

COMMENTARY

Is sodium chloride worth its salt?

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See related research by Roquilly *et al.*, <http://ccforum.com/content/17/2/R77>

Abstract

The choice of fluid for resuscitation of the brain-injured patient remains controversial, and the 'ideal' resuscitation fluid has yet to be identified. Large volumes of hypotonic solutions must be avoided because of the risk of cerebral swelling and intracranial hypertension. Traditionally, 0.9% sodium chloride has been used in patients at risk of intracranial hypertension, but there is increasing recognition that 0.9% saline is not without its problems. Roquilly and colleagues show a reduction in the development of hyperchloremic acidosis in brain-injured patients given 'balanced' solutions for maintenance and resuscitation compared with 0.9% sodium chloride. In this commentary, we explore the idea that we should move away from 0.9% sodium chloride in favor of a more 'physiological' solution.

Brain-injured patients present a clinical quandary when it comes to the optimal choice of fluid therapy for resuscitation. It requires careful consideration to strike the balance between volume resuscitation to maintain adequate cerebral perfusion pressure and iatrogenic alterations in the electrolyte status which result in cerebral edema and raised intracranial pressure.

In the previous issue of *Critical Care*, Roquilly and colleagues [1] present a double-blind pilot randomized controlled trial investigating the effects of maintenance and resuscitation with 0.9% sodium chloride versus balanced iso-osmolar solutions on the development of hyperchloremic acidosis in brain-injured patients. The authors showed a statistically significant reduction in hyperchloremic acidosis in the balanced solution group. They also showed no difference in the development of intracranial hypertension or the intracranial pressure in

these patients, although the study was not powered to this end-point. The study adds evidence to the argument for replacing 0.9% sodium chloride solutions with the more 'physiological' balanced electrolyte solutions.

The argument for the use of 0.9% sodium chloride is founded mainly on the fact that it is approximately iso-osmolar to plasma and therefore will not cause an osmotic gradient across the blood-brain barrier which would favor the entry of water into the cerebral tissue and the development of edema which would result in intracranial hypertension and exacerbate secondary brain injury [2,3]. The use of previously available 'balanced' solutions such as Hartmann's solution is not recommended, as they are hypo-osmolar [4].

The problem with 0.9% sodium chloride is that the proportions of sodium and chloride are equal in solution, and administration of large volumes will result in a rise in serum chloride. The lactate, acetate, and gluconate anions that replace chloride in balanced solutions are removed rapidly from the plasma by the liver (which is faster than renal chloride elimination) and this widens the plasma strong-ion difference (SID) and is alkalinizing. Hyperchloremia (relative to serum sodium) results in a metabolic acidosis because of the fall in SID, first described by Stewart in 1983 [5]. Roquilly and colleagues have demonstrated this effect clearly in their study.

It is important to consider the mortality increase demonstrated in some studies with the use of colloids such as hydroxyethyl starch (HES/HAES non-ionic starch derivatives) and albumin over crystalloid solutions in certain patient groups [6,7]. The authors designed their study, which included colloid solutions, before these data were publicly available and acknowledge this potential limitation in their article. Interestingly, a *post hoc* analysis of the SAFE (Saline versus Albumin Fluid Evaluation) trial has implicated albumin in the pathophysiology of post-traumatic, intracranial hypertension [2], increasing interest in crystalloid fluid resuscitation in neurological patients.

Newer balanced electrolyte solutions tend to be closer to isotonic than Hartmann's solution, and it is a reasonable hypothesis that they will not cause an increase in either the incidence or magnitude of intracranial hypertension. It also seems reasonable to hypothesize that

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administering an electrolyte solution that is closer in composition to human plasma will result in a more normal biochemical profile. Recent evidence supports this hypothesis [8]. The problem, however, is that demonstrating a difference (or lack thereof) in a biochemical or physiological variable does not necessarily translate into meaningful benefit to our patients. This commendable pilot study (assessing disease-oriented end-points) should now inform a larger, adequately powered trial with patient-oriented outcomes as the primary end-point.

The increase of randomized controlled trials as the gold standard for answering important clinical questions tops the list of key advances in scientific medicine during the past half century. Neurological critical care has been poor at delivering such trials and therefore robust evidence for many of the interventions we use in patients with acute brain injury [9].

Without evidence of improvement in patient-oriented outcomes such as mortality, morbidity, return to work, quality of life, and cost, we cannot yet wholeheartedly recommend consigning 0.9% sodium chloride to the history books.

Abbreviation

SID, strong-ion difference.

Competing interests

The authors declare that they have no competing interests.

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