

ASSESSMENT OF HYPONATREMIA IN PNEUMONIA IN CHILDREN

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ABSTRACT

Introduction

Pneumonia has been the leading cause of mortality in children. Among the various complications of pneumonia, hyponatremia has often been overlooked which incidentally happens to be the commonest and life threatening as well. There are several reports on high prevalence of hyponatremia in the western countries as an indicator of severity of pneumonia. These researches have been lacking in Nepal.

Objectives

The objectives of this study was to determine the prevalence of hyponatremia in children between 2 months to 5 years of children with radiologically or clinically proven pneumonia admitted at Birat Medical College & Teaching Hospital (BMCTH) and also also to investigate the relationship between serum sodium level and other laboratory parameters.

Methodology

A descriptive cross-sectional study was carried out at BMCTH on children aged 2 months to 5 years admitted with pneumonia. Those who met the inclusion criteria were included. History and physical examination was done to confirm diagnosis and classify the severity of pneumonia on the basis of WHO classification. A 2ml blood sample was then withdrawn from the patient and taken to the laboratory for serum sodium as well as other relevant parameters.

Results

A total of 50 children of age ranging from 2 months to 5 years who were admitted with clinical or radiological diagnosis of pneumonia were enrolled in the study. Cough was present in 76% of studied children while fever was present in 92%. Clinical diagnosis revealed majority of children with severe pneumonia (40%). Leukocytosis was seen in 70% of children while acute phase reactants CRP was positive in 86% of the children. Hyponatremia was revealed in 80% of the children with pneumonia. Among children between 2 months to 12 months 20% had severe hyponatremia while children in age group between 1 to 3 years 6% had severe hyponatremia and between 3 to 5 yrs of children 8% had severe hyponatremia. The relation was statistically not significant. leukocytosis was demonstrated in 58% of children with hyponatremia . The relation however was not statistically significant. CRP was found positive in 76% of children with hyponatremia. This was statistically significant. There were 18% of the children who had very severe pneumonia along with severe hyponatremia. While 14% with severe hyponatremia had severe pneumonia and only 2% of the children with severe hyponatremia had pneumonia. In children with moderate hyponatremia 16% of them suffered from moderate pneumonia and 10% had very severe pneumonia and 4% had pneumonia. Among children with pneumonia 12% had pneumonia only while 2% had severe pneumonia and 6% had very severe pneumonia.

Conclusion

Children admitted with clinical or radiological diagnosis of pneumonia and were assessed for sodium level. Hyponatremia was detected in children with pneumonia which was statistically significant. Hence along with management of pneumonia, hyponatremia should also be cautiously addressed in these patients.

