

1.8% Balanced Sodium Bicarbonate/Sodium Chloride Compared to 3% Sodium Chloride for the Management of Cerebral Edema

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Disclosure Statement

These individuals have the following to disclose concerning possible financial or personal relationships with commercial entities (or their competitors) that may be referenced in this presentation.

- Rebecca Ortega (nothing to disclose)
- Project Advisors & Co-Investigators:
 - Eric Shaw, PhD (nothing to disclose)
 - Emily Bowers, PharmD (nothing to disclose)
 - Alisha B. Terry, PharmD (nothing to disclose)

Background

Cerebral edema (CE)

- Swelling of brain from accumulation of excess fluid within cells or extracellular spaces
- Underlying cause(s) vary due to a variety of neurovascular injuries
- Leading cause of in-hospital mortality
- Peak at 24 to 96 hours after initial injury

Hypertonic saline

Increases
blood
osmolarity

Decreases
cerebral
edema

Improved
cerebral
blood flow

Decreased
CSF
production

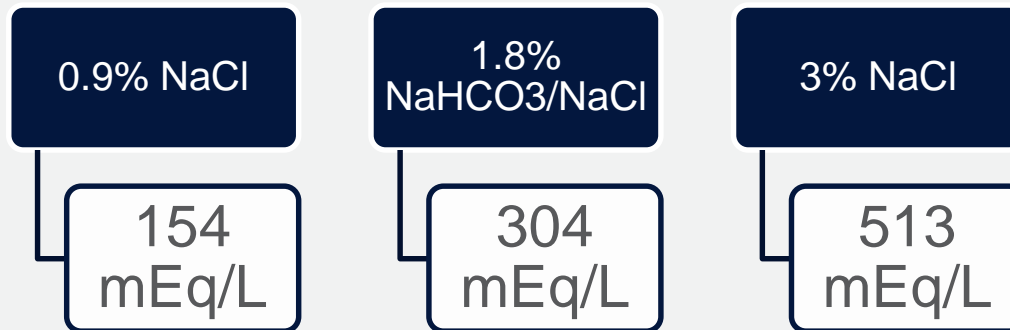
Neurocrit Care. 2020;32(3):647-666

Neuropharmacology. 2019;145(Pt B):230-246

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Background

- Ongoing shortages pose challenges in using IV fluids for cerebral edema
- Memorial Health University Medical Center compounded a 1.8% balanced $\text{NaHCO}_3/\text{NaCl}$ solution during national shortage of 3% NaCl and 23.4% NaCl



