Rapid bicarbonate bolus post extensive neonatal resuscitation leads to increased perfusion to the heart and brain

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A new study examines the effect of rapid infusion of 2meq/kg of sodium bicarbonate ($NaHCO_3$) in an ovine model on gas exchange and

coronary and cerebral perfusion in the immediate post-resuscitation phase. Findings from the study will be presented during the Pediatric Academic Societies (PAS) 2022 Meeting, taking place April 21-25 in Denver.

$NaHCO_3$ is not routinely recommended in neonates with metabolic acidosis. However, post-resuscitation and in infants with perinatal metabolic acidosis and hypoxic-ischemic encephalopathy, $NaHCO_3$ continues to be used to correct acidosis. Rapid infusion of $NaHCO_3$ can lead to carbon dioxide formation, myocardial injury and fluctuations of cerebral blood flow. The acute effects of rapid infusion of $NaHCO_3$ on cerebral and coronary perfusion, especially post extensive neonatal resuscitation, remain unknown.

The study found that following extensive resuscitation, rapid $NaHCO_3$ administration led to a significant rise in myocardial and cerebral perfusion along with higher levels of exhaled carbon dioxide. The effect of increased flow appears to be primarily due to changes in carbon dioxide levels. These acute changes could be detrimental especially during the reperfusion phase of ischemic injury post neonatal resuscitation.

Figure 1A: Baseline Characteristics		
Parameter	**pH <7.1 (N=8)**	**pH ≥ 7.1 (N=4)**
Gestation age(days)	138 ± 0.7	140 ± 0.5
Birth Weight (kgs)	3.6 ± 0.7	3.8 ± 0.8
Sex (N)	M=4, F=4	M=4, F=0
Multiplicity	Twin =5, Triplet=3	Twin =2
pH	7.06 ± 0.11	7.15 ± 0.15
Data represented as average and standard deviation.		

Figure 1B: Gas Exchange				
Parameter	**pH < 7.1 (N=8)**		**pH ≥ 7.1 (N=4)**	
Bicarbonate status	**Before Bicarb**	**After Bicarb**	**Before Bicarb**	**After Bicarb**
Base excess	-13.7 ± 4.96	-8.5 ± 4.8*	-10.05 ± 2.38	-4.4 ± 2.9
$PaCO_2$ (mmHg)	55.7 ± 3.48	58.8 ± 12.2	28.15 ± 6.8	58.5 ± 2.6*
ETCO2(mmHg)	48 ± 11	62±10*	40 ± 9	59 ± 11*
PaO_2 (mmHg)	48 ± 22	57.2 ± 24	53.4 ± 6.3	64.9 ± 19
Data represented as average and standard deviation.*p<0.01 by t-test				

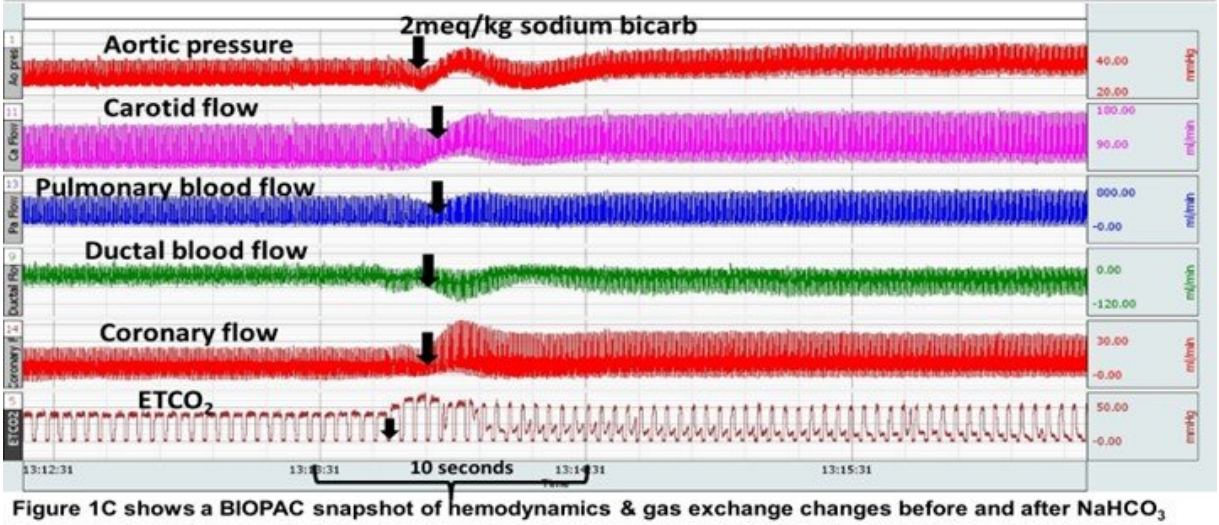


Figure 1C shows a BIOPAC snapshot of hemodynamics & gas exchange changes before and after $NaHCO_3$

