Can Univentricular Heart Be Associated with “Rigid Body Rotation”? A Case from the Three-Dimensional Speckle-Tracking Echocardiographic MAGYAR-Path Study

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Left ventricular (LV) twist results from the movement of two orthogonally oriented muscular bands of a helical myocardial structure with a consequent clockwise rotation of the LV base and counterclockwise rotation of the LV apex.1-3 Three-dimensional (3D) speckle-tracking echocardiography (STE) is useful for the non-invasive evaluation of LV rotational mechanics.2-4 We present the case of an 18-year-old boy with a univentricular heart due to tricuspid atresia after a Fontan procedure, with LV characteristics, who was examined with standard two-dimensional echocardiography and 3DSTE at the Cardiology Center of the University of Szeged, Hungary. He was involved in the MAGYAR-Path Study (Motion Analysis of the heart and Great vessels bY three-dimensionAl speckle-tRacking echocardiography in Pathological cases). Informed consent was obtained from the patient’s family and the study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, as reflected in a priori approval by the institution’s human research committee. Two-dimensional echocardiography confirmed the univentricular heart (Figure 1). Three short-axis views and the apical 4-chamber and 2-chamber views extracted from 3D echocardiographic datasets are shown in Figures 2 & 3. During 3DSTE analysis, severely decreased basal and apical rotations could be detected, which were in the same counterclockwise direction with a near absence of twist—the so-called “rigid body rotation” (RBR) of the LV (Figure 4).

In a recent study, a dramatic decrease in apical rotation could be demonstrated in patients with a single ventricle using STE (velocity vector imaging).5 Van Dalen et al were the first to demonstrate LV-RBR in patients with non-compaction of the LV.6 LV-RBR could be demonstrated in 53.3% of 60 patients with non-compaction cardiomyopathy (NCCM).7 In another smaller study, 9 out of 9 NCCM patients showed LV-RBR.8 Other authors found the sensitivity and specificity of LV-RBR to be 88% and 78%, respectively, for differentiating NCCM from non-specific “hypertrabeculation” of the LV.9 To the best of the authors’ knowledge, this is the first time that RBR has been demonstrated in a univentricular heart. However, further studies with a larger number of patients with a univentricular heart are warranted to confirm our findings.
Univentricular heart and “Rigid Body Rotation”

**Figure 1.** An 18-year-old boy with a univentricular heart is imaged by transthoracic echocardiography.

**Figure 2.** Apical 4-chamber (A) and 2-chamber (B) views at different levels of the left ventricle extracted from the three-dimensional echocardiographic dataset.
Figure 3. Short-axis views at different levels of the left ventricle extracted from the three-dimensional echocardiographic dataset.

Figure 4. A three-dimensional cast of the left ventricle (LV) and calculated volumetric and functional LV parameters. LV basal and apical rotations proved to be in the same direction, with a near absence of LV twist, in the patient with a univentricular heart. EDV – end-diastolic volume; ESV – end-systolic volume; EF – ejection fraction; est. LV mass – estimated left-ventricular mass.

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References