Brain volumetry in infants with congenital heart disease: pre- and postoperative assessments using cerebral MRI compared to healthy controls

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Objectives. MRI studies in neonates with congenital heart disease (CHD) have demonstrated delayed brain maturation and mostly focal brain injury. To better define the distribution of cerebral injuries and regional brain growth in neonates with CHD, we compared volumetric measures from pre- and postoperative MRI of patients to healthy neonates.

Methods. Cerebral MRIs of 32 term-born CHD patients, scanned before and after heart surgery (mean age: 6.8 days and 26.8 days, respectively), were manually segmented to measure volumes of total, grey and white matter and of selected brain regions. Results were compared with MRIs of 17 healthy term born neonates (mean age: 23.5 days).

Results. Between pre- and postoperative MRI, patients showed significant brain growth, especially in the cortical grey matter (0.25%/day), cerebellum (0.20%/day), and deep gray matter structures (0.10-0.15%/day, all p< 0.004). Volume increase of the white matter was 0.05-0.06%/day (left/right; p=0.017/0.003); increase of total brain volume was 0.14%/day (p< 0.001). Compared to healthy controls, the size of all brain structures (except ventricles and right amygdala) was significantly reduced postoperatively. Largest differences were found in deep gray matter structures (13.8-16.8%, p=0.05-< 0.001), cortical grey (12.1%, p=0.01) and white matter (11.8%, p< 0.001). Total brain volumes were reduced by 11.3% (p< 0.001).

Conclusions. In neonates with CHD, significant differences of white and deep grey matter volumes were found postoperatively. Brain growth was high, with notable regional differences. Our results contribute to the knowledge on the timing of cerebral injury in neonates with CHD.