Baseline Characteristics. Credit: Jacobs School of Medicine and Biomedical Sciences, University at Buffalo

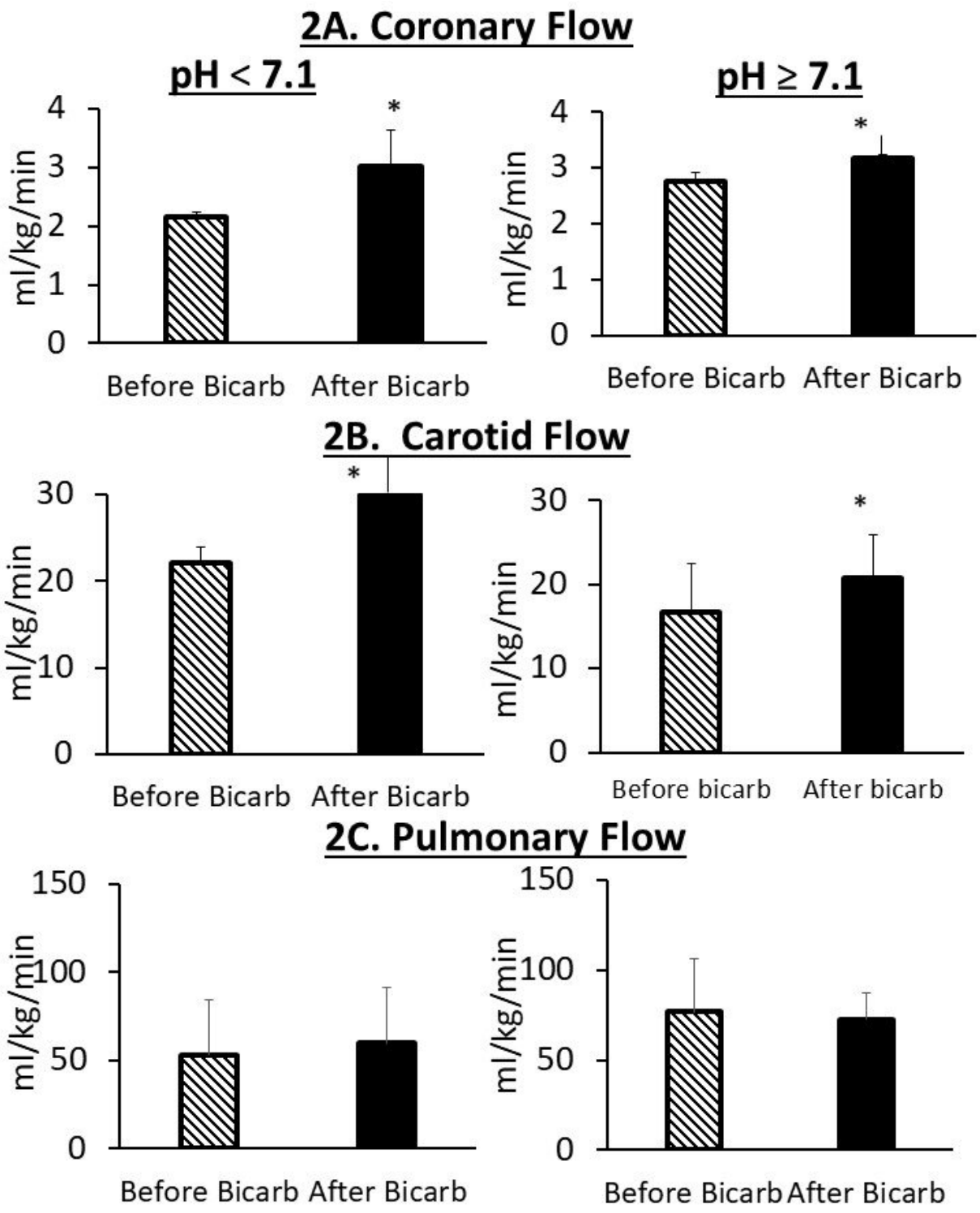
