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Reducing Errors in Fluid Therapy Management

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COMMENTARY

Opinions expressed in this commentary are those of the author and not necessarily those of the American Academy of Pediatrics or its Committees.

Reducing Errors in Fluid Therapy Management

ABBREVIATION. ECF, extracellular fluid.

The article by Moritz and Ayus in this month's issue of *Pediatrics*[1] noted errors in fluid therapy management causing hyponatremia, brain damage, and death in previously well children who had been hospitalized with an acute illness or for elective surgery. The authors have done a service in calling attention to the problem. However, their proposal to avoid this complication, using 0.9% saline rather than standard 0.25% saline[2] for meeting maintenance fluid needs would, in our view, do more harm than good. The risk for other errors would increase.

Many children who were cited in their report suffered because of egregious errors in management, not from conventional fluid therapy.[3] Children with acute problems that require fluid therapy commonly have central nervous system, pulmonary, or gastrointestinal illness; injuries requiring surgery; or are admitted for elective surgery. Some have plasma dislocated to interstitial fluid from accompanying inflammation, whereas others have losses of extracellular fluid (ECF) or a prolonged period with little or no intake. These factors elicit a nonosmotic stimulus to antidiuretic hormone secretion that impairs free water clearance,[4] making these children vulnerable to hyponatremia.

Current practice would promptly treat many of these children initially by expanding ECF volume with 20 to 40 mL/kg 0.9% saline, minimizing this vulnerability. For those going to surgery, current practice would continue the infusion of 0.9% saline throughout surgery in the event of shock, need for intravenous medication, or an unanticipated error in infusion. An additional safeguard would be to give half the average recommended maintenance fluid (50 instead of 100 mL/100 kcals per day) for the first day and monitor serum sodium daily should the need for fluid therapy continue.

Our recommendations are broader than those of Moritz and Ayus[1] to avoid other errors in fluid therapy. These errors include hypernatremia, inadequate expansion of ECF in dehydration and shock, and gross overload of circulation in patients whose prescriptions are not properly indexed to the patient's size or clinical state.

Hypernatremia, like hyponatremia, is a cause of brain injury and death.[5] The common cause of hyponatremia is excess salt intake. Because hypernatremia is reported in children with sodium chloride intakes[6] well below those that would follow from the recommendations of Moritz and Ayus,[1] their regimen would incur that risk.

In the last few decades, it has become standard practice to give more generous prescriptions of 0.9% saline to infants with moderate to severe dehydration.[7] We have recommended giving 60 to 100 mL/kg in the first 2 to 4 hours.[8] Other physicians treating children with burn[9] or septic shock[10] have recommended giving 60 to 200 mL/kg in 2 to 4 hours to restore circulation. These regimens more quickly restore perfusion of the gastrointestinal tract and kidneys; early oral feedings then are readily tolerated and acute acidosis is quickly repaired. The nonosmotic stimulus to antidiuretic hormone release is removed; mortality is decreased.

Patients needing fluid therapy today are more likely to include children with chronic disease: bronchopulmonary dysplasia, asthma, congenital heart disease, and renal insufficiency. These patients have lower tolerance for excess water or saline.

The maintenance regimen we proposed in 1957,[2] indexing maintenance requirements to estimated calorie expenditure,[a] antedated the introduction of rapid ECF expansion. Oral rehydration therapy, which has been introduced since then, has shortened the course of intravenous fluid therapy—often to less than a day. However, for those needing parenteral fluid therapy for longer periods, the original regimen remains appropriate.

The electrolyte intakes per 100 kcals proposed by this maintenance regimen are: sodium, 3; potassium, 2; chloride, 2 meq/100 cals per day.[2] These intakes were questioned by Moritz and Ayus[1] as, perhaps, too little. The sodium and chloride intakes are twice that provided by human milk and are adequate unless losses of body fluids are appreciable.

The current practices we cite minimize the risk for hyponatremia and do not incur the risk of hyper-

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[a] 3–10 kg- 100 kcals/kg; 12–20 kg: 1000 kcals + 100 kcals/2 kg > 10; 25–70 kg: 1500 kcals + 100 kcals/5 kg >20 kg. For example, 12kg- 1100 kcals; 25 kg- 1600 kcals, 45 kg- 2000 kcals, 70 kg –2500 kcals.

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natremia. They set standards for rapid ECF expansion when that is indicated and limit overload that causes pulmonary congestion. These principles are a safer preventive for hyponatremia than using 0.9% saline for maintenance therapy.

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Love SM. Preventive medicine, properly practiced. *New York Times*. July 16, 2002

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ERRATUM

An error occurred in the commentary by Holliday and Segar titled "Reducing Errors in Fluid Therapy Management," which appeared in the February 2003 issue (*Pediatrics.* 2003;111:424–425). On page 424, in the right column, second paragraph, the second sentence in the paragraph reads: The common cause of hyponatremia is excess salt intake. That sentence should now read: The common cause of hypernatremia is too much salt intake.

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