

Maintenance Intravenous Fluids in Children, Should We Change?

Tawfiq Taki Al-Lawati^{1*} and Adawiya Al Jamie²

¹Department of Child Health, Royal Hospital, Muscat, Oman

²Department of Child Health, Nizwa Hospital, Nizwa, Oman

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Maintenance intravenous fluids (IVFs) are an integral part of daily hospital care for sick children. Children who are awaiting surgery and kept nil per oral or children who cannot or should not take orally for various clinical conditions are kept on IVFs.

The type of maintenance IVFs chosen for children was historically based on sodium chloride (NaCl) and fluid requirements of the patients as estimated by Holliday and Segar in 1957.¹ Solutions containing NaCl concentrations including 0.18%, 0.2%, 0.3%, 0.45%, and 0.9% have been used for children with different clinical conditions.

Solutions containing sodium concentrations close to the human serum sodium concentration of 135–145 mmol/L are collectively called isotonic solutions. Isotonic solutions include 0.9% NaCl containing 157 mmol/L and Ringer's lactate containing 130 mmol/L NaCl.² Ironically, although being called isotonic solutions, neither 0.9% NaCl nor Ringer's lactate have sodium content in the range of normal human serum. A sodium concentration of 157 mmol/L in 0.9% solution is actually suprphysiological and also contains suprphysiological amounts of chloride. On the other hand solutions containing less sodium than the above 'isotonic' solutions are called as hypotonic solutions and include 0.18%, 0.2%, 0.3%, and 0.45% NaCl solutions.

In the early 1990s, concerns were raised about using different kinds of hypotonic IVFs, with few children developing devastating outcomes like hyponatremic encephalopathy and death.³

More reports of hyponatremia emerged during the early years of the millennium about children admitted to the intensive care unit who were not on 0.9% NaCl.^{4,5} Authors hence advocated for the

use of 0.9% NaCl as a safer option in response to iatrogenic hyponatremia in children, particularly the critically ill.⁶

The American Academy of Pediatrics (AAP) in 2018 reviewed the meta-analyses and randomized controlled trials looking at the use of isotonic versus hypotonic IVFs in children. The AAP recommended using 0.9% NaCl or isotonic solutions as maintenance fluids in children aged one month to 18 years of age.² Studies that were reviewed in the guidelines included children who were on different hypotonic maintenance fluids, including 0.18% NaCl. The guidelines excluded children with neurosurgical disorders, congenital or acquired, cardiac disease, hepatic disease, cancer, renal dysfunction, diabetes insipidus, voluminous watery diarrhea, severe burns, neonates younger than 28 days old, or in the neonatal intensive care unit.²

The guidelines also directed future research addressing the suitability of a 0.9% NaCl solution for children and the risk of hypernatremia, acidosis, or other complications from such fluids.²

Like many parts of the world, the tertiary hospitals in Oman have recently adopted the AAP guidelines and started using 0.9% NaCl in children for fear of hyponatremia-related brain injury when using hypotonic saline solutions.

Previously, the standard practice in Oman was to use 0.45% NaCl as the maintenance solution for children and no other hypotonic solutions. Although many clinicians in Oman report that they have not encountered the side effects reported by other studies of iatrogenic hyponatremia, they are all concerned about the safety of their patients. On the other hand, clinicians are concerned that using suprphysiological concentrations of 0.9% NaCl

might lead to unintended hypernatremia, particularly in smaller children. Hyperchloremia, in addition, has been associated with increased mortality in sick children.⁷ These concerns are significant as IVFs in pediatric patients need continuous assessment as younger children's conditions are dynamic.

The AAP recommendations have excluded many patient categories that are commonly admitted in the Omani hospitals, leaving a narrow spectrum of patients who fulfill the AAP criteria for 'isotonic' solutions. Hence, any change in the child's condition can easily exclude him/her from the AAP recommendations of 0.9% NaCl solution, such as when the child develops diarrhea, renal dysfunction, or seizures while in hospital.

Furthermore, unlike the American and European systems, the pediatric practice in Oman is limited to 13 years old, with a substantial number of children admitted under the age of two years or weighing < 10 kg.

All of the above facts and in line with the AAP who advocated further research in the new practice of using 'isotonic' saline, we advocate that secondary and tertiary hospitals in Oman review and audit their local data regarding hyponatremia before embarking on significant changes in practice. A robust protocol for monitoring all these patients should also be put in place alongside the new practice.

Furthermore, conducting randomized, double-blind studies in our local population comparing 'isotonic' saline with the current 0.45% NaCl solution is worthwhile. Local data will have a better impact on decision-making on changing fluids and potentially causing harm to our patients.

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