

Tissue Doppler imaging in healthy children: normal systolic velocities, timings, and time differences in left ventricle and right ventricle

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Introduction: Tissue Doppler imaging (TDI) has recently emerged as an important diagnostic tool to assess myocardial velocities and timings of peak systolic velocities at the right (RV) and left ventricle (LV) and within the ventricles. However, in children, normal age-related values of peak systolic velocities, time to peak systolic velocities and intra-ventricular time differences within the LV and RV remain largely unknown. Normal age-related values of peak systolic velocities in children could serve as a reference for future studies on global and regional myocardial performance in pediatric patients. Reference values on intra-ventricular time differences could help to refine therapeutic strategies in pediatric patients, including cardiac resynchronisation therapy (CRT).

The objectives of this study were to assess peak systolic velocities, timings of peak systolic velocities and intra-ventricular time differences in the LV and RV of healthy children with TDI and to provide age-related normal values.

Methods: Consecutive healthy children (0-18 years) underwent transthoracic echocardiography. TDI data was acquired at the conventional apical 4-chamber view and at a dedicated apical RV outflow tract (RVOT) view. Peak systolic velocity (S') and time to peak systolic velocity (tS') were assessed at the basal segments of the LV lateral wall (LVlat), inter-ventricular septum (IVS), RV free wall (RVFW) and at the RVOT. Time differences in peak systolic velocities within the RV and LV were calculated. Regression analysis was performed to assess the age-dependency of the observed TDI data.

Results: A total of 123 children were included. The observed TDI values are summarized in Table 1. Within the RV of healthy children, a significant time delay was observed. At all regions, S' significantly increased with age (LVlat: $r=0.75$, $p<0.01$, IVS: $r=0.54$, $p<0.01$, RVFW: $r=0.42$, $p<0.01$, RVOT: $r=0.38$, $p<0.01$). Furthermore, tS' related significantly with age at all regions (LVlat: $r=0.57$, $p<0.01$, IVS: $r=0.41$, $p<0.01$, RVFW: $r=0.58$, $p<0.01$, RVOT: $r=0.70$, $p<0.01$). The observed intra-ventricular time differences did not correlate with age.

Conclusions: In healthy children, there is a significant intra-ventricular time delay within the RV. TDI-derived peak systolic velocities and timings are significantly related to age in healthy children. However, intra-ventricular time differences are not related to age in healthy children.

Table 1. TDI-derived values of peak systolic velocities, timings and time differences

Peak systolic velocity (cm/s)	
<i>Left ventricle</i>	
LVlat	6.3 (5.1 – 7.9)
IVS	6.0 (5.4 – 6.7)
<i>Right ventricle</i>	
RVFW	10.2 (8.9 – 11.3)
RVOT	7.2 (6.0 – 8.2)
Time to peak systolic velocity (ms)	
<i>Left ventricle</i>	
LVlat	101 (91 – 112)
IVS	114 (100 – 128)
<i>Right ventricle</i>	
RVFW	177 (157 – 194)
RVOT	100 (88 – 113)
Time differences (ms)	
<i>Left ventricle</i>	
LVlat - IVS	10 (0 – 20)
<i>Right ventricle</i>	
IVS - RVFW	62 (45 – 75)
RVOT - RVFW	74 (59 – 93)

Values are presented as median and inter-quartile range.

IVS: inter-ventricular septum, LVlat: left ventricular lateral wall

RVFW: right ventricular free wall, RVOT: right ventricular outflow tract