Original Article

Indian Journal of Trauma and Emergency Pediatrics
Volume 10 Number 1, January - March 2018
DOI: http://dx.doi.org/10.21088/ijtep.2348.9987.10118.2

Incidence of Hyponatremia in Hospitalized Children Receiving Multiple Electrolytes and Dextrose Versus Ringer Lactate Fluid for Maintenance Therapy

Charanraj Honnalli*, Chetakkadbasalbasavaraja, M.D. Ravi***, Sachin. S. Hatti******

Abstract

Introduction: It has now become apparent that the majority of hospital-acquired hyponatremia in children is iatrogenic and due in large part to the administration of hypotonic fluids to patients with elevated Arginine vasopressin levels (AVP). The practice of administering hypotonic parental fluids was established over 50 years ago, before recognition of the fact that there are numerous potential stimuli for AVP production in most hospitalized patients. *Methodology:* Hospitalized children who fulfilled inclusion criteria and not having any of the exclusion criteria were considered for the enrolment after written informed consent. Venous blood samples were taken at enrolment for estimation of serum sodium, potassium, chloride, blood sugar, blood urea, serum creatinine. *Results:* The incidence of hyponatremia in group B was highly significant 25% (p value 0.006) in comparison with group A (RL) which was only 6.66% and was not significant. The incidence of hyponatremia in group B was highly significant 30% (p value 0.049) in comparison with group A (RL) which was only 15% and was not significant. *Conclusion:* There is significant increase in the hospital stay in hyponatremic patients more so in group B.

Keywords: Hyponatremia; Multiple Electrolytes; Maintenance Therapy.

Introduction

Hyponatremia is the most common electrolyte abnormality encountered in childrens [1].

Recent data have determined that hyponatremia is a more serious condition than previously believed. Hyponatraemia arises in 20% to 45% of sick hospitalized children [2].

It has now become apparent that the majority of hospital-acquired hyponatremia in children is iatrogenic and due in large part to the administration of hypotonic fluids to patients with elevated Arginine vasopressin levels (AVP) [3].

Author Affiliation: *Assistant Professor ****Senior Resident, Department of Pediatrics, Khaja Banda Nawaz Institute of Medical Sciences, Kalburagi , Kalaburagi, Karnataka 585104, India. **Assistant Professor ***Professor, Department of Pediatrics, JSS Medical College, Mysuru, Karnataka 570015, India.

Corresponding Author: Charanraj Honnalli, Assistant Professor, Department of Pediatrics, Khaja Banda Nawaz Institute of Medical Sciences, Kalburagi , Kalaburagi, Karnataka 585104, India.
E-mail: charanrajhunnalli.5@gmail.com

Received on 09.05.2018, **Accepted on** 23.05.2018

The practice of administering hypotonic parental fluids was established over 50 years ago, before recognition of the fact that there are numerous potential stimuli for AVP production in most hospitalized patients [4].

Recent prospective studies have demonstrated that administration of 0.9% sodium chloride in maintenance fluids can prevent the development of hyponatremia [3].

There is a growing concern regarding development of hyponatremia in children on the maintenance fluid therapy with 0.2% normal saline (most of the commercially available maintenance fluids). This stems from the following issues [5]:

- It is believed that especially in an older child the requirement of sodium is more than 0.2% Normal Saline.
- Utilization of dextrose in maintenance fluid makes this fluid all the more hypotonic in vivo.
- Release of vasopressin during stress (not uncommon during illness) leads to retention of free water causing hyponatremia.

Hence maintenance fluid in older child should contain 0.45% normal saline with 5% dextrose [6].

Hospital-acquired hyponatremia can be lethal. There have been multiple reports of death or permanent neurological impairment in both children and adults. The main factor contributing to the development of hospital acquired hyponatremia is routine use of hypotonic fluids in patients in whom the excretion of free water, which is retained in response to excess Arginine vasopressin (AVP), might be impaired. Virtually all neurological morbidity resulting from hospital-acquired hyponatremia has been associated with administration of hypotonic fluids. Patients at greatest risk of developing hyponatremic encephalopathy following hypotonic fluid administration includes children [4].

