Diffusion tensor cardiovascular magnetic resonance detects altered myocardial microstructure in patients with acute st-elevation myocardial infarction

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Background: Diffusion Tensor Cardiovascular Magnetic Resonance (DT-CMR) can quantify metrics of tissue integrity (mean diffusivity [MD] and fractional anisotropy [FA]) and changes in laminar microstructures (sheetlets), which reorientate from more wall-parallel in diastole (DIA) towards wall-perpendicular in systole (SYS) as the myocardium thickens, quantified by E2 angle [E2A]. Microstructural changes after STEMI may provide new insights into adverse LV remodelling and risk stratification.

Methods: In vivo DT-CMR was performed 3–5 days after PPCI for first presentation STEMI (N=19, mean age 57±9, 79% male). DT-CMR was acquired in 2 short-axes (SYS & DIA) using a STEAM-EPI sequence. 12 segment analysis of MD, FA, E2A and E2A mobility (△E2A = E2ASYS – E2ADIA) was performed. Infarct (INF) segments were defined as >25% LGE, adjacent (ADJ, located contiguous to INF) and remote (REM, all other segments). Wilcoxon signed rank tests were used with threshold $P<0.017$ (Bonferroni corrected).

Results: See Table.

MD in both SYS and DIA was significantly higher in INF and ADJ regions compared to REM. FA in both SYS and DIA was lower in the INF and ADJ compared to REM. E2ADIA was higher in INF, indicating a more wall-perpendicular orientation of sheetlets, compared to ADJ and REM zones. E2ASYS in INF was significantly reduced, indicating a more wall-parallel orientation of sheetlets, compared to ADJ and REM regions, resulting in significantly reduced sheetlet mobility (△E2A).

Conclusions: Microstructural changes can be detected after acute STEMI by in vivo DT-CMR. Zonal changes in MD and FA may suggest loss of barriers to water diffusion and altered cardiomyocyte organisation, respectively. We provide the first report of reduced sheetlet mobility after acute STEMI in INF. Ongoing work is evaluating the mechanisms and prognostic importance of altered sheetlet mobility after STEMI.

Acute DT-CMR parameters in STEMI

		INF	ADJ	REM
MD (10^{-3} mm^2 s^{-1})	DIA	1.27 [1.25–1.37]*	1.17 [1.15–1.26]¶	1.15 [1.11–1.18]
	SYS	1.29 [1.25–1.35]§	1.13 [1.09–1.14]‖	1.04 [1.02–1.08]
FA	DIA	0.49 [0.42–0.51]*	0.57 [0.54–0.62]‡	0.60 [0.58–0.63]
	SYS	0.41 [0.39–0.46]$	0.46 [0.43–0.48]	0.48 [0.45–0.49]
E2A (°)	DIA	29 [22–33]#	20 [17–25]	19 [16–30]
	SYS	44 [29–57]^!	55 [51–59]	58 [54–64]
E2A mobility (°)		15 [7–26]+	30 [26–40]	34 [27–41]

Results are shown as median [IQR]. *p=0.0001vADJ and REM; ¶p=0.013vREM; §p=0.0002vADJ and REM; ‖p=0.0008vREM; ‡p=0.0057vREM; $p=0.0018vADJ and REM; #p=0.008vADJ ; ^p=0.009vADJ; !p=0.006vREM; +p=0.0006vADJ and REM.