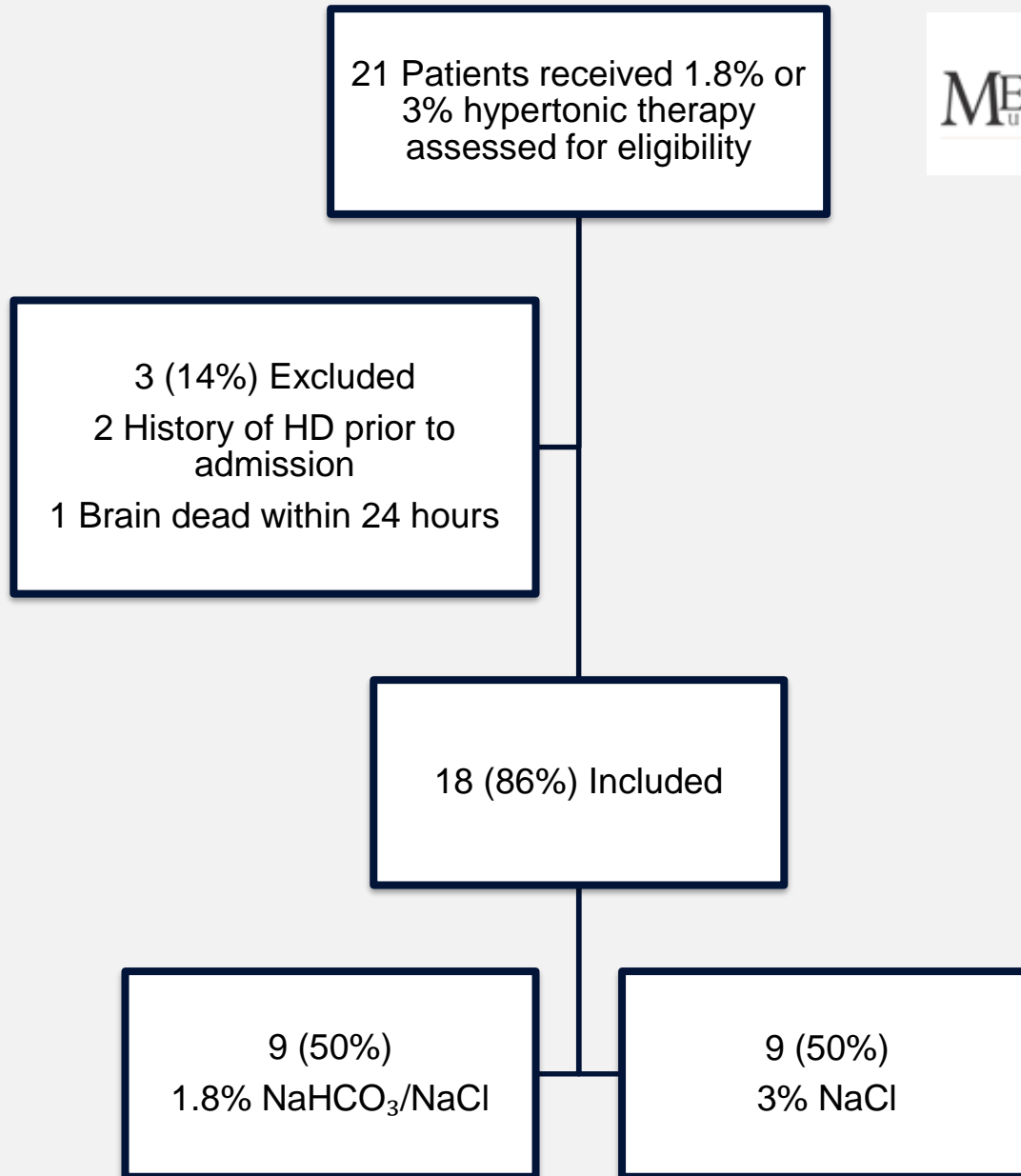
Purpose

Assess the effect of 1.8% balanced sodium bicarbonate/sodium chloride solution administration to attain target serum sodium level compared to 3% sodium chloride for the management of cerebral edema

Methods

- Single-center, retrospective, observational, chart review
 - October 1, 2021 to August 31, 2022
- Institutional Review Board approved

Inclusion Criteria	Exclusion Criteria
≥ 18 years of age	Received hyperosmolar therapy for Na ⁺ < 130 mEq/L
Critically ill patients	Brain dead within first 24 hours after injury
Received either 3% NaCl or 1.8% NaHCO ₃ /NaCl solution	Incarcerated
	Pregnant
	Required hemodialysis (HD) prior to hospital admission



