Comparison of 3% NaCl Infusion vs. 23.4% NaCl Bolus for Cerebral Edema in Critically Ill Adults

Jennifer Bahamonde, PharmD; Andrew Beyer, B.S., Pharm.D., BCCCP; Marianela Robainas, Pharm.D., BCPS, BCCCP;
Angel Maldonado, Pharm. D., MSPH, BCCCP, FCCM; Melissa Santibañez, Pharm.D., FCCM, BCCCP

Memorial Healthcare System
MEMORIAL REGIONAL HOSPITAL

BACKGROUND

- Cerebral edema (CE) is a complication of acute brain injury due to excess brain parenchymal fluid, increasing intracranial pressure (ICP)[1,2]
- CE is linked to worse outcomes; 10–20× higher in-hospital mortality vs no edema[3]
- Increased CE burden worsens outcomes; midline shift predicts poor outcomes[4]
- Neurocritical Care Society guidelines suggest hypertonic saline (HTS) over mannitol for CE in AIS, SAH, and ICH; symptom-based dosing is primarily supported in SAH[2]
- Limited data comparing 3% vs 23.4% NaCl in non-traumatic CE; optimal strategy unclear
- This study compared intensive care unit (ICU) length of stay (LOS) and outcomes between 3% and 23.4% NaCl in non–traumatic cerebral edema

OBJECTIVES

PRIMARY OBJECTIVE

- Compare ICU LOS between continuous 3% NaCl infusion and 23.4% NaCl bolus therapy in adults with non-traumatic cerebral edema

SECONDARY OBJECTIVES

CLINICAL OUTCOMES

- Therapy escalation
- Discharge disposition

THERAPY & UTILIZATION

- Pupillary response
- Post HTS GCS and ICU discharge GCS
- 28–day mortality

SAFETY ENDPOINTS

- Acute kidney injury (AKI)
- Hypernatremia
- Hyperchloremic acidosis
- Incidence of ICP > 22 mmHg
- Renal replacement therapy (RRT)

METHODS

DESIGN
Multicenter retrospective cohort
(Sep 2023–Aug 2025)

POPULATION
Neuro ICU patients with cerebral edema

ASSIGNMENT
- Assigned by initial HTS
- Escalation permitted

STATISTICS
- Categorical: χ^2/ Fisher's exact
- Continuous: t-test/ Mann–Whitney U

INCLUSION
- Adults (18–89 years)
- Non–traumatic intracranial pathology
- Neuro intensive care unit admission
- Admitted Sep 2023–Aug 2025
- 3% NaCl infusion or 23.4% NaCl bolus

EXCLUSION
- Traumatic etiology excluded
- Treated with >2 doses of mannitol
- HTS not initiated or <6 h regimen
- Death/comfort care within the first 24hrs of admission
- Transfer from outside hospital
- Pregnant, incarcerated, or RRT dependent patients

