

Original research article

Study of Incidence of Hyponatremia in Paediatric Pneumonia and Correlation of Sodium Levels to Severity

Dr. Manoranjan Kumar¹, Dr. Pawan Kumar², Dr. C. B. Kumar³

¹Junior Resident, Department of Paedia PMCH Patna

²Senior Resident, Department of Paedia PMCH Patna

³Associate prof. Department of Paedia PMCH Patna

Corresponding Author: Dr. C. B. Kumar

Abstract

Background: Hyponatremia is a common electrolyte imbalance which occurs in children with pneumonia. Many studies have reported the incidence of hyponatremia around 40 to 45%. Presence of hyponatremia adds to the morbidity apart from the disease itself. Hence the present study was taken up to find the incidence of hyponatremia in pneumonia.

Methods: This prospective observational study involved 122 children admitted to the paediatric ward and PICU of PMCH, Patna. Children diagnosed as pneumonia as per WHO guidelines between 1 to 5 years were included. Beside other relevant blood investigations, blood samples for electrolytes were analysed using automated analyser that uses ISE (ion selective electrode) technology for sodium determination.

Conclusion: Hyponatremia is common electrolyte imbalance found in community acquired pneumonia and more commonly seen in severe pneumonia.

Keywords: Pneumonia, Hyponatremia.

Introduction

Pneumonia defined as inflammation of lung parenchyma, is the leading cause of death globally among children younger than age 5 years¹. Pneumonia affects 156 million children under the age of five years every year across the globe. Around 16% of all deaths of children under 5 years old, killing 920,136 children in 2015. The regions with high prevalence of the disease are South Asia and Sub Saharan Africa². Despite the various simple interventions to prevent this disease like routine vaccination, safe drinking water and sanitation, vitamin A and zinc supplementation, exclusive breast feeding for six months, early detection and treatment, it still remains a major problem in India. India has a mortality rate of 322 per 1,00,000 under five population. Pneumonia is a frequent cause of hospitalization and is associated with several complications. One of the common metabolic complications is hyponatremia.³ Various studies done in western countries have reported a high prevalence of hyponatremia in community acquired pneumonia. Hyponatremia has also been documented as a marker of severe illness and increased mortality³. It is therefore important for clinicians to understand this common electrolyte abnormality and have a high index of suspicion to timely recognize and treat it. This

will help in initiating appropriate treatment resulting in better outcomes. Only few similar studies have been done in India, especially in south India . Hence the purpose of this study is to identify the incidence of hyponatremia in pneumonia in children hospitalized in rural tertiary setting between 1 and 5 years of age and to correlate the sodium levels to severity of pneumonia.

Objectives

To find out the incidence of hyponatremia.

To correlate the severity of pneumonia to hyponatremia.

Material and Methods

This prospective observational study involved 122 children admitted to the paediatric ward and PICU of Patna medical college and Hospital Patna, Bihar. Study duration of Two years. Children diagnosed as pneumonia as per WHO guidelines between 1 to 5 years were included. Beside other relevant blood investigations, blood samples for electrolytes were analysed using automated analyser that uses ISE (ion selective electrode) technology for sodium determination.

Inclusion criteria

Children aged 1 year to 5 years.

Pneumonia diagnosed according to WHO guidelines.

Exclusion criteria

Children with previous respiratory and cardiac morbidity

Children having associated diarrhoea

Children on medications and diseases affecting sodium homeostasis

Detailed history was elicited from the parents/guardians with relevance to the case and detailed clinical examination was done. At the time of admission, blood samples for electrolytes were analysed using automated analyser that uses ISE (ion selective electrode) technology for sodium determination and other relevant investigations like CBC , CRP , Blood culture and X Ray were done. All the samples were collected and values documented. Patients clinical data including age, sex, duration of hospital stay and the final outcome (death or discharged) were recorded in all cases. Serum sodium concentration $<135\text{mEq/L}$ was considered hyponatremia, The severity of pneumonia is classified according to WHO guidelines.

