

HYPONATREMIA IN CHILDREN OF 2 MONTHS TO 5 YEARS OF AGE WITH COMMUNITY ACQUIRED PNEUMONIA AND ITS CORRELATION WITH SEVERITY OF ILLNESS AND OUTCOME

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Abstract

Background: Pneumonia is a leading infectious cause of death in children under five years old, with a high prevalence in South Asia and Sub Saharan Africa. Hyponatremia is a common electrolyte abnormality encountered in pneumonia and has been associated with increased mortality and signs of serious illness. The purpose of this study was to identify the prevalence of hyponatremia in pediatric community acquired pneumonia in a rural tertiary setting and to correlate sodium levels with pneumonia severity. **Materials and Methods:** This was a prospective observational study conducted over a period of one year at the Paediatric Department of Assam Medical College and Hospital, Dibrugarh. Ninety-five children aged 2 months to 5 years, diagnosed clinically as community acquired pneumonia according to WHO criteria, were included. Serum electrolytes were analysed at admission, and hyponatremia was classified as mild, moderate, or severe. Data on age, sex, nutrition status, severity of pneumonia, requirement of ventilation, duration of hospital stay, and outcome were collected. **Result:** Of the 95 patients included in the study, 46.32% had hyponatremia. Hyponatremia was more commonly seen in severe pneumonia compared to pneumonia (73.80% vs 24.52%, $p < 0.01$). Children with hyponatremia had a prolonged duration of hospital stay compared to children without hyponatremia ($p = 0.024$). Mortality in patients with hyponatremia was 11.36% compared to 0% in patients with normonatremia ($p = 0.016$). **Conclusion:** Hyponatremia is prevalent in paediatric community acquired pneumonia and is associated with increased severity, prolonged hospital stay, and mortality. Caregivers should be aware of this electrolyte abnormality and have a high index of suspicion to facilitate proper treatment and improve outcomes.

INTRODUCTION

Pneumonia is a significant cause of morbidity and mortality in children under five years old, accounting for an estimated 920,000 deaths each year worldwide.^[1] It is characterized by inflammation of the lung parenchyma and can be caused by a variety of pathogens, including viruses, bacteria, and fungi. In developing countries, pneumonia remains a leading infectious cause of death, with a high prevalence in South Asia and Sub-Saharan Africa.^[1] The incidence of pneumonia is highest in children under five years old, with 156 million cases each year worldwide.^[2]

Hyponatremia, defined as a serum sodium content of less than 135mq/dl, is a common electrolyte abnormality encountered in pneumonia.^[3,4]

Hyponatremia can result from a sodium deficit or a surplus of water and can be caused by primary illness, impaired water excretion, inappropriate release of vasopressin, use of hypotonic fluids, redistribution of sodium and water, sickle cell syndrome, and several drugs (5,6,7,8). Several studies have reported a high prevalence of hyponatremia in community-acquired pneumonia and have associated hyponatremia with increased mortality and signs of serious illness.^[4] Early identification and treatment of hyponatremia can improve outcomes in pediatric community acquired pneumonia. Therefore, the purpose of this study was to identify the prevalence of hyponatremia in pediatric community acquired pneumonia in a rural tertiary setting and to correlate sodium levels with pneumonia severity.

MATERIALS AND METHODS

Study Design: This was a prospective observational study conducted in the Pediatric Department of Assam Medical College and Hospital, Dibrugarh, over a period of one year from 2021 to 2022.

Sample Size Calculation: The sample size was calculated using the formula $n = \frac{4pq}{(e)^2}$, where n = sample size, p = prevalence of hyponatremia in community-acquired pneumonia, $q = 1 - p$, and e = margin of error. Based on the previous studies conducted, the prevalence of hyponatremia was estimated to be around 45%. Considering a margin of error of 10%, the minimum required sample size was calculated to be 95.

Inclusion Criteria

Children aged between 2 months to 5 years, admitted to the hospital and diagnosed clinically as community-acquired pneumonia according to the WHO criteria (presence of fever, cough, and tachypnea for age) were included in the study.

Exclusion Criteria

Children with acute gastroenteritis, renal disease such as nephritic syndrome, nephrotic syndrome, acute kidney injury, chronic renal failure, malignancies, pre-existing cardiac and respiratory morbidity on medication, receiving drugs affecting sodium hemostasis, diagnosed with pneumonia due to nosocomial infection, aspiration pneumonia, severe acute malnutrition, and receiving ORS were excluded from the study.

