Three-Dimensional Analysis of Septal Curvature from Cardiac Magnetic Resonance Images for the Evaluation of Severity of Pulmonary Hypertension

Francesco Maffessanti, M Agustina Sciancaleopre, Amit R Patel, Mardi Gomberg-Maitland, Enrico G Caiani, Benjamin H Freed, Roberto M Lang and Victor Mor-Avi*

Politecnico di Milano, Milan, Italy, and University of Chicago, IL, United States

Although abnormal motion of the interventricular septum (IVS) caused by elevated right ventricular pressure in patients with pulmonary hypertension (PH) is easy to recognize visually, determination of the severity of PH relies on measurements of pulmonary arterial pressure. We hypothesized that quantitative 3D analysis of regional IVS curvature throughout the cardiac cycle could be used to differentiate patients with different degrees of PH. Cardiac MR images (Philips 1.5T) were obtained in 31 patients (14 normal controls; 17 patients with PH) undergoing right heart catheterization, who were divided into 3 subgroups according to mean pulmonary arterial pressure (mild: 25-34 mmHg, moderate: 35-50 mmHg, severe: $>$50 mmHg). Images were used to reconstruct dynamic 3D LV endocardial surfaces (TomTec 4DLV software), which were analyzed to calculate 3D IVS curvature throughout the cardiac cycle. To compensate for changes in IVS curvature secondary to changes in LV size, curvature was normalized at every phase of the cardiac cycle by mean LV curvature. In normal subjects, IVS curvature was positive, reflecting the convex septal shape and showed little change throughout the cardiac cycle. In contrast, in patients with PH, IVS curvature was lower, reflecting septal flattening, and fluctuated throughout the cardiac cycle, reflecting the abnormal bouncing septal motion. In patients with severe PH, IVS curvature reached negative values, reflecting transient concave septal shape. Dynamic 3D analysis of IVS curvature from cardiac MR images may provide an alternative for noninvasive assessment of severity of PH.