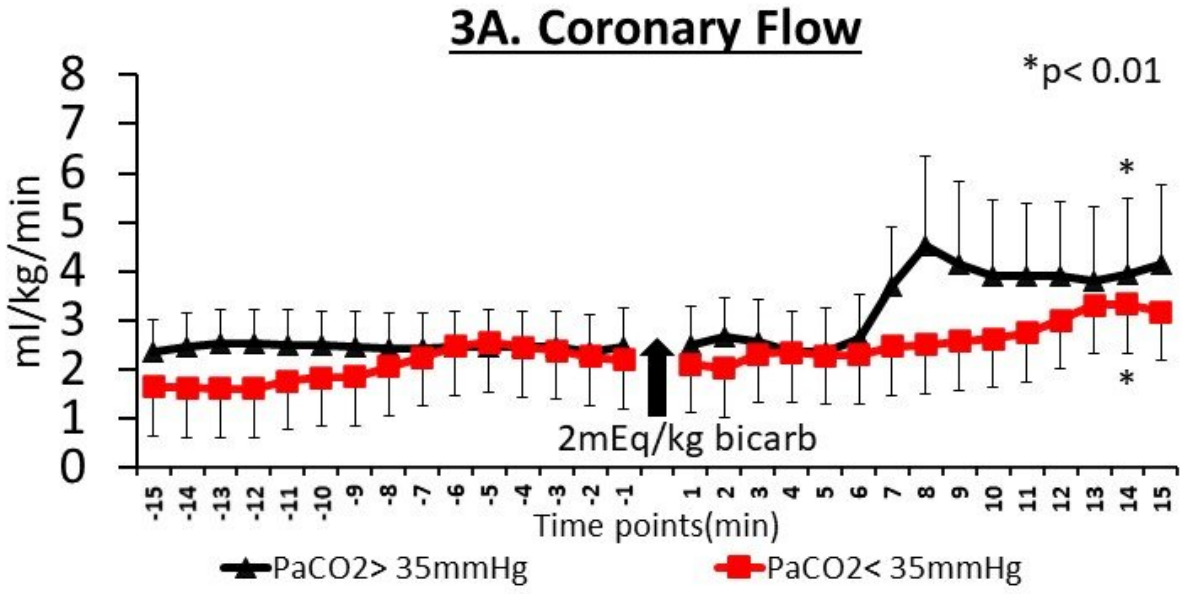
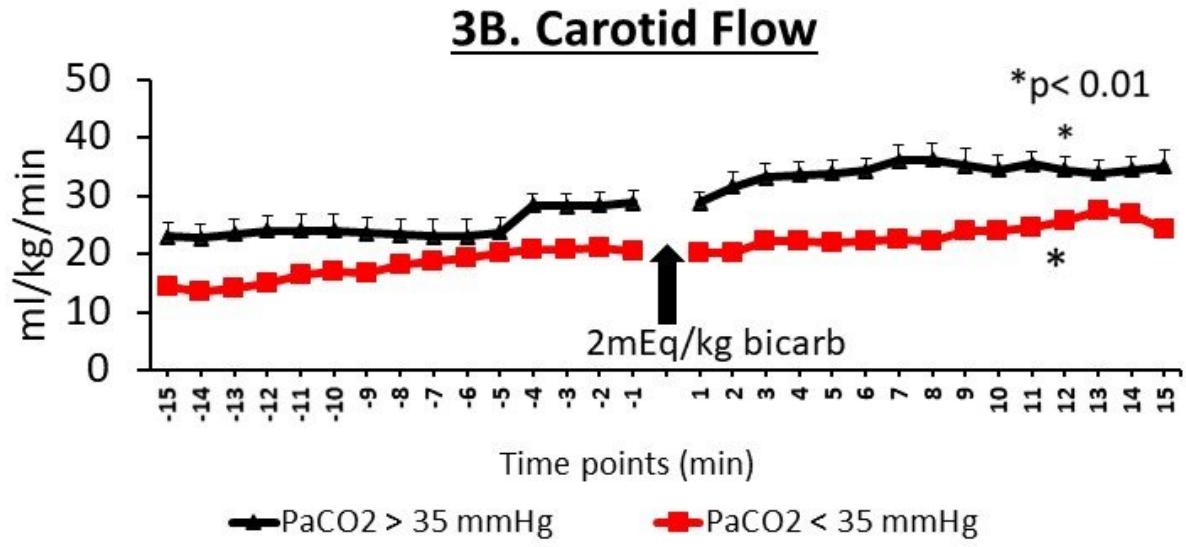
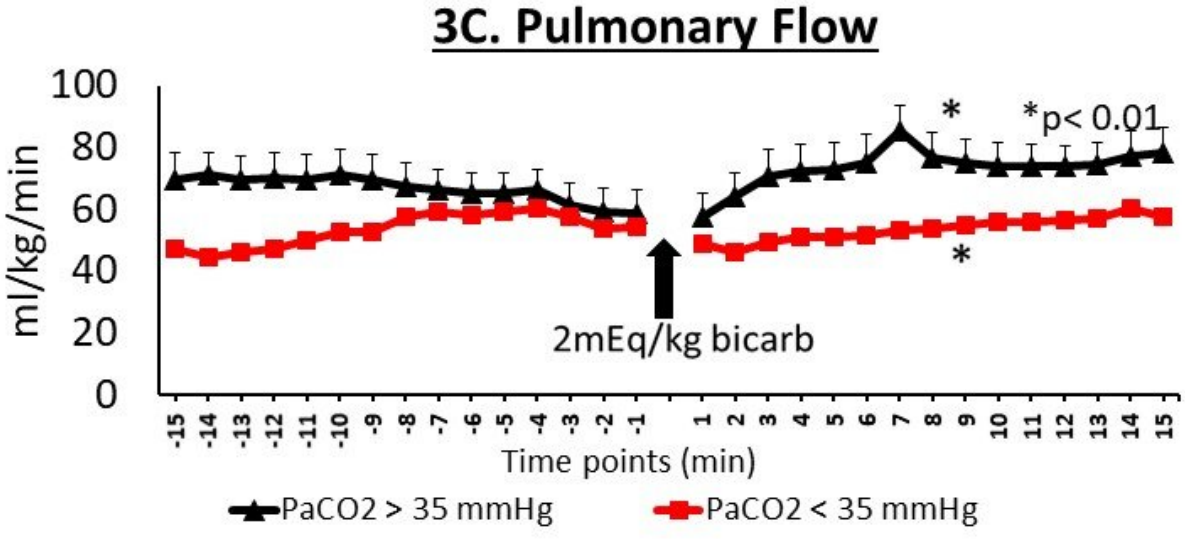


