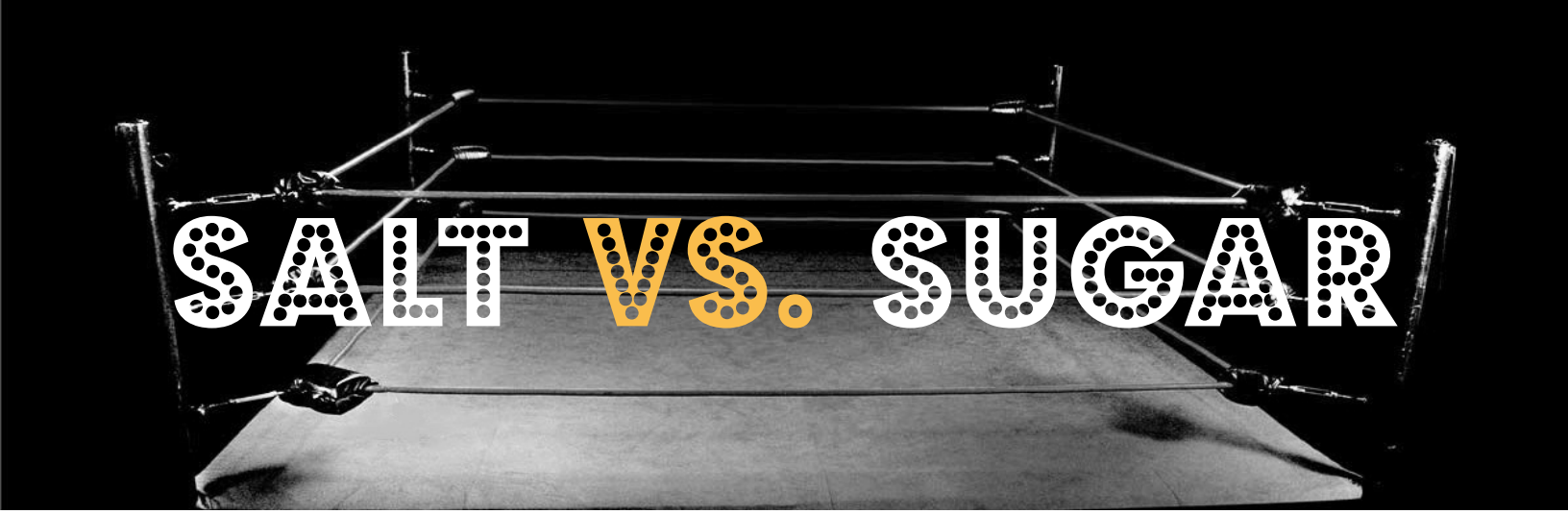


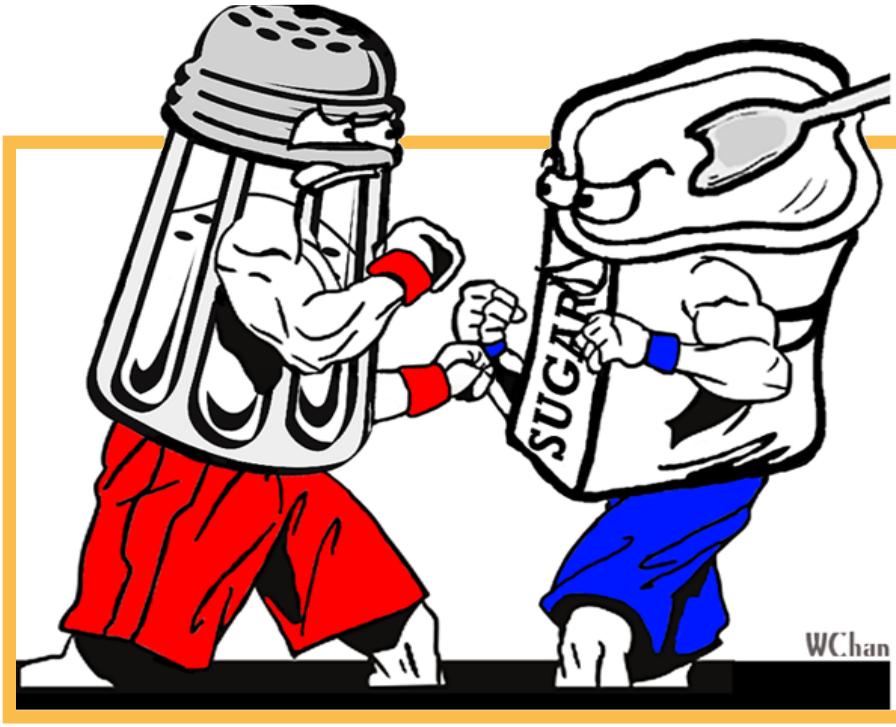
Traumatic brain injuries can be devastating.

The most common cause of death is increased intracranial pressure (ICP) leading to poor cerebral perfusion and brainstem compression. Mortality is 18.4% if ICP is less than 20mmHg compared to 55.6% if ICP is greater than 40mmHg. Above 20mmHg, the brain cannot regulate fluid shifts and, thus, small increases in volume lead to exponential increases in ICP. The control of ICP is essential for survival and clinical outcomes. Among the currently recommended therapies, hyperosmolar solutions have the best adverse effect profile and are readily available to ED physicians.

