



INCIDENCE OF HYPONATREMIA IN PAEDIATRIC PNEUMONIA AND CORRELATION OF SODIUM LEVELS TO SEVERITY

Paediatrics

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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. **MATERIAL AND METHODS:** This prospective observational study involved 122 children admitted to the paediatric ward and PICU of N.M.C.H. Jamuhar, Sasaram, Rohtas, Bihar. 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. 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 mortality. 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.

REVIEW OF LITERATURE

The word pneumonia has its origin from the Greek word Pneumon- the organ which moves air in and out of the body. The inflammation involving the pneumos is pneumonia. The respiratory tract and its mucosal surfaces provide the host with multiplicity of defence mechanism. The etiological agent causing infection varies with different age groups. In neonates Group B streptococci and E coli are responsible for majority of the causes of pneumonia. Between 3 weeks to 4 years viruses are the most common cause of infection. Atypical organisms predominate the list beyond 5 years of age. It is the most common bacterial cause of pneumonia in children. Primary infection with the pneumococci is as such rare. Usually follows a viral URI. The disease onset is marked by sudden onset of fever, breathlessness, chills etc. The child appears toxic and ill. Often leads to consolidation of lobes. Streptococci are gram positive cocci arranged in chains. GABHS infection usually occurs after an exanthematous fever. It is an aggressive disease. It produces interstitial type of lung involvement. Pneumatocele, lung abscess or empyema can occur as complications with the infection with staphylococci is less common in immunocompetent

children. The disease has a fulminant course and hence should be treated vigorously, the bacteria multiplies rapidly producing a necrotising toxin which is implicated in tissue destruction. It is the common cause of ARTI in children above 5 years of age. Also known as "Walking Pneumonia". The infection usually produces a low grade fever. Dry cough and dyspnoea is usually preceded by prodromal symptoms like headache, malaise, URI etc. The infection can also occur in younger children. Chest X ray predominantly shows an interstitial infiltrate. Influenza is an RNA virus which causes infection more commonly in winter. The risk of infection is increased in children with chronic illness. The symptom starts 1 to 5 days after being infected with the virus. The infection usually starts as upper respiratory tract infection. The children may present with the high fever with chills and breathlessness. Pneumonia can cause a wide variety of complications in paediatric age group. It can cause both pulmonary and extra pulmonary complications. Direct spread of organisms within the thoracic cavity can cause complications like empyema, pleural effusion, lung abscess, pyopneumothorax, pericarditis, pericardial effusion etc. Sodium is a predominant cation of extracellular fluid (ECF). It is a principal cation which determines the osmolality of ECF. This ion helps in maintaining intravascular volume status of an individual. Nearly 40 % of this ion in the body is present in the bone. Sodium balance is regulated in the body by the kidneys and it is principal site for its excretion.

Hyponatremia is a common electrolyte imbalance which occurs in children with pneumonia. Many studies have reported the incidence of hyponatremia around 40 to 45%. *Kazunari et al* studied the medical records of children admitted with RTI to find out the prevalence of hyponatremia. Study concluded that high prevalence of hyponatremia (28.9%) was found in children with deeper site of inflammation of respiratory tract. *Don et al* studied that children with hyponatremia in pneumonia had higher initial body temperature, higher mean duration of tachypnoea, longer time for defervescence, greater length of hospital stay, longer duration oxygen requirement. Hyponatremia could result from a sodium deficit or surplus of water.

