

125 REDISTRIBUTION OF CARDIAC OUTPUT COMPROMISES SPLANCHNIC BLOOD FLOW DURING AND FOLLOWING PROLONGED HYPERCARBIA IN THE NEWBORN PIGLET.

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Episodes of prolonged hypercarbia frequently occur during treatment of respiratory distress in preterm infants and may induce redistribution of cardiac output similar to the redistribution seen during hypoxia. This hypothesis was tested by exposing 7 newborn piglets to four hours of hypercarbia (8,5 - 10 Kpa) followed by return to normocarbia. Cardiac output and organ blood flow (micropheres) were measured during baseline, 1/2, 2 and 4 hours of hypercarbia and 15 and 45 min. following return to normocarbia.

Prolonged hypercarbia resulted in redistribution of cardiac output with increments distributed to the brain and diafragma and reductions to the liver (hepatic artery), small intestine and kidneys. The reduction in cardiac output distribution to the splanchnic circulation persisted following return to normocarbia. Thus: episodes of prolonged PaCO₂ elevation in the neonate may compromise splanchnic blood flow.

126 ESTIMATED TOTAL LIMB BLOOD FLOW IN VERY PREMATURE NEWBORN INFANTS. Geerdink JJ, Asselt WA van, Simbruner G, Okken A. Div. Neonatology, Dept. Paediatrics, State University Groningen, The Netherlands.

Heat production in the neonate occurs predominantly in the head and the trunk. A part of the heat produced in the head and the trunk is transferred by the bloodstream to the limbs. We measured total heat production and heat loss using indirect calorimetry. Limb heat flow was calculated from total heat production and limb heat loss. Total limb blood flow (TLBF) was derived from limb heat flow, temperature difference between core and limb skin, and specific heat of blood. Birthweight and gestational age of the infants studied so far were 1.290±0.206 kg (mean±SD) and 28.3±1.0 wks respectively (n=5). Measurements were performed at low and high water vapour pressure P(H₂O) in the incubator. Results:

Age (d)	T _{incub} (°C)	P _{H₂O} (mmHg)	TLBF (ml/min/m ²)
2- 5	35.0 ± 0.3	15 ± 2	230 ± 124
	35.0 ± 0.2	31 ± 1	450 ± 251
9-11	34.4 ± 0.3	19 ± 4	276 ± 139
	34.2 ± 0.3	28 ± 3	421 ± 256
16-17	33.6 ± 0.6	20 ± 1	491 ± 265
	33.6 ± 0.5	27 ± 1	417 ± 92

It is concluded that limb blood flow increases with age and that thermoregulatory responses in very premature newborn infants include alterations in limb blood flow.

127 CHRONIC HYPOXEMIA IN THE 5-WEEK-OLD LAMB. M Dalinghaus, JRG Kuipers, JH Koers, AM Gerding, G Kwant, B Oeseburg, WG Zijlstra. Depts of Pediatric Cardiology and Fysiology, University of Groningen, Groningen, The Netherlands.

The mechanisms involved in the adaptation to chronic hypoxemia, so as to maintain normal systemic oxygen delivery (SOD), are not quite clear. Therefore we studied these mechanisms by inducing chronic hypoxemia in 6 newborn lambs. We placed an inflatable balloon around the pulmonary artery after atrial septostomy, and inserted catheters. On days 3-4 after surgery the balloon was gradually inflated. In another 6 lambs only catheters were placed. At 5 weeks of age the lambs were studied. The hypoxemic lambs had a lower aortic and mixed venous oxygen saturation (60±10 (SD) vs 93±2, and 34±7 vs 58±2%, resp., p<0.001), and higher hemoglobin concentration (132±15 vs 101±10 g.l⁻¹, p<0.002). Their P50 as well as their systemic blood flow were not significantly different. The heart rate of the hypoxemic lambs, however, was higher (205±22 vs 153±42, p<0.05). Although SOD in the hypoxemic lambs was lower than in the control lambs, this difference was not statistically significant (17.0±3.4 vs 21.2±5.9 ml.min⁻¹.kg⁻¹). The mean weight gain of the hypoxemic lambs was lower (90±39 vs 153±34 g.day⁻¹, p<0.02), while their oxygen consumption was the same as in the control lambs (7.0±2.2 vs 7.2±1.5 ml.min⁻¹.kg⁻¹).

These data show that to adapt to chronic hypoxemia the lamb increases its hemoglobin concentration to improve arterial oxygen content, and its heart rate to maintain cardiac output. We speculate that the costs of chronic hypoxemia, such as increased cardiac work, are probably effected at the expense of growth.