The revised classification divides the children into 2 groups as Pneumonia and Severe Pneumonia.

Table 1:

CLASSIFICATION	CLINICAL FEATURES	TREATMENT
PNEUMONIA	Fast breathing Chest in drawing	Oral, amoxicillin Home based care
Severe pneumonia or very severe disease	General danger signs Not able to drink Persistent vomiting Convulsion Lethargy Unconsciousness Stridor in a calm child	First dose antibiotic and referral to a health care facility

HYPONATREMIA⁴

Serum sodium level less than 135 mEq/L is taken as hyponatremia. The severity of hyponatremia is classified under

1. **MILD** (131 TO 134)
2. **MODERATE** (126 TO 130)
3. **SEVERE** (125 and Less)

Results

The study was done on 122 children admitted with pneumonia to MVJMC and RH. The study included children aged 1 to 5 years.

Table 2: AGE DISTRIBUTION

Age in Years	Number of children (n=122)	Percentage of children (%)
1-2	94	77
2-5	28	23
Total	122	100

In this study around 77 % (94) of children were aged 1 to 2 years and 23 % (28) of children were aged 2 to 5 years.

Table 3: Correlation of x ray to clinical diagnosis of pneumonia

PNEUMONIA	Number of children (n=122)	Percentage of children (%)
Radiological Positive	116	95
Radiological Negative	6	5
Total	122	100

Out of 122 children admitted with pneumonia, 95% (116) cases had X-ray features suggestive of pneumonia.

Table 4: CORRELATION OF CRP WITH PNEUMONIA

C-Reactive Protein	Number of children (n=122)	Percentage of children (%)
Positive	117	96
Negative	5	4
Total	122	100

Out of 122 children with Pneumonia, 96% (117) cases had positive CRP while in 4% (5) cases, CRP was negative.

Incidence of Hyponatremia in pneumonia

Hyponatremia was defined as sodium <135 mEq/L and confirmed cases of pneumonia were categorised into Pneumonia with hyponatremia and Pneumonia without hyponatremia.

Table 5: Incidence of hyponatremia in pneumonia

	Number of children (n=122)	Percentage (%)
Pneumonia without hyponatremia	69	56.5%
Pneumonia with hyponatremia	53	43.5%
Total	122	100

Out Of 122 cases with pneumonia, 53 cases had hyponatremia which was 43.5% of the total

cases and is expressed in the figure below. Out of 53 children with hyponatremia, majority of the cases i.e. 35 children (66%) had mild hyponatremia, followed by moderate hyponatremia being found in 11(21%) cases and severe hyponatremia in 7(13%) cases. Pneumonia cases were further grouped into 2 categories as 1-2 years and 2-5 years. 94 cases were aged 1-2 years and 28 cases were aged 2-5 years. Out of 94 cases in the age group of 1-2 years, 42(42%) cases developed hyponatremia. 13 out of 28 cases (46%) in the age group of 2-5 years developed hyponatremia. Hyponatremia was almost observed equally in both the age groups. Out of 92 cases with normal nutrition, 37 i.e. 40% had hyponatremia and out of 30 cases with malnutrition, 16 (53%) cases had hyponatremia. It was found that hyponatremia was found in both groups with normal nutrition and malnutrition and there was no statistical significance ($P>0.05$). Pneumonia was classified based on WHO guidelines 2014 into two categories, Pneumonia group and Severe Pneumonia group. Out of 68 cases in the pneumonia group, 16 cases i.e. 23% had hyponatremia. Out of 54 cases of severe pneumonia, 37 (68%) cases had hyponatremia. Hyponatremia was more commonly seen in severe pneumonia group when compared to the pneumonia group. The difference was found to be statistically significant ($p<0.01$). In children with hyponatremia, severity of pneumonia was correlated with severity of hyponatremia. In Pneumonia group, mild hyponatremia was seen in 15(94%) followed by severe hyponatremia, which was seen only in 1 case (6%). In children belonging to severe pneumonia group, mild hyponatremia was found in 20/37(54%) cases followed by moderate hyponatremia in 11/37 (30%) cases and severe hyponatremia in 6/37 i.e. 16% of cases. It was also noted that mild hyponatremia was more common in both the Pneumonia and Severe pneumonia group. Moderate and severe hyponatremia was more common in the severe pneumonia group compared to pneumonia group. In our study, out of 122 children, 22 (18%) cases had shock. Amongst them, 20(91%) cases had hyponatremia. Out of 100 children without shock, 33 had hyponatremia. Hyponatremia was more commonly seen in children with shock compared to children without shock and the difference was statistically significant ($P<0.01$). In our study out of 122 cases, 8(6.5%) children expired. Out of the 53 children with hyponatremia, 7 children (13%) expired and 50 (87%) improved. Out of 65 children without hyponatremia, 1 child (1.5%) expired and 64 (98.5%) improved. Mortality was more in children with hyponatremia than in children without hyponatremia.

