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REGIONAL LOW FLOW PERFUSION SUPPORTS BOTH CEREBRAL HEMISPHERES DURING NEONATAL AORTIC ARCH RECONSTRUCTION

Andropoulos DB[1], Stayer SA[1], McKenzie ED[2], Fraser Jr CD[2]
Pediatric Cardiovascular Anesthesiology[1] and Congenital Heart Surgery[2], Texas Children's Hospital/Baylor College of Medicine, Houston, TX

Introduction: Regional low flow cerebral perfusion (RLFP) is used frequently during neonatal aortic arch reconstruction to avoid or limit deep hypothermic circulatory arrest (DHCA) (1). RLFP has been demonstrated to adequately deliver blood flow to the brain (2); however, there are no reports of measurement of blood flow or cerebral oxygenation to both cerebral hemispheres. The purpose of this study was to compare cerebral blood flow and oxygenation between cerebral hemispheres before, during, and after RLFP, with the hypothesis that RLFP supports both cerebral hemispheres adequately.

Materials and Methods: Patients undergoing RLFP for the Norwood operation, or aortic arch advancement were studied. Deep hypothermic bypass with baseline bypass flows of 150-200 ml/kg/min with pH stat blood gas management was utilized. Bypass was initiated via a 3.5 mm Gore-Tex® graft to the base of the right innominate artery for arterial inflow. Phenoxybenzamine, 0.25-1.0 mg/kg, or phentolamine 0.15-1 mg/kg was used. Cerebral cortical oxygen saturation (ScO_2) using near-infrared spectroscopy was measured with bilateral forehead sensors, and cerebral blood flow velocity (CBFV) using transcranial Doppler ultrasound over bilateral temporal windows, or through the anterior fontanel was measured at the bifurcation of the middle and anterior cerebral arteries. RLFP was instituted with brachiocephalic vessels snared and flow through the right innominate artery only during aortic arch reconstruction. Bypass flow during RLFP was adjusted using right-sided TCD to maintain CBFV within 10% of pre-RLFP values. ScO_2 and CBFV were measured at 18º C before RLFP on full flow bypass, during RLFP, and after RLFP on full flow bypass. T test was used to compare paired values for ScO_2 and CBFV during these time periods.

Results: Sixteen patients were studied, mean age 9 ± 13 days and weight 3.2 ± 0.6 kg. Eight patients underwent the Norwood operation for hypoplastic left heart syndrome, and 8 underwent aortic arch advancement with other intracardiac procedures for severely hypoplastic or interrupted aortic arch. Bypass time was 173 ± 67 minutes, aortic crossclamp time 87 ± 49 minutes, DHCA time 9 ± 8 minutes, and RLFP time 51 ± 23 minutes. Mean RLFP flow was 62 ± 15 ml/kg/min. ScO_2 and CBFV values are shown in the Table. Paired values for CBFV were the same before, during and after RLFP. ScO_2 values were slightly lower on the left side during RLFP. Four of 17 patients experienced a difference of e• 10% in ScO_2 during RLFP, always with the left side lower than the right; the largest single discrepancy was one patient with 92% on the right and 68% on the left, which was the only patient with ScO_2 <70%. Seven of 17 patients experienced a difference of e• 25% in CBFV during RLFP, R > L in 5, L > R in 2. There were no in hospital deaths within 30 days of operation, and no new neurologic deficits after surgery in this group of patients.

Discussion: This study demonstrates that RLFP, when guided by TCD, results in adequate blood flow and oxygenation to both cerebral hemispheres. The mean 6% difference in ScO_2 between right and left hemispheres during RLFP is not clinically significant. Discrepancies between hemispheres in individual patients suggest that bilateral monitoring, especially of ScO_2, may be useful. Thus, although the Circle of Willis is expected to be intact without stenoses in newborn patients, RLFP performed as in this study may result in preferential flow to the right cerebral hemisphere in some patients.

References

1) J Thorac Cardiovasc Surg 2000;119:331-9.
2) Anesth Analg 2002;93:SCA55.

Table. ScO_2 and CBFV Values

	Pre RLFP R	Pre RLFP L	During RLFP R	During RLFP L	After RLFP R	After RLFP L
SCO_2 %	92 ± 5	89 ± 8	92 ± 4	85 ± 9*	90 ± 6	87 ± 10
CBFV, cm/sec	21 ± 9	19 ± 7	22 ± 8	20 ± 9	18 ± 8	16 ± 5

**p=.015 by T test, R vs. L side. ScO_2 = cerebral cortical oxygen saturation as measured by near-infrared spectroscopy; CBFV = cerebral blood flow velocity as measured by transcranial Doppler ultrasound*