RESULTS

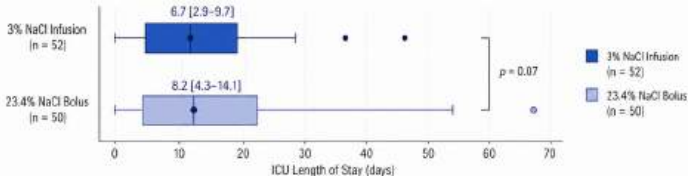
TABLE 1. BASELINE DEMOGRAPHICS

	3% NaCl Infusion (N=52)	23.4% NaCl Bolus (N=50)	P–value
Age, years	65.5 [54.0–78.3]	64.0 [53.0–77.0]	0.64
Male	31 (59.6)	30 (60.0)	0.97
Race			0.62
White	31 (59.6)	26 (52.0)	
Black	17 (32.7)	21 (42.0)	
Other	4 (7.7)	3 (6.0)	
Diagnosis			0.98
AIS	21 (40.4)	18 (36.0)	
ICH	17 (32.7)	17 (34.0)	
SAH	2 (3.8)	3 (6.0)	
Mixed	7 (13.5)	7 (14.0)	
Other	5 (9.6)	5 (10.0)	
Hunt and Hess Scale^			0.52
Low grade SAH (HH 1–3)	3 (75.0)	2 (40.0)	
High grade SAH (HH 4–5)	1 (25.0)	3 (60.0)	
NIHSS^			0.67
Minor (NIHSS 0–4)	9 (19.1)	6 (13.0)	
Moderate (NIHSS 5–15)	13 (27.7)	12 (26.1)	
Severe (NIHSS ≥ 16)	25 (53.2)	28 (60.9)	
ICH Score^	3 [1–4]	2 [2–3]	0.58
Cumulative Na Dose, mEq	358 [222–871]	484 [299–694]	0.90
Duration of HTS therapy, hours	21.9 [12.9–49.7]	35.9 [19.1–49.4]	0.17
Admission GCS	14 [9–15]	14 [10–15]	0.44
Baseline GCS	9.5 [7–14]	8.5 [6.25–10.8]	0.22
ICP Monitoring	12 (23.1)	15 (30.0)	0.43
Neurosurgical Intervention	15 (28.8)	25 (50.0)	0.03

^Denominators vary due to missing data; percentages reflect available cases per group
Data are presented as n (%) unless otherwise specified; continuous variables are reported as median [IQR]

TABLE 2. OUTCOMES

PRIMARY OUTCOME

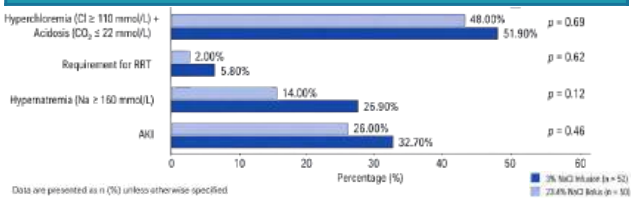


SECONDARY OUTCOME(S)

	3% NaCl Infusion (n=52)	23.4% NaCl Bolus (n=50)	P–value
Discharge Disposition			0.64
Expired	25 (48.1)	25 (48.1)	
Favorable	10 (19.2)	13 (26.0)	
Unfavorable	17 (32.7)	17 (34.0)	
Post–HTS peak GCS	11.5 [7.8–15]	11.0 [9–14]	0.43
ICU Discharge GCS^	14 [10.8–15]	12 [9–14.8]	0.22
Pupillary Response			0.47
Improvement	9 (17.3)	12 (24.0)	
No improvement	43 (82.7)	38 (76.0)	
28–day Mortality	21 (40.4)	22 (44.0)	0.71
Therapy Escalation	17 (32.7)	8 (16)	0.05
Sustained ICP ≥ 22 mmHg^	2 (16.7)	3 (20.0)	1.00

^Denominators vary due to missing data; percentages reflect available cases per group
Data are presented as n (%) unless otherwise specified; continuous variables are reported as median [IQR]

TABLE 3. SAFETY OUTCOMES



DISCUSSION

- Baseline characteristics were overall well balanced between groups
- Patients receiving 23.4% NaCl were more likely to undergo neurosurgical intervention
- No statistically significant difference in ICU LOS was observed; ICU LOS was shorter in the 3% NaCl group
- Higher rates of therapy escalation in the 3% group likely reflect a stepwise treatment approach
- No differences were observed in neurologic recovery metrics, including GCS and pupillary response
- Safety outcomes were similar, though hypernatremia and AKI appeared more frequent in the 3% NaCl group

LIMITATIONS

- Retrospective design with potential for incomplete data capture
- Limited sample size reducing power to detect differences and control for confounding
- Concomitant mannitol use as a potential confounder
- Inherent limitations of chart review, including variability in documentation accuracy

CONCLUSION

- Continuous 3% NaCl and 23.4% NaCl bolus demonstrated comparable outcomes in patients with non-traumatic cerebral edema
- A non-significant trend toward shorter ICU length of stay was observed with 3% NaCl cohort, which may reflect limited statistical power
- The 23.4% NaCl cohort likely represents higher baseline severity
- Higher rates of therapy escalation in the 3% group likely reflect a stepwise treatment strategy
- Overall, both hypertonic saline strategies appear clinically reasonable, and therapy should be individualized based on patient severity and clinical context

REFERENCES

SCAN FOR FULL REFERENCES

DISCLOSURES

Nothing to disclose for this project