There are very few studies regarding the incidence of hyponatremia in hospitalised children on maintenance IV fluids especially in India.

Hence, this study was undertaken to emphasize the importance of focussing on hyponatremia in hospitalised children on IV fluids.

Methodology

Hospitalized children who fulfilled inclusion criteria and not having any of the exclusion criteria were considered for the enrolment after written informed consent. Venous blood samples were taken at enrolment for estimation of serum sodium, potassium, chloride, blood sugar, blood urea, serum creatinine.

After randomization into two groups, 60 children in each group were allocated using computer generated random numbers. one group of children received Ringer Lactate (of same brand Baxter)at standard maintenance rate [using Holiday Segar Formula. The second group of children received Multiple Electrolytes And Dextrose (of same Brand Baxter) at standard maintenance rate. Serum Na+, K+ Cl, were estimated every 12 hourly by ion specific electrode method, till the patient was on intravenous fluid therapy and 12 hrs after stopping intravenous maintenance fluids. Serum osmolality was estimated every 24 hrs.

The end point was: Cessation of intravenous fluid or Occurrence of hyponatremia.

The outcome studied will be incidence of hyponatremia (defined as serum Na+ less than 135 m mol/L.

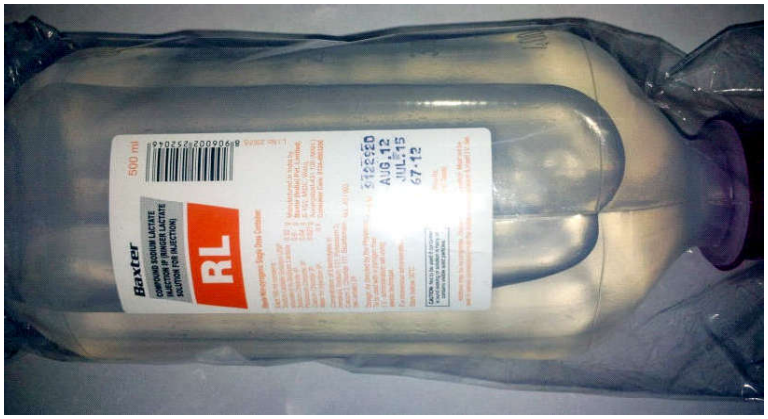


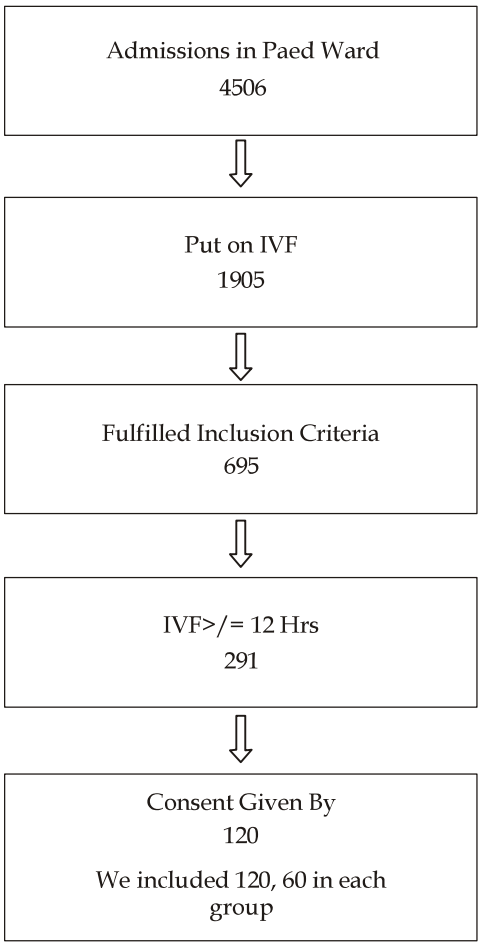
Fig. 1: Group A: Children on ringer lactate Fluid

