

## Assessment of Hyponatremia in Children Admitted at Pediatric Intensive Care Unit of Gujarat Adani Institute of Medical Science, Bhuj, Kutch

Arun Parikh\*, Tushar Parikh\*

\*Associate Professor, Dept of Paediatrics, Gujarat Adani Institute of Medical Science, Bhuj, Kutch, Gujarat, India.

---

### Abstract

*Background and Aim:* Hyponatremia is supposed to be the most common electrolyte abnormality in the paediatric intensive care unit (PICU), and is associated with increased morbidity and mortality. Present study was carried out with an aim to study on hyponatremia in children admitted in Pediatric intensive care unit. *Material and Methods:* Present study was carried out in the Department of Pediatrics, Gujarat Adani institute of medical science, Bhuj for over a period of March 2015 to June 2016. Using aseptic technique, 2ml of blood was introverted from the antecubital fossa of each patient and put in a vacutainer. Samples were stored at 2-80 C. Samples were sent for serum electrolytes to the Department of Biochemistry. *Results:* In this study incidence of hyponatremia in bronchopneumonia was 22.88%. Incidence of hyponatremia in bronchiolitis was 27.99%. Incidence of hyponatremia in seizures was 17.52%. Incidence of hyponatremia in meningitis was 59.01%. Incidence of hyponatremia in fevers was 13.90%. Incidence of hyponatremia in other diseases was 08.99%. *Conclusion:* There is a high prevalence of hyponatremia in children admitted in PICU. Meningitis, Acute gastroenteritis/acute diarrhoeal illness, Bronchopneumonia and Bronchiolitis patients were having hyponatremia in the majority of them. Premature recognition of hyponatremia is obligatory to start proper fluid management, or else additional hyponatremia causes permanent brain damage and death.

**Keywords:** Bhuj; Children; Electrolyte; Hyponatremia; Incidence.

---

### Introduction

Electrolyte abnormalities are common in children who need intensive care. They occur in a variety of conditions, may remain unrecognized and result in morbidity and mortality irrespective of the primary problem [1-4].

Hyponatremia in PICU has been associated to the syndrome of unsuitable secretion of antidiuretic hormone (SIADH) [5-7]. ADH excess results in water retention and volume expansion leading to fall in serum osmolality below the reference range. Hyponatremia does not develop except the patient is ingesting or receiving some source of free water. Most children in PICU cannot preserve adequate fluid intake necessitating fluid therapy. Administration of

hypotonic fluids may lead to development of acute hyponatremia which leads to a rapid shift of fluids into brain cells. The resulting cerebral edema is associated with high mortality. Hyponatremia has also been documented as a marker of severe illness and increases mortality. It's therefore paramount for clinicians to understand common electrolyte abnormalities, have a high index of suspicion and timely recognize them. This will facilitate institution of appropriate treatment resulting in better outcomes.

### Methodology

Present study was carried out in the Department of Pediatrics, Gujarat Adani institute of medical science, Bhuj for over a period of March 2015 to June

---

**Corresponding Author:** Arun Parikh, Associate Professor, Dept of Paediatrics, Gujarat Adani Institute of Medical Science, Bhuj, Kutch, Gujarat 370001, India.

E-mail: [dranparikh@gmail.com](mailto:dranparikh@gmail.com), [researchguide86@gmail.com](mailto:researchguide86@gmail.com)

Received on 01.04.2017, Accepted on 13.04.2017

2016. Ethical clearance was taken from the institutional ethics board. Consent for this study was taken from the school heads as well as from the parents. Various investigations are done on the admitted cases. Serum electrolytes were evaluated for all PICU cases. At PICU, complete history and physical examination were done.

Using aseptic technique, 2ml of blood was introverted from the antecubital fossa of each patient and put in a vacuoner. Samples were stored at 2-80 C. Samples were sent for serum electrolytes to The Department of Biochemistry, Gujarat Adani institute of medical science, Bhuj on the next morning.

#### Exclusion Criteria

Children with known Systemic Diseases, Children admitted in terminal stage, Children whose parents refused to give consent.

#### Results

Out of 240 PICU admissions included, 20.32% were hyponatremic, 09.32% were hypernatremic and rest 70.36% were eunatremic. Sixty three children were between 2 - 12 months, out of these 27.01% were hyponatremic; 112 children were between 1-5 years,

out of these 23.39% were hyponatremic; 65 children were between 6-12 years, out of these 14.11% were hyponatremic. Out of 240 PICU admissions included in this study, 51 children were suffering from bronchopneumonia, 33 children were suffering from bronchiolitis, 59 children were suffering from seizures, 15 children were suffering from meningitis, 51 children were suffering from fevers, 16 children were suffering from Diarrhoea/ Dysentery and 23 children were suffering from other diseases.

