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OXYHEMOGLOBIN AFFINITY MODULATES CEREBRAL BLOOD FLOW (CBF) IN PREMATURE BABIES. A.Lipp, A.Müller, P.Tuchschmid, G.Duc. Div.of Neonat., Univ.Children's Hospital, Zürich, Switzerland.

Low CBF is thought to cause periventricular leukomalacia in premature babies, but a normal outcome has also been observed. Low CBF found after exchange transfusion in lambs was explained by the lower oxygen affinity of adult as compared to fetal hemoglobin (HbF). We studied the influence of relative HbF concentration [HbF] and thus the oxygen affinity on CBF in 41 small premature infants: GA 29.1 ±2.0 wks, BW 1064 ±153 g (mean ±1SD). In cerebral ultrasonography 12 were found normal, 14 had subependymal or intraventricular hemorrhage (SEH/IVH), and 15 had intraparenchymal anomalies (IPE). CBF was measured with the i.v. Xe-133 method at day 1,3 and 7, and [HbF] was obtained chromatographically. In normal babies a positive correlation between [HbF] and CBF was found: day 1 r= 0.62*, day 3 r=0.64*, day 7 r=0.63* (*=p<0.05). In those with SEH/IVH this correlation was significant only on day 3, in those with IPE only on day 7. Multiple regression analysis including all babies exept IPE showed a significant influence of [HbF] on CBF, independent of BP, pCO2 and Hct. We conclude that normal babies and to a lesser extent those with SEH/IVH or IPE can adapt their CBF to the actual oxygen affinity of blood.

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A NEW DEVICE FOR CONTINUOUS DOPPLER-FLOW MONITORING OF CEREBRAL VESSELS IN VERY LOW BIRTH WEIGHT INFANTS

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Continuous monitoring of cerebral blood flow velocities was confined to the Transcranial Doppler Technique, which has its disadvantages: 1) high level of energy output; 2) large size of Doppler probe; 3) big sample volume; 4) lack of duplex scan. We have developed a Transfontanellar Doppler Transducer specified for continuous measurements in very low birth weight infants: 1) miniature pulsed Doppler 5-MHz transducer (13 mm * 9 mm * 25 mm) with a highly flexible cable; 2) variable small sample volume which position is documented by duplex scan; 3) sterilizable silicone/rubber fixation which can easily be attached to the infants' head of any size without extra plaster; 4) energy levels reduced to one tenth of the transcranial method; 5) computer program for intermittent long term measurements, so reducing the exposure time of the patient. So far, this device has been used for 100 hours to monitor very low birth weight infants.

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EFFECT OF SLEEP STATE ON CEREBRAL HAEMOGLOBIN (Hb) VOLUME IN TERM NEWBORN INFANTS ASSESSED BY NEAR INFRARED SPECTROSCOPY (NIRS)

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NIRS can be used for monitoring cerebral haemodynamics and oxygenation in newborn infants. The AIM of this study was to assess the difference in cerebral Hb volume (Hb-tot = Hb-ox + Hb-red) between quiet and active sleep and to observe Hb during sleep state transitions. METHOD: NIRS (Wyatt, Lancet 1986;2:1063) was performed on 20 healthy term infants (birthweight: 2570 to 4150g, age: 2 to 8 days). TcpCO2, tcpO2, SO2 and heart rate were recorded and sleep states assessed according to Prechtl (Brain Res 76, p 185, 1974).
RESULTS (values are median (range) umol/l): After transition from quiet to active sleep Hb-ox decreased: -3.0 (+5 -10) p>0.001 and Hb-tot: -4 (+5 -10) p<0.002. From active to quiet sleep Hb-ox increased: 3.5 (0 +13) p<0.001 and Hb-tot 3.3 (0 +16) p<0.001. Heart rate increased by 9 bpm (p<0.001) from quiet to active sleep while Hb-red, tcpO2, tcCO2 and SO2 did not change significantly.
CONCLUSION: These findings demonstrate that sleep state changes correlate with changes in cerebral Hb volume (around 5 %) and therefore must be taken into account during studies of cerebral haemodynamics.

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RENAL, INTESTINAL, CEREBRAL AND OPHTHALMIC BLOOD FLOW VELOCITIES (BFV) DURING PATENT DUCTUS ARTERIOSUS (PDA).

