

Neurodevelopmental Outcomes after Staged Palliation for Hypoplastic Left Heart Syndrome – Impact of Cerebral Tissue Oxygen Saturation

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Background: Patients undergoing the Norwood procedure are at risk for impaired neurodevelopmental outcome. Perioperative cerebral hypoxia might be causative. We evaluated the impact of cerebral tissue oxygenation on neurodevelopmental outcome.

Methods: Neurocognitive testing was performed in 22 patients with hypoplastic left heart syndrome (HLHS) at a median age of 4.0 (3.1-5.0) years. Verbal IQ, performance IQ and full scale IQ were evaluated with the Hannover-Wechsler-Intelligence scale (HAWIVA-III). The German “Kognitiver Entwicklungstest für das Kindergartenalter” (KET-KID), which is composed of a global scale for cognitive development, a verbal and a nonverbal scale, was applied to assess cognitive functions. Cerebral oxygen saturation (cSO₂) was recorded for 24 hours before and 48 hours after the Norwood procedure. Mean preoperative cSO₂ values and the mean cSO₂ of the first 4 postoperative hours were calculated. The duration of cSO₂ below 40% was determined.

Results: Median verbal IQ was 100 (78-127), performance IQ was 93 (84-112) and median full scale IQ was 96 (81-111). Full scale IQ was below average in 4 cases; additional 5 cases had results in the low normal range. Median percentile ranks of the KET-KID were 38 (0-88) for the global scale, 48 (0-96) for the verbal and 39 (0-77) for the nonverbal scale. Results on the global scale were below average in 5 patients; another 5 had results in the low normal range. Overall, HAWIVA-III or KET-KID results were below average in 6 patients. In 13 patients with results in the low normal range or results below average, preoperative cSO₂ and early postoperative cSO₂ were lower compared to remainder (61 ±4% vs. 65 ±3%, p=0.013 and 42 ±5% vs. 49 ±7%, p=0.015). The duration of cSO₂ below 40% was not different (40 (0-290) vs. 180 (0-400) minutes, p=0.385). Preoperative cSO₂ correlated with the verbal (r=0.46, p=0.033) and full scale IQ (r=0.46, p=0.030) and with the global (r=0.59, p=0.005), verbal (r=0.55, p=0.010) and nonverbal (r=0.45, p=0.039) scale of the KET-KID.

Conclusions: Overall, HAWIVA-III and KET-KID results of HLHS patients after Fontan completion were in the normal range. Lower preoperative and early postoperative cerebral tissue oxygen saturations were associated with worse test results.