

A Report on Cerebral Blood Flow and Metabolism in New Born

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BRIEF REPORT

Ensuring adequate oxygenation of the developing brain is the cornerstone of neonatal critical care. Despite decades of clinical research dedicated to this issue of paramount importance, our knowledge and understanding regarding the physiology and pathophysiology of neonatal cerebral blood flow are still rudimentary. This review primarily focuses on currently available human clinical and experimental data on cerebral blood flow and auto regulation in the preterm and term infant. Limitations of systemic blood pressure values as surrogates for monitoring adequate cerebral oxygen delivery are discussed. Particular emphasis is placed on the high interindividual variability in cerebral blood flow values, vasoreactivity, and auto regulatory thresholds making the applications of normative values highly questionable. Technical and ethical difficulties to conduct such trials leave us with a near complete lack of knowledge on how pharmacological and surgical interventions impact on cerebral auto regulation. The ensemble of these works argues for the necessity of highly individualized care by taking advantage of continuous bedside monitoring of cerebral circulation. They also point to the urgent need for further studies addressing the exciting but difficult issue of cerebral blood flow auto regulation in the neonate.

Cerebral blood flow, plasma epinephrine, and plasma norepinephrine were measured in 25 spontaneously breathing; preterm neonates (mean gestational age 30.4 weeks) 2 hours after birth, during a routine screening for low blood glucose levels. Increased cerebral blood flow and plasma epinephrine values were observed when blood glucose levels were low, whereas plasma norepinephrine was constant throughout the blood glucose range. Hypoglycemia was found in 13 neonates who were treated with intravenous glucose and milk enterally. Blood glucose levels were normal in the remaining 12 control neonates who received milk by a gastric line. Approximately 30 minutes after treatment with intravenous glucose and/or milk. Mean arterial blood pressure and blood gas values were identical between groups throughout the investigation. It is suggested that a normal coupling between cerebral metabolic demands and flow is present in very preterm neonates and that epinephrine may play a role in the cerebral hyperperfusion. Although none of the neonates had clinical signs of hypoglycaemia.

Cerebral blood flow (CBF) volume can be measured quantitatively

by colour duplex sonography. To test the reliability of CBF volume measurements in newborns, two "blinded" examiners performed a prospective test-retest study in 32 neonates (postmenstrual age 32 to 42 weeks). Measurements were done in the internal carotid and vertebral arteries. Intravascular flow volumes (FV) were calculated as the product of angle-corrected time-averaged flow velocity and the cross-sectional area of the vessel. The CBF volumes measured by the two examiners were very close. The 95 percent limits of agreement, according to Bland and Altman, ranged from -7.3 to +8.4 mL/min. In comparison with other test-retest studies, the reproducibility of quantitative CBF measurements reported here is among the best ever found. We conclude that CBF volume can be measured reliably even in preterm neonates.

In normal newborn term and preterm infants CBF is relatively low corresponding to a low metabolic rate for oxygen, whereas cross-brain oxygen extraction is similar to that in adults. This provides for a considerable reserve capacity to deal with decreased CBF or decreased oxygen content in arterial blood. CBF reactivity to CO₂ is normal, and the evidence is that pressure-flow auto regulation is present, even in very preterm infants. Absence of auto regulation and CBF-CO₂ reactivity has been documented in severely asphyxiated infants, and in preterm infants who went on to develop severe intracranial hemorrhage. A number of methods are available to study CBF and brain metabolism in newborn infants. Several of them involve ionizing radiation, which has limited their use, even though it is unlikely that the associated risks are particularly high. Magnetic resonance spectroscopy has demonstrated a delayed disturbance of energy metabolism following severe asphyxia. Doppler ultrasound has rarely been helpful to obtain quantitative data. Near infrared spectroscopy has now been in use for more than 10 years. It has been slow to fulfil its promise as a continuous monitor of cerebral circulation and of oxygen sufficiency of neurons.

The interobserver reliability for absolute cerebral-blood-flow-velocity measurements by colour and duplex Doppler sonography was tested in 32 neonates with a mean birth weight of 1489 (SD 644) g, and a gestational age of 29.9 (SD 3.5) weeks. Using standardized technique, two observers recorded on videotape, the Doppler spectrum of the anterior cerebral artery, the intracranial internal carotid artery and the middle cerebral artery. Peak systolic flow, end diastolic flow, mean flow velocity, resistive index and pulsatility index were computed from 3 consecutive waveforms

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by each observer. The estimates of interobserver reliability using the intraclass correlation coefficient of the examiners varied from

0.95 to 1.00. Therefore, cerebral blood flow velocity can be reliably measured in premature infants.