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Improved Carotid and Mesenteric Blood Flows with the Use of 21% Oxygen During Resuscitation of Newborn Piglets with Severe Asphyxia

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BACKGROUND: Hypoxic-ischemic injury to the vital organs is a common complication of perinatal asphyxia. Despite the similar effectiveness with 21% oxygen, it is standard to resuscitate the asphyxiated newborn with 100% oxygen, thereby creating a hypoxia-reoxygenation process that may affect the vasomotor regulation. The regional blood flow during graded reoxygenation after asphyxia is not certain.

OBJECTIVE: To determine the effects of hypoxemia and reoxygenation with 21, 50, or 100% oxygen on carotid, intestinal, and renal blood flows in newborn piglets.

DESIGN/METHODS: Thirty-two piglets (1-3 days, 1.5-2.1 kg) were acutely instrumented. Transonic flow probes were placed for continuous monitoring of blood flows at the left carotid, superior mesenteric (SMA) and left renal arteries. Hypoxia was induced by decreasing the inspired oxygen concentration to 10-15% for 2 hr. Randomized piglets were then reoxygenated for 1 hr with 21, 50, or 100% oxygen (n=8 each), followed by 3 hr at 21% oxygen. Control piglets (n=8) underwent the same experimentation without hypoxia-reoxygenation.

RESULTS: After 2 hr of severe hypoxemia (PaO2 32-34 mmHg) piglets were acidotic (pH 7.06 0.02) and hypotensive (mean arterial pressure 28 2 mmHg) (vs. controls, $p<0.001$, ANOVA). Following a transient elevation (37-40 vs. 28 mL/min/kg of controls at 1 hr of hypoxia), the carotid arterial flow became similar to controls after 2 hr of hypoxia, whereas both SMA and left renal arterial flows decreased to 13-14 and 4 mL/min/kg (vs. 40 and 14 mL/min/kg of controls, respectively, $p<0.001$). During the first 15 min of reoxygenation carotid and SMA flows increased significantly in the 21% group, while SMA flow in the 50% and 100% groups were elevated only at 5 min of reoxygenation (vs. baseline values, $p<0.05$). The recovery of left renal arterial flow was gradual and comparable in all experimental groups. All regional blood flows were similar to control values by 1 hr after reoxygenation.

CONCLUSIONS: Resuscitation with 21% oxygen caused higher carotid and mesenteric blood flows but similar recovery of renal blood flow during the early phase of reoxygenation, compared to 50 or 100% oxygen. The effect of different oxygen concentrations on the restoration of regional blood flow may be important in determining the optimal oxygen concentration for neonatal resuscitation.