In vitro Testing of the Accuracy of Electrolyte Correction in Blood Priming on the Aquadex machine

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Objective

- At Children's of Alabama, we sought to test our blood prime protocol in vitro.

Introduction

- The addition of smaller circuits and neonatal-specific devices for continuous renal replacement therapy (CRRT) has decreased the threshold for using blood primes for smaller patients.
- Given the increase in filters and devices that specialize in immunomodulation, the need for blood priming remains an important part of any institution's program.
- Treating packed red blood cells (PRBC) to present a more homeostatic product can be done in several ways but should be performed consistently to prevent electrolyte abnormalities for the patient.
- The optimal method for treating packed red blood cells (PRBC) to present a more homeostatic product has yet to be determined.

Methods and Materials

Current Guideline

- 1:1 ratio of bicarbonate mixture (15 mEq of NaHCO3 (150 mEq/L) with 85 mL of sterile water) and PRBC of the same volume.
- Upon initiation, the patient is given 100 g or 300 g of calcium gluconate (100 mg/mL), depending on the extracorporeal volume of the circuit.

Guideline Tested

- Blood prime was tested in vitro, using a sterile bag to mimic the circuit.
- Six scenarios were created based on the bicarbonate mixture and calcium volume.
    - We used 20 mL of bicarbonate mixture and PRBC (baseline, 125%, 150%) with 1 mL and 0.6 mL of calcium gluconate.
- Arterial blood gas testing was performed on:
    - Gas 1: PRBCs alone
    - Gas 2: Bicarbonate/PRBC mixture after five minutes
    - Gas 3: Bicarbonate/PRBC mixture with the addition of calcium
- Four different PRBC units were used.
- We evaluated four laboratory values: pH, calcium, sodium, and potassium.

Results

Table 1. Labs at Gases 1-3 at varying sodium bicarbonate concentrations with 0.6 mL of calcium gluconate

		0.6 mL CaGluc			
Variable	Gas	1:1 (Bicarb:PRBC)	1.25:1 (Bicarb:PRBC)	1.5:1 (Bicarb:PRBC)	p-value
pH	1	6.6	6.6	6.6	1
	2	7.13 (6.6,7.22)	7.21 (6.6,7.23)	7.41 (6.6,7.47)	0.23
	3	7.2 (7.12,7.23)	7.21 (7.21,7.26)	7.44 (7.4,7.47)	**0.03**
Calcium (mmol/L)	1	0.16	0.16	0.16	1
	2	0.16 (0.16,0.16)	0.16 (0.16,0.16)	0.16 (0.16,0.16)	1
	3	1.85 (1.85,1.85)	1.85 (1.37,1.85)	0.99 (0.61,1.15)	**0.01**
Sodium (mEq/L)	1	80 (79,80)	92 (80,93.5)	94 (93,95)	**0.02**
	2	122 (80,150)	135 (93,153.8)	179 (94.5,179)	0.16
	3	141 (119,151.5)	135 (134,149)	179 (179,179)	**0.04**
Potassium (mEq/L)	1	14 (14,14)	14 (14,14)	14 (14,14)	1
	2	14 (14,14)	14 (12.6,14)	12.8 (11.7,14)	**<0.01**
	3	14 (14,14)	12.6 (12.1,14)	11.6 (11.4,12)	**<0.01**

Table 2. Labs at Gases 1-3 at varying sodium bicarbonate concentrations with 1 mL of calcium gluconate

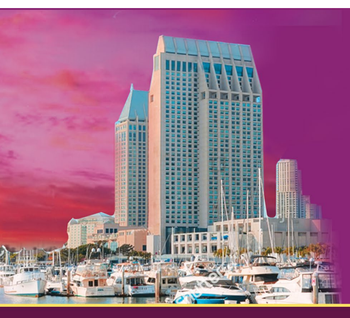
		1 mL CaGluc			
Variable	Gas	1:1 (Bicarb:PRBC)	1.25:1 (Bicarb:PRBC)	1.5:1 (Bicarb:PRBC)	p-value
pH	1	6.6	6.6	6.6	1
	2	7.09 (6.6,7.11)	7.18 (6.6,7.2)	7.29 (6.6,7.32)	**0.03**
	3	7.11 (7.09,7.13)	7.19 (7.14,7.2)	7.3 (7.26,7.37)	**<0.01**
Calcium (mmol/L)	1	0.16	0.16	0.16	1
	2	0.16 (0.16,0.16)	0.16 (0.16,0.16)	0.16 (0.16,0.16)	1
	3	1.85 (1.85,1.85)	1.85 (1.85,1.85)	1.85 (1.85,1.85)	1
Sodium (mEq/L)	1	92 (92,92.5)	80 (79.5,80.5)	77 (77,77)	**<0.01**
	2	117 (92,124)	125 (80,145)	179 (77,179)	0.17
	3	117 (114,118)	143 (112.5,144.5)	179 (179,179)	**<0.01**
Potassium (mEq/L)	1	14 (14,14)	14 (14,14)	14 (14,14)	1
	2	14 (14,14)	14 (14,14)	9.7 (9.4,14)	**<0.01**
	3	14 (14,14)	14 (14,14)	9.3 (9.3,9.45)	**<0.01**

Results Summary

- We had a total of 84 blood gases
- Gas 1 - The baseline gas (PRBCs alone)
- Gas 2 - As the bicarbonate:PRBC ratio increased:
    - pH increased
    - Sodium increased
    - Calcium had no change
    - Potassium decreased
- Gas 3 - Two different calcium gluconate doses (0.6 mL and 1 mL):
    - No significant change in pH, sodium, or potassium
    - A change in the distribution of calcium

Conclusions

- To improve acidosis, increasing sodium bicarbonate at the current concentration can be effective; however, hypernatremia can be a potential issue.
- A smaller dose of calcium than our current standard may be sufficient to correct hypocalcemia.
- Hyperkalemia remains an issue.
- Additional testing is needed to determine the optimal method to make pRBC homeostatic for CRRT blood prime.



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