Fig. 2 Group B: Children on Multiple Electrolytes and Dextrose Fluid

Parameters Studied

The parameters measured were Serum Sodium, Potassium, Chloride, at the time of enrolment, 12th hrly till on IV fluids and 12 hrs after stopping IV fluids. Serum Urea, Creatinine, RBS at the time of enrolment, 24th hrly till on IV fluids and 12 hrs after stopping IV fluids. Serum osmolality was calculated at the time of enrolment, 24th hrly till on IV fluids and 12 hrs after stopping IV fluids using the following formula. Serum Osmolality = 2 × [Na] + [glucose]/18 + urea/6.

Flowchart showing inclusion of the patients



Results

There was fall in mean serum sodium by 1.35meq at 12 hrs, 2.66 at 24 hrs,3.16 at 36 hrs which were highly significant and hence degree of hyponatremia increases with time of infusion in group B.

There was no fall in mean sodium with time in group A instead rose by 0.8 meq at 12 hrs of infusion.

Table 1: Incidence of Hyponatremia Group A= 6.66%, Group B=25%

Group * Hypon Cross tabulation					
			Hypon		Total
			No	Yes	
Group	Group A	Count	56	4	60
		% of Hypon	55.4%	21.1%	50.0%
	Group B	Count	45	15	60
		% of Hypon	44.6%	78.9%	50.0%
	Total	Count	101	19	120
		% of Hypon	100.0%	100.0%	100.0%

Hyponatremia was Significant in Group B (p value 0.006)

Table 2. Mean drop in serum sodium before IVF compared with 12, 24 and 36 hrs for group B

	Mean	N	Std. Deviation	Std. Error Mean
NA0	136.8167	60	1.64153	.21192
NA12	135.4667	60	2.10300	.27150
NA0	137.1667	18	1.94785	.45911
NA24	134.5000	18	1.58114	.37268
NA0	137.5000	6	2.58844	1.05672
NA36	134.3333	6	2.16025	.88192

	Paired Differences	T	DF	Sig (2-tailed)...
	Mean			
NA0 - NA12 ...	1.3500	5.255	59	.000
NA0 - NA24 ...	2.6667	5.924	17	.000
NA0 - NA36 ...	3.1667	3.124	5	.026

Table 3. Incidence of hypoosmolality
Group A = 15%, Group B = 30%

Group * Hypos Cross tabulation					
			Hypos		Total
			Yes	No	
Group	Group A	Count	9	51	60
		% of Osmsc_G	33.3%	54.8%	50.0%
	Group B	Count	18	42	60
		% of Osmsc_G	66.7%	45.2%	50.0%
Total		Count	27	93	120
		% of Osmsc_G	100.0%	100.0%	100.0%

Table 4. Present study (Results)

	Group A (n=60)	Group B (n=60)	P Value
Incidence of hyponatremia	6.6% (4/60)	25%(15/60)	0.006
Incidence of hypoosmolality	15%(9/60)	30%18/60)	0.049
Mean time of hyponatremia after starting iv fluids	18HRS	17.6HRS	
Mean time of hypoosmolaltity after starting iv fluids	24HRS	24HRS	
Incidence of symptomatic hyponatremia	0	0	
Mean drop in serum Na at 12,24,36hrs	No Drop	1.35,2.66,3.16 Respectively	0.000

Discussion

The incidence of hyponatremia in group B was highly significant 25 % (p value 0.006) in comparison with group A (RL) which was only 6.66% and was not significant. The incidence of hyponatremia in group B was highly significant 30 % (p value 0.049) in comparison with group A (RL) which was only 15% and was not significant.

