Clinical trials – whether aimed towards the evaluation of new pharmaceutical compounds or finding new ways to predict risk of clinical events – require the use of quantitative information to be followed in serial studies. In cardiovascular MR, there is a series of imaging based biomarkers that have been used for different types of clinical trials such as the evaluation of heart functions. This lecture will focus on another area of CMR application - its role in vessel wall imaging compared to other imaging modalities - and more specifically in the evaluation of atherosclerotic lesion progression and regression.

Atherosclerosis is widely recognized as a multifactorial disease with outcomes arising from complex factors such as plaque components, blood flow, luminal stenosis, and inflammation. Due to compensatory remodeling, atherosclerotic lesion may grow outward without impacting lumen size. Thus, MR based vessel wall imaging has focused on the visualization of the vessel wall, and the identification and quantification of atherosclerotic plaque tissue components. Over the years, with continuous technical advancements, a series of parameters associated with in vivo plaque morphology and composition have been evaluated and validated against histology and other imaging based gold standard. Technically, MRI of atherosclerosis relies on the use of combined black and bright blood techniques to distinguish vessel lumen and wall tissues, specific multi-sequence approach to identify main plaque tissue components, the use of novel coil designs to improve image SNR and spatial resolution, and contrast-agent applications which highlight vessel neovasculature and improve tissue contrast.

This lecture will review the use of vessel wall MRI in clinical trials to evaluate treatment effects of various compounds in different vascular beds and to monitor atherosclerotic lesion progression. Comparison of MRI based techniques and other imaging modalities for such studies will also be discussed. In general, MRI based vessel wall imaging provides a non-invasive comprehensive means to evaluate plaque burden and tissue composition in 3D.