Biology and Pathology

Cardiovascular Disease

Introduction to MR and PET Imaging – Atherosclerosis

Rene Botnar
London, UK

Learning Objectives:

- Understand basic MR sequences for atherosclerosis imaging
- Understand basic contrast mechanisms in MRI (T1. T2, proton density, magnetization transfer contrast)
- Understanding basic principle of contrast enhanced MRI (inversion recovery, Look Locker, T1 and T2/T2*mapping, positive contrast)
- Understand basic motion compensation approaches
- Understand basic PET quantification and partial volume correction

Despite advances in diagnosis and treatment complications due to atherosclerosis remain the number one killer in the western world and developing countries. Current diagnostic tests focus on the detection of lumen stenosis either using angiography or by measuring myocardial or cerebral blood flow but have failed to predict future cardiovascular events. This is because most myocardial infarctions and strokes are caused by rupture of an unstable atherosclerotic plaque and often occur suddenly in patients without previous symptoms of cardiovascular disease. Autopsy studies have shown that features characteristic for disrupted plaques include a thin heavily inflamed fibrous cap, a large lipid core, large plaque burden, expansive positive remodeling, neovascularization and intra plaque hemorrhage. Other features include dysfunctional endothelial function, endothelial activation, inflammation, extracellular matrix remodeling, hypoxia, activation of proteases and endothelial erosion. To detect these vessel wall changes several new imaging techniques have been developed with MRI and PET being one of the most promising non-invasive approaches. In this lecture the basic principles of MR and PET imaging of atherosclerosis will be introduced. This will include measurement of tissue properties by use of MR prepulses, visualization and quantification of MR contrast agents, discussion of the basic principles of MR contrast agents and concluding with discussion of motion correction techniques. PET imaging of atherosclerosis will be only touched on briefly, discussing signal quantification, partial volume correction and the basic differences between PET tracers and MR contrast agents.