Effect of carbon dioxide levels post extensive neonatal resuscitation on cerebral and myocardial hemodynamics and oxygenation

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Background

- In the post-resuscitation phase following asphyxia, fluctuations in carbon dioxide could influence cerebral and myocardial perfusion and oxygenation
- In infants ≥36weeks GA (n=204) undergoing whole body hypothermia for HIE, cumulative exposure to hypocarbia was associated with increased death/disability at 18-22 months of age

Objectives

To study the **effect of fluctuations of arterial carbon dioxide** (PaCO2)level following extensive resuscitation of bradycardic term lambs on **hemodynamics and oxygenation** based on the following definitions:

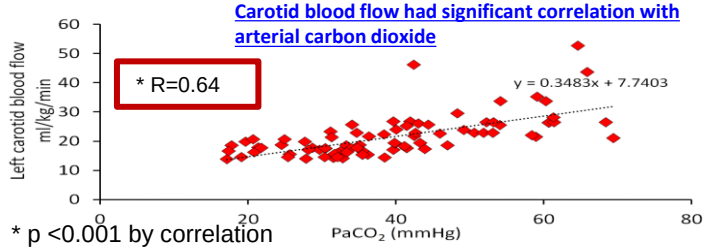
- Hypocapnia < 35 mmHg
- Normocapnia 35 – 50 mmHg
- Hypercapnia > 50 mmHg

Methods

- ✓ Umbilical cord occluded till heart rate <60bpm
- ✓ Resuscitation with ventilation/chest compressions with 100% O_2
- ✓ Epinephrine according to Neonatal Resuscitation Program(NRP)
- ✓ Return of Spontaneous Circulation (ROSC) =HR≥100bpm & DBP>20mmHg
- ✓ O_2 titrated according to NRP targets

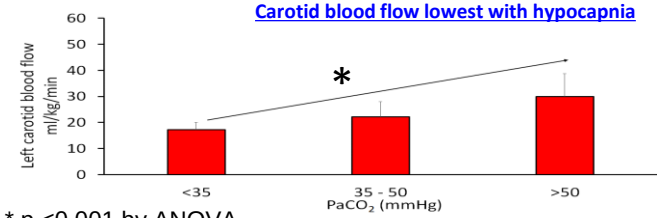
Results

Carotid blood flow had significant correlation with arterial carbon dioxide



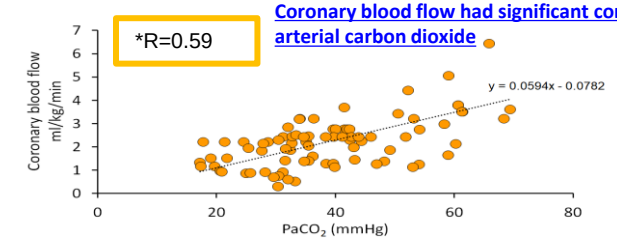
* p <0.001 by correlation

Carotid blood flow lowest with hypocapnia



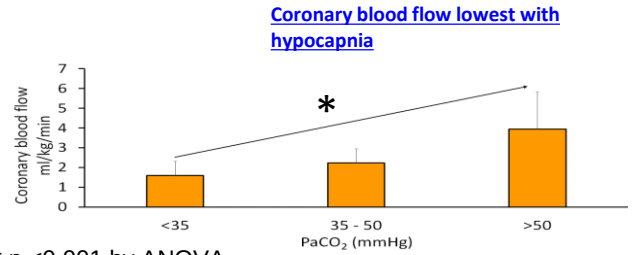
* p <0.001 by ANOVA

Coronary blood flow had significant correlation with arterial carbon dioxide



* p <0.001 by correlation

Coronary blood flow lowest with hypocapnia

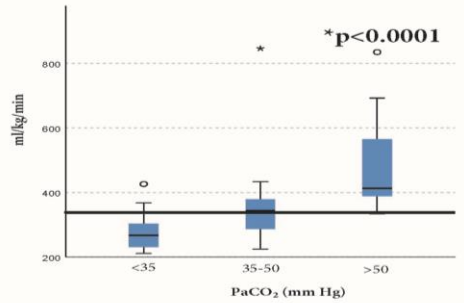


* p <0.001 by ANOVA

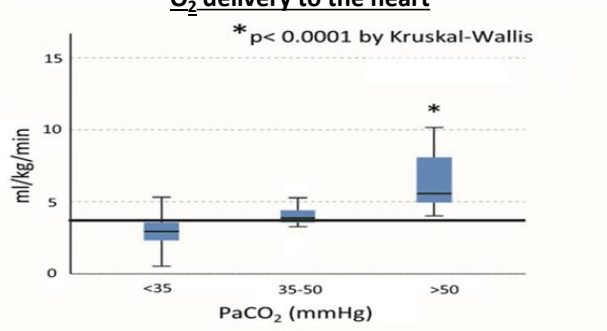
Results continued

O_2 delivery decreased to brain and heart with hypocapnia

O_2 delivery to the brain



O_2 delivery to the heart



Parameters	Hypocapnia ($PaCO_2$ <35 mmHg) 28±5 mmHg	Normocapnia ($PaCO_2$ 35 - 50 mmHg) 42±6 mmHg	Hypercapnia ($PaCO_2$ > 50 mmHg) 61±5 mmHg
Oxygen (%)	30±14	29±9	33±11
Diastolic BP (mmHg)	35±10	37±9	35±9
Mean BP (mmHg)	40±10	42±11	40±12
HR (bpm)	163±25	172±25	178±28
Pulmonary Blood flow (ml/kg/min)	44.5 (IQR 33.6, 68.8)	54.0 (IQR 34.6, 75.1)	59.2 (IQR 40.2, 85.0)
Ductal Blood flow (ml/kg/min)	-22.3 (IQR -37.3, -4.9)*	-15.8 (IQR -40.6, 44.15)	-8.0 (IQR -12.0, 1.2)
pH	7.26±0.12*	7.15±0.10	7.13±0.12
PaO_2 (mmHg)	67.5±37.4	56.7±22.6	47.3±7.5
Base deficit (mmol/L	-13±3*	-14±4	-7±6

*p<0.01. Data presented as mean & SD or as median & IQR. A negative DBF signifies systemic to pulmonary shunting (left to right).

References: Pappas A et al, Hypocarbia and adverse outcome in neonatal hypoxic-ischemic encephalopathy.
Wyatt JS et al. Response of cerebral blood volume to changes in arterial carbon dioxide tension in preterm and term infants

Conclusion

- ❑ Fluctuations in CO_2 led to cerebral and myocardial perfusion changes in the immediate post resuscitation phase
- ❑ Hypocapnia in the immediate post-resuscitation phase led to worsening of hypoxia and decreased cerebral and myocardial oxygen delivery to brain and heart

Acknowledgement

Neonatal Resuscitation Program

NIH National Heart, Lung, and Blood Institute

The ZOLL Foundation Resuscitation and Acute Critical Care