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To evaluate hemodynamic effects of PDA, left ventricular output (LVO) and BFV in the renal, mesenteric, ophthalmic and median cerebral arteries were serially measured (duplex pulsed Doppler) in 11 preterm normoventilated infants (GA 26-31 wks) during PDA and after ligation. While LVO increased, mean (m) diastolic (d) BFV's decreased gradually, whereas m-systolic BFV's did not change significantly. LVO and BFV's normalized after ligation. The decrease of renal and mesenteric mdBFV was earlier and larger than of cerebral mdBFV, and preceded clinical signs of PDA. Similar changes of organ blood flow have been observed in lambs (Clyman et al, J Ped 111:579,1987). Conclusion: Evaluation of regional BFV's yields additional information on the hemodynamic significance of a PDA in preterm infants.

BFV (cm/s):		Symptom. PDA		after Ligat.
Cerebral	m-diast.	4 (0 - 5)	*	9 (4 - 20)
	m- syst.	21 (14 - 43)	ns	27 (13 - 37)
Opthalm.	m-diast.	-1 (-11- 2)	*	3 (0 - 11)
	m- syst.	16 (7 - 22)	ns	13 (11 - 30)
Renal	m-diast.	-8 (-31- 4)	*	10 (1 - 18)
	m- syst.	41 (22 - 56)	ns	32 (12 - 54)
Mesenter.	m-diast.	-4 (-6 - 0)	*	8 (6 - 18)
	m- syst.	32 (15 - 32)	ns	22 (19 - 34)
LVO	(ml/min.kg)	405 (376-495)	*	254 (230-285)

median and range; negative data are reverse BFV's; n=11; * p<0.01.

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REGIONAL CEREBRAL BLOOD FLOW IN THE FETUS AND NEWBORN UNDER PHYSIOLOGICAL AND ASPHYXIAL CONDITIONS.

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Developmental changes in regional cerebral blood flow (RCBF) were determined using radioactively labelled microspheres to measure flow to the cortex (Cx), brainstem (Bs), cerebellum (Cbl), white matter (WM), caudate nucleus (CN) and choroid plexus (CP) in 3 groups of chronically catheterised lambs under physiological and asphyxial conditions: 90-100 day preterm fetal lambs, 125-136 day near-term fetal lambs and newborn lambs 5-44 days old. In all 3 groups the high flow areas are the CP and CN while the lowest flow area is the WM. There is a different heirarchy of RCBF in utero (Bs and Cbl > Cx) compared to extrauterine life in the newborn lamb (Cx and Cbl > Bs). Analysis of regional cerebral oxygen delivery demonstrated a progressively increasing oxygen transport to the Cx with increasing gestational maturity, and after birth. Oxygen transport to the Bs, Cbl and WM increased with gestational age, but did not increase after birth. RCBF measurements revealed significantly different responses to asphyxia in the 3 groups. With asphyxia, there were significant decreases in oxygen transport to all cerebral regions with the exception of the Bs in the preterm lamb, in contrast to the maintenance of oxygen delivery to the Bs, Cbl, Cx, CN and WM in the near-term and newborn lambs. The response of CBF to hypotension during asphyxia revealed that the preterm brain was the most vulnerable, while the near-term and newborn brains were able to autoregulate regional CBF except in the CP. These experiments demonstrate that maturity of the animal is an important determinant of the response to asphyxia.

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CEREBRAL ARTERIAL AIR EMBOLISM IN EXPERIMENTAL NEONATAL PNEUMOTHORAX.

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Neonatal pneumothorax is associated with serious neurological disturbances and sequelae. Sudden deterioration of the patients' condition is also common. We observe the pial--arachnoideal microcirculation intravitally (open cranial window, WILD Photomacroscope, M 400) on anaesthetized, immobilized and artificially ventilated (IPPB; FiO_2 = 0.21, I/E = 1:1, rate = = 40/min, PIP max = 14 cmw, PEEP = 0) newborn piglets during the course of induced pneumothorax (see Ref. below). Up to now we have studied 45 animals and in 5 cases we have found artificial cerebral arterial air microembolism with fatal outcome within minutes. The affected vessels (diameter = 50-180 um) showed significant vasoconstriction with rapid cessation of the blood flow. Our in vivo observations suggest that air embolism may occur more frequently than has been reported during neonatal air leaks, affecting cerebral microcirculation, too.

Ref.: P.Temesvári and J.Kovács, Selective opening of the blood-brain barrier in newborn piglets with experimental pneumothorax. Neurosci. Letters 93: 38, 1988.