Right ventricular dysfunction by 3D echocardiography is the best predictor for death and re-hospitalization in patients with heart failure with reduced ejection fraction

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Background: In patients with heart failure with reduced ejection fraction (HFrEF), right ventricular (RV) size and dysfunction by 2-dimensional echocardiography (2DE) were identified as risk factors for mortality and morbidity, but 3-dimensional echocardiography (3DE) enabled itself as a more reproducible and accurate method.

Aim: To assess the comparative prognostic value of parameters of RV size and dysfunction, measured by 2DE and 3DE, in patients with ischemic and non-ischemic HFrEF, on optimal clinical care, at long-term follow-up.

Methods: 142 consecutive patients (62±12 yrs, 104 males) with HFrEF, in sinus rhythm, were assessed by 2DE and 3DE, including RV full-volume acquisitions. RV diameter (RVd), RV end-systolic (RV_EDA) and end-diastolic areas (RV_ESA), RV fractional area change (RVFAC), and 2D_TAPSE were measured by 2DE. RV end-diastolic (RV_EDV) and end-systolic volumes (RV_ESV), RV ejection fraction (RV_EF), and 3D_TAPSE were measured by a dedicated 3DE software. Patients were followed for 37±16 months after the index event. Primary outcome was cardiac death (CD). Secondary outcomes were: 1) HF hospitalizations (HFH); 2) a composite cardiac events (CE) end-point of CD or HFH, myocardial infarction, coronary revascularization, arrhythmias, or CRT.

Results: 38 CD, 47 HFH, and 62 CE occurred during follow-up. Mean RVd was 34±7 mm, RV_EDA 20±11 cm^2, RV_ESA 12±5 cm^2, RV_FAC 37±13%, RV_EDV 84±25 ml/m^2, RV_ESV 52±22 ml/m^2, and RV_EF 39±10%. Mean 2D_TAPSE was 18±4 mm, while mean 3D_TAPSE was 16±4 mm. By 2DE, only RV_ESA and RV_FAC, but not RV_EDA or RVd, correlated with CD, HFH, and CE. 2D_TAPSE correlated with HFH, but not with CD or CE, while 3D_TAPSE correlated with all primary and secondary outcomes. By 3DE, RV_ESV, but not RV_EDV, correlated with CD, HFH, and CE. Moreover, 3D RV_EF had better correlations with primary and secondary outcomes than 2D RV_FAC (z=3.8, z=2.5, and z=2.5, all p<0.01). By multivariate linear regression analysis including RV_ESA, RV_FAC, RV_ESV, RV_EF, and 3D_TAPSE, only RV_EF was an independent predictor for CD and HFH (r^2=0.68 and r^2=0.30, both p<0.001).

Conclusion: In patients with ischemic and non-ischemic HFrEF, 3DE parameters of RV size and dysfunction are better predictors for death and re-hospitalization than 2DE parameters. The RV_EF measured by 3DE was the best predictor for death in patients with HFrEF.

2DE vs. 3DE r correlations with outcomes

	RV_ESA	RV_FAC_2D	TAPSE_2D	RV_ESV	RV_EF	TAPSE_3D	RV_FAC_3D
Cardiac death	0.30	0.25	NS	0.40	0.62	0.35	0.55
HF hospitalization	0.29	0.33	0.25	0.35	0.57	0.33	0.45
Cardiac events	0.25	0.25	NS	0.34	0.50	0.35	0.48