KEY WORDS

Children, Hyponatremia, Pneumonia



INTRODUCTION

Lower respiratory tract infections (LRTIs) are common during childhood and can have high morbidity and mortality rates if not treated.¹ The 2005 report of the World Health Organization states that LRTIs cause approximately 19% of the 10.5 million annual deaths.² It is among the serious health problems specifically in less than 5 years of age requiring hospitalisation and attributes to 30% of deaths yearly worldwide especially due to pneumonia as the leading cause.³ LRTI is infection listed below the level of the throat where there is swelling of the airways/pulmonary tissue due to viral or bacterial infection and might be taken to include: Bronchiolitis, bronchitis, pneumonia and empyema. Pneumonia is the leading reason for major illness and death in children accounting for 20-25% in under 5 age around the world and it can be generally specified as swelling of the lung parenchyma. Bronchiolitis is a typical childhood disease and its most typical etiologic representative is breathing syncytial virus (RSV).^{3,4} Hospitalization is required in around 1% of afflicted kids, primarily because of dehydration, insufficient oral intake, or breathing deficiency. Between 10-15% of hospitalized children needs extensive care due to impending breathing failure.^{3,4,5} Fluids and electrolytes are the primary pillars in the upkeep of body homeostasis. The most essential among electrolytes is salt which is the abundant cation of the extracellular fluid. Hyponatremia is the most common electrolyte abnormality seen in the intensive care unit (ICU), with an occurrence as high as 30% in some reports.^{5,6} Hyponatremia typically establishes in severe inflammatory diseases such as meningitis, breathing tract infections, febrile convulsions, and Kawasaki disease in children.⁷⁻¹⁰ Patients with pneumonia the most typical diseases that come across in pediatric basic practice, are at particular danger of establishing hyponatremia due to antidiuretic hormonal agent (ADH) oversecretion.¹¹⁻¹³ Hyponatremia related to paediatric pneumonia is most typically due to the syndrome of unsuitable antidiuretic hormone secretion (SIADH).¹⁴ Hyponatremia is defined as a serum sodium level below 135 mmol/L. It is the most common clinical electrolyte imbalance.¹⁵ The hyponatremia rate in inpatients is 15%-30%.¹⁶ Hyponatremia can be classified into three groups as mild (131-135 mmol/L), moderate (126-130 mmol/L), and severe (≤ 125 mmol/L).¹⁷ Mild hyponatremia is the most common type and usually produces no clinical findings. Severe hyponatremia is rare and has high morbidity and mortality rates if not treated.^{18, 19} The main causes of hyponatremia are volume depletion (bleeding, vomiting, diarrhea, and urinary loss), syndrome of inappropriate antidiuretic hormone (SIADH) secretion, congestive heart failure, thiazide diuretics, cirrhosis, renal failure, primary polydipsia, adrenal insufficiency, hypothyroidism, and pregnancy.²⁰ Several lung disorders, including pneumonia, can cause SIADH through unknown mechanisms.²¹

It was in 1920 when Lussky and co workers described the retention of water in children with pneumonia, which was found to be associated with an increased blood volume and a low plasma chloride value, these findings are explained by the syndrome of inappropriate secretion of anti diuretic hormone which has been described in children with pneumonia. However it was in 1962 that the correlation of hyponatremia and pneumonia in children was first

described by Stormont and water house.²²

Dhavan and colleagues from Chandigarh reported that hyponatremia was found in 31% of children with pneumonia and SIADH was the cause in almost 94% cases.²³

Alkahtani Hassan Naseer and colleagues reported that hyponatremia is common amongst kids hospitalized with lower breathing tract infections typically due to SIADH which substantially increases the morbidity and mortality.²⁴

Chaitra K.M. and his colleagues concluded that mild hyponatremia is common among children with lower respiratory tract infections.²⁵

The rationale of this study is to find out the prevalence of hyponatremia in a child with pneumonia so that while treating pneumonia, hyponatremia is not overlooked and treated simultaneously.

OBJECTIVE

The objectives of the study are to identify the incidence of hyponatremia in children between 2 months to 5 years of children with pneumonia and to investigate the relationship between serum sodium levels and other laboratory parameters.

METHODOLOGY

The study population consists of children with pneumonia aged 2 months–5 years who were seen at pediatrics OPD or admitted for treatment to and monitoring at BMCTH Pediatrics Ward between June two December 2017 in the duration of 6 months. It is a prospective study with sample size of 50.

Children between 2 month to 5 years visiting OPD clinic and admitted to BMCTH with clinically or radiologically confirmed pneumonia were the study population. Children with tachypnea (infants from 2 months to 1 year): Respiratory rate more than equal to 50 breaths/minutes and children 1 to 5 years: Respiratory rate more than equal to 40 breaths/min) and any one or more of the following criteria were included in the study.

Infants from 2 months to 1 year: chest recession, nasal flaring, cyanosis, intermittent apnoea, grunting respiration, not feeding, capillary refill time more than 2 secs, oxygen saturation less than 92%. Children 1 to 5 years: chest recession, nasal flaring, cyanosis, grunting respiration, capillary refill time more than 2 secs, oxygen saturation less than 92%.

