



A Study of Incidence of Hyponatremia and Its Influence on Outcomes in Children Admitted in PICU With Lower Respiratory Tract Infection

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ABSTRACT

Hyponatremia is the common electrolyte disturbances occurring in the hospitalized children. The objective is to characterize the relationship between hyponatremia within 2 hours of admission to the PICU in the setting of lower respiratory tract infections and to investigate whether there is a relation between hyponatremia and the severity and outcome of LRTI. To study the relation between hyponatremia and the severity and outcome of LRTI. The study was conducted in the department of pediatrics of VINAYAKA MISSION'S KIRUPANANDA VARIYAR MEDICAL COLLEGE AND HOSPITAL. 200 patients with lower respiratory tract infections admitted during one year were prospectively enrolled in the study. Serum sodium levels were assessed within 2 hrs of admission in PICU and before 5 hours of discharge from PICU. Hyponatremia was found in 38% of children at the time of admission. Mild hyponatremia seen in 22% and moderate hyponatremia was seen in 16%. Hyponatremia was associated with heart rate with p-value 0.001 and tachycardia with p-value is 0.001. Hyponatremia was associated with leukocytosis with a p-value of 0.001 and associated with prolonged hospital stay with a p-value of with mean of 4.6 for moderate hyponatremia and mean of 4.5 for mild hyponatremia. This study shows hyponatremia is a common electrolyte disturbance occurring in children with lower respiratory tract infections. Thus serum electrolytes should be assessed for all children admitted in PICU with lower respiratory tract infections. In our study tachycardia, tachypnea increased leukocyte count could be considered as possible risk factors influencing the degree of hyponatremia and the outcome of hospital stay. Mild and moderate hyponatremia is common among hospitalized children and influences the length of the stay in the hospital.

Keywords: LRTI, PICU, Respiratory infection, hyponatremia

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INTRODUCTION

Lower respiratory tract infection (LRTI) is one of the serious illnesses especially in less than 5 years of age requiring hospitalization and attributes to 30 % of deaths annually worldwide especially due to pneumonia as the leading cause [1]. LRTI is an infection below the level of the larynx and include: bronchiolitis, bronchitis, pneumonia, and empyema. Fluids and electrolytes are the main pillars in the maintenance of body homeostasis [2]. The most important among electrolytes is sodium which is the abundant cation of the extracellular fluid [3]. Hyponatremia is the most common electrolyte abnormality seen in the intensive care unit (ICU), with an incidence as high as 30% in some reports [4]. Hyponatremia often develops in acute inflammatory diseases such as meningitis, respiratory tract infections, febrile convulsions, and Kawasaki disease in children [5]. Patients with pneumonia and bronchiolitis, the most common diseases encountered in pediatric general practice, are at particular risk of developing hyponatremia due to antidiuretic hormone (ADH) oversecretion. Hyponatremia associated with pediatric pneumonia is most commonly due to the syndrome of inappropriate antidiuretic hormone secretion (SIADH) [6]. This syndrome is characterized by hyponatremia and hypoosmolality and results from the

inappropriate and continued secretion and/or action of antidiuretic hormone despite normal or increased plasma volume [7]. Hyperinflation of the lungs, a hallmark of bronchiolitis, wheezing, asthma, reduces blood flow to the right atrium and stimulates the release of AVP from infection, below the level of the larynx from the posterior pituitary [8].

MATERIAL AND METHODS

The study was conducted in the department of pediatrics of Vinayaka Mission'S Kirupananda Variyar Medical College and Hospital. 200 patients with lower respiratory tract infections admitted during one year were prospectively enrolled in the study. Serum sodium levels were assessed within 2 hours of admission of PICU and before 5 hours of discharge from PICU. Inclusion criteria: Children with lower respiratory tract infection admitted to PICU. Exclusion criteria: Endocrine disorders, Renal failure, Metabolic disease, Chromosomal disorder and genetic disorders, Recent surgery, Previous history, and diagnosis of syndrome of inappropriate antidiuretic hormone syndrome, Diarrhoea, Chronic diseases, Parents who refuse to give consent. The demographic profile and relevant information of individual patient were collected by using a structured proforma by interviewing the mother and informed consent was obtained. Serum sodium levels were estimated for all the patients admitted in PICU with LRTI within 2 hours of admission. Serum sodium values were assessed before 5 hours during discharge from PICU. 2 ml of venous blood sample were collected from the patients admitted with LRTI in PICU within 2 hours of admission for the assessment of serum sodium levels. 2 ml of the venous blood sample was again collected from the patient 5 hours before discharge for assessment of serum sodium levels for the patients enrolled in the study. Temperature of the children was measured at the axilla using a digital thermometer. Oxygen saturation was measured using pulse oximetry. Complete blood counts were analyzed using an auto hematology analyzer. Serum sodium levels were measured using an EasyLyte plus analyzer. All the investigations were collected and documented

RESULT

The collected data were analyzed with SPSS statistics software 23.0 version. Chi-square test was used to determine the association between the outcome variable and the dependent variable. Mean and standard deviation were used to assess the other parameters.

