

Hypo Versus Isotonic Solutions in Intravenous Fluid Maintenance of Acutely Ill Pediatric Patients

Regina Grigolli Cesar*

PICU of Sabará Children's Hospital, Brazil

Submission: March 19, 2017; Published: April 21, 2017

*Corresponding author: Regina Grigolli Cesar, PICU of Sabará Children's Hospital, Santa Casa de São Paulo School of Medicine, Rua Corumbatai, 57, Lapa, SÃo Paulo, SP, Zip code: 05076-040, Brazil, Email: reginautiped@uol.com.br

Abstract

This brief review had as objective to remember the position of some experts in fluid resuscitation at the question about which is the better saline solution, i.e., with less risk of potentially lethal complications related to hypo or hypernatremia, that guarantee the maintenance of hydroelectrolytic homeostasis in acute ill pediatric patients. In the last decades, "hypotonic" and "isotonic" saline solutions has been investigated and its effects compared, but seems that the remaining issue is beyond its tonicity, and refers to more about which, in what phase and clinical condition, a specific saline solution is more physiologic, or in other words, effective and safe.

Keywords: Hypotonic solutions; Isotonic solutions; Hyponatremia; Hypernatremia; Pediatrics

Abbreviations: RCT: Randomized Controlled Trials; ADH: Antidiuretic Hormone; SIADH: Syndrome of Inappropriate Antidiuretic Hormone Secretion; ECF: Extra Cellular Fluid

Introduction

Basic principles on the prescription of parenteral maintenance fluids in children has been investigated for decades. M.A. Holliday & W.E. Segar, in 1957, published. The Need for Water Maintenance in Parenteral Fluid Therapy [1], presenting a simple formula that results in a hypotonic saline solution equivalent to NaCl 0.2% and dextrose 5% in water, which became widely accepted and used, but a variable incidence of hyponatremia has been reported among cases maintained with this fluid. In a review of literature published in 2003 [2], it was concluded that isotonic saline solution may be used, instead of hypotonic fluid, as an ideal fluid of maintenance.

Hypotonic versus isotonic saline solutions

In 2004, in an observational study [3] involving 1586 children in an emergency department, the administration of hypotonic fluid was the principal risk factor for hyponatremia. Last than 1 year after, M.A. Holliday [4] published a letter to the editor suggesting that the hyponatremia in that study [3] could be result of limited water renal excretion due to non-osmotic ADH stimulation in cases of hypovolemia or fast and great expansion of the extracellular fluid in children acute ill and mild hypovolemia, similarly (although less intense) in severe dehydration, burning and septic shock. The author [4] argues

too that, after the expansion of extracellular compartment, the hypotonic saline solution is safe to maintenance, and that the term "maintenance", as used in that review [2] does not correspond to the original meaning according to the pioneering works of Gamble, Darrow, Butler and other authors of the 1940s, as a reposition of insensible and urinary losses after rehydration (expansion of ECF). The author [4] remember that the reposition of hypotonic losses with isotonic saline solution would impose an excessive load of sodium, potential risk factor to cerebral damage and death.

According the last extensive review [5], including among others more than 15 RCTs involving at least 2000 patients, majority of whom were surgical and critical care pediatric patients, the prevalent practice is still the administration of intravenous hypotonic fluids in both children and adults, despite the high incidences of iatrogenic hyponatremia. Isotonic fluids has been more effective in preventing hyponatremia, and are not associated with development of hypernatremia or fluid overload. In contrast, rapid volume expansion or high volume of fluid in resuscitation or during surgery using normal saline may be associated with hyperchloremic metabolic acidosis, renal vasoconstriction, decreased urine output, hyperkalemia, and increased incidence of acute renal injury requiring renal

replacement therapy. Although balanced solutions are an isotonic alternative, data are lacking that support their superiority as maintenance fluids relative to normal saline [5-7].

A proposed alternative explanation for the occurrence of iatrogenic hyponatremia or hypernatremia, could be a calculation error of maintenance fluids for a given patient, it being necessary, at first, to define and reach the desired state of equilibrium to calculate the volumes and electrolyte content, and then recalculate the supply at regular intervals considering the urinary sodium and potassium excretion and the flow rate in the calculation of free, negative or positive water clearance, and isotonic losses. The best guidance for avoiding serious complications would be an algorithm for constructing a therapeutic plan for each patient in particular [8].

Conclusion

The question “which is the better solution for maintenance of hydroelectrolytic balance” is often presented as “hypo versus isotonic solutions”, what can suggest a reductionism of the issue in a simple problem of tonicity of fluid (sodium concentration in the intravenous solution) compared to the plasmatic sodium concentration. It would be remembered that, once in the bloodstream, sodium is the main determinant of extracellular compartment volume, and the water determines its tonicity [9,10]. Thus, better it could be asking which fluid can be considered physiological, isotonic or not, in each clinical condition, in each phase of the water and electrolytes supply, ever considering a balance between lost and gain. This still requires further investigations.

References

1. Holliday MA, Segar WE (1957) The maintenance need for water in parenteral fluid therapy. *Pediatrics* 19(5): 823-832.
2. Moritz ML, Ayus JC (2003) Prevention of Hospital-Acquired Hyponatremia: A Case for Using Isotonic Saline. *Pediatrics* 111(2): 227-230.
3. Hoorn EJ, Geary D, Robb M, Halperin ML, Bohn D (2004) Acute hyponatremia related to intravenous fluid administration in hospitalized children: an observational study. *Pediatrics* 113(5): 1279-1284.
4. Holliday MA (2005) Isotonic Saline Expands Extracellular Fluid and Is Inappropriate for Maintenance Therapy. *Pediatrics* 115(1): 193-194.
5. Moritz ML, Ayus JC (2015) Maintenance intravenous fluids in acutely ill patients. *N Engl J Med* 373(14): 1350-1360.
6. Chua HR (2016) Maintenance intravenous fluids in acutely ill patients. *N Engl J Med* 21 374(3): 289.
7. Lief (2016) Maintenance intravenous fluids in acutely ill patients. *N Engl J Med* 21 374(3): 289-290.
8. Seifter JL (2016) Maintenance intravenous fluids in acutely ill patients. *N Engl J Med* 21 374(3): 289-291.
9. Feld LG, Friedman A, Massengill SF. (2011) Disorders of water homeostasis. In: LG Feld & FJ Kaskel (Eds.), *Fluid and Electrolytes in Pediatrics. A Comprehensive Handbook*. Humana Press – Springer, New York, NY, USA, p. 3-46.
10. Gordillo R, Kumar J, Woroniecki RP (2011) Disorders of sodium homeostasis. In: LG Feld & FJ Kaskel (Eds.), *Fluid and Electrolytes in Pediatrics. A Comprehensive Handbook*. Humana Press – Springer, New York, NY, USA, p. 47-65.



This work is licensed under Creative Commons Attribution 4.0 License
DOI: [10.19080/JAICM.2017.02.555589](https://doi.org/10.19080/JAICM.2017.02.555589)

Your next submission with Juniper Publishers will reach you the below assets

- Quality Editorial service
- Swift Peer Review
- Reprints availability
- E-prints Service
- Manuscript Podcast for convenient understanding
- Global attainment for your research
- Manuscript accessibility in different formats
(Pdf, E-pub, Full Text, Audio)
- Unceasing customer service

Track the below URL for one-step submission

<https://juniperpublishers.com/online-submission.php>