

Right ventricle morphological and functional phenotypes in heart failure with reduced ejection fraction: from pathophysiology to prognostic significance

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Background: Right ventricle (RV) remodeling is a marker of advanced disease and impaired prognosis in heart failure reduced ejection fraction (HFrEF) patients [1]. The assessment of RV remodeling is limited with standard echocardiography. Three-dimensional speckle-tracking echocardiography (3DSTE), with advanced post-processing, allows for RV shape and regional function assessment, potentially providing additional information [2].

Purpose: 1) to describe global and regional RV shape and function in a HFrEF cohort of patients; 2) to define RV remodeling phenotypes according with pulmonary haemodynamics; 3) to test the prognostic significance of RV shape and functional parameters.

Methods: 81 HFrEF patients were prospectively enrolled and followed-up (median time 760 days) for the composite end-point of death, heart failure hospitalization, heart transplant and left ventricular assist device implantation. They received standard 3DSTE evaluation, consisting of end-diastolic volume index (EDVi), end-systolic (ES) volume index (ESVi) and ejection fraction (EF) measurement via commercial software (TomTec Imaging Systems GmbH, Germany). Advanced post-processing provided RV free-wall and septal mean curvatures (Km) and minimum principal strain (MPS) [3] quantification. A subgroup of 40 subjects underwent right heart catheterization (RHC) and were classified in: group A – no pulmonary hypertension (PH) (n=15), group B – PH but normal pulmonary vascular resistance (PVR) (n=15) and group C – PH and increased PVR (n=10). Roc curves

were used to identify RV parameters able to discriminate subjects belonging to group A. Prognostic significance of RV remodeling parameters was tested for the composite end-point.

Results: Patients who did receive RHC showed lower ES free-wall Km (0.052 vs 0.058 mm⁻¹, p<0.01) and impaired RV EF (35.9 vs 40.9%, p=0.04) if compared to those who didn't. A progressive RV dilatation, global and regional dysfunction were observed according with the degree of pulmonary haemodynamic worsening (ES free-wall Km 0.054, 0.052, 0.044 mm⁻¹, p<0.02 and free-wall MPS -23.1, -21.3, -19.2%, p<0.02, for groups A, B and C, respectively, Fig. 1). RV ESVi, ES free-wall Km, global and regional MPS showed a good ability to discriminate patients without PH (ES free-wall MPS Sensitivity=0.72, 1-Specificity=0.4, area under curve=0.71). At univariable Cox Regression, the presence of more than moderate mitral regurgitation (MR), RV EF <38% and free-wall MPS >-22.4% (threshold discriminating normal pulmonary hemodynamic) resulted statistically associated with prognosis (Fig. 2).

Conclusion: In HFrEF patients, RV remodeling is progressively associated with unfavourable pulmonary haemodynamic, with a free-wall negative remodeling (abnormal curvature) resulting in loss of systolic function. RV free-wall function is tightly associated with the development of PH. 3DSTE indexes of RV global and regional function showed prognostic significance together with MR coexistence.

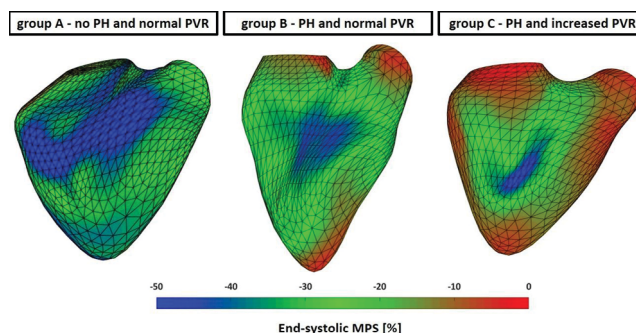


Figure 1. End-systolic MPS distribution

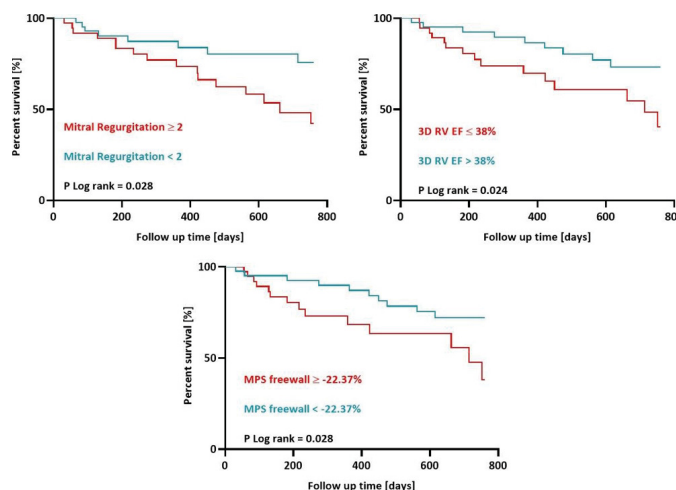


Figure 2. Kaplan-Meier survival analysis