At the time of enrollment an informed written consent was obtained from the parents. Detailed history was taken from parents/guardians with relevance to the case. Detailed clinical examination was done. Chest x-ray was taken. All children were screened for dyselectrolytemia on admission. Other investigations were done whenever required.

Collected data were analysed by frequencies, percentages, mean, standard deviation and by Chi-square test by using SPSS 16.0.

Inclusion criteria

Children between 2 months to 5 years with radiologically confirmed pneumonia and clinical features defined as per modified WHO/BTS guidelines.



Exclusion criteria

1. Infants less than 2 months of age
2. Children more than 5 years of age
3. Children with renal disorders
4. Children with associated CNS infections
5. Children with gastroenteritis
6. Children with chromosomal or genetic disorder
7. Children on drugs which can cause electrolyte imbalance such as diuretics, anticonvulsants etc.

RESULTS

The study population comprised of 50 children suffering from pneumonia admitted to pediatrics ward at BMCTH. Here are the findings.

Table 1. Socio- demographic characters (n=50)

Variables	N=50	%
AGE		
2mo-<12mo	30	60
1-<3yrs	11	22
3-<=5yrs	9	18
GENDER		
Male	34	68
Female	16	32
RELIGION OF PARENTS		
Hindu	41	82
Muslim	7	14
Buddhist	2	4

A total of 50 children of age ranging from 2 months to 5 years who were admitted with clinical or radiological diagnosis of pneumonia were enrolled in the study. The mean age of children was 1.3 (\pm)2.5 years with age ranging from 3 months to 4 years. Maximum number of children (60%) belonged to age group between 2 months to 12 months while the least number of children(18%) belonged to age group between 3 to 5 years. Male to female ratio was 2.1:1 with fairly large number involving male child i.e. 68%. Most of the parents who brought their child for assessment belonged to hindu religion (82%).

Table 2 : Clinical Presentation

Variables	N=50	%
COUGH		
Present	38	76
Absent	12	24
FEVER		
Present	46	92
Absent	4	8
CHEST PAIN		
Present	10	20
Absent	40	80
NASAL CONGESTION		
Present	13	26
Absent	37	74
ABDOMINAL PAIN		
Present	14	28
Absent	36	72
GRADING OF PNEUMONIA		
Pneumonia	13	26
Severe pneumonia	20	40
Very severe pneumonia	17	34

Clinical assesment was done prior to investigations. 5 clinical profiles along with the clinical parameters that distinguished the grading of pneumonia were done and is presented in above table 2. Respiratory rate was increased in all the children. Mean respiratory rate was for 2 month to 12 months ranging from 52 to 80 per minute. Mean respiratory rate was for those above 12 months with respiratory rate ranging from 46 to 76 per minute. Cough was present in 76% of studied children while fever was present almost invariably i.e. 92%. There were more children presenting with abdominal pain (28%) than those with chest pain (20%). The complaint of nasal congestion was present in 26%. Clinical diagnosis revealed majority of children with severe pneumonia (40%) followed by very severe pneumonia (34%) followed by pneumonia (26%).

Table 3: Lab parameters

Variable	N=50	%
TOTAL LEUKOCYTE COUNT		
4000-11000 cu/mm	5	10
>11,000 cu/mm	35	70
<4,000 cu/mm	10	20
CRP		
Positive	43	86
Negative	7	14
SODIUM		
Normal sodium level (135-145 meq/L)	10	20
Hyponatremia (<135 meq/L)	40	80

Table 3 shows some of the lab assessment. Leukocytosis was seen in 70% of children while leucopenia in 20% of the children.

Acute phase reactants CRP was positive in 86% of the children. Hyponatremia was revealed in 80% of the children with pneumonia. Mean sodium level was 128.34 \pm 7.3 ranging from 112 to 145 meq/L.

