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SY22-01

# Cardiac function: what more can we learn from strain?

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Calculation of ejection fraction (EF) using different imaging modalities currently is considered as the gold standard for assessing cardiac function. Over the years, cardiovascular magnetic resonance (CMR) has become the reference standard for cardiac anatomy and functional assessment. However, changes in EF may occur in later stages of the majority of heart diseases, and may not reflect changes in the stage of early disease. Also, EF is limited to reflect regional myocardial dysfunction because it is a measure of global function.

Recently, CMR feature tracking techniques has emerged as a more accurate tool for quantitative evaluation of cardiovascular function by directly evaluating myocardial fiber deformation. It is commonly applied to cine images, in particular steady-state free precession, acquired during routine CMR examination. Feature-tracking derived strain parameters enable the early diagnosis of primitive cardiomyopathies by identifying subtle myocardial abnormalities before overt clinical manifestations. In addition, CMR feature tracking allows identification of cardiac involvement in systemic diseases, detection of drug-related cardiac toxicity as well as risk stratification and monitor of treatment effects in patients with heart failure of various etiologies.

This lecture provides reviews of the basic principles, current clinical applications and prognostic implications of CMR myocardial feature tracking.

Keywords : Strain, Feature tracking, Tissue tracking, Cardiac function

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# Functional Evaluation in Repaired TOF

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Tetralogy of Fallot (ToF) is the most common complex congenital heart disease. Significant progress in the surgical treatment resulted in low early mortality and a favourable course during the first two decades of life. Consequently, well hemodynamic and mechanical evaluation of the ventricular and great arterial functions in patients with repaired ToF is important for to survive to adulthood.

Recent advances of cardiac MRI including (1) 4D flow; (2) feature tracking for ventricular strain; (3) tissue phase mapping for intramural motion; (4) T1 and ECV for tissue characteristic and fibrosis have matured to be a clinical reality for routine use. The new methods allow de novo investigation of functional adaptation in rTOF and shed light on the new guidance of treatment to improve long term survival and life quality in rTOF patients.

Keywords : Tetralogy of Fallot, Prognosis, MRI,

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# Role of Native T1 and ECV measurement in cardiomyopathy

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In recent years, due to the development of imaging technology, myocardial T1 relaxation time can be quantified, and product-version sequences for generating T1 maps are available in clinical MR scanners. In T1 mapping, quantitative data reflecting a wide range of myocardial pathology can be non-invasively obtained. Late gadolinium-enhanced imaging conventionally used for the evaluation of myocardial characteristics depicts abnormal myocardium as a hyperintense region compared with normal-looking regions, however, it has a limitation for detecting lesions in diffuse myocardial diseases. On the other hand, T1 mapping is expected to improve the sensitivity of diffuse lesions based on pixel values of the myocardium.

T1 values reflect myocardial conditions differently in non-contrast-enhanced and contrast-enhanced T1 maps. Native T1 allows for visualization of the myocardial and interstitial lesions without using gadolinium contrast medium. T1 values alter in various pathologies such as myocardial edema, fat, and iron deposition. With contrast enhancement, T1 values reflecting the contrast media distributed in the extracellular space are measured, and extracellular fluid fraction (ECV) is calculated by pre- and post-contrast-enhanced T1 and the hematocrit values. ECV correlates with the extent of myocardial fibrosis.

There are various imaging methods for T1 mapping, using inversion pulse, saturation pulse, and their hybrid type. Of these, modified Look-Locker imaging (MOLLI) is the most widely used. Since the obtained T1 values differ not only by the magnetic field strength but also imaging methods and scanners, it is recommended that normal reference values are acquired in each facility. In addition, acquired original images should be carefully observed to evaluate potential artifacts caused by misregistration, susceptibility effects, etc.

Clinical application of T1 mapping for cardiomyopathy may include complementary tools for differential diagnosis of cardiomyopathy, grading disease activity, monitoring progression and treatment effects, and predicting prognosis; there is growing evidence for the use of T1 mapping for cardiomyopathy.

This talk presents current clinical applications of T1 mapping for various cardiomyopathies and reviews the evidence on their clinical values in various clinical conditions. Topics also include cardio-oncology, where myocardial damages caused by anti-cancer treatment are discussed. T1 mapping is expected to further extend the ability of cardiovascular MR and to play a role for imaging biomarkers.

Keywords : Cardiac Magnetic Resonance Imaging, Cardiomyopathy, Quantification, T1.

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# Role of MRI in patients with arrhythmia

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Arrhythmia is a condition of irregular heartbeat which may cause severe morbidity or mortality. Commonly, symptomatic arrhythmia may be associated with structural heart disease. Scar-related sustained monomorphic ventricular tachycardia (VT) is most commonly seen after myocardial infarction. The incidence of atrial fibrillation (AF) has been consistently increased with aging. Catheter ablation is a promising therapeutic strategy for patients with drug refractory arrhythmia such as VT and AF. Successful ablation requires the detail assessment of cardiac anatomy and the correct identification of underlying critical arrhythmogenic substrates. Cardiovascular magnetic resonance imaging (MRI) is a non-invasive imaging modality to help characterize cardiac anatomy and function. Furthermore, myocardial scar of left atrium and left ventricle, the most common arrhythmogenic substrate, can be easily displayed by late gadolinium-enhanced (LGE) cardiac MRI. Recently, the parallel development of cardiac MRI techniques has been considered essential to plan and guide the electrophysiological procedures and improve their outcomes.

Keywords : Arrhythmia, Ventricular tachycardia, Atrial fibrillation, Magnetic resonance imaging, Catheter ablation