The development of the mammalian heart is not fully completed at the time of birth. However, significant hemodynamic changes occur during the neonatal period. Only a few studies have given insight how the immature heart responds to these challenges. Tissue Doppler Imaging (TDI) has been used to evaluate longitudinal systolic contractility and diastolic relaxation while reducing the effects of loading on these variables. Strain and Strain Rate Imaging have the additional advantage of being more independent of the adjacent myocardial areas. Therefore, we have prospectively investigated a cohort of 16 healthy children during the first month of life with these relatively novel imaging techniques.

16 neonates were investigated at 3 time points during the first month of life:

- T1: 2-3. day of life
- T2: 2. week of life
- T3: 4. week of life

All investigations were performed by one single echocardiographer (HD). Neonates lay quietly in their mother’s arm, breathing room air. Cardiac anomalies were excluded using conventional 2D echocardiography. Echo Machine: Vivid 7 (GE)

All measurements were performed in triplicates. Statistics: Average across triplicates, paired T-Test, \( P < 0.05 \).

**TDI Peak Velocity (Sw, Ew, Aw)**

Peak systolic, early diastolic and atrial diastolic TDI velocities increased significantly in all 3 measured points by an average factor of about 1.55 (Sw), 1.69 (Ew) and 1.5 (Aw) during the first month of life.

**Electromechanical Interval**

Electromechanical Intervals shortened significantly upon subsequent visits in all segments measured (to 89% after 1 week and to 80% after 1 month), including the lateral annulus, no significant dyssynchrony could be detected.

**Peak Systolic Strain (S) / Strain Rate (SR)**

Systolic strain, but not strain rate increased significantly by an average factor of 1.32 (IVS base), 1.32 (IVS mid wall), 1.24 (LV base) and 1.28 (LV mid wall) during the first month of life.

**Measurements of Intra-Ventricular Dyssynchrony**

Comparing QS-intervals of opposing wall segments and the tricuspid and mitral annulus, no significant dyssynchrony could be detected.

During the first month of life, significant changes occur in the longitudinal contractility of the heart and the electromechanical interval:

- Systolic longitudinal contractility increases significantly, arguing for improved contractile function
- Diastolic tissue velocities increase significantly, arguing for improved ventricular compliance
- QS-Intervals shorten significantly in the left ventricle, arguing for more efficient excitation-contraction coupling

**Potential Biological Correlates:**

- **Improved Contractile Function:** Increasing Density of Contractile Elements (Koizumi in “Heart Disease in Infants, Children and Adolescents” 1989)
- **Ventricular Compliance:** Transition from Collagen Type I to Collagen Type III (Koizumi-Barny et al., Early Hum Dev 2001;67:49-59)
- **Excitation-Contraction Coupling:** Maturation of the Ryr-mediated SR Ca²⁺ release, from sarcomemmal Ca²⁺ dependent at birth, to CIKR dependent (Escobar et al., Am J Physiol Heart Circ Physiol 2004;286:H757-8)