Title: A COMPARISON OF THE CEREBRAL AND HEMODYNAMIC EFFECTS OF MANNITOL AND HYPERTONIC SALINE IN A RABBIT MODEL OF BRAIN INJURY

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Introduction: There has recently been an increased interest in the use of hypertonic saline solutions (HS) for the fluid resuscitation of trauma victims. Many these patients have sustained head injuries in addition to their peripheral injuries and present with intracranial hypertension. Recent experiments have suggested that HS may be useful for reducing intracranial pressure (ICP).[1] We therefore compared the cerebral effects of HS with those of mannitol (M) in an animal model of acute brain injury.

Methods: Following institutional review, 21 New Zealand white rabbits were anesthetized with halothane in oxygen, intubated, and mechanically ventilated with 0.7% halothane in 70% N2O in oxygen. Femoral arterial and central venous catheters were inserted and an ICP monitor placed over the right cerebral hemisphere. A cryogenic lesion was created by the application of liquid nitrogen to the left hemisphere for a period of 90 seconds. 45 minutes later the animals received an infusion of 20% M (2 g/kg) or an equal volume and osmolal load of HS (approx. 3% solution) over a 5 minute period. Saline (S) animals received an equal volume of normal (0.9%) saline. Mean arterial pressure (MAP), ICP, central venous pressure (CVP), arterial blood gases, oncotic pressure, and plasma osmolality (OSM) were recorded prior to the creation of the cryogenic lesion, 45 minutes post-freeze (PF), at the end of the infusion (EI) of M, HS, or S, and at 15, 30, 60, 90, and 120 minutes following the infusion. Upon completion of the 120 minute period, the animals were killed and their brains removed for regional water content determinations using the specific gravity method.

Results: There were no significant differences in MAP between the M, HS or S groups at any point during the experiment. There was a significant increase in CVP during the infusion of HS or M. The PaCO2 was maintained at 35-40 mmHg. ICP increased by 9.2±5.0 mmHg (mean±SD) over the 45 minute period following the application of the liquid nitrogen. The infusion of either HS or M caused a transient decrease in ICP lasting 60-90 minutes whereas animals receiving S demonstrated a continuous increase in ICP (See Fig. 1). Plasma osmolality showed similar changes in both the HS and M groups over the course of the experiment (See Fig. 2). Brain water content was significantly increased in the vicinity of the cryogenic lesion, but no differences could be detected between the various groups at any sampling site.

Discussion: HS appears to be as effective in the control of ICP as M in this animal model of brain injury. As desired, plasma osmolality increased to a similar degree in both M and HS groups following the infusion of either solution and resulted in a decrease in ICP. The inability to detect differences in the regional brain tissue specific gravity may be due to a re-equilibration of water between the intravascular, interstitial and intracellular compartments by 120 minutes. This hypothesis is supported by the fact that no differences in ICP could be detected between the three groups 2 hours after the infusion of M, HS, or S.

References: 1) Zornow MH, Scheller MS, Shackford SR, Moore SS, Bloom AE: Effect of a hypertonic lactated Ringers solution on cerebral edema and intracranial pressure following cryogenic brain injury. Anesthesiology 67:A654, 1987

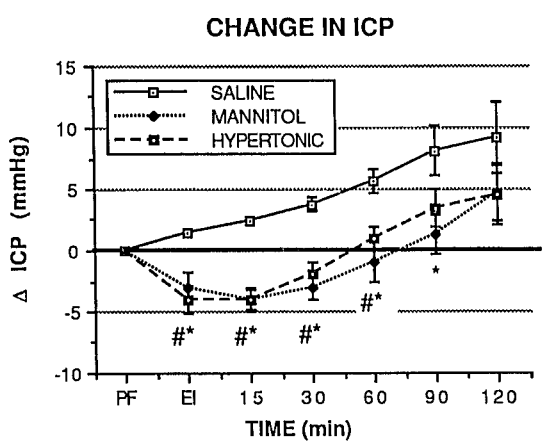

Fig. 1 Changes in ICP (mean ±SEM) over the course of the experiment. PF= 45 minutes post-freeze, EI=end infusion. ΔICP=change in ICP from PF value. #=HS<S, p<0.05, *=M<S, p<0.05. There were no differences between the HS and M groups at any point.

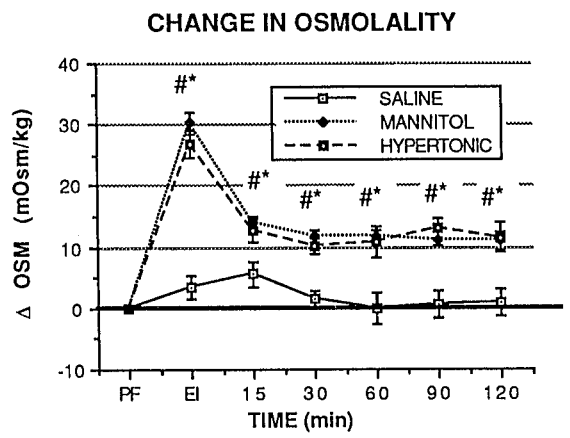

Fig. 2 Changes in plasma OSM (mean ± SEM) over the course of the experiment. PF= 45 minutes post-freeze, EI=end infusion. ΔOSM=change in OSM from PF value. #=HS>S, p<0.05, *=M>S, p<0.05. There were no differences between the HS and M groups at any point.