



## Monitoring serum electrolyte levels in pediatric inpatients receiving IV fluids: A hospital based prospective study.

### KEYWORDS

Hyponatremia, IV Fluids, electrolyte imbalance

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### ABSTRACT

**BACKGROUND:** Managing fluids and electrolytes in children is an important skill for the treating pediatrician, who can play an important role in monitoring therapy. Increasing evidence has shown that hypotonic maintenance fluids can lead to potentially fatal hyponatremia in cases of excess antidiuretic hormone (ADH) production. Although it is well established that isotonic saline should be used for fluid resuscitation in children to raise circulatory volume while preventing the development of hyponatremia, it has not been an accepted practice to use isotonic saline as a maintenance fluid. Hence, this study was done to evaluate the effectiveness of IV fluid in managing electrolyte imbalance.

**METHODOLOGY:** A hospital based prospective study was done on 50 children admitted in the Pediatric ward, receiving IV fluids. Serum electrolytes were tested for the children at the time of admission and after 24 hours of starting IV fluids.

**RESULTS:** There was statistically significant improvement in serum sodium levels following administration of IVF from  $139.7 \pm 3.2$  mg/dl to  $140.8 \pm 2.7$  mg/dl with a p value of 0.001 (strongly significant); an improvement of  $1.14 \pm 1.04$  mg/dl for those children receiving isotonic fluid.

**CONCLUSION:** Appropriate use of IV fluids is important to avoid electrolyte imbalance especially hyponatremia in hospitalised children.

### INTRODUCTION

Intravenous (IV) maintenance fluids are designed to provide free water and electrolyte requirements in a fasting patient. The prescription for IV maintenance fluids was originally described in 1957 by Holliday and Segar, who equated free water requirements from energy expenditure in healthy children. The Holliday-Segar system remains the most universally used to date, because of the simplicity of their formula. (1)

Managing fluids and electrolytes in children is an important skill for the treating physician, who can play an important role in monitoring therapy. Fluid therapy is divided into maintenance, deficit, and replacement requirements. The Holliday-Segar equation remains the standard method for calculating maintenance fluid requirements. Maintenance intravenous (IV) fluids are designed to maintain homeostasis when a patient is unable to uptake required water, electrolytes, and energy. After Holliday and Segar made recommendations for maintenance fluid in children, hypotonic fluids are still the most commonly prescribed IV fluids for pediatric hospitalized patients. (2,3)

The numbers of deaths and significant neurological sequelae from hospital acquired hyponatremia in children receiving hypotonic maintenance solutions have increased in the past 10 years. Hyponatremia is the most frequently encountered electrolyte disorder in hospitalized patients and suggests that there is a surplus of water and /or a deficit of Na<sup>+</sup> in the extracellular fluid (ECF) compartment. (4)

Fluid and electrolyte therapy is an essential component in the care of hospitalized children, and a thorough understanding of the changing requirements of growing children is fundamental in appreciating the many important pharmacokinetic changes that occur from birth to adulthood. While there are many factors that contribute to the fluid and electrolyte needs of children, approaching this therapy in a systematic, organized fashion can help physicians meet ongoing as well as changing needs of the patient. Organizing fluid therapy into maintenance, deficit, and replacement requirements, and then monitoring the patient for response to therapy makes fluid therapy

manageable. (4,5)

Inappropriate IV fluid therapy (incorrect volume or incorrect type of fluid) is one of the main causes of morbidity and mortality in hospitalised children. Administration of the wrong type of fluid results in derangement of serum sodium concentration, which, if severe, leads to serious neurological injury. So it is important to have a basic understanding of the different IV fluids and to choose the fluid most appropriate to the patient's needs. Proper fluid management plays very vital role in treatment of all critical patients. Goal of fluid therapy is to provide the right amount of the right fluid at the right time. Basic principle of fluid therapy is that fluid replacement should be as close as possible in volume and composition to those fluids lost for given patient. (4,5,6)

### METHODOLOGY:

This study was conducted in the department of Pediatrics at Yenepoya Medical College & Hospital, Mangalore during the study period of January 2017 to March 2017. Ethical clearance was obtained from Institutional Ethical committee. An informed consent was obtained from the parents before conducting the study. Parents were given the free choice of participation in the study. Parents were also given the choice to withdraw from the study at any time.

This study was conducted on 50 children admitted in Pediatrics ward.

### Inclusion criteria

50 children of age group 1 month to 15 years admitted in Pediatric ward who received IV fluids.

### Exclusion criteria

Children with following features were excluded from the study;

1. Hemodynamic instability
2. Diabetes mellitus or Diabetes insipidus
3. Kidney failure
4. Received IV fluids in preceding 3 hours
5. On diuretics.

The IV fluids used for the study were Normal saline, Ringer's lactate solution, Isolyte-p, DNS and ½ DNS. Serum electrolyte levels were tested at the time of admission before starting IV fluids and it was repeated after 24 hours of starting IV fluids. 2ml of heparinised sample of blood was taken from the chosen subjects following which Ion Selective Electrode method was performed to check the serum electrolyte levels.

