

Cerebral Magnetic Resonance Imaging before and after Neonatal Cardiac Surgery for severe Congenital Heart Disease

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Objectives

To determine the influence of neonatal cardiac surgery on brain metabolism in neonates with congenital heart disease (CHD) using cerebral magnetic resonance imaging (MRI) and spectroscopy (MRS).

Methods

Cerebral MRI (3T scanner), including single voxel spectroscopy in white matter (WM) and basal ganglia, was performed before and after neonatal cardiac surgery in fourteen patients with severe cyanotic CHD. Twelve patients were treated for transposition of great arteries (TGA) by arterial switch, 2 for hypoplastic left heart syndrome by Norwood or hybrid transcatheter-surgical palliation.

Results

Preoperative MRI was performed at median age of 6 days (range 1 -12 d) before resp. 26 days (19-31 d) after neonatal cardiac surgery. Rashkind procedure was performed in 9 patients (75%) with TGA immediately after birth. Before surgery, all patients (100%) showed signs of generalized hypoxia with hyperintensity of the white matter (WM) on T2, with punctuate WM lesions in three patients (21%). Six patients (43%) showed hemorrhages either subdurally (n=3) or in choroid plexus (n=3). MRS was pathological in all patients with elevated brain lactate and decreased N-acetyl-aspartate (NAA) values. Only one patient (7%) with TGA had two small cerebral strokes after emergency shunt palliation due to closure of patent arterial duct. After surgery, hyperintensity of the WM decreased in most patients (54%). One patient (7%) had a new punctuate WM lesion. New hemorrhages occurred in 3 patients (21%) either subdurally (n=1) or in choroid plexus (n=2). Postoperative MRS could be analyzed in seven patients. The ratios of choline/creatine (pre 0.58 vs. post 0.46, p=0.018) and myoinositol/creatine (1.74 vs. 1.48, p=0.043) decreased from before to after surgery, whereas no significant difference was in ratio of lactate/creatine (0.28 vs. 0.22, p=0.398). Neurological assessment showed muscular hypotonia (70%), but no focal neurological deficit or seizures.

Conclusions

Signs of generalized hypoxia in the WM are observed in all infants before cardiac surgery for CHD, but the extend of hypoxic brain alterations decreases after surgery. Hemorrhages are frequently observed, while cerebral strokes are rare in our population. None of the observed pathologies was accompanied by severe neurological symptoms. Further clinical follow up after one year is necessary.