Misalignment of hemodynamic forces in the left ventricle is associated with adverse remodeling following STEMI

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Background: Infarct size (IS), area at risk (AAR) and microvascular obstruction (MVO) are well known predictors of adverse remodeling (aLVr) following acute myocardial infarction, while the pathogenic role of left ventricular (LV) hemodynamic forces (HDFs) is still unknown. Recent evidence suggests the role of HDFs in negative remodeling after pathogenic events.

Purpose: To identify LV HDFs patterns associated with aLVr in reperfused ST-segment elevation MI (STEMI) patients.

Methods: Forty-nine acute STEMI patients underwent CMR at 1 week (baseline) and 4 months (follow-up) after MI. The following parameters were measured: left ventricular end-diastolic and end-systolic volume index for body surface area (LVEDVi and LVESVi), left ventricular ejection fraction (LVEF) and LV mass index, AAR and IS. LV HDFs were computed at baseline from cine CMR long axis datasets using a novel method based on LV endocardial boundary tracking. LV HDFs were calculated both in apex-base (A-B) and latero-septal (L-S) directions. The distribution of LV HDFs were evaluated by L-S over A-B HDFs ratio (L-S/A-B HDFs ratio %). All HDFs parameters are computed over the entire heartbeat, in systole and diastole. aLVr was defined as an absolute increase in LVESV of at least 15% (ΔLV-ESV ≥15%).

Results: Patients with aLVr (n = 18; 37%) had significant greater value of AAR (32 ± 23 vs 22 ± 18; p = 0.03) and slightly larger IS (23 ± 16 vs 15 ± 11; p= 0.07) at baseline. In patients with aLVr at FU, baseline systolic L-S HDF were lower (2.7 ± 0.9 vs 3.6 ± 1; p = 0.027) while diastolic L-S/A-B HDF ratio was significantly higher (28 ± 14 vs 19 ± 6; p = 0.03), reflecting higher grade of diastolic HDFs misalignment. At univariate logistic regression analysis, higher IS [Odd ratio (OR) 1.05; 95% confidence interval (95% CI) 1.01-1.1; p= 0.04] L-S HDFs (OR 0.41; 95% CI 0.2-0.9; p= 0.04] and higher diastolic L-S/A-B HDFs ratio (OR 1.1; 95% CI 1.01-1.2; p= 0.05) were associated with aLVr at FU (Table). At multivariate logistic regression analysis, L-S/A-B HDF ratio remained the only independent predictor of adverse LV remodeling after correction for other baseline determinants.

Conclusion: Misalignment of diastolic HDFs following STEMI is associated with aLVr observed after 4 months.

Predictors of adverse remodeling

	Univariate		Multivariate	
Parameter	OR (95% CI)	P	OR (95% CI)	P
IS (%)	1.05 (1.01-1.1)	0.042	-	-
Systolic L-S HDF	0.41 (0.2-0.9)	0.04	-	-
Diastolic L-S/A-B HDF Ratio	1.1 (1.01-1.2)	0.05	1.1 (1.01-1.2)	0.04

A-B:apex-base; L-S: latero-septal; HDFs: hemodynamic forces

Abstract Figure. Diastolic HDFs distribution and aLVr