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Parametric Mapping

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This lecture reviews the clinical applications of cardiovascular magnetic resonance (CMR) as a multiparametric imaging modality for cardiac phenotyping, using major techniques such as cine imaging, late gadolinium enhancement (LGE) imaging, stress perfusion imaging, and parametric T1/T2/ extracellular volume (ECV) mapping. Cine imaging produces movie images of high spatial resolution for evaluation of cardiac anatomy and function. LGE imaging permits non-invasive visualisation of ischaemic scars from myocardial infarction, which may be distinguished from non-ischaemic aetiologies based on LGE patterns, extent and distribution. CMR stress perfusion produces high resolution images for detection of regional inducible hypoperfusion to evaluate the functional significance of obstructive coronary artery disease, and recent pixel-wise perfusion maps allows quantification of myocardial blood flow at rest and during stress, opening the doors for the non-invasive assessment of microvascular dysfunction.

Quantitative mapping is widely regarded as the 4th era of CMR development, after cine imaging, LGE imaging, and perfusion imaging. The lecture will cover clinical applications of T2* imaging as the first example of CMR mapping that achieved widespread clinical adoption, now routinely employed to assess myocardial iron loading and reducing cardiac death by 71% in patients with thalassaemia (c.2008). It will then move on to review the development and clinical applications of T1-mapping, T2-mapping and ECV-mapping, with various examples of clinical utility. The European Society of Cardiology (ESC) Heart Failure Association Position Statement (November 2018) stated that CMR Parametric Mapping is one of six Innovative imaging methods in assessing heart failure. The most recent update to the Lake Louise Criteria 2018 now includes the use of T1/T2/ECV mapping.

CMR is increasingly used in clinical practice, and is expected to help diagnose and better manage patients with a variety of cardiac conditions as a “one-stop shop” due to its multiparametric capabilities.

Keywords: Cardiovascular magnetic resonance, T1-mapping, T2-mapping, ECV, Tissue characterisation