

Syllabus Sessions: Vascular MRI (Wednesday 14 May 2014)

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Highlights:

- The latest & the greatest of black-blood pulse sequences
- Clinical applications of vessel wall MRI
- Black-blood MRI of vulnerable plaques, vasculitis, dissection & more

### **Vessel wall imaging**

Target Audience:

Radiologists and physicists who are keen to learn the technical requirements and the clinical usefulness of black-blood MRI

Objectives:

- To understand the technical requirements and the pitfalls of vessel wall MRI
- To get acquainted with MR protocols and sequence considerations for different vascular beds
- To learn about typical disease patterns in vessel wall MRI
- To get accommodated with MR biomarkers indicative of the vulnerable atherosclerotic plaque

Purpose:

A myriad of vascular diseases affect the head and neck. Although the clinical presentation is highly variable including headache, encephalopathy, seizures, dizziness and visual disturbances, all of them may cause severe morbidity and mortality in the form of blindness, TIA or stroke. They can be classified into inflammatory causes such as central nervous system (CNS) arteritis, Takayasu arteritis, Giant cell arteritis and carotidynia and non-inflammatory causes such as atherosclerosis, fibromuscular dysplasia, reversible vasoconstriction syndrome and CADASIL. Additionally any diseased vascular wall may be subject to dissection and thrombus / aneurysm formation.

Conventional imaging methods, such as CT and MR angiography, as well as digital subtraction angiography allow the vessel lumen but not the vessel wall to be depicted. However, most of the vascular diseases affect primarily the vessel wall; therefore

conventional imaging modalities often fail to make a definite diagnosis. Thus imaging methods are needed that depict the vessel wall and thus allow to directly visualizing the underlying pathology.

#### Methods / Results:

In recent years in-vivo carotid black blood MRI (bb-MRI) has evolved to be a promising method for imaging atherosclerotic disease of the cervical arteries<sup>1</sup>. Advantages such as non-invasiveness, lack of radiation exposure, excellent soft tissue contrast, accuracy and reproducibility have contributed to its acceptance. Recent developments of bb-MRI enable to reliably identify and quantify plaque components and to detect features of the vulnerable plaque, such as a thin or ruptured fibrous cap, large necrotic core, intraplaque hemorrhage, macrophage infiltration and neovascularization<sup>2</sup>. In addition, carotid bb-MRI allows to evaluating mechanical forces and the biological activity of atherosclerotic plaques. More recently the use of this technique has been expanded for the diagnosis of intracranial and extracranial vasculitis<sup>3,4</sup>.

Historically most of the black-blood sequences were two-dimensional TSE/FSE sequences which used either inflow saturation or double (quadruple) inversion recovery techniques. More recently, new three-dimensional black-blood pulse sequences, such as MERGE<sup>5</sup> or the T2-weighted VISTA / SPACE sequence<sup>6</sup> have been developed which will be discussed briefly.

#### Summary:

This talk will discuss the capabilities of bb-MRI for quantitative assessment of the composition and morphology of atherosclerotic lesions and for diagnosing other vascular pathologies. Technical requirements, such as hardware, software and sequence considerations will be discussed. Studies will be shown which used bb-MRI to compare symptomatic and asymptomatic plaques, to study the natural history of atherosclerosis, to evaluate the effect of anti-atherosclerotic drugs on the regression / progression of atherosclerosis and to identify biomarkers of plaque vulnerability<sup>7-9</sup>. Interesting clinical cases will be shown and discussed.

#### Conclusion:

BB-MRI is a non-invasive tool which is widely used for research purposes and for clinical use. As demonstrated in this talk this technique can be easily integrated into the clinical routine and in many occasions it is extremely helpful in clinical decision making.

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