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Blunted heart rate reserve as an imaging-independent predictor of abnormal left ventricular contractile reserve

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Background: Stress echocardiography (SE) relies on regional wall motion and left ventricular contractile reserve (LVCR) based on force (systolic blood pressure/end-systolic volume). An additional non-imaging parameter based on EKG is the blunted heart rate reserve (HRR) which is a simple marker of altered autonomic balance and is associated with worse prognosis independently of ischemia.

Aim: To assess the relationship between HRR and LVCR in patients undergoing SE.

Methods: We enrolled 4707 patients (age 63.6±11.3 yrs, 2800 males) referred to SE for known or suspected coronary artery disease (CAD) and/or heart failure (HF) in 21 SE laboratories in 8 countries. The employed stress was exercise (n=2062), dipyridamole (n=2007) or dobutamine (n=638). We assessed LVCR (stress/rest ratio of force=systolic blood pressure/end-systolic volume, ESV). Stress-specific abnormal cutoff value of LVCR were <2.0 for exercise and dobutamine and <1.1 for dipyridamole. All readers had passed the upstream quality control reading for wall motion abnormalities and ESV. HR (with 12-lead ECG) was obtained each minute and recorded at rest and peak stress. HR reserve (HRR) was calculated as the peak/rest HR ratio.

Results: HRR was related to LVCR at cumulative (n=4707; r=0.351; p<0.001: see figure) and stress-specific analysis for exercise (r=0.351; p<0.001), dipyridamole (r=0.241; p<0.001) and dobutamine (r=0.214; p<0.001). At multivariate logistic regression analysis, blunted HRR (optimal cutoff: 1.73 for exercise, 1.306 for dipyridamole, 1.932 for dobutamine) was a significant predictor of abnormal LVCR at stress-specific analysis for exercise (Odds ratio = 0.285, 95% Confidence Intervals: 0.149–0.546, p=0.0001), dobutamine (Odds ratio = 0.187, 95% Confidence Intervals: 0.057–0.617, p=0.0001) and dipyridamole (Odds ratio = 0.263, 95% Confidence Intervals: 0.115–0.602, p=0.002).

Conclusion: A blunted HRR is a useful non-imaging predictor of abnormal LVCR response during exercise or pharmacological SE. HRR is a simple biomarker of autonomic unbalance of physiologic and potentially prognostic meaning. A "slow heart" during stress (with blunted HRR) is more often a "weak heart", with blunted increase in force.