Table 4 : Grading of Severity of hyponatremia

Grading of hyponatremia	Frequency	%
Normal sodium level	10	20
Mild hyponatremia (131-135 meq/l)	8	16
Moderate hyponatremia (126-130 meq/l)	15	30
Severe hyponatremia (<=125 meq/l)	17	34

Table 5 shows grading of hyponatremia. 34% of the studied children had hyponatremia while 30% had moderate hyponatremia and 16% and 20% had normal sodium level.



Table 5: Distribution of children by age by hyponatremia (n=50)

Age	Normonatremic group (135-145 meq/L)	Hyponatremic groups (<135 meq/L)
	Number of cases	Number of cases
2mo-<12mo	4 (8%)	26 (42%)
1-<3yrs	4(8%)	7 (14%)
3-<=5yrs	2(4%)	7(14%)

P= 0.583

Analysis of hyponatremia in relation to age was done. The relation was not significant but maximum number (42%) belonged to age group 2 months to 12 months.

Table 6: Association of age of children with grading of hyponatremia

Age	Grading of hyponatremia			
	Normal sodium level	Mild hyponatremia (131-135 meq/l)	Moderate hyponatremia (126-130 meq/l)	Severe hyponatremia (<=125 meq/l)
2mo-<12mo	4 (8%)	5 (10%)	11(22%)	10(20%)
1-<3yrs	4(8%)	1(2%)	3(6%)	3(6%)
3-<=5yrs	2(4%)	2(4%)	1(2%)	4(8%)

P=0.56

Table 6 shows the relation between sodium level with age of the children. Among children between 2 months to 12 months (20%) had severe hyponatremia while children in age group between 1 to 3 years 6% had severe hyponatremia and between 3 to 5 yrs of children 8% had severe hyponatremia. The relation was statistically not significant.

Table 7: Association of Total leukocyte count with sodium level

Leukocyte count	Normal sodium level 135-145 (meq/L)	Hyponatremia (<135 meq/L)
	4000-11000 cu/mm	3(6%)
>11,000 cu/mm	6(12%)	29(58%)
<4,000 cu/mm	1(2%)	9(18%)

P=.094

Table 7 shows the association of total leukocyte count with sodium level. 58% of children with hyponatremia demonstrated leukocytosis. The relation however was not statistically significant.

Table 8: Association of CRP with sodium level (n=50)

CRP	Normal sodium level(135-145 meq/L)	Hyponatremia (<135 meq/L)
	Positive	5(10%)
Negative	5(10%)	2(4%)

P=.02

Table 8 shows the association between C reactive protein and hyponatremia. 76% of children with hyponatremia had positive CRP. This was statistically significant.

Table 9: Association of grading of hyponatremia with grading of pneumonia

Grading Pneumonia	Grading of hyponatremia			
	Normal sodium level	Mild hyponatremia (131-135 meq/l)	Moderate hyponatremia (126-130 meq/l)	Severe hyponatremia (<=125 meq/l)
pneumonia	6(12%)	4(8%)	2(4%)	1(2%)
Severe pneumonia	1(2%)	4(8%)	8(16%)	7(14%)
Very severe pneumonia	3(6%)	0(0)	5(10%)	9(18%)

P=.002

Table 9 shows the association of grading of hyponatremia with grading of pneumonia. 18% of the children with severe hyponatremia had very severe pneumonia. While 14% with severe hyponatremia had severe pneumonia and only 2% of the children with severe hyponatremia had pneumonia. In children with moderate hyponatremia 16% of them suffered from moderate pneumonia and 10% had very severe pneumonia and 4% had pneumonia. Among children with pneumonia 12% had pneumonia only while 2% had severe pneumonia and 6% had very severe pneumonia. The data is statistically significant.

