

# Hypertonic Saline is Superior to Mannitol for the Combined Effect on Intracranial Pressure and Cerebral Perfusion Pressure Burdens in Patients With Severe Traumatic Brain Injury

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**BACKGROUND:** Hypertonic saline (HTS) and mannitol are effective in reducing intracranial pressure (ICP) after severe traumatic brain injury (TBI). However, their simultaneous effect on the cerebral perfusion pressure (CPP) and ICP has not been studied rigorously.

**OBJECTIVE:** To determine the difference in effects of HTS and mannitol on the combined burden of high ICP and low CPP in patients with severe TBI.

**METHODS:** We performed a case-control study using prospectively collected data from the New York State TBI-trac<sup>®</sup> database (Brain Trauma Foundation, New York, New York). Patients who received only 1 hyperosmotic agent, either mannitol or HTS for raised ICP, were included. Patients in the 2 groups were matched (1:1 and 1:2) for factors associated with 2-wk mortality: age, Glasgow Coma Scale score, pupillary reactivity, hypotension, abnormal computed tomography scans, and craniotomy. Primary endpoint was the combined burden of ICP<sub>high</sub> (> 25 mm Hg) and CPP<sub>low</sub> (< 60 mm Hg).

**RESULTS:** There were 25 matched pairs for 1:1 comparison and 24 HTS patients matched to 48 mannitol patients in 1:2 comparisons. Cumulative median osmolar doses in the 2 groups were similar. In patients treated with HTS compared to mannitol, total number of days ( $0.6 \pm 0.8$  vs  $2.4 \pm 2.3$  d,  $P < .01$ ), percentage of days with ( $8.8 \pm 10.6$  vs  $28.1 \pm 26.9\%$ ,  $P < .01$ ), and the total duration of ICP<sub>high</sub> + CPP<sub>low</sub> ( $11.12 \pm 14.11$  vs  $30.56 \pm 31.89$  h,  $P = .01$ ) were significantly lower. These results were replicated in the 1:2 match comparisons.

**CONCLUSION:** HTS bolus therapy appears to be superior to mannitol in reduction of the combined burden of intracranial hypertension and associated hypoperfusion in severe TBI patients.

**KEY WORDS:** Cerebral perfusion pressure, Hypertonic saline, Intracranial pressure, Mannitol, Traumatic brain injury

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Traumatic brain injury (TBI) is a significant cause of morbidity and mortality in developed countries and is emerging as a major cause of death in developing countries. More than 500 000 individuals with TBI suffer permanent neurological disability and 50 000 die each year in the United States.<sup>1</sup>

Surgical and medical management of severe TBI has undergone significant advancement in

the last decades as evidenced by decreasing mortality. Development and compliance with the Brain Trauma Foundation guidelines (hereafter referred to as Guidelines) for management of severe TBI has been key in significantly reducing mortality.<sup>2</sup> While primary surgical intervention is aimed at evacuating extra-axial hematomas, the overarching principle of medical management is to treat elevated

**ABBREVIATIONS:** AIS, American Spinal Injury Association Impairment Scale; CBF, cerebral blood flow; CPP, cerebral perfusion pressure; CT, computed tomography; GCS, Glasgow Coma Scale; HTS, hypertonic saline; ICP, intracranial pressure; IQR, interquartile range; ISS, injury severity score; TBI, traumatic brain injury

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