Title : REGIONAL CEREBRAL BLOOD FLOW DURING NEONATAL ASPHYXIA

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Introduction. Neonatal asphyxia is commonly encountered in early postnatal life and associated with a high risk of brain injury and major irreversible neurological problems in surviving children. These include cerebral palsy, mental retardation, and epilepsy. While in adults permanent brain damage or death may result even after brief periods of asphyxia, in newborns, considerably longer periods may be tolerated. Despite the magnitude of the clinical problem, there is relatively little information on how asphyxia affects the cerebral circulation of newborns.

In the present study, we have determined the effects of severe, acute asphyxia on regional cerebral blood flow (rCBF) in the newborn dog, an animal employed recently by us (1) and others (2) as a model for the study of neonatal cerebral vascular physiology.

Methods. Newborn dogs (1-7 days of age), paralyzed and ventilated with 70% N_2O and 30% O_2, were used. An autoradiographic technique using ^{14}C-iodoantipyrine (3) was used to measure rCBF in one group of normoxic, normocarbic newborn dogs, and in another group that was asphyxiated. Asphyxia was produced by turning the respirator off and clamping the hoses to the endotracheal tube.

Results. Conditions of normoxia, normocarbia and normotension prevailed in the control group, as shown in Table 1. Asphyxia, however, produced marked changes in cardiovascular and respiratory parameters. After 5 minutes of asphyxia, arterial P_{O_2} was lowered significantly by 96% from control levels. In addition, arterial P_{CO_2} increased by 59 Torr above controls. Mean arterial blood pressure (MABP) fell by 29 Torr from the control levels in the asphyxiated group, although the initial cardiovascular response was one of marked tachycardia and a moderate increase in MABP.

Table 1.

	MABP (Torr)	pH_a	P_{CO_2} (Torr)	P_{O_2} (Torr)
Normoxia	64 ± 4	7.30 ± 0.03	40 ± 3	87 ± 14
Asphyxia	35 ± 12	6.95 ± 0.04	99 ± 8	3 ± 2

Measurements of rCBF were conducted in 14 regions of the brain, and are shown in Table 2. Our results indicate that asphyxia causes significant changes in rCBF, including ischemia of forebrain gray and white matter, and hyperemia in brainstem and spinal cord. Mean cerebral cortex values decreased by 56% to 75%. Similarly, blood flow to other noncortical structures of the forebrain also decreased, notably in subcortical white matter, where an 83% drop was noted. The most striking increases in rCBF during asphyxia were those of medulla and proximal spinal cord; blood flow in these structures rose by 80% and 83%, respectively.

Discussion. Based on our present results, we speculate that the decreases in rCBF that asphyxia produces in forebrain gray and white matter underlie the residual neurological damage caused by this condition in newborns. Furthermore, the increased perfusion of brainstem and spinal cord which we have observed may be at least partially responsible for the tolerance of the newborn to asphyxia. The observed changes in rCBF may help preserve the vital cardiovascular centers of the medulla in the newborn during asphyxia.

Table 2

MEAN rCBF VALUES (± S.D.) IN VARIOUS BRAIN REGIONS

Region	rCBF NORMOXIA (ml/min/100gm)	rCBF ASPHYXIA (ml/min/100gm)
Frontal Cortex	18 ± 3	8 ± 2**
Parietal Cortex	20 ± 4	5 ± 2**
Temporal Cortex	18 ± 4	7 ± 2**
Occipital Cortex	19 ± 4	6 ± 2**
Subcortical white	6 ± 2	1 ± 1**
Hippocampus	18 ± 4	12 ± 2**
Thalamus	17 ± 5	10 ± 5**
Hypothalamus	17 ± 3	14 ± 2**
Cerebellar Vermis	15 ± 4	16 ± 5
Pons	21 ± 10	28 ± 7*
Medulla	25 ± 6	45 ± 9**
Spinal Cord	23 ± 5	43 ± 8**

*p <0.05
**p <0.01

References.

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