Mannitol has traditionally been the hyperosmolar therapy of choice. However, hypertonic saline (HTS) has been gaining popularity despite no large RCT demonstrating superiority. HTS appeals to ED physicians because, unlike mannitol, it can be used in hemodynamically unstable patients and titrated using serum sodium before ICP monitoring is established. In 2007, the Brain Trauma Foundation recommended treating increased ICP with mannitol and listed HTS as an alternative, citing insufficient current evidence to recommend its use. However, since this recommendation was made, a significant amount of literature has come out in support of HTS over mannitol.

What does this mean in the ED when a patient with head trauma and a GCS of 6 rolls in?

Should you reach for the sugar or the salt?



Hypertonic
"Pretty Boy"
Saline
vs.
Manny
"Sugar"
Mannitol

We reviewed the literature to provide you with a head to head battle of HTS vs. Mannitol!

Three recent meta-analyses compared the use of HTS to mannitol in patients with increased ICP. Kamel et al. found greater ICP reduction with HTS; Rickard et al. found a trend, but no statistical significance. Mortazavi et al. found lower treatment failure rates with HTS. His study also contained a literature review that observed HTS had greater ICP control, longer duration of action, better cerebral perfusion, and was more effective in treating refractory intracranial hypertension. The studies included in these meta-analyses were small and heterogeneous. We used the GRADE system to profile the data and concluded that the overall quality of evidence was low to moderate.

Take a dive into the data!

CLICK HERE

TALE OF THE TAPE

SALT		SUGAR
↓ ↓	effect on ICP	↓
beneficial	refractory ICP	not beneficial
16% *	failure rate	35% *
hypernatramia	side effects	rebound ↑ ICP, hypovolemia, ARF
must monitor serum sodium	ease of use	usually ICP must be monitored
+ +	cerebral perfusion	+
no evidence	neurological improvments or mortality benefits	no evidence
longer	duration	shorter

* OR 0.36, p = .006 based on meta-analysis of 260 treatment failures, see works cited

Based on the current studies, HTS use for traumatic brain injuries is more efficacious in treating increased ICP and has fewer side effects. HTS in varying concentrations (3% to 23.4%) in bolus and continuous infusions all have favorable results, and there is no current consensus on which form is most advantageous. While not a **bloody knockout** for HTS over mannitol, the judges here crown HTS victor by **split decision**! But don't run to the bookie and cash out just yet. Until there is a large RCT demonstrating hyperosmolar therapy improves neurological outcomes and mortality, we must recognize that any hyperosmolar therapy may only be a temporizing intervention with theoretical long-term benefits.

GOLDEN RULES

- Dosages: HTS 3% 150 ml boluses, 7.5% 75 ml boluses or 23.4% 30 ml boluses q 2-4 hours. Mannitol 20% 1g/kg q 2-4 hours.
- Keep systolic blood pressure > 90 mmHg. This is no time for permissive hypotension!
- Avoid hypoosmolarity of plasma when treating hypovolemia. Use NS; avoid LR and D5.
- Target ICP < 20 mmHg.
- Target osmolality 300-320 mOsm/L.
- Target serum sodium 145-150 mmol/L.

References:

Gantner, D., et al. “Intravenous Fluids in Traumatic Brain Injury.” Current Opinion in Critical Care 20.4 (2014): 385-89. Web.

“Guidelines for Management of Severe Traumatic Brain Injury.” Journal of Neurotrauma 24 (2007). The Brain Trauma Foundation. Brain Trauma Foundation, 2007. Web. 14 May 2015.

Guyatt, G. H., et al. “What is ‘Quality of Evidence’ and Why is it Important to Clinicians?” BMJ 336.7651 (2008): 995-98. Web.

Kamel, H., et al. “Hypertonic Saline versus Mannitol for the Treatment of Elevated Intracranial Pressure: A Meta-analysis of Randomized Clinical Trials.” Critical Care Medicine 39.3 (2011): 554-59. Web.

Li, M., et al. “Comparison of Equimolar Doses of Mannitol and Hypertonic Saline for the Treatment of Elevated Intracranial Pressure After Traumatic Brain Injury.” Medicine 94.17 (2015). Web.

Mangat, H. S., et al. “Hypertonic Saline for the Management of Raised Intracranial Pressure after Severe Traumatic Brain Injury.” Annals of the New York Academy of Sciences (2015). Web.

Mojtahedzadeh, M., et al. “Hypertonic Saline Solution Reduces the Oxidative Stress Responses in Traumatic Brain Injury Patients.” Journal of Research in Medical Sciences 9.19 (2014): 867-74. Print.

Mortazavi, M. M., et al. “Hypertonic Saline for Treating Raised Intracranial Pressure:
Literature Review with Meta-analysis.” Journal of Neurosurgery 116.1 (2012): 210-21. Web.

Rickard, A. C., et al. “Salt or Sugar for Your Injured Brain? A Meta-analysis of Randomised Controlled Trials of Mannitol versus Hypertonic Sodium Solutions to Manage Raised Intracranial Pressure in Traumatic Brain Injury.” Emergency Medicine Journal 31.8 (2013): 679-83. Web.

Roberts, I., et al. “Mannitol for Acute Traumatic Brain Injury.” The Cochrane Database of Systematic Reviews Reviews 8 (2013). Web.

Ropper, A. H. “Management of Raised Intracranial Pressure and Hyperosmolar Therapy.” Practical Neurology 14.3 (2014): 152-58. Web.

*Torre-Healy, A., et al. “Hyperosmolar Therapy for Intracranial Hypertension.” Neurocritical Care Neurocrit Care 17.1 (2011): 117-30. Web.

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