

Fluid Management in Pediatric Urology: A Review of the Literature and Call for a Change in Practice

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Abstract

Introduction: We investigate the intravenous fluid ordering practices of pediatric urologists. We also provide evidence for the use of isotonic fluids and, thus, establish a new standard for the field.

Methods: An online questionnaire was distributed via the listserv of the American Academy of Pediatrics Section on Urology. For 3 patient scenarios the respondents were asked to select which intravenous fluid they would prescribe and which infusion rate they would choose. Fluid choices were listed as lactated Ringer solution, normal saline, 0.45% normal saline, 5% dextrose in lactated Ringer solution, 5% dextrose in 0.45% normal saline, none and other (with write-in option). Infusion rate choices were listed as maintenance (defined according to the Holliday-Segar 4-2-1 nomogram), $\frac{1}{2}x$ maintenance, 1.5x maintenance, 2x maintenance and other (with write-in option). A final question probed physician reason(s) for selections.

Results: The survey had a 35% response rate. The majority of respondents use 5% dextrose in 0.45% normal saline, and the most common infusion rate is 1.5x maintenance. Additionally, choices for fluid use and infusion rate were based on a combination of physician training and personal experience. Only 13% of respondents stated that they routinely avoid isotonic fluids. A PubMed® literature search demonstrated that the general pediatric and surgical specialty literature discourages hypotonic fluids and favors the judicious use of isotonic hydration and dextrose.

Conclusions: A change in pediatric urology needs to occur such that isotonic fluids at maintenance rate become the standard, with the addition of dextrose and/or increasing of rate only for carefully selected patients.

Key Words: perioperative care, pediatrics, hypotonic solutions, isotonic solutions

Abbreviations and Acronyms

ADH = antidiuretic hormone

D5 $\frac{1}{2}$ NS = 5% dextrose in 0.45% normal saline

LR = lactated Ringer solution

NS = normal saline

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Intravenous fluid is a key part of treating a postoperative patient. However, currently there is little discussion in the pediatric urology literature about what is optimal. Historically, hypotonic fluids have been recommended for children due to their inherently higher free water requirements.¹ However, several studies in the literature of general pediatrics and other surgical subspecialties have shown that hypotonic fluids predispose children to hyponatremia.^{2–11} This tendency is worsened in the patient after surgery due to the influences of the “third space” and the nonphysiological secretion of antidiuretic hormone.

The lack of information in the literature regarding parenteral prescribing practices led us to question what pediatric urologists are using. Are hypotonic fluids still being issued? Is there any consistency in the field? We provide a definitive answer to these questions and standardize fluid use among pediatric urologists to provide the best care and outcomes for our patients.

Methods

An online questionnaire was sent to the listserve of the American Academy of Pediatrics Section on Urology. The email was sent once in February 2014 and again the following month. Respondents were asked to select which intravenous fluid they prescribe routinely, and the rate at which they order the fluids to infuse in 3 case scenarios, including 1) a 1-year-old girl undergoing bilateral ureteral reimplantation, 2) a 6-month-old boy undergoing pyeloplasty and 3) a 7-year-old girl undergoing ileocystoplasty with appendicovesicostomy.

The choices of fluids were listed as LR, NS, 0.45% normal saline, 5% dextrose in LR, 5% dextrose in 0.45% normal saline, none and other (with write-in option). Options for the infusion rate were listed as maintenance (according to the Holliday-Segar 4-2-1 nomogram,¹ $\frac{1}{2}x$ maintenance, 1.5x maintenance, 2x maintenance and other (with write-in option). The last question of the survey asked the physicians to clarify their reasoning for their choices of fluids.

Results

A total of 68 members of the Section of Urology of the American Academy of Pediatrics are registered for the listserve. We had a 35% response rate. The results for the types of fluids chosen and the selections for the rates at which they are infused are shown in the table.

For all 3 cases the majority of pediatric urologists opted for D5 $\frac{1}{2}$ NS. Three urologists chose isotonic fluids (NS or LR) across the board and several chose the same type of fluid

	No./Total No. (%)		
	Case 1	Case 2	Case 3
Type of fluid:			
LR	2/24 (8)	2/24 (8)	2/24 (8)
NS	1/24 (4)	1/24 (4)	2/24 (8)
D5LR	1/24 (4)	-	2/24 (8)
D5 $\frac{1}{2}$ NS	16/24 (67)	15/24 (63)	13/24 (54)
Other	4/24 (17)	6/24 (25)	5/24 (21)
Fluid rate:			
Maintenance	5/24 (21)	15/24 (63)	12/24 (50)
$\frac{1}{2}x$ Maintenance	1/24 (4)	1/24 (4)	-
1.5x Maintenance	15/24 (63)	8/24 (33)	10/24 (42)
2x Maintenance	-	-	2/24 (8)
Other	3/24 (13)	-	-

in each scenario, changing only the rates. Two of the urologists who would order “other” solutions used D5 $\frac{1}{2}$ NS with 20 meq potassium chloride. One physician chose NS with 5% dextrose and a fourth selected 5% dextrose in 0.2% normal saline.

For case 1 the majority of respondents chose to infuse the fluids at rate of 1.5x maintenance. Two of those in the other category chose a slower rate at 1.25x maintenance, while the last respondent in that category suggested a specific, varied regimen of 2x maintenance for the first 4 hours then 1.5x maintenance for 4 hours then maintenance.

There was less variability in prescribing practices in the latter 2 cases. The majority of respondents selected for the fluids to run at maintenance. In both cases the greater part of the remaining responses was in favor of an infusion rate of 1.5x maintenance. The sole remaining urologist in case 2 opted for $\frac{1}{2}x$ maintenance, while the last 2 urologists in case 3 chose a rate of 2x maintenance.

The explanations for fluid choice and infusion rate were varied. However, the majority of urologists (20 of 24) stated that their practice habits were formed by their personal experience compounded with how they were taught during training. One respondent cited the child’s age and type of surgery as the basis for his choices. Three urologists defended their choices by asserting that hypotonic fluids are to be avoided.

Discussion

Although a routine part of treating postoperative patients is ordering parenteral fluids, there are no standardized guidelines in pediatric urology on which fluids a child should receive. Commonly, children are prescribed hypotonic fluids, ie with an osmolarity less than that of the extracellular fluid. This practice stems from the findings of Holliday and Segar that children have greater free water requirements.¹ However, several studies in the current

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