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Neurodevelopmental outcome at one year of age after neonatal cardiac surgery for severe congenital heart disease in relation to perioperative cerebral magnetic resonance imaging

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Objectives. To analyse impact of neonatal cardiac surgery for severe congenital heart disease (CHD) on neurodevelopmental outcome at one year of age in relation to perioperative cerebral magnetic resonance imaging (MRI) and spectroscopy (MRS) .
Methods. Cerebral MRI was performed before and after cardiac surgery in 30 neonates with d-transposition of great arteries, hypoplastic left heart syndrome and other severe CHD. Follow up included standardized neurological examinations at neonatal age and the Bayley Scales of Infant Development III at 1 year of age.
Results. Before surgery, in 26 patients (87%) MRI showed signs of generalized hypoxia with hyperintensity of the white matter (WM) on T2, with punctuate WM lesions in 5 (17%). Ten patients (33%) showed subdural and 8 (27%) had choroid plexus hemorrhages. Four patients had small cerebral strokes. After surgery WM hyperintensities (T2) were observed in 24 patients (82%). Two patients developed new WM lesions. New subdural hemorrhages were found in 5, new plexus choroid hemorrhages in 2. No new cerebral strokes were seen after surgery, while all cerebral strokes detected before surgery decreased in size. MRS was abnormal in all patients with elevated lactate in WM and basal ganglia and decreased N-acetyl-aspartate (NAA) values. Before and after surgery the standardized neurological examination (Zurich Neuroscore, range 0-18 points) was similar with mild abnormalities (median score = 2 before/after surgery) with predominantly muscular hypotonia, but no focal neurological deficit. There was one patient with tonic-clonic seizures before surgery (no WM lesion or cerebral stroke). So far, twelve patients had a one-year neurodevelopmental examination. Median cognitive score was 105 (range 60-120), language score was 94 (65-106) points and motor score was 91 (46-103).
Conclusions. Signs of generalized hypoxia in the WM with pathologic MRS values are the predominant findings in more than 80% of infants, while intracranial hemorrhages are observed in half of infants, and punctuate WM lesions and cerebral strokes in less than 20%. Neurological findings in the neonatal period are mostly mild and non-focal and at one year of age, the cognitive and motor outcome is within the normal limits, but with a very wide variability.