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The added value of exercise stress echocardiography in heart failure patients: the role of dual evaluation of cardiac index and pulmonary congestion

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Background. Doppler echocardiography can provide reliable and repeatable measures of cardiac index (CI), whereas lung ultrasound (LUS) represents a novel, quantitative approach to assessment of pulmonary congestion. In ambulatory HF patients, exercise stress echocardiography (ESE) may endow with hemodynamic information that can allow us to classify patients into hemodynamic categories with different risk.

Aim. Our study tested the hypothesis that simultaneous ESE assessment of CI and LUS is valuable to define categories of HF outpatients with different risks of adverse outcome.

Methods and results. Standard transthoracic and LUS evaluation were assessed during semi-supine ESE in 105 NYHA class I-III HF patients (86 males; age 67±11 years) with reduced left ventricular ejection fraction (30 ± 7%). CI and B-lines were measured at baseline and at peak stress. Resting plasma BNP levels were also evaluated. Patients were classified into four profiles: A), peak CI = 3.5 l/min/m2 and stress-B lines = 15 (no evidence of congestion or hypoperfusion, n = 55); B), peak CI < 3.5 l/min/m2 and stress-B lines = 15 and (hypoperfusion without congestion, n = 14); C), peak CI = 3.5 l/min/m2 and stress-B lines > 15 (congestion with adequate perfusion, n = 20); and D), peak CI < 3.5 l/min/m2 and stress-B lines > 15 (congestion and hypoperfusion, n = 16). There were 18 deaths and 19 hospitalization for worsening HF during a median follow-up of 27 months. Combination of stress-induced B-lines at LUS and CI < 3.5 l/min/m2 (D profile) was the most powerful independent predictor of death or hospitalization for worsening HF (Odds Ratio [OR]: 4.46; p = 0.0002) followed by BNP levels (OR: 1.00; p = 0.02). 36-month event-free survival at Kaplan-Meier estimates showed that prognosis was worse in patients with D profile (13%) followed by patients with C (71%), B (75%) and A (83%) profiles (log-rank: 57.5; p < 0.0001).

Conclusion. Dual evaluation of CI and LUS during ESE is useful to risk stratify patients with chronic HF and reduced ejection fraction. Evidence of pulmonary congestion and low CI at peak stress identifies a subgroup with a very high risk of adverse outcome.