Data Collection Procedure: Detailed history and clinical examination were conducted in all patients admitted with pneumonia. Pneumonia and severe pneumonia were defined according to the WHO ARI guidelines. At the time of admission, blood samples (1.5ml) for serum electrolytes were collected in a sterile clot activator vial from the cubital vein and analyzed using an Ortho chemical diagnostic Vitros 5600 fully automated system for sodium determination. Other relevant investigations like Total Leucocyte Count (TLC), Differential leucocyte count (DLC), C reactive protein (CRP), blood culture, and chest X-ray were also done. The subject's clinical data including age, sex, requirement of ventilation, duration of hospital stay, and the final outcome (death or discharge) were recorded in all patients.

Classification of Hyponatremia: Hyponatremia was classified as mild, moderate, and severe as follows: Serum sodium of 131 to 134 mEq/L was considered mild, 126 to 130 mEq/L as moderate, and equal to or less than 125 mEq/L as severe hyponatremia.

Data Analysis: The statistical analysis of data was performed using the computer program, Statistical Package for Social Sciences (SPSS for Windows, version 20.0. Chicago, SPSS Inc.) and Microsoft Excel 2010. Results on continuous measurements

were presented as mean \pm standard deviation and compared using Student t-test. Discrete data were expressed as number (%) and were analyzed using the Chi-square test and Fischer's exact test (where the cell counts were <5 or 0). Pearson's correlation coefficient (r) was used to measure the associations among continuous variables. For all analyses, the statistical significance was fixed at a 5% level (p -value <0.05).

Ethical Considerations: Ethical clearance was obtained from the ethical committee of the institution before conducting the study. Informed consent was taken from the parents or guardians of all patients included in the study. Confidentiality was maintained throughout the study, and patient data were used only for research purposes.

RESULTS

A total of 95 children admitted with community acquired pneumonia were included in the study. Out of these, 44 (46.32%) children had hyponatremia. [Table 1]. Hyponatremia was classified as mild, moderate, and severe in 29 (65.91%), 9 (20.45%), and 6 (13.64%) patients, respectively. [Table 2]

The majority of the patients with hyponatremia were in the age group of 2 months to 2 years (46.15%). There was no statistically significant difference in the frequency of hyponatremia between different age groups ($p > 0.05$). Hyponatremia was more commonly seen in females (52.77%) than males (42.37%), but the difference was not statistically significant ($p > 0.05$). The prevalence of hyponatremia was higher in children with malnutrition (52.17%) compared to those with normal nutrition (44.44%), but the difference was not statistically significant ($p > 0.05$).

Hyponatremia was significantly associated with the severity of pneumonia ($p < 0.01$). Of the 53 patients with pneumonia, only 13 (24.52%) had hyponatremia, whereas 31 (73.80%) out of 42 patients with severe pneumonia had hyponatremia. [Table 3]

Hyponatremia was also significantly associated with shock ($p < 0.01$) and the need for mechanical ventilation ($p < 0.01$). Of the 15 patients with shock, 13 (86.66%) had hyponatremia compared to 31 (38.75%) out of 80 patients without shock. [Table 4] Of the 11 patients requiring mechanical ventilation, 10 (90.90%) had hyponatremia compared to 34 (40.47%) out of 84 patients not requiring mechanical ventilation. [Table 5]

Furthermore, patients with hyponatremia had a longer duration of hospital stay ($p = 0.024$) [Table 6] and a higher mortality rate ($p = 0.013$) [Table 7] compared to patients without hyponatremia. Mortality was 11.36% in patients with hyponatremia compared to 0 mortality in patients with normonatremia.

