Original Research Article

# A clinical study of pneumonia with special reference to hyponatremia among children aged 1–5 years admitted in teaching hospital

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## Abstract

**Introduction:** Pneumonia probably is one of the oldest diseases, as old as antiquity known to human kind and has always remained a subject of challenge to medical science, despite extensive research. Hyponatremia is the most common electrolyte disorder among hospitalized patients and has been associated with increase in mortality. **Objectives:** 1) To study clinical profile of pneumonia among children aged 1-5 years. 2) To determine the frequency of hyponatremia in pneumonia. **Methodology:** This was a hospital based cross sectional study of pneumonia with special reference to hyponatremia conducted among children aged 1-5 years who were admitted in pediatric wards of Assam Medical College Dibrugarh, Assam, during the period April 2012 to March 2013. **Results:** In the present study, outof 300 cases of pneumonia, 78 (26%) cases were hyponatremic. Among them 9 (11.5%) cases were pneumonia, 51 (65.4%) cases were severe pneumonia and 18 (23.1%) cases were very severe pneumonia. Mean duration of hospital stay of patient with hyponatremia with pneumonia was 9.54 ± 2.63 and those with normonatremia with pneumonia were 6.43 ± 1.16. **Conclusion:** Incidence of hyponatremia in pneumonia is common and its incidence is more common in cases of very severe pneumonia. Mean duration of hospital stay of patient with hyponatremia with pneumonia is more compared to those with normonatremia with pneumonia.

**Key words**: Pneumonia, Hyponatremia, Children aged 1-5 years

## Introduction

Pneumonia probably is one of the oldest diseases, as old as antiquity known to human kind and has always remained a subject of challenge to medical science, despite extensive research. Childhood pneumonia is an important cause of morbidity in the developed world and morbidity and mortality in the developing world. Over the years the mortality remained almost the same and hence it is also called as “forgotten killer” or “silent killer”. R.M. Douglas describes the acute respiratory tract infections of childhood as “Cinderella of communicable disease” [1].

The terms ‘pneumonia’ and ‘pneumonitis’ strictly represent any inflammatory condition involving the lungs, which include the visceral pleura, connective tissue, airways, alveoli, and vascular structures. The World Health Organization (WHO) estimates there are 156 million cases of pneumonia each year in children younger than five years, with as many as 20 million cases severe enough to require hospital admission. In the developed world, the annual incidence of pneumonia is estimated to be 33 per 10,000 in children younger than five years and 14.5 per 10,000 in children 0 to 16 years [2].

Hyponatremia is the most common electrolyte disorder among hospitalized patients and has been associated with increased mortality. Hyponatremia is defined as a serum sodium concentration ([Na+]) less than 135 mEq/L [3]. Serum sodium levels and serum osmolality are normally maintained under precise control by homeostatic mechanisms involving thirst, anti-diuretic hormone and the renal handling of filtered sodium [4].

Hyponatremia frequently accompanies pulmonary diseases, both infectious and neoplastic. With respect to pneumonia, a recent single-center cohort study found the incidence of hyponatremia at hospital admission among Community acquired pneumonia (CAP) patients

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to be 28% [5], was associated with not only prolongation of hospitalization, but also with an increase in mortality in hospital [6]. Nair and coworkers in a prospective cohort study among all patients hospitalized with CAP, found prevalence of hyponatremia, to be 28% among 342 study patients and was associated with increase in risk of death in hospital [5].

Water retention, fall in serum concentration of chloride and fixed base and diminished osmolality were described in lobar pneumonia in 1920, further studies have shown an increase in plasma volume and extra vascular fluid and severe hyponatremia in association with pneumonia. Inappropriate secretion of antidiuretic hormone (SIADH) has been suggested as the likely underlying mechanism for changes in fluids and electrolytes [7,8]. Childhood pneumonia is an important cause of mortality and morbidity in India. Also hyponatremia occurs in 1/4th of CAP and has been associated with increase inseverity and worsened outcome of the disease. Hence, this study was undertaken to evaluate such a factor with below mentioned aims and objectives:

## Aims and Objectives

1. To study clinical profile of pneumonia among children aged 1-5 years.
2. To determine the frequency of hyponatremia