Figure 2A shows the coronary flow before and after bicarb bolus with pH<7.1 and pH ≥ 7.1, 2B shows the carotid flow before and after bicarb bolus with pH<7.1 and pH ≥ 7.1, 2C shows the pulmonary flow before and after bicarb bolus with pH<7.1 and pH ≥ 7.1. *p <0.01 by t-test before and after bicarb bolus.

Coronary Flow. Credit: Jacobs School of Medicine and Biomedical Sciences, University at Buffalo


3A. Coronary Flow
*p< 0.01
ml/kg/min
2mEq/kg bicarb
Time points(min)
PaCO2> 35mmHg
PaCO2< 35mmHg


3B. Carotid Flow
*p< 0.01
ml/kg/min
2mEq/kg bicarb
Time points (min)
PaCO2 > 35 mmHg
PaCO2 < 35 mmHg


3C. Pulmonary Flow
*p< 0.01
ml/kg/min
2mEq/kg bicarb
Time points (min)
PaCO2 > 35 mmHg
PaCO2 < 35 mmHg

Coronary Flow. Credit: Jacobs School of Medicine and Biomedical Sciences, University at Buffalo

"Despite the lack of evidence and concerns about its safety, $NaHCO_3$ continues to be used in neonates with perinatal metabolic acidosis especially after extensive neonatal resuscitation," said Mausma Bawa, MD, fellow physician at Jacobs School of Medicine and Biomedical Sciences at the University at Buffalo. "We wanted to evaluate the effect of rapid infusion of $NaHCO_3$ bolus in an ovine asphyxiated model in the immediate post-resuscitation phase on gas exchange and hemodynamics. In our study, we observed that post rapid $NaHCO_3$ administration after extensive resuscitation, there was a significant rise in end tidal carbon dioxide levels, and significantly higher coronary and carotid blood flows. We speculate that in the setting of hypoxic ischemic injury, these higher blood flows to the brain and the heart could be detrimental especially during the reperfusion phase."

More information: Conference: www.pas-meeting.org/

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