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Combining systolic and diastolic feature tracking myocardial strain parameters for a more comprehensive assessment of the different characteristics in HFpEF

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Background: Heart Failure with Preserved Ejection Fraction (HFpEF) is a disease commonly associated with impaired myocardial relaxation, stiffening of the ventricles and consecutive diastolic dysfunction. Due to a left ventricular ejection fraction (LVEF) greater than 50%, the severity of heart failure or progression of systolic dysfunction may be underappreciated. Feature-tracking (FT) CMR is becoming a diagnostic and prognostic tool in cardiovascular disease. This technique has been most validated for peak strain, a marker of systolic function. Current software now allows for a variety of systolic and diastolic parameters to be extrapolated from these images, which in combination with tissue characterization and myocardial function assessments may provide a more comprehensive assessment of HFpEF.

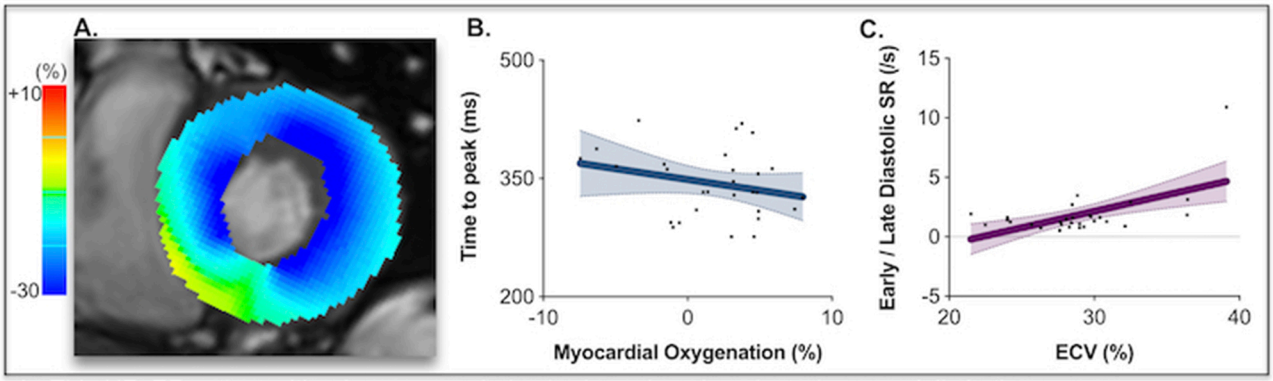
Purpose: To investigate ventricular systolic and diastolic strain measurements obtained by FT-CMR in relation to other CMR characteristics of HFpEF patients.

Methods: HFpEF patients with diastolic dysfunction (LVEF > 50%) underwent standard cine acquisition of the ventricles at rest. These images were analyzed with FT software for systolic parameters of peak strain, time to peak strain, along with systolic and diastolic strain rates (SR) in a circumferential and longitudinal orientation. T2 mapping and T1-based contrast enhanced extracellular volume (ECV) maps were acquired, while the myocardial oxygenation response was assessed with an oxygenation-sensitive image during a vasoactive stimulus induced by 60s of rapid-paced breathing and subsequent apnea.

Results: Thirty patients (47% female) with a mean age of 61 ± 14 (SD) completed the CMR exam. Global peak circumferential strain was related to EF (r=-0.409, p = 0.025) for circumferential only, while peak strain and systolic SR in both orientations were associated with an enlarged mass index (r > 0.365, p < 0.050). A poor myocardial oxygenation response was associated with an increase in longitudinal time to peak strain (r=-0.383, p = 0.044). T2 was not associated with peak strain, but with circumferential time to peak (r = 0.533, p = 0.004) and an attenuated systolic SR (r = 0.440, p = 0.015). On the other hand, ECV was associated with the circumferential diastolic SR ratio of the early and atrial peaks (r = 0.576, p = 0.001).

Conclusion: Using an array of strain parameters from FT-CMR may add more insight into various presentations of HFpEF, and into the progressive deterioration of myocardial relaxation and ventricular compliance. Diastolic parameters were found to be associated with measurements indicating ventricular stiffness, whereas inducible myocardial ischaemia and edema were associated with signs of systolic dysfunction, especially time to peak strain. This parameter and abnormal myocardial oxygenation could be early markers for progressive systolic involvement with diastolic dysfunction in HFpEF. Larger samples as well as myocardial segmental analysis may help to better characterize HFpEF pathophysiology

Abstract P429 Figure. Feature Tracking in HFpEF



A. This HFpEF patient with a larger mass index had a reduced peak strain, especially in the septum.
B. Myocardial oxygenation correlated with longitudinal time to peak strain, while ECV (C.) was associated with the ratio of peak early over peak atrial circumferential diastolic strain rate.