TABLE 1: AGE WISE DISTRIBUTION AMONG STUDY GROUP

Age	Frequency	Percentage
Less than 1 yr	15	7.5
1 - 5 yrs	89	44.5
6 - 10 yrs	62	31.0
11 - 15 yrs	34	17.0
Total	200	100.0

Table 1 shows the age-wise distribution of the study population. It is seen from the table majority of the study subjects were in the age group from 1-5 years of age.

TABLE 2: GENDER WISE DISTRIBUTION AMONG STUDY GROUP

Sex	Male	Female
Male	115	57.5
Female	85	42.5
Total	200	100

Table 2 shows gender wise distribution among the study group. It is seen that table shows males are more in number than females.

TABLE 3: CHEST INDRAWING IN THE STUDY POPULATION

Chest Indrawing	Frequency	Percentage
+	123	61.5
Nil	77	38.5

TABLE:3 shows the majority of the children is having chest indrawing on admission

TABLE 4: HYPONATREMIA IN THE STUDY GROUP

Hyponatremia	Moderate		Mild		Normal		Total	Chi-square	p
	N	%	N	%	N	%			
At admission	32	16.0	44	22.0	124	62.0	200	90.50	0.001**
At discharge	-	-	1	0.5	199	99.5	200		

Table 4 showing the hyponatremia is common with LRTI which was statistically significant with a p-value of 0.001

TABLE 5: SHOWING HYPONATREMIA VERSUS CHEST INDRAWING

Hyponatremia	Chest Indrawing				Total		Chi-square	p
	Nil		+		N	%		
	N	%	N	%				
Moderate	0	0	32	16	32	16	73.44	0.001**
Mild	0	0	44	22	44	22		
Normal	77	38.5	51	25.5	124	62		
	77	38.5	123	61.5	200	100		

Table 5 showing hyponatremia is associated with chest indrawing with a p-value of 0.001

TABLE:6 COMPARISON OF SERUM SODIUM WITH 2 HOURS OF ADMISSION VERSUS HEIGHT , WEIGHT , HEART RATE , RESPIRATORY RATE , SPO2 IN ROOM AIR, HB , TOTAL COUNT AND DURATION OF ICU STAY

TABLE 6	Hyponatremia At admission	N	Mean	SD	SE	ANOVA	P
Height	Moderate	32	103.75	25.24	4.46	8.52	0.001**
	Mild	44	96.05	18.45	2.78		
	Normal	124	111.63	22.32	2.00		
	Total	200	106.94	22.85	1.62		
Weight	Moderate	32	18.08	10.11	1.79	2.45	0.089
	Mild	44	16.57	16.53	2.49		
	Normal	124	20.72	9.14	0.82		
	Total	200	19.39	11.39	0.81		
Heart rate	Moderate	32	132.84	21.45	3.79	85.90	0.001**
	Mild	44	135.82	17.58	2.65		
	Normal	124	99.92	17.46	1.57		
	Total	200	113.09	24.74	1.75		
Respiratory rate	Moderate	32	44.59	15.68	2.77	134.32	0.001**
	Mild	44	46.11	13.07	1.97		
	Normal	124	21.06	6.79	0.61		
	Total	200	30.34	15.65	1.11		
Spo2 in room air	Moderate	32	92.78	1.79	0.32	216.60	0.001**
	Mild	44	94.11	2.13	0.32		
	Normal	124	97.95	1.05	0.09		
	Total	200	96.28	2.63	0.19		
Hb	Moderate	32	10.79	2.03	0.36	1.22	0.299
	Mild	44	10.17	1.93	0.29		
	Normal	124	10.63	1.89	0.17		
	Total	200	10.56	1.93	0.14		
Total count	Moderate	32	15987.50	2543.40	449.61	86.23	0.001**
	Mild	44	15263.64	3274.86	493.70		
	Normal	124	8905.65	3759.79	337.64		
	Total	200	11437.50	4756.33	336.32		
Duration of ICU Stay	Moderate	32	4.69	2.51	0.44	33.42	0.001**
	Mild	44	4.57	2.05	0.31		
	Normal	124	2.57	1.30	0.12		
	Total	200	3.35	1.98	0.14		

TABLE 6 Showing initial heart rate was associated with hyponatremia with a p-value of 0.001 There is no significant association between hyponatremia and hemoglobin Hyponatremia was associated with the increased respiratory rate with a p-value of 0.001. Hyponatremia was associated with increase in the total count with a p-value of 0.001 There is no significant association between the weight of the study population and hyponatremia. Decreased oxygen saturation was observed in children with hyponatremia

with a p-value of 0.001. Duration of ICU stay was associated with hyponatremia with a p-value of 0.001.

