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Left atrial volumes by 3-dimensional but not 2-dimensional echocardiography predict cardiac death and events in patients with heart failure with reduced ejection fraction

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Background. Patients with heart failure with reduced ejection fraction (HFrEF) are at high risk for mortality and morbidity. Left atrial volumes (LAVs), measured by 2-dimensional echocardiography (2DE), have been suggested as possible prognostic markers. However, LAVs measured by 2DE are prone to errors due to geometric assumptions and increased variability, whereas 3-dimensional echocardiography (3DE) has been proved to be a more accurate and reproducible method for volume assessment.

Purpose. To assess the comparative prognostic value of LAVs, measured by 2DE and 3DE, in patients with ischemic and non-ischemic HFrEF, on best clinical care.

Methods. 135 consecutive patients (59 ± 15 years, 91 males), diagnosed with HFrEF, in sinus rhythm, were assessed by 2DE and 3DE, including full-volume multi-beat acquisitions of the LA and left ventricle (LV). Maximal and minimal indexed LAVs were measured from the 2DE datasets using biplane area-length formula (2D_LAVmax and 2D_LAVmin); and from the 3DE datasets using a dedicated software package (3D_LAVmax and 3D_LAVmin). Patients were followed for 23 ± 14 months after the index event. Primary outcome was cardiac death (CD); secondary outcomes were: 1) HF hospitalization (HFH); 2) a composite cardiac events (CE) end-point, of cardiac death or hospitalization for heart failure, myocardial infarction, coronary revascularization, arrhythmias, or cardiac resynchronization therapy.

Results. 26 CD, 32 HFH, and 48 CE occurred during follow-up. 2DE and 3DE measurements are in the table. LAVs measured by 2DE did not correlate with outcome. However, 3D_LAVmax and 3D_LAVmin correlated with CD ($r = 0.40$ and $r = 0.38$) and CE ($r = 0.30$ and $r = 0.29$), all $p < 0.05$, but not with HFH. By multivariate linear regression analysis, only 3D_LAVmax and 3D_LAVmin were independent predictors for CD and CE, in patients with HFrEF ($r^2 = 0.30$ and $r^2 = 0.32$; $p < 0.01$).

Conclusion. In patients with HFrEF, LA volumes measured by 3DE, but not by 2DE, were independent predictors for cardiac death and events. However, even LA volumes by 3DE did not have predictive value for future HF rehospitalizations.

Echo features for patients with HFrEF

3D end-diastolic LV volume (ml/m2)	101 ± 32
3D end-systolic LV volume (ml/m2)	71 ± 29
3D LV ejection fraction (%)	30 ± 8
2D_LAVmax (ml/m2)	52 ± 18
2D_LAVmin (ml/m²)	31 ± 15
3D_LAVmax (ml/m2)	43 ± 18
3D_LAVmin (ml/m2)	29 ± 16