In this study incidence of hyponatremia in bronchopneumonia was 22.88%. Incidence of hyponatremia in bronchiolitis was 27.99%. Incidence of hyponatremia in seizures was 17.52%. Incidence of hyponatremia in meningitis was 59.01%. Incidence of hyponatremia in fevers was 13.90%. Incidence of hyponatremia in other diseases was 08.99%.

Out of 54 cases of hyponatremia, 21.99% children were suffering from bronchopneumonia; 16.60% children were suffering from bronchiolitis; 17.87% children were suffering from seizures; 18.54% children were suffering from meningitis; 10.78% children were suffering from fevers; 9.72% children were suffering from Diarrhoea/Dysentery; 3.9% children were suffering from other diseases. The average duration of hospital stay in the present study was 7.99 days/head; while with hyponatremia was 7.87 days/head.

**Table 1:** Incidence of hyponatremia in various diseases

Diseases	Total	Hyponatremia	%
Bronchopneumonia	51	13	22.88
Bronchiolitis	33	8	27.99
Seizures	59	11	17.52
Meningitis	15	9	59.01
Fever	51	7	13.90
Diarrhoea /Dysentery	16	4	24.99
Others	23	2	8.99

#### Discussion

Present study was conceded in the Department of Pediatrics, Gujarat Adani institute of medical science, Bhuj for over a period of March 2015 to June 2016. The selection was unbiased. Out of 240 PICU admissions included in our study, there were 20.32% hyponatremic patients. In a study done by S.V.S.S. Prasad et al at PGI Chandigarh found Hyponatremia in 29.8% and was more recurrent in summer than in winter ( $p < 0.001$ ). The frequency was unaltered by the sex of the children. Study done by Prasad et al [1] hyponatremia in meningitis/encephalitis was 33.3%. Study done by SubbaRao et al<sup>2</sup> hyponatremia in central nervous system disorders was 41.4%. It

appears that, hyponatremia occurs repeatedly without any major alterations in extracellular fluid volume in children with infectious diseases requiring hospitalization, and should therefore be looked for dynamically in children with these analytical entities, and managed appropriately [9-12].

In this study 16 children were suffering from Diarrhoea/Dysentery, out of these 29.41% were hyponatremic. Prasad et al [1] found 34% of children with acute diarrhoea had hyponatremia. Samadiet al<sup>2</sup> found hyponatremia in 20.8% of Bangladeshi children underneath 3 years of age with diarrhoea. Hyponatremia in diarrhoea is hypovolemic type caused by excessive sodium loss in gastro-intestinal secretions, intake of salt free drinks and augmented

loss of salt through sweating in our climate might have contributed. In this study 33 children were suffering from bronchiolitis, out of these 27.99% were hyponatremic. A exact connection between respiratory illnesses such as bronchiolitis and asthma and increased circulating levels of ADH (Antidiuretic Hormone) has been well acknowledged. Hyperinflation of the lungs stimulates the release of 3-4 ADH from the posterior pituitary, when under the power of ADH and presented with a high urine flow rate, the distal nephron extracts free water and excretes the bulk of the salt load in the urine, thereby recurring hypotonic fluid to the movement and generating hyponatremia [13-15].

In this study 51 children were suffering from bronchopneumonia, out of these 22.88% were hyponatremic. Study conducted by Singhi S [5] et al hyponatremia was found in 27% of pneumonia cases. It's been postulated that hyponatremia in pneumonia is associated to syndrome of inappropriate secretion of ADH (SIADH) which results in retention of fluid despite normal plasma osmolarity [4,6]. Rigorous infections are connected with release of inflammatory cells which stimulates ADH production. Inflammatory markers besides stimulate thermoregulatory centre ensuing in reset of the thermostat hence the high temperatures [7,8]. These observations were in comparison to a study done by Don M Valerio et.al that found hyponatremia to be connected with significantly higher mean white blood cell count, neutrophils, reactive protein and initial temperature in children with pneumonia [9]. Studies have also verified that, respiratory compromise is a co-morbid factor in patients with hyponatremia noticeably increasing the risk of death from pneumonia [10]. The primary mechanism is probably hypoxia, a chief risk factor for the development of hyponatremic encephalopathy [11,12]. Adaptation of the brain to hyponatremia principally depends on extrusion of sodium from the intracellular space via sodium-potassium ATPase pumps. This energy-dependent process is impaired under hypoxic conditions. The mixture of systemic hypoxia and hyponatremia is more harmful than is either condition alone, because hypoxia impairs the ability of the brain to become accustomed to hyponatremia, worsening hyponatremic encephalopathy [13].