TABLE 7: COMPARISON OF SERUM SODIUM AT DISCHARGE VERSUS HEIGHT, WEIGHT, HEART RATE, RESPIRATORY RATE, SPO2 IN ROOM AIR, HB, TOTAL COUNT, DURATION OF PICU STAY

	Hyponatremia At Discharge	N	Mean	SD	SE	ANOVA	p
Height	Mild	1	110.00	.	.	0.02	0.894
	Normal	199	106.92	22.91	1.62		
	Total	200	106.94	22.85	1.62		
Weight	Mild	1	18.00	.	.	0.01	0.903
	Normal	199	19.39	11.42	0.81		
	Total	200	19.39	11.39	0.81		
Heart rate	Mild	1	87.00	.	.	1.12	0.292
	Normal	199	113.22	24.73	1.75		
	Total	200	113.09	24.74	1.75		
Respiratory rate	Mild	1	14.00	.	.	1.09	0.297
	Normal	199	30.42	15.65	1.11		
	Total	200	30.34	15.65	1.11		
Spo2 in room air	Mild	1	98.00	.	.	0.43	0.513
	Normal	199	96.27	2.63	0.19		
	Total	200	96.28	2.63	0.19		
Hb	Mild	1	11.00	.	.	0.05	0.818
	Normal	199	10.55	1.93	0.14		
	Total	200	10.56	1.93	0.14		
Total count	Mild	1	10000.00	.	.	0.09	0.763
	Normal	199	11444.72	4767.22	337.94		
	Total	200	11437.50	4756.33	336.32		
Duration of Picu Stay	Mild	1	3.00	.	.	0.03	0.860
	Normal	199	3.35	1.98	0.14		
	Total	200	3.35	1.98	0.14		

TABLE 7 Showing there is no statistical significance between the heart rate, respiratory rate, total count, spo2 in room air, and serum sodium levels at discharge

DISCUSSION

The present study is a prospective study was conducted in a PICU for all the patients admitted with lower respiratory tract infection. The etiology of hyponatremia in critically ill children may reflect an endogenous state of sodium dysregulation, iatrogenic causes, or both.[9] Children admitted to the critical care unit for respiratory insufficiency or respiratory failure due to lower respiratory tract infections have been recognized as having an increased risk for developing hyponatremia possibly due to dysregulation of arginine vasopressin, an antidiuretic hormone excessive. [10] In our study Hyponatremia was a frequent finding in LRTI in the majority of cases. Hyponatremia was mild in 22% of cases ,moderate in 16% of cases which can be compared with a study conducted by Harari M. in which 91 children were enrolled out of which hyponatremia is predominant in all cases .100% hyponatremia is seen in cases with empyema. [11] All the patients with bronchopneumonia were found to have hyponatremia. In our study, children with hyponatremia had tachycardia, tachypnea, fever, and increased leukocyte count which increased the hospital stay in children. These findings can be compared with the study conducted by HenricksonKJ et.al in which Increased heart rate and tachypnoea at admission were correlated with lower values of sodium ($z = -2.664, p = 0.007$ and $z = -1.705, p = 0.089$ respectively) in children with pneumonia. Moderate to severe hyponatremia seems to be substantially more common in developing tropical countries than elsewhere. [12] For example, the 27–31% of Indian children admitted with both community-acquired pneumonia and hyponatremia had more severe disease, less favorable outcomes, longer hospitalizations, higher occurrence of complications, and higher mortality rates than those admitted with pneumonia but without hyponatremia.[13] In our study outcome of severity is based on the duration of hospital stay which is compared with the study by Wrotek et al which reported that children aged >4 years with both pneumonia and hyponatremia had higher WBC counts than those without hyponatremia, and we found that the age at admission was significantly higher in children with hyponatremia. In our study, there is an increased WBC count in patients with hyponatremia.[14] The etiology of CAP was revealed by serology in 97 patients. HN (serum sodium < 135 mmol/l) was present in 49 (45.4%) children, and it was mild (> 130 mmol/l) in 92% of the cases. On admission, hyponatremic patients had higher body temperature (38.96 degrees C vs 38.45 degrees C, $P = 0.008$), white blood cell

count (21,074/microl vs 16,592/microl, $P = 0.008$) in our study showing higher temperature and high leucocyte count. [15] Hyponatremia was frequently associated in ICU admissions with lower respiratory tract infection in our study with a p-value of 0.001 which can be compared with Light MJ. Et.al who conducted a cross-sectional study in patients admitted with pneumonia with a hyponatremia p-value of 0.01.[16] In our study, the duration of hospital stay in patients with hyponatremia is more, moderate hyponatremia had prolonged duration of hospital stay which can be compared with a study by Lussky HO study and which had with moderate hyponatremia in 25.4% & severe hyponatremia in 13.7% the duration of hospital stay was increased.[17,18,19,20]

CONCLUSION

This study shows hyponatremia is a common electrolyte disturbance occurring in children with lower respiratory tract infections. Thus serum electrolytes should be assessed for all children admitted in PICU with lower respiratory tract infections. In our study tachycardia, tachypnea increased leukocyte count could be considered as possible risk factors influencing the degree of hyponatremia and the outcome of hospital stay. Mild and moderate hyponatremia is common among hospitalized children and influences the length of the stay in the hospital. Most of the cases of hyponatremia fluid restriction are necessary. Hyponatremia can be used to predict the severity of the disease to a certain extent.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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