTA is often challenged in the presence of heavily calcified vessels. Extensive calcification typically leads to overestimation of the degree of stenotic disease. With MRA, the effect of calcium is eliminated, however, the inability to identify calcium can also be seen as a negative aspect of MRA, when information about calcified vessel segments is beneficial for the planning of interventions or vascular surgery.

When comparing the level of accuracy for the detection of stenotic disease, both techniques show comparable results with sensitivity and specificity values typically exceeding 90% compared to catheter angiography. MRA may provide additional functional information, if phase-contrast or time-resolved techniques are used.

MRA is generally considered the safer imaging method. However, it may be contraindicated in patients with metallic devices such as pacemakers or defibrillators. Potential disadvantages of MRA include longer breath hold times for data acquisition and overall longer examination times.

In addition, longer image reconstruction times as well as inferior spatial resolution are often mentioned as shortcomings of MRA.

In general the choice of CTA and MRA is not mutually exclusive and is rather based on a combination of factors including availability and scanner type, physician’s and patient’s preference as well as patient’s condition and suspected pathology to determine the suitable procedure. Professional expertise and quality of the equipment are factors to be considered in the decision process. In general, MRA is preferred for imaging of the carotid arteries, since the neurology community has embraced MRI. The diffusion/perfusion information that is routinely obtained with brain MRI is extremely valuable, but still regarded a research application for body applications. For the aorta, CTA is typically preferred, particularly in the emergency room. In the case of renal arteries peripheral vessels, MRA may be advantageous, particularly in patients with advanced diabetes or patients of advanced age, when heavily calcified arteries are expected.