**STATISTICAL ANALYSIS**

Data was analysed by test parameters (proportions, sensitivity, specificity, positive and negative predictive value) and statistical analysis was done using Paired t test.

**RESULTS**

Following the inclusion and exclusion criteria, 50 pediatric patients were chosen for the study. Serum electrolyte levels were checked at the time of admission and 24 hours post administration of IV fluids. Isotonic solutions were used predominantly in the study. About 60% (n=30) of children received isotonic fluid.

Paired t test was done to compare between serum electrolyte levels before and after 24 hours of starting IV fluids.

**Paired Samples Test**

**Table 1:** showing paired difference of serum electrolytes at the time of admission and 24 hours after starting IV fluids.

		Paired Differences				T	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	Na – sodium	-1.1400	1.0499	.14849	-1.43840	-.84160	-7.677	49	.001
Pair 2	K – potassium	-.0200	.13248	.01874	-.05765	.01765	-1.067	49	.291
Pair 3	Cl – chloride	.3000	1.88712	.26688	-.23631	.83631	1.124	49	.266

There is statistically significant improvement in serum sodium following administration of IVF from 139.7 ± 3.2 mg/dl to 140.8 ± 2.7 mg/dl with a p value of 0.001 (strongly significant); an improvement of 1.14 ± 1.04 mg/dl in the sodium levels.

**DISCUSSION**

Hyponatremia occurs because of a deficit in sodium or a potassium balance of electrolyte free water. Many studies have shown that serum electrolyte imbalance; especially hyponatremia is a common problem in hospitalised children. The role of hypotonic parenteral solutions in the pathogenesis of hospital-acquired hyponatremia in children has been much debated for almost two decades, but there has been a paucity of prospective trials evaluating the safety of common maintenance solutions for children.

In a study done by Choong et al, it was seen that isotonic fluids were significantly safer than hypotonic fluid in preventing hospital acquired hyponatremia. A total of 258 patients were enrolled and assigned randomly to receive hypotonic or isotonic fluid in the study. Hypotonic saline increased the risk of hyponatremia, compared with the isotonic fluid. (4)

Wang et al in another study showed that isotonic fluids are safer than hypotonic fluids in hospitalised children requiring maintenance I.V fluid therapy. In the study there was significantly greater fall in serum sodium in children who received hypotonic IV fluid compared to isotonic fluid. (5)

**CONCLUSION**

Hyponatremia is a common preventable condition in hospitalized pediatric patients. The administration of Isotonic fluids as

maintenance fluid helps in overcoming Hyponatremia. However, serum electrolytes should be evaluated at the time of admission, according to which appropriate IV fluid should be administered.

**REFERENCES**

- Moritz ML, Ayus JC. Prevention of hospital-acquired hyponatremia: a case for using isotonic saline. *Pediatrics*. 2003 Feb 1;111(2):227-30.
- Choong K, Arora S, Cheng J, Farrokhlyar F, Reddy D, Thabane L, Walton JM. Hypotonic versus isotonic maintenance fluids after surgery for children: a randomized controlled trial. *Pediatrics*. 2011 Nov 1;128(5):857-66.
- Hoorn EJ, Geary D, Robb M, Halperin ML, Bohn D. Acute hyponatremia related to intravenous fluid administration in hospitalized children: an observational study. *Pediatrics*. 2004 May 1;113(5):1279-84.
- Choong K, Kho ME, Menon K, Bohn D. Hypotonic versus isotonic saline in hospitalised children: a systematic review. *Archives of disease in childhood*. 2006 Oct 1;91(10):828-35.
- Wang J, Xu E, Xiao Y. Isotonic versus hypotonic maintenance IV fluids in hospitalized children: a meta-analysis. *Pediatrics*. 2013 Dec 1:peds-2013.
- Moritz ML, Ayus JC. Prevention of hospital-acquired hyponatremia: do we have the answers?. *Pediatrics*. 2011 Nov 1;128(5):980-3.
- Pandya S. Fluid Therapy in Medical Disorders.
- Holliday MA, Segar WE. The maintenance need for water in parenteral fluid therapy. *Pediatrics*. 1957 May 1;19(5):823-32.
- Wallace WM. Quantitative requirements of the infant and child for water and electrolyte under varying conditions. *American journal of clinical pathology*. 1953 Nov 1;23(11):1133-41.
- Darrow DC, Pratt EL. Fluid therapy: relation to tissue composition and the expenditure of water and electrolyte. *Journal of the American Medical Association*. 1950 Jun 3;143(5):432-9.
- Choong K, Kho ME, Menon K, Bohn D. Hypotonic versus isotonic saline in hospitalised children: a systematic review. *Archives of disease in childhood*. 2006 Oct 1;91(10):828-35.