Discussion

In our study, 94 children were in age group of 1-2 yrs. and 28 children were in the age group of 2-5 yrs. Among 122 children included in the study, 73 were males (60%) and 49 (40%) were females. This distribution is similar to studies done by Mandal et al⁵ and Duru et al⁶ showing 62 % and 57 % males respectively. Among 122 children, 116 children had radiologic features. CRP was positive in 96 % of children which is similar to study done by Rahul et al³ which showed 90% of children who had CRP positive. Only 5(4%) children showed positive blood culture. This is supported by studies done by Shah et al⁷ showing blood culture positivity of only 6%.

This study showed that hyponatremia was a common finding in children admitted with pneumonia. The incidence of hyponatremia in children with pneumonia was 43.5%. Studies done by Don M et al⁸ and Otheo et al⁹ showed almost similar incidence like our study. The study conducted by [unintelligible] found hyponatremia in 45.4 % of children with pneumonia. Similarly, another study done that hyponatremia is the most common electrolyte imbalance in the clinical practice and is a common finding in children with community acquired pneumonia, usually attributed to SIADH. It was present in 60 out of 151 patients, i.e. in 39.7% patients,

which is comparable with our incidence of 43.5%. However, some studies done in India, showed hyponatremia in 21-31 % of patients with pneumonia. In a study done in India, by Mandal et al⁵ recorded hyponatremia in 21% of pneumonia cases which is lesser than that seen in our study. Similarly, in a study done at **PGI Chandigarh**, out of 264 children with pneumonia, 27% of cases were associated with hyponatremia. Of all the hyponatremia, 68% were secondary to SIADH. Slightly increased incidence seen in our study could be because many of our patients were referred from other nursing homes and had received hypotonic fluids as intravenous therapy prior to admission to our hospital⁵⁵. In our study, mild hyponatremia was the commonest and was seen in 66% of children with hyponatremia. Only 21 % had moderate and 13 % had severe hyponatremia. This was comparable to the study done by Mandal et al⁵ and Nair et al¹⁰. Study done by Mandal et al⁵ showed that mild hyponatremia was more common (81%) when compared to moderate hyponatremia (14 %) and severe hyponatremia (5%). Another study done showed that 92% cases had mild hyponatremia. Even the study done by Nair et al¹⁰ showed only 4.1% of patients with community acquired pneumonia had serum sodium level < 130mEq/ L. Hyponatremia was also more commonly seen in children with shock (91%) compared to children without shock (9%) and children requiring mechanical ventilation (87%) than in children not requiring mechanical ventilator (38%). Both the presence of shock at the time of admission and requirement of mechanical ventilation suggest the severity of illness. Most probably significant association of hyponatremia with shock and requirement of mechanical ventilation is because of severe nature of the illness. hyponatremia in a study done at Kenya national hospital, showing 81.8% children with very severe pneumonia having hyponatremia. In a study by Dhawan et al¹², symptoms and signs indicative of severe pneumonia were two to three times more frequent in children with hyponatremia. Of 122 children enrolled in the study, 8 (6.5%) children had expired. Mortality was 13 % in children with hyponatremia compared to 1.5 % in children without hyponatremia. Hyponatremia is strongly associated with worse outcome in form of mortality(p<0.001) which was similar to as seen in study done by *Guruswamy et al*¹¹. Prospective study done by Dhawan et al¹² showed that mortality was 3.5 times higher in patients with hyponatremia when compared to those without hyponatremia. A study done by Singhi et al¹³ showed that 4/100 children died and all four of them had a serum sodium concentration ≤ 125 mmol/L which persisted till death and concluded that presence of severe hyponatremia was associated with three fold increase in risk of death. Respiratory compromise is a comorbid factor in hyponatremia increasing the risk of death. The underlying mechanism could be probable hypoxia, which impairs the volume regulation of brain cells and decreases perfusion. Adaptation of brain to hyponatremia largely depends on extrusion of sodium from intracellular space via sodium-potassium ATPase pump which is impaired in hypoxic conditions. Hence the combination of hypoxia and hyponatremia is more deleterious than is either condition alone which is observed in the above study.

