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Impairment in arterial-ventricular coupling and its prognostic value in patients with decompensated heart failure

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Objective: The interaction of the left ventricle (LV) with the arterial system, termed ventricular-arterial coupling (VAC), is a central determinant of cardiovascular performance and cardiac energetics. Heart failure (HF) modifies the structure and function of LV. The aim of the study was to assess VAC parameters and their prognostic value in patients with different phenotypes of decompensated HF.

Methods: Parameters of VAC were assessed by 2-dimensional echocardiography in 355 patients admitted with decompensated HF (198 male, 72±11 years (M±SD), arterial hypertension 94%, previous myocardial infarction 42%, HF with preserved ejection fraction (HFrEF) 36%, reduced EF (HFrEF) 44%, mid-range EF (HFmrEF) 20%, diabetes 40%, NTproBNP 3763 (1801; 5486) pg/ml, eGFR 51 (41; 64) ml/min/1.73 m² on the admission. VAC was expressed as the ratio arterial elastance (Ea)/end-systolic LV elastance (Ees) and was considered optimal at range of 0.6–1.2. Patients received standard therapy (334 (94%) beta-blockers, 312 (88%) iv diuretics, 170 (48%) – iv nitrates, 280 (79%) and 57 (16%) ACEI and ARB, 270 (76%) MRA).

Hospital length of stay was 10 (8; 12) days. P<0.05 was considered statistically significant.

Results: The median values of Ea, Ees and VAC were 2.2 (1.7; 2.9) mmHg/ml, 1.8 (1.0; 3.0) mmHg/ml and 1.32 (0.75; 2.21). Impairment of VAC was revealed in 63% of patients: VAC >1.2 – in 55% (predominantly patients with HFrEF), VAC<0.6 – in 8% of patients (all with HFpEF). Normal VAC was observed in 78% of patients with HFpEF, 42% of patients with HFmrEF and only in 1% with HFrEF. There was significant correlation between VAC and levels of NTproBNP (r=0.35), hematocrit (r=−0.29), hemoglobin (r=−0.26), systolic pulmonary artery pressure (sPAP) (r=0.18), diameters of left atrium (r=0.32) and right ventricle (RV) (r=0.32).

In-hospital mortality was 1.5%. After 6 months of follow-up 72 (20.3%) patients were readmitted with decompensated HF and 42 (11.8%) patients died. Patients with vs without worse prognosis had lower Ea (2.1 (1.7; 2.8) vs 2.3 (1.9; 3.0) mmHg/ml, Ees (1.5 (0.7; 2.5) vs 1.9 (1.0; 3.1) mmHg/ml, systolic blood pressure (130 (115; 150) vs 140 (130; 160) mmHg), higher level NTproBNP (4687 (3277; 6220) vs 3396 (1555; 5052) pg/ml), RV diameter (3.3 (3.0; 3.7) vs 3.0 (2.8; 3.5) cm), p<0.05 for all. There was increased risk of re-hospitalizations with decompensated HF and all-cause death in patients with decrease of Ea <2.2 mmHg/ml (OR 2.5, 95% CI 1.39–4.34, p<0.05), increase sPAP >45 mmHg (OR 3.7, 95% CI 1.74–7.45, p<0.05).

Conclusion: Impairment of VAC was revealed in 63% of patients with decompensated HF. Decrease of arterial elastance <2.2 mmHg/ml and increase of sPAP >45 mmHg are associated with risk of all-cause death and decompensated HF re-admissions in 6 month follow-up.