Outcomes

Primary outcome

- Achievement of target serum Na⁺ levels

Secondary outcomes

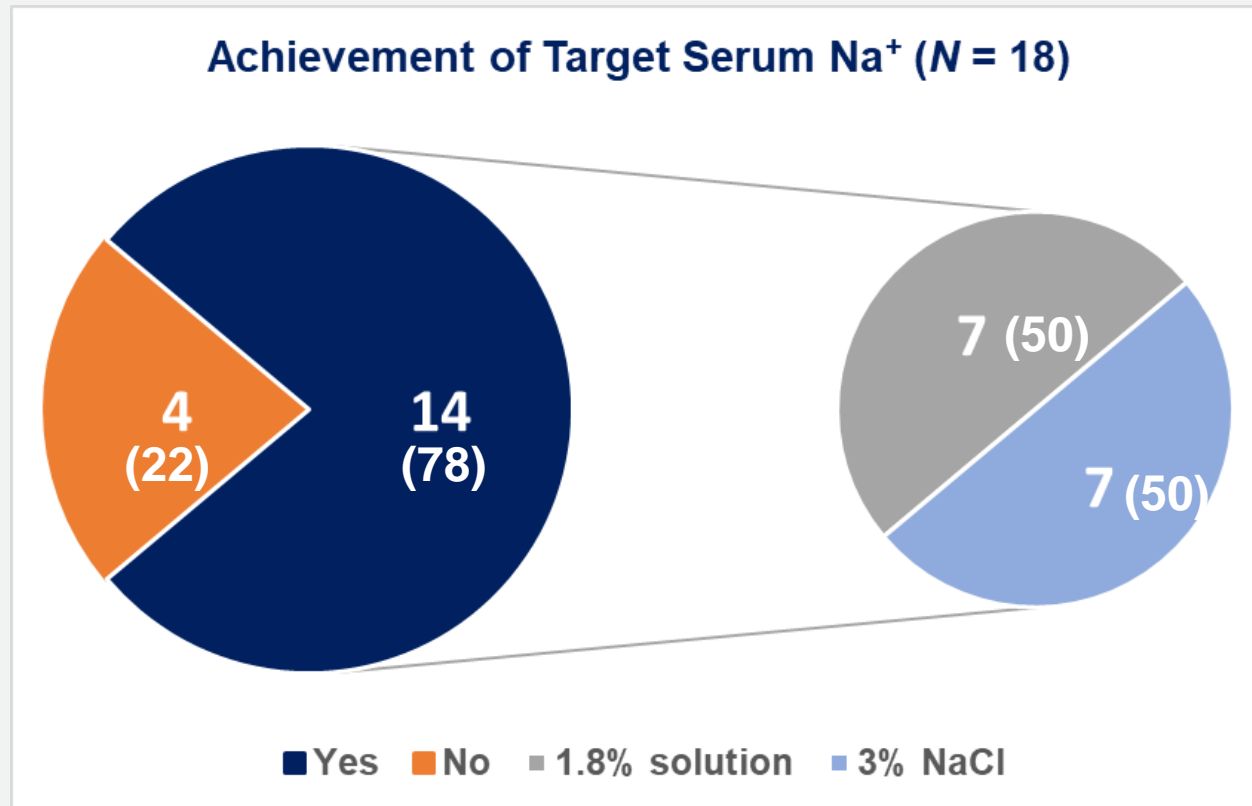
- Time to goal serum Na⁺ range
- Net change in serum Na⁺ from start of hypertonic therapy to 96 hours
- Composite of neurologic outcomes
- Incidence of hyperchloremia (>109 mEq/L)
- Occurrence of acute kidney injury
- ICU length of stay
- Hospital length of stay
- Inpatient mortality

Patient Demographics

	1.8% NaHCO ₃ /NaCl n = 9	3% NaCl n = 9	p-value
Age in years, mean (±SD)	58 (±16)	67 (±15)	0.24
Male, n (%)	4 (44)	4 (44)	1.00
Comorbidities, n (%)			
End stage renal disease	1 (11)	-	1.00
Atrial fibrillation	2 (22)	2 (22)	
PE/DVT	-	-	
Type of injury, n (%)			
Intracranial hemorrhage	8 (89)	7 (78)	0.53
Acute ischemic stroke	2 (22)	3 (33)	0.60
Subdural hematoma	2 (22)	2 (22)	1.00
Subarachnoid hemorrhage	1 (11)	1 (11)	1.00
Diffuse axonal injury	-	-	
Epidural hematoma	-	-	

Results

Primary outcome



Results

Secondary outcomes

	1.8% NaHCO ₃ /NaCl n = 9	3% NaCl n = 9	p-value
Hospital LOS, mean (±SD)	11 (5.9)	6 (2.7)	0.50
ICU LOS, mean (±SD)	11 (5.9)	6 (2.7)	0.04
Inpatient mortality*, n (%)	3 (33)	4 (44)	0.63
Time to goal serum Na⁺ range, hrs	32.3	19.3	0.03
145-150 mEq/L	8.5	-	
150-155 mEq/L	37.3	24.9	
Net change in serum Na⁺ from start of hypertonic therapy to 96 hrs, mean (±SD)	10 (5.5)	16 (8.5)	0.10
Incidence of AKI, n (%)	3 (37.5)	7 (78)	0.09

