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PREVENTION OF HYPERNATREMIA DURING PERIOPERATIVE PHASES OF CARDIOPULMONARY BYPASS IN PEDIATRICS: EVALUATION OF ACIDIC BIOMARKERS AND OPTIMIZATION OF SODIUM BICARBONATE ADMINISTRATION

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Hypernatremia is associated with numerous intra and post-operative complications that leads to longer hospital stay, morbidity and mortality especially in neonates and infants undergoing cardiopulmonary bypass (CPB) with Profound Hypothermic Perfusion (PHP). PHP and pH-stat acid-base management further influences hypercarbia status and the requirement of more Sodium Bicarbonate ($NaHCO_3$) to maintain normal pH, bicarbonate level (HCO_3) and acceptable base deficit. Addition of blood bank preserved acidic packed red blood Cells (PRBC's) requires more $NaHCO_3$ to buffer the CPB perfusate. Combination of all these interventions and intracellular acidity results in a static hypernatremia during rewarming and sustains till weaning from bypass and continues post-operatively. The objective of this study are to rationalize the administration of sodium bicarbonate during PHP, keeping acidic-biomarkers (pH, pCO_2, HCO_3 and base deficit) within near normal physiological limits and preventing hypernatremia during perioperative phases of CPB in neonates and infants.

Neonates and infants who required CPB-profound hypothermic perfusion and pH stat acid-base management during 2016 and 2018 were characterized in this study. Amount of $NaHCO_3$ given in the prime and during bypass and regulation of acidic-biomarkers (pH, pCO_2, HCO_3 and base deficit) were measured. In the control group, temperature corrected pH was maintained at 7.25-7.30, pCO_2 was maintained around 45-50 mmHg and End Tidal Carbon Dioxide (ETCO2) kept 40-45 mmHg. $NaHCO_3$ was administered to maintain bi-carbonate (HCO_3) around 26-28 mEq/L and base deficit (BE) between -2 to +2mEq/L at all levels of temperature. In study group, temperature corrected pH value was maintained at 7.35-7.45, pCO_2 kept around 30-35mmHg and End Tidal Carbon Dioxide (ETCO2) was maintained 30-33mmHg. $NaHCO_3$ was administered to keep bi-carbonate (HCO_3) around 22-24 mEq/L. In both groups adjunct CO_2 was added that equals 4-5% of the ventilating (sweep) gas. $NaHCO_3$ was administered only after normalizing non-HCO_3 variables (pCO2, glucose, reservoir volume) and didn't administer if the sodium level was 145mEq/L and above.

PH PH stat Temp Corrected	PCO2 mmHg Temp Corrected	PCO2 mmHg Temp Not - Corrected	ETCO2 mmHg	HCO3 mEq/L	BE mEq/L	Na mEq/L	Osmolar Moles/Lit
CONTROL GROUP (n = 35)							
7.25 – 7.30	45 - 50	80 - 110	40 - 45	28 - 32	-2 to +2	155±5	358±8
STUDY GROUP (n = 35)							
7.35 – 7.45	30 - 35	50 - 70	30 - 33	22 - 24	Ignored	139±3	304±5

During perioperative CPB phase, in control group, serum sodium level was around 155±5 mEq/L and the perfusate was hyperosmolar (358±8) moles/L; and in the study group, serum sodium level was around 139±3 mEq/L and the osmolality was within physiological limits (358±8) moles/L. Less $NaHCO_3$ was administered in study group. Acidic biomarkers (pH, pCO_2, HCO_3 and base deficit) were regulated within near normal physiological limits. This approach facilitated prevention of hypernatremia during perioperative phases of CPB.

During CPB and profound hypothermic perfusion, keeping the acidic-biomarkers (pH, pCO_2, $ETCO_2$, HCO_3 and base deficit) within near normal acceptable physiological limits and prevention of over correction of metabolic acidosis with $NaHCO_3$ facilitates maintaining serum sodium level within safe and normal physiological limits and prevention of Hypernatremia.