Specialty area:	**Cardiovascular MRI: Vascular Flow & Angiography** **The Basics of a Vascular MRI Exam**
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TALK TITLE
Anatomy, Stenoses/Coarct, Shunts, Dissections, Contrast Agents & Application Protocols

HIGHLIGHTS

- Vascular MRI is a flexible tool for imaging a wide range of vascular pathologies, including visualization and grading of vascular stenosis and many other entities such as aneurysms, dissections, shunts, etc.
- There are a number of competing imaging modalities (MRI, Computed Tomography, Ultrasound, etc.) with specific advantages and disadvantages for depicting these vascular pathologic entities.
- Depending on the clinical question and underlying pathology, vascular MRI protocols, choice of contrast agent (or non-contrast-enhanced MRA), and contrast agent protocols have to be adapted and optimized.

TARGET AUDIENCE

Attendees who have an interest in vascular MRI exams of various clinical indications, intending to broaden their knowledge in the correct use and technical implementation of various vascular MRI tools in different vascular beds and for a number of underlying pathologies.

OUTCOME/OBJECTIVES

At the end of this course, attendees will have an overview on a number of pathophysiological vascular processes to be imaged by vascular MRI and will have an understanding of the correct choice of vascular imaging modalities as well as the optimal MRI imaging protocol, depending on the clinical problem or question.

BACKGROUND INFORMATION AND COMPETING MODALITIES

Imaging of the vasculature has evolved greatly in the past decades. In many instances, either MR or CT has replaced x-ray angiography as the imaging modality of choice for vascular imaging, due to their non-invasive application, the ease and comfort to the patients, and the clinical versatility of these imaging methods. While MRI is more flexible in terms of adaptation of the acquisition protocol (high-resolution MR angiography (MRA), time-resolved MRA, phase-contrast MRI, vessel wall imaging, etc.), CT is a very fast and robust tool with a very high spatial resolution (even better than that of MRA) and with new concepts, such as Dual-Energy CT or low-kV scanning, potentially reducing the need for radiation dose and/or contrast agent volume. Thus, both imaging modalities are competing in a number of vascular imaging indications (1).

MAIN VASCULAR PATHOLOGIES

The vascular pathologies to be discussed in this course include a broad range of potential clinical questions and problems. These pertain the depiction and exact grading of vascular stenoses (e.g., in the carotid, renal, or peripheral arteries) (2), as well as the depiction of acute and chronic, pre- and post-interventional pathologies of the aorta (i.e., aortic dissection, aortic

aneurysms, etc.). In vascular stenoses, not only the area and diameter stenosis can be measured, but also stenosis morphology (eccentric / concentric stenosis) or the vessel wall composition might be assessed (3). In aortic dissections, detailed information on luminal enhancement, organ perfusion and flow dynamics are essential (4). Also, abnormalities and variations of normal blood flow will be touched, such as vascular shunts and coarctations.

CONTRAST AGENTS AND APPLICATION PROTOCOLS OF VASCULAR MRI

MRA has evolved rapidly since its introduction more than 20 years ago. Today, MRA is still being considered as the problem solving vascular imaging modality, as it enables high-resolution MR Angiography, time-resolved imaging to depict vascular flow dynamics including 4D Flow imaging, imaging of blood flow (phase-contrast MRI) and even the potential to image the arterial wall in greater detail, e.g., in the carotid arteries (5). In principal, MRA can be applied to any vascular region. Typical problems such as blooming and beam hardening artifacts encountered in CTA do not occur with MRA. Typical indications of MRA include particularly renal MRA, MRA of the peripheral and supra-aortic vessels. Recently, the use of non-contrast enhanced MRA further broadens the clinical use of MRA, e.g., in patients with renal impairment (6,7).

CONCLUSION

With recent technical advances, comprehensive vascular MR imaging including sub-millimeter spatial resolution and/or dynamic and flow imaging can be achieved in most vascular beds throughout the body. As MR angiography is non-invasive and does not require ionizing radiation for image acquisition, dedicated vascular applications including time-resolved imaging studies, complex flow analyses, and large field-of-view (whole-body) MRA applications are increasingly used in clinical routine.

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