* = ≥ 24 hours after injury

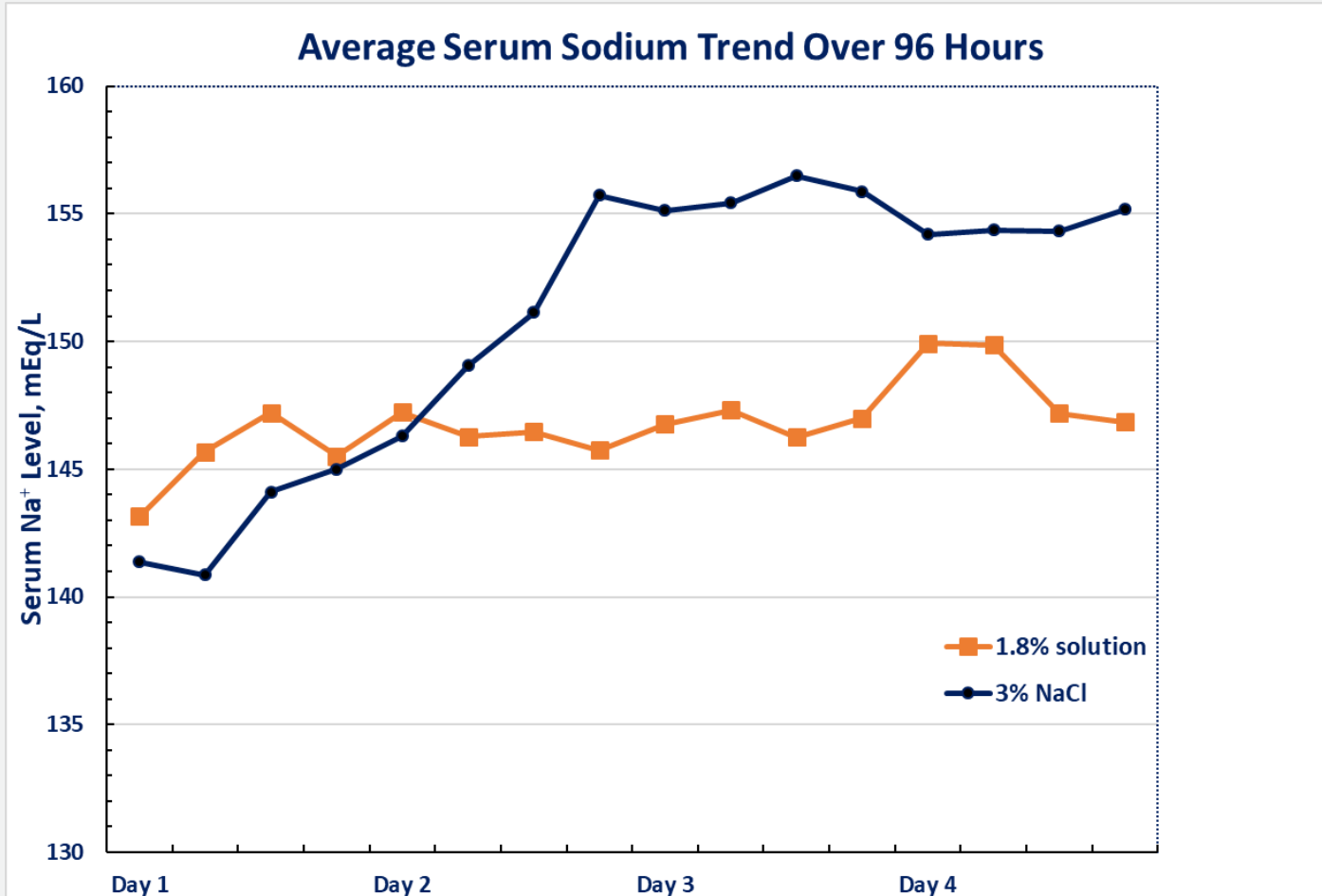
Results

Secondary outcomes

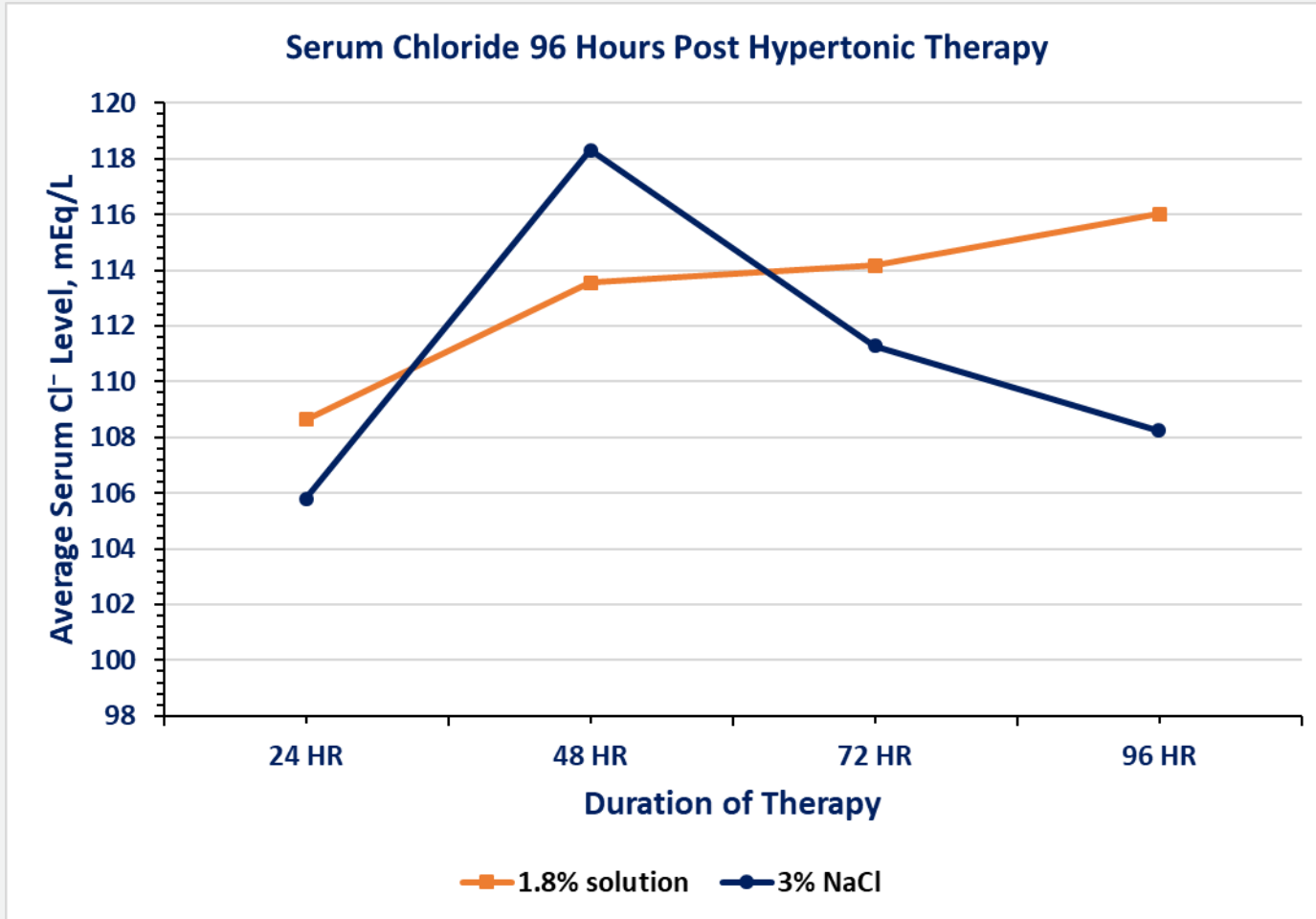
	1.8% NaHCO ₃ /NaCl n = 9	3% NaCl n = 9	p-value
Composite of neurologic outcomes, n (%)	9 (100)	9 (100)	1.00
Increased cerebral edema	3 (33)	3 (33)	
Hematoma expansion	-	-	
Worsening ICPs	2 (22)	-	
Unplanned surgical intervention*			
Craniotomy	1 (11)	-	
EVD	2 (22)	3 (33)	
Neurologic decline**	8 (89)	9 (100)	

* = ICP monitor placement, decompressive craniotomy, ** = decrease in GCS or need for intubation

Results



Results



Discussion

- Target serum sodium levels were achieved with 1.8% NaHCO₃/NaCl solution similarly achieved with 3% NaCl for cerebral edema management
- Use of 1.8% NaHCO₃/NaCl could be considered as an alternative to 3% NaCl for cerebral edema management.

Discussion

Strengths

- Novel study
- Included net change of Na⁺ and time to reach specific goal
- Included 96 hour trends of labs

Limitations

- Single-center, retrospective study
- Small sample size
 - Power unable to be calculated
- Literature in this population is scarce with safe, efficacious alternative hyperosmolar therapy

Conclusion

Target serum sodium levels were achieved with the 1.8% NaHCO₃/NaCl solution similarly to that achieved with 3% NaCl for cerebral edema management.

Self Assessment Question

Does a 1.8% NaHCO₃/NaCl balanced solution attain target serum sodium levels for the management of cerebral edema if 3% NaCl is unavailable?

A. Yes

B. No

Acknowledgements

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