Tissue Characterization: Clinical Needs

Cardiac Function, Perfusion & Tissue Characterization
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Take-home messages:

- A broad range of cardiovascular conditions affect the myocardium.
- The presence and extent to which the myocardium is affected can be estimated with magnetic resonance-based tissue characterization techniques.
- The extent to which these techniques have been validated varies; the certainty with which a cardiac magnetic resonance (CMR)-based tissue characteristic is assigned to a specific histopathological feature should be tempered by the validation data available for such.
- Longitudinal studies support CMR's diagnostic and prognostic value in myocardial characterization.

Considerable technical advances now afford robust *in vivo* myocardial tissue characterization with CMR. The most commonly used parameters include T1, T2 and T2*. Before considering the techniques, though, it is worth noting why we would consider CMR vs. other approaches for tissue characterization. The unmet clinical need typically consists of questions like: 1) what is the etiology of cardiac symptoms, heart failure and/or arrhythmia? 2) if ventricular function is reduced, can it improve? 3) should a patient be referred for endomyocardial biopsy? Echocardiography's ubiquity makes it a widely used test in these clinical settings, though limited capabilities for tissue characterization offer a role for CMR when these questions are not adequately answered.

Conditions that can be diagnosed unequivocally by CMR tissue characterization (TC-CMR) include iron overload cardiomyopathy and gross lipid deposition syndromes. The unique T2*-shortening effect of iron aggregates in tissues allows one to noninvasively estimate the amount of iron per gram of dry weight myocardium [1]. The impact on human health has been impressive, with a mortality reduction of over 70% in regions where iron overload is a major cause of cardiomyopathy [2]. Myocardial lipid imaging has been a less consistently applied and interpreted technique, particularly when relied upon to diagnose arrhythmogenic right ventricular cardiomyopathy (ARVC). Recognition of myocardial fat i) in ARVC, ii) replacing infarcted myocardium and iii) as a *de novo* finding in patients without arrhythmia or infarct history highlights the sensitivity of the technique and need to better understand the significance of this tissue characteristic.

Late post-gadolinium enhancement imaging (LGE) remains the workhorse TC-CMR technique, with established diagnostic [3] and prognostic [4] value across a broad spectrum of cardiovascular diseases. A wealth of literature has emerged ascribing distinct myocardial abnormalities such as diffuse interstitial fibrosis to quantitative changes in myocardial T1 beyond the typically qualitative information obtained from T1-weighted LGE images [5]. Similarly, T2 imaging has been widely used as a biomarker of myocardial inflammation and edema [6]. Tissue mapping techniques have been rapidly adopted in both clinical and translational cardiovascular research. Ongoing work is needed to fill gaps between these techniques and histopathological corroboration plus their predictive value across a variety of myocardial disorders to insure appropriate translation of imaging findings to clinical care.

Literature Cited

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