Hyponatremia decreases the extracellular osmolality. This causes movement of water into the cells to maintain the equilibrium which ultimately causes swelling of the cells. This increase in the cell size does not cause any symptoms in most of the areas except the brain. When the brain tissue swells up it causes increase in intracranial pressure and herniation of brainstem resulting in symptoms. The symptoms of hyponatremia occur only when the sodium level drops acutely. The treatment of hyponatremia depends on the specific aetiology, type of hyponatremia and severity. In general all cases of severe hyponatremia and symptomatic hyponatremia are to be corrected. It is important to remember that rapid correction of hyponatremia can result in central pontine myelinolysis which can further aggravate the complications. *Don et al* also studied incidence of hyponatremia in CAP. Out of 108 patients 49 (45.4%) had hyponatremia. Study concluded that hyponatremia was associated

with severity of CAP, which was assessed by high temperature, demand for hospitalization and serum nonspecific marker. In children with community acquired pneumonia, hyponatremia has been associated with severity. Hyponatremia has also been documented as a marker of severe illness and increase mortality.

MATERIAL AND METHODS

This prospective observational study involved 122 children admitted to the paediatric ward and PICU of Narayan Medical College and Hospital, Jamuhar Sasaram Rohtas, Bihar. 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.

A total of 122 children between the age group of 1-5 years admitted with pneumonia were included in the study. Pneumonia and Severe pneumonia were defined according to WHO ARI guidelines. 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.

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

MILD (131 TO 134)

MODERATE (126 TO 130)

SEVERE (125 and Less)

RESULTS

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

AGE DISTRIBUTION

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

Distribution Of Children According To Severity(WHO)

WHO Classification	Number of children (n=122)	Percentage of children (%)
Pneumonia	68	56
Severe Pneumonia	54	44
Total	122	100

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.

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.

Correlation Of Age With Hyponatremia

Age in Years	Normonatremia (n=69)	Hyponatremia (n=53)	Total number of children(n=122)	P value
1-2	54(58%)	40(42%)	94	0.71
2-5	15(54%)	13(46%)	28	
Total	69	53	122	

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. There is no statistical significance noted in the occurrence of hyponatremia in both the age groups (p value >0.05). 73 were males and 49 were females. 29 out of 73 males (40%) developed hyponatremia and 24 out of 49 females (49%) developed hyponatremia. Hyponatremia was more commonly seen in females when compared to males, however there was no statistical significance (P value >0.05).

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.

Correlation Of Hyponatremia To Length Of Hospital Stay

Length of stay	Normonatremia (n=68)	Hyponatremia (n=48)	Total number of children(n=114)	P Value
<7 days	50(74%)	24(52%)	74	0.01
>7days	18(26%)	22(48%)	40	
Total	68	46	114	

it was seen that out of 46 cases who had hyponatremia, 24(52%) cases had upto 7 days of hospital stay, 48% had stay more than 7 days. Out of 68 cases without hyponatremia, 50 (74%) had upto 7 days hospital stay and 26% had stay more than 7 days. Children with hyponatremia required longer duration of hospital stay and P value=0.01. 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 al** and **Duru et al** 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 al** which showed 90% of children who had CRP positive. Only 5(4%) children showed positive blood culture. 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 al** and **Otheo et al** showed almost similar incidence like our study. The study conducted by **Don M et al** found hyponatremia in 45.4 % of children with pneumonia. Similarly, another study done by **Otheo et al** showed 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. 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 al** and **Nair et al**. Study done by **Mandal et al** showed that mild hyponatremia was more common (81%) when compared to moderate hyponatremia (14 %) and severe hyponatremia (5%). Another study done by **Don M et al** showed that 92% cases had mild hyponatremia. Even the study done by **Nair et al**, 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. We observed in our study that severe hyponatremia was more commonly associated with severe pneumonia. 16% of patients with severe pneumonia had severe hyponatremia compared to 6% of patients with pneumonia. However,

we could not find any other study correlating severity of hyponatremia and severity of pneumonia. A study done by *Singhi et al* 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.

CONCLUSION

Hyponatremia was significantly associated with increased length of hospital stay and increased mortality. Hyponatremia is commonly seen in children with Pneumonia with incidence of 43.5% in our study. hyponatremia in pneumonia did not show any correlation with different age groups, gender or nutrition status. Mild hyponatremia was the commonest form of hyponatremia seen.

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