Delayed brain maturation correlates with motor impairment at one year of age in children with severe congenital heart disease

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Objective: Neonates with severe congenital heart disease (CHD) are at risk for impaired neurodevelopmental outcome. Focal white matter injuries and small strokes can be detected on cerebral MRI before and after open heart-surgery. In addition, brain maturation may be delayed. It is unclear, how these changes relate to later neurodevelopmental outcome. We aimed on the relationship between brain maturation in the neonatal period and neurodevelopmental outcome at one year of age. Design/Methods: We recruited 30 term-born neonates with severe CHD (d-transposition of the great arteries, single ventricle physiology, interrupted aortic arch). They underwent cerebral MRI before (median age 6 days, 1-12 days) and after (median age 26 days, 13-52 days) open-heart surgery (median age 15 days, range 7-62). At one year of age neurodevelopmental outcome was evaluated with the Bayley Scales of Infant Development III (BSID III). We also recruited 20 healthy term-born neonates. They underwent cerebral MRI at a median age of 23 days (range 13-33) Cerebral MRIs were analyzed using a standardized brain maturation score (TMS) (1).

Results: The median TMS of the preoperative MRI of the patients was 12 (10-14.5), of the postoperative MRI 13.3 (10.5-15.5). Controls had a higher median TMS of 13.4 (11-16), although not statistically significant when controlled for gestational age. The Cognitive Composite Score (CCS) of the BSID III at age one year was 104 (60-125), the Language Composite Score (LCS) 91 (65-132) and the Motor Composite Score (MCS) 90 (46-130). CCS and MCS were significantly lower compared to controls. In patients with severe CHD, the preoperative TMS correlated significantly with the BSID III Motor Composite Score (R=0.6, p=0.003, Spearman Rho bivariate correlation) at one year of age, but not with other developmental domains. In the controls, the preoperative TMS did not correlate with any outcome parameter.

Conclusions: Our results suggest that patients with delayed brain maturation before surgery are at higher risk for later motor impairment. These results offer new insights into possible mechanisms of brain injury and developmental impairments in this population.