MR Screening in Cardiovascular Disease

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Synopsis

The use of imaging methods for disease screening and for quantification of progression and regression of atherothrombosis could play an important role in the management of patients. CMR imaging has the potential to provide anatomical information about the lumen and the vessel wall. Furthermore, CMR has the ability to characterize plaque composition and therefore to identify lesions at risk to rupture or erosion. The high resolution of CMR and the development of sophisticated contrast agents offer the promise of in vivo molecular imaging of the plaque. This may aid early intervention in both primary and secondary treatment of vascular disease.

Atherothrombosis is a diffusive and systemic arterial disease originally involving mostly the intima of large- and medium-sized systemic arteries including the carotid, aorta, coronary and peripheral arteries.[1] The main components of the atherothrombotic plaques are:[2-4] a) connective tissue extracellular matrix, including collagen, proteoglycans and fibronectin elastic fibers; b) crystalline cholesterol, cholesteryl esters, and phospholipids; c) cells such as monocyte-derived macrophages, T-lymphocytes, and smooth-muscle cells, and d) thrombotic material with platelets and fibrin deposition; varying proportions of these components occur in different plaques, thus giving rise to a heterogeneity or spectrum of lesions. These components mainly affect the intima, but secondary changes also occur in the media and adventitia,[5] presumably including growth of vasa vasorum.[6]

The lesions may be quite heterogeneous. For example, disruption-prone plaques in the coronary arteries, the so-called "vulnerable plaques," tend to have a thin fibrous cap (cap thickness ~65-150 μm) and a large lipid core (>40% of the total lesion area).[4] Acute coronary syndromes (ACS) often result from disruption of a modestly stenotic vulnerable plaque, not visible by x-ray angiography,[7] which results in a thrombotic complication. However, although approximately two thirds of the ACS relate to the disruption and thrombosis of non-severely stenotic lipid-rich plaques, about one third relates to a "complicated" occlusive thrombus overlying a superficial erosion of a markedly stenotic and fibrotic plaque.[8] Furthermore, in contrast to coronary and thoracic aorta vulnerable plaques, carotid artery and peripheral artery plaques prone to thrombotic complications are predominantly fibrotic and severely stenotic.[9] Today, we refer to all these plaques as "high-risk plaques."[9]

Since the composition of the "high-risk plaques" varies depending on the arterial region, and since there is striking heterogeneity in the composition of human atherothrombotic plaques even within the same individual, reliable imaging modalities able to detect atherothrombotic disease in the various stages and regions and characterize the composition of the plaques are clinically desirable.[9] The availability of such imaging modalities will improve our understanding of the pathophysiological mechanisms underlying the atherothrombotic processes and allow us to better risk-stratify the "burden" of disease. Additionally, such tools may permit optimal tailoring of treatment and allow direct monitoring of the vascular response. Several invasive and noninvasive imaging techniques are available to assess atherosclerotic disease.[9,10] Cardiovascular Magnetic Resonance (CMR) has emerged as the one of the most promising noninvasive imaging modalities for coronary atherothrombotic disease detection.[11] CMR directly images the atherosclerotic lesions, measures atherosclerotic burden, and characterizes the plaque components.

As we will described in this talk CMR provides unique information that may predict cardiovascular risk, facilitate screening, study of the mechanisms of atherothrombosis progression and its response to therapy, and allow for assessment of subclinical disease.

References

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