Title: The reliability and feasibility of a three-dimensional speckle-tracking echocardiography system, using comparison with cardiac magnetic resonance imaging and to assess the contribution of regional RV function to global function in COPD patients with heart failure preserved LV function

Category: Heart Failure and Cardiomyopathies

Abstract

Background: Chronic obstructive pulmonary disease may alter right and left ventricular function by changing intrathoracic pressure. Pulmonary hyperinflation may increase right atrial pressure, leading to reduced venous return and subsequent reductions in RV pre-load. In COPD patients, hyperinflation has been directly correlated with reduced atrial chamber size, global RV dysfunction, and reduced LV filling. Accurate assessment of global and regional right ventricular (RV) systolic function is challenging.

Purpose: The aims of this study were to confirm the reliability and feasibility of a three-dimensional (3D) speckle-tracking echocardiography (STE) system, using comparison with cardiac magnetic resonance imaging (CMR), and to assess the contribution of regional RV function to global function.

Methods: In a retrospective, cross-sectional study setting, RV volumetric data were studied in 302 patients of COPD with heart failure preserved LV function who were referred for both CMR and 3D echocardiography within 1 month. Three-dimensional STE-derived area strain, longitudinal strain, and circumferential strain were assessed as global, inlet, outflow, apical, and septal segments.

Results: 208 patients (69%) had adequate 3D echocardiographic data. RV measurements derived from 3D STE and CMR were closely related (RV end-diastolic volume, $R2 = 0.88$; RV end-systolic volume, $R2 = 0.81$; RV ejection fraction [RVEF], $R2 = 0.69$; $P < .004$ for all). RVEF and RV end-diastolic volume from 3D STE were slightly but significantly smaller than CMR values (mean differences, −2.8% and −7.8 mL for RVEF and RV end-diastolic volume, respectively). Among conventional echocardiographic parameters for RV function (tricuspid annular plane systolic excursion, fractional area change, S' of the tricuspid annulus, RV free wall two-dimensional longitudinal strain), only fractional area change was significantly related to RVEF ($r = 0.29$, $P = .003$). Among segmental 3D strain variables, inlet area strain ($r = −0.48$, $P < .002$) and outflow circumferential strain ($r = −0.37$, $P < .003$) were independent factors associated with CMR-derived RVEF.

Conclusions: Regional RV wall motion showed that heterogeneous segmental deformations affect global RV function differently; specifically, inlet area strain and outflow circumferential strain. RV volume and RVEF determined by STE were comparable with CMR measurements. Severity of COPD influences RV systolic dysfunction, which is reflected in speckle tracking 3D echocardiographic parameters.