DISCUSSION

The commonest dyselectrolytemia in hospitalized patients is hyponatremia. It complicates many conditions including respiratory, central nervous system, malignancies etc and it's a marker of severe illness resulting in high mortality and morbidity²⁶⁻²⁹

Electrolyte disturbances have been described in a wide variety of acute infections including pneumonia, which complicates the management and prognosis.³⁰ Most of the studies have shown hyponatremia due to Syndrome of Inappropriate Antidiuretic Hormone secretion (SIADH) as the most common electrolyte abnormality^{31,32}

The stimulus of ADH release in pulmonary disease is likely to be nonosmotic; in particular, lung hyperinflation and pulmonary infiltrates may stimulate ADH secretion by causing a false perception of hypovolemia by intrathoracic receptors.³³

The goal of this study was to find out the prevalence of hyponatremia in children with pneumonia so that while treating pneumonia, hyponatremia is not overlooked and treated simultaneously.

This study was a descriptive cross sectional study done in children diagnosed to have pneumonia as per the WHO ARI guidelines at the Pediatrics ward and ICU in BMCTH.

Out of 50 children enrolled in the study maximum number of children (60%) belonged to age group between 2 months to 12 months. Male to female ratio was 2.1:1 with larger number(68%) being the male child. 92% of children were brought with fever while cough in 76% and nasal congestion in 28% while almost all presented with rapid breathing with difficulty. On the basis of WHO classification of ARI severe

pneumonia was found in 40% while very severe pneumonia in 34% and pneumonia in 26%. Leukocytosis was observed in 70% of the children while CRP was positive in 86%.

The prevalence of hyponatremia was found to be 80% which is similar to the study done in kenyatta hospital by Dr. Eunice where the prevalence was 71.9%.³⁴ In India the prevalence of hyponatremia was 27% which is 2.5 times lower than that found in the current study.³⁵ These findings could be attributed to the fact that hyponatremia was defined as sodium level of <130mmol/l in the study done in india as compared to study done here where hyponatremia is <135 mmol/l.

Severe hyponatremia was found in 34% of the children and moderate hyponatremia in 30% while mild hyponatremia in 16% of the children. 42% of the children with hyponatremia belonged to age group between 2 months to 12 months.

In a study done at tamilnadu India mild hyponatremia was seen in 24.2% and moderate hyponatremia was seen in 16.7% of children which is comparable to our results. However, None of the cases had severe hyponatremia which is in contrast to our studies³⁶.

There was no statistical significance between the age group of children with hyponatremia though.(p=0.58). Moderate hyponatremia was more common (22%) in children age group between 2 months to 12 months, while moderate and severe hyponatremia were equally common(6%each) in children aged 1 to 3 years. Among children between 3 to 5 years severe hyponatremia was more common (8%). The association of age of children with grading of hyponatremia was done and it was statistically not significant.(p=0.56)

The association of total leukocyte count with sodium values were compared and it too was statistically not significant (p=0.94) though higher numbers of children with hyponatremia (58%) had leukocytosis. 76% of children with hyponatremia had positive CRP. The association between CRP and hyponatremia was statistically significant.(p=0.02)

The grading of severity of pneumonia was compared with grading of hyponatremia. In this study 18% of the children with severe hyponatremia hadvery severe pneumonia. The

data is statistically significant.The grading of pneumonia as against the grading of hyponatremia was statistically significant. (p = 0.002) similar to a significant association between very severe pneumonia and hyponatremia (p=0.002) that was observed in a study done at kanyatta hospital.³⁴

CONCLUSION

Hyponatremia is prevalent in children with pneumonia. The children admitted with pneumonia have higher morbidity when associated with hyponatremia. In our study too hyponatremia was detected in children with pneumonia that was statistically significant. Hence along with management of pneumonia, hyponatremia should also be cautiously addressed in these patients.

RECOMMENDATIONS

Children admitted with clinical or radiological diagnosis of pneumonia should be promptly checked for serum sodium value and management should be started. Care should be taken while instituting fluid in these children as electrolyte imbalance might be aggravated.

LIMITATION OF THE STUDY

The limitation of the study was the sample size which was small and the cases were included from only one center. The other investigations like serum and urine osmolality and urine sodium could not be done since our facility was not equipped with these investigations.

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CONFLICT OF INTEREST

None.

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