Conclusion

Incidence of hyponatremia in pneumonia did not show any correlation with different age groups, gender or nutrition status. Incidence and severity of hyponatremia correlated with severity of pneumonia. Mild hyponatremia was the commonest form of hyponatremia seen. Hyponatremia was significantly associated with increased length of hospital stay and increased mortality. Thus serum electrolytes should be measured in children hospitalised with pneumonia.

References

1. Sandora T, Sectish Community acquired pneumonia. In : Kliegman R M , Stanton BF , Geme JWS , Schor NF , Behrman R E .Nelson textbook of paediatrics , 1st south Asia ed.Philadelphia: Elsevier ,Delhi. 201 .p.1470- 1474.
2. World Health Organization .Pneumonia. Fact sheet No .331. 2016. Available at: <http://www.who.int/mediacenter/factsheets/fs331/en/index.html>. Updated 7 November 2016.
3. Rahul V, Jose O. Prevalence of Hyponatremia in Children with Pneumonia. *IOSR Journal of Dental and Medical Sciences*, 16(3), p.46-50.
4. Greenbaum LA .Electrolyte and Acid Base Disorders .In:Kliegman RM ,Stanton BF ,Schor NF , St.Geme JW (Eds).Nelson Textbook of Paediatrics . 20th ed.Philadelphia :Elsevier ;2016.p.350.(International Edition) .
5. Mandal P, Garg M. To Study the association and significance of Hyponatremia in Pneumonia in Paediatric Patients treated in hospital setting. *Int J of contemp med resear*. 2018; 5(1):11-14.
6. Duru N, Civibil M. Hyponatremia in Children Hospitalised withPneumonia.*J Pediatr Inf* 2013;7:102-5.
7. Kulpati DD, Kumar A.Flexible fiberoptic bronchoscopy in lower respiratory tract infection. *Indian J Chest Dis Allied Sci* 1980;22:39-46.
8. Don M, Valerio G, Korppi M, Canciani Hyponatremia in pediatric community acquired pneumonia.*Pediatr Nephrol*.2008 Dec; 23(12):2247- 2253.
9. Otheo E, Rodriquez M. Hyponatremia is an inflammatory marker in children with Community Acquired Pneumonia. *Clinical Infectious Diseases:Respiratory Infections*. 2016:136.
10. Nair V, Nierdman MS , Masani N , Fishbane S. Hyponatremia in community acquired pneumonia .*Am J Nephrol*.2007 ;27(2):184-190.
11. Guruswamy NT, Khan H.Correlation of hyponatremia in children presenting with acute lower respiratory tract infection in a tertiary care hospital. *Int J recent tren in sci and techn*.2014;12(3):631-634.
12. Singhi S, Dhawan A .Frequency and significance of electrolyte abnormalities in pneumonia .*India Pediatr*.1992 Jun, 29(6):735-40.
13. Singhi S .Hyponatremia in hospitalized critically ill children current concepts. *Ind J Pediatr*.2004 Sep; 71(9):803-807.