128 ELECTRICAL RESISTIVITY OF CARDIAC MUSCLE RELATED TO PERFUSION P Steendijk, AD van Dijk, J Karsdon, M Marcus, J Baan Clin Physiol Lab, Dept Pediatrics, Leiden University Hospital

Electrical resistivity of the myocardium is anisotropic and dependent on muscle fiber direction. An effect as yet not studied, is the influence of blood in the capillary vessels on the electrical properties of the myocardial wall. We developed an electrode system consisting of 2 perpendicular arrays of 4 electrodes with an inter-electrode distance of 1 mm, incorporated in a small flexible suction cup. The sensor is affixed to the epicardium using vacuum, resulting in very little tissue damage. Using a 4-electrode method (excitation current: 10 µA, 15 kHz), resistivity is measured in two perpendicular directions. With the present sensor resistivity measurements are limited to an epicardial layer of 2-3 mm. In 5 anesthetized dogs we positioned the sensor in the perfusion region of the left anterior descending coronary artery (LAD) and studied wall resistivity while monitoring coronary flow with a probe on the LAD. Global changes in coronary perfusion were induced by occluding the descending aorta, local changes by transiently occluding the LAD. Under normal flow conditions, resistivity ranged from 2.4-3.3 ohm m in the fiber direction (ρ_l) and from 3.6-4.6 ohm m perpendicular to it (ρ_t). When increasing global flow by aortic occlusion, ρ_t decreased and ρ_l tended to increase. Decreasing local flow by LAD occlusion gave a increase in ρ_t (12%) and tended to increase ρ_l . After removal of either occlusion ρ_t and ρ_l returned to control. As these effects appear to reflect changes in regional myocardial blood flow, this technique is concluded to be promising.

129 CARDIAC OUTPUT CHANGES SECONDARY TO THEOPHYLLINE THERAPY IN PRETERM INFANTS. Walther F.J., Sims M.E., Siassi B., Wu P.Y.K. Neonatology Div., Depts. of Pediatrics, Univ. of Limburg, Maastricht, The Netherlands, and Univ. of Southern California School of Medicine, LAC-USC Medical Center, Los Angeles, USA.

The action of theophylline on the neonatal heart was studied in 11 clinically stable preterm infants. Mean (+SE) birth weight was 1230±390 g and the gestational age 30.7±2.8 wks. Median postnatal age was 12 days. Indications for theophylline therapy were BPD in 3, extubation in 7, and apnea in 1 neonate. Theophylline was given as IV aminophylline using a loading dose of 6.8 mg/kg and a maintenance dose of 2 mg/kg q 8 h. Cardiac output, stroke volume; and heart rate were measured using a combination of pulsed Doppler ultrasound and M-mode echocardiography before the start, on days 1, 2, 3 and 7, and after discontinuation of the drug. Arterial blood pressure was obtained by Dinamap.

An increase in cardiac output (p<0.01) was found on days 1, 2, 3, and 7. Stroke volume was significantly higher (p<0.02) on days 1, 2, 3, but comparable to pretreatment values by day 7. Heart rate was augmented significantly (p<0.01) throughout the treatment period. Mean arterial blood pressure did not change. All but one of the neonates had theophylline levels between 6 and 13 mg/l.

We conclude that during the first days of theophylline therapy both inotropic and chronotropic effects prevail. At 7 days the inotropic effect has disappeared, whereas the chronotropic effect persists. The metabolic cost of the increased cardiac output during theophylline therapy in the preterm infant deserves further attention.

130 CARDIOVASCULAR CHANGES IN PRETERM INFANTS NURSED UNDER RADIANT WARMERS. Walther F.J., Wu P.Y.K., Siassi B. Neonatology Div., Depts. of Pediatrics, Univ. of Limburg, Maastricht, The Netherlands, and Univ. of Southern California School of Medicine, LAC-USC Medical Center, Los Angeles, USA.

Radiant warmers compare favourably with incubators for the easy access they provide to critically-ill infants without disturbing the thermal environment. The major disadvantage of radiant warmers are increased insensible water loss and increased oxygen consumption. Its cardiovascular effects are largely unknown. We measured cardiac output, stroke volume, heart rate, lower limb and skin blood flow in twenty preterm newborn infants nursed in an incubator and under a radiant warmer at an abdominal skin temperature of 36.5°C. Mean (+SE) birth weight was 1.57±0.06 kg, gestational age 31.7±0.4 wk, weight at exam 1.69±0.02 kg, and median postnatal age 15 days. Cardiac output and stroke volume were estimated using a combination of pulsed Doppler and M-mode echocardiography. Limb blood flow was measured in the right calf by strain gauge plethysmography and blood flow through the cutaneous microcirculation in the left calf by photoplethysmography.

Skin and limb blood flow increased by 44-55% with radiant heat (p<0.001 and <0.01). Cardiac output increased by 5.4% (p<0.02) under the radiant warmer secondary to a small but significant (p<0.05) rise in heart rate.

We conclude that in preterm infants, radiant heat leads to an increase in skin and limb blood flow and a small rise in cardiac output and heart rate. The changes in cardiac output are comparable to the reported changes in oxygen consumption in that situation.