Table 1: Prevalance of Hyponatremia in Pneumonia

Pneumonia	Number (n)	Percentage (%)
Without Hyponatremia	51	53.68
With Hyponatremia	44	46.32
Total	95	100.00

Table 2: Distribution of severity of hyponatremia with pneumonia

Hyponatremia	Number (n)	Percentage (%)
Mild	29	65.91
Moderate	9	20.45
Severe	6	13.64
Total	44	100.00

Table 3: Correlation of severity of pneumonia with hyponatremia

WHO classification	Normonatremia		Hyponatremia		Number of children (n)	p value*
	n	%	n	%		
Pneumonia	40	75.47	13	24.52	53	<0.001
Severe Pneumonia	11	26.19	31	73.80	42	
Total	51	53.68	44	46.31	95	

Table 4: correlation of shock with hyponatremia

SHOCK	Normonatremia		Hyponatremia		Number of children (n)	p value*
	n	%	n	%		
Absent	49	61.25	31	38.75	80	<0.001
Present	2	13.30	13	86.66	15	
Total	51		44		95	

Table 5: correlation of mechanical ventilation with hyponatremia

Mechanical Ventilation	Normonatremia		Hyponatremia		Number of children (n)	p value*
	n	%	n	%		
Not Required	50	59.52	34	40.47	84	0.002
Required	1	9.09	10	90.90	11	
Total	51		44		95	

Table 6: correlation of hospital stay with hyponatremia

Hospital Stay (in days)	Normonatremia		Hyponatremia		Number of children (n)	p value*
	n	%	n	%		
≤7	39	76.47	21	53.85	60	0.024
>7	12	23.53	18	46.15	30	
Total	51		39		90	

Table 7: correlation of outcome with hyponatremia

Outcome	Normonatremia		Hyponatremia		Number of children (n)	p value*
	n	%	n	%		
Death	0	0.00	5	11.36	5	0.013
Improved	51	100.00	39	88.64	90	
Total	51		44		95	

DISCUSSION

In our study, we found that almost half (46.32%) of the children with community-acquired pneumonia had hyponatremia, with the majority having mild hyponatremia. These findings are consistent with previous studies by Simma et al,^[9] Mousa et al,^[10] and Zahorec,^[11] that have reported a high prevalence of hyponatremia in children with pneumonia. The underlying mechanisms of hyponatremia in pneumonia are multifactorial, including primary illness, impaired water excretion, inappropriate release of vasopressin, the use of hypotonic fluids, redistribution of sodium and water, and several drugs.^[5-8] However, the exact mechanism of hyponatremia in children with pneumonia remains unclear and needs further investigation.

We also found that hyponatremia was more commonly seen in severe pneumonia than in mild pneumonia, with a statistically significant difference. Similar findings have been reported in previous studies by Lai et al,^[12] Gunasekaran et al,^[13] and Zhou et al,^[14] that have demonstrated an association between hyponatremia and the severity of pneumonia. The severity of pneumonia is usually determined by the presence of respiratory distress, tachypnea, hypoxemia, chest radiography, and clinical parameters such as fever and cough. However, these parameters are not always reliable indicators of the severity of pneumonia, and the addition of hyponatremia as a marker of disease severity may help in the clinical management of these patients.

Furthermore, we found a statistically significant correlation between hyponatremia and shock,

mechanical ventilation, duration of hospital stay, and mortality. Patients with hyponatremia were more likely to develop shock, require mechanical ventilation, have a prolonged hospital stay, and have a higher mortality rate than those without hyponatremia. These findings are consistent with previous studies by Wald et al,^[15] Vaara et al,^[16] and Yoon et al,^[17] that have shown an association between hyponatremia and adverse clinical outcomes, such as increased mortality and morbidity. The association between hyponatremia and adverse outcomes in children with pneumonia may be explained by several factors. Hyponatremia is known to cause cerebral edema, leading to neurological symptoms such as seizures, coma, and death (Arieff et al).^[18] In addition, hyponatremia can lead to hypovolemia, hypotension, and shock, which can be life-threatening in severe cases (Berend et al).^[19] Moreover, hyponatremia can cause electrolyte imbalances, leading to arrhythmias, cardiac arrest, and other cardiovascular complications (Berend et al).^[19] These factors may contribute to the higher morbidity and mortality rates observed in children with pneumonia who develop hyponatremia.

CONCLUSION

In conclusion, our study demonstrated that hyponatremia is a prevalent electrolyte abnormality in pediatric community-acquired pneumonia and is significantly associated with increased severity, prolonged hospital stay, and higher mortality. Caregivers and healthcare professionals should be aware of this potential complication and maintain a high index of suspicion when treating children with pneumonia. Early detection and appropriate management of hyponatremia in these patients may help improve clinical outcomes and reduce the morbidity and mortality associated with pediatric community-acquired pneumonia. Further large-scale, multi-center studies are needed to better understand the underlying mechanisms of hyponatremia in children with pneumonia and to explore the potential benefits of early intervention in this platform.

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