The incidence of hospital-acquired hyponatremia and who received maintenance fluids in the form of multiple electrolytes and dextrose (hypotonic fluid) in accordance with the standard recommendations was high and progressive over time. There is significant increase in the hospital stay in hyponatremic patients more so in patients on multiple electrolytes and dextrose. There was no significant hyponatremia, no incidence of hypernatraemia in children on ringer lactate.

Though there were no symptomatic hyponatremia, no significant low Serum Sodium values (<125) in our study, mean fall in serum sodium levels in patient on multiple electrolytes and dextrose was highly significant, hence it is better to use ringer lactate and prevent hyponatremia and its complications than to induce hyponatremia by giving hypotonic fluids (multiple electrolytes and dextrose) leading to complications and give them the neurological sequele which is well documented in many of the studies [7,8].

Despite an increasing number of publications suggesting that the use of hypotonic saline places children at risk [9,1], this type of fluid continues to be prescribed. In a study, Fifty patients on IVF dextrose saline(0.18% saline with 4% dextrose), 0.9% saline(isotonic) at 2/3rd and full maintenance were enrolled. Plasma sodium fell in all groups (at 12hrs): mean fall 2.3 (standard deviation 4.0) mmol/L. Fluid type (P = 0.0063) but not rate (P = 0.12) was significantly associated with fall in plasma sodium. Dextrose saline produced a greater fall in plasma sodium than normal saline: difference 3.0, 95% confidence interval 0.8–5.1 mmol/L. Similarly in our study, serum sodium fell in group B by (1.35,2.66,3.16 at 12,24 and 36 hrs respectively) which were statistically significant.

Conclusion

There is significant hyponatremia in hospitalized children on multiple electrolytes and dextrose (hypotonic) IVF. There is no significant hyponatremia in children on ringer lactate (near isotonic). Degree of hyponatremia in group B increased with the time of IVF infusion. There is no incidence of hypernatraemia in children on ringer lactate. There is no difference in mean time of hyponatremia in both groups.

References

1. Kannan L, Lodha R, Vivekanandhan S, Bagga A, Kabra SK, Kabra M. Iv fluid regimen and hyponatraemia among children: RCT PediatrnNephrol. 2010 Nov; 25(11):2303–9.
2. Moritz ML and Ayu JC. New aspects in the pathogenesis, prevention, and treatment of hyponatremic encephalopathy in children. Pediatr Nephrol 2010 Jul;25(7):1225–38.
3. Moritz ML and Ayu JC. Hospital-acquired hyponatremia—why are hypotonic parenteral fluids still being used? Nat ClinPractNephrol CME. 2007; 3(7):374–382.
4. Arieff AI. Postoperative hyponatraemic encephalopathy following elective surgery in Children. Paediatr Anaesth 1998;8:1–4.
5. Halberthal M, Halperin ML, Bohn D. Acute hyponatraemia in children admitted to hospital: retrospective analysis of factors contributing to its development and resolution. Brit Med J 2001;322: 780–82.
6. Moritz ML, Ayus JC. Prevention of hospital acquired hyponatremia: a case for using isotonic saline. Paediatrics 2003;111:227–30.
7. Judd BA, Haycock, Dalton N et al. ADH following surgery in children, Acta Paediatr scand;1990;79: 401–06.
8. Pouring salt on troubled water D Taylor and A DurwardArch Dis Child 2004;89:411-14.
9. Andersen LJ, Norsk P, Johansen LB, et al. Osmoregulatory control of renal sodium excretionafter sodium loading in humans. Am J Physiol 1998;275: R1833–42.
10. Olhager E, Flinke E, Hannerstad U, et al. Studies on human body composition during the first 4 months of life using magnetic resonance imaging and isotope dilution. Pediatr Res 2003;54:906–12.
11. Dear love or, Ram AD, Natsagdoy S, Humphrey G, Cunliffe M, Potter F. Hyponatraemia after postoperative fluid management in children. Br J Anaesth 2006;97:897–8.