In this study 59 children were suffering from seizure disorder, atypical febrile seizures, out of these 17.59% were hyponatremic. Study done by SubbaRao et al states hyponatremia in central nervous system disorders was 41.4% [14]. In this study 51 children were suffering from fevers out of these 13.90% were hyponatremic. Studies done by SubbaRao et al

suffering from other diseases, out of these 2 were hyponatremic. About 80% of cases of hyponatremia allied with acute respiratory illness, meningitis/encephalitis, septicemia, seizures and miscellaneous diseases were of euvoletic hypotonic (dilutional) type while in all children with hyponatremia associated with acute diarrheal illness it was of hypovolemic type treatment [15-19].

The study sample was fairly representative of the type of sick children admitted to our service with respect to their age, sex and the disease entities. The data may therefore, be generalized on a population of sick children seeking emergency care.

### Conclusion

There is a high prevalence of hyponatremia in children admitted in PICU. Meningitis, Acute gastroenteritis/Acute diarrhoeal illness, Bronchopneumonia and Bronchiolitis patients were having hyponatremia in the majority of them. Custom estimation of serum electrolytes is compulsory in all PICU admissions since clinical manifestations are restrained at beginning. Most of the clinical manifestations imitate central nervous system disorders. Hyponatremia is one of the indicators of sternness of the illness. Premature recognition of hyponatremia is obligatory to start proper fluid management, or else additional hyponatremia causes permanent brain damage and death.

### References

1. Prasad SV, Singhi S, Chugh KS. Hyponatremia in sick children seeking pediatric emergency care. *Indian Pediatrics*- Mar 1994;31(3):287-94.
2. Samadi AR, Wahed MA, Islam MR, Ahmed SM. Consequences of hyponatremia and hypernatremia in children with acute diarrhoea in Bangladesh. *Br Med J* 1983;286:671-673.
3. Eisenhut M. Extra pulmonary Manifestations of Severe Respiratory Syncytial Virus Infection- Systematic Review, *Critical Care*. 2006;10(4):159.
4. R. P. Rivers, M. L. Forsling and R. P. Olver, "Inappropriate Secretion of Antidiuretic Hormone in Infants with Respiratory Illness," *Archives of Disease in Childhood*, 1981;56:358-363.
5. Singhis, Dhawan A. frequency and significance of electrolyte abnormalities in pneumonia. *Indian Pediatr*.1992 Jun;29(6):735-40.
6. World Health Organization. Acute respiratory tract infections in children. Case management in small

- hospitals in developing countries. WHO/ARI/905.
7. Dreyfuss D, Leviel F, Paillard M, et al. Acute infectious pneumonia is accompanied by a latent vasopressin-dependent impairment of renal water excretion. *Am Rev Respiratory Diseases*. 1988;138:583-589.
  8. Palin K, Moreau ML, Sauvant J, et al. Interleukin-6 activates arginine vasopressin neurons in the supraoptic nucleus during immune challenge in rats. *Am J Physiological Endocrinol Metabolism*. 2009;296:E1289- E1299.
  9. Massimiliano Don, Giuliana Valeria. Hyponatremia as a marker of invasiveness of pediatric respiratory tract infections - *Journal pediatric endocrinology and metabolism*. 2008;21(7):657-664.
  10. Arieff AL, Ayus JC, Fraser CL. Hyponatraemia and death or permanent brain damage in healthy children. *BMJ*.1992;304:1218-1222.
  11. Nzerue C et al. Predictors of mortality with severe hyponatremia *Journal of American society of Nephrology*. 2002;20(13):A0728.
  12. Halberthal M, Halperin ML, Bohn D. Acute hyponatraemia in children admitted to hospital: retrospective analysis of factors contributing to its development and resolution. *BMJ*. 2001;322:780-782.
  13. Kennedy PG, Mitchell DM, Hoffbrand BI. Severe hyponatraemia in hospital inpatients. *BMJ*. 1978; 2:1251-1253.
  14. S.D. SubbaRao, Biju Thomas - Electrolyte Abnormalities in Children Admitted to Pediatric Intensive Care Unit - Department of Pediatrics, St.John's Medical College Hospital, Bangalore, India. *Indian Pediatrics* December 2000;37:1348-1353.
  15. Prasad SV, Singhi S, Chugh KS. Hyponatremia in sick children seeking pediatric emergency care. *Indian Pediatrics* 1994 Mar;31(3):287-94.
  16. Berry PL, Belsha CW. Hyponatremia. *Pediatr Clin North Am* 1990;37(2):351-363.
  17. Schrier RW. The patient with hyponatremia or hypernatremia. In: *Manual of nephrology Diagnosis and therapy*; 3rd Edn, Ed, Schrier RW, Little Brown and Co. 1990.p.20-36.
  18. Haycock GB. The syndrome of inappropriate antidiuretic hormone. *Pediatric Nephrology* 1995; 9:375-381.
  19. Maurice Laville et al. Hyponatremia secondary to the syndrome of inappropriate secretion of antidiuretic hormone (SIADH) *Clinical kidney journal Oxford University* - November, 2013.
-