

Mechanical Dyssynchrony and Abnormal Regional Strain Promote Erroneous Estimates of Systolic Function in Pediatric Heart Transplant

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Introduction: Clinical experience suggests that estimates of left ventricular (LV) ejection fraction (EF) using two-dimensional echocardiography (2DE) are often inaccurate relative to three dimensional (3DE) methods in patients with heart transplant (Tx). We hypothesized that LV mechanical dyssynchrony and abnormal regional strain (ϵ) are present in asymptomatic pediatric Tx patients and these entities promote errors in estimates of LV function when 2DE is used.

Methods: Tx subjects and normal volunteer children (NORM) were prospectively enrolled. All had normal estimated right ventricular systolic pressure and function. EF, global and regional ϵ , and systolic dyssynchrony index (SDI) were quantified using real time 3DE (4DLV, Tomtec). SDI (%) was determined from volume-time curves of the 16 LV segments and expressed as the standard deviation of the heart rate corrected time to reach minimal segmental systolic volume. Septal ϵ was defined as the average of 5 segments in the interventricular septum. In addition to 3D, Teichholz, biplane Simpsons and bullet methods were used to measure EF in each subject.

Results: 70 examinations were done, 35 NORM (age 12±10 yr, 9 male, n=35) and 35 Tx (age 10±6 yr, 21 male, n=26). SDI was greater in Tx (5.5±4.0) than NORM (2.3±1.2), p<0.001. ϵ was lower among Tx than NORM (**Table**). EF divergence (absolute difference between 2D and 3D EF estimates) was greater among Tx (4 ±2.4) than NORM (1±0.4), p<0.001. EF divergence had strong positive correlation with SDI (adjusted r²=0.462, p<0.001) and negative correlations with all measures of ϵ (range of adjusted r² 0.127-0.315). SDI had no particular relation to LV mass or to QRS duration.

Group	Global ϵ			Septal ϵ		
	Radial	Circumferential	Longitudinal	Radial	Circumferential	Longitudinal
Tx	35±5*	-23±5*	-19±3*	29±8*	-19±6*	-17±5**
NORM	42±4	-28±4	-22±3	40±6	-27±5	-20±4
Tx vs. NORM *p<0.001 **p=0.007						

Conclusion: Children after Tx have abnormal LV mechanics characterized by greater dyssynchrony and lower ϵ . These features correlate with, and may possibly cause, difference between 2DE and 3DE estimates. EF should be calculated using 3DE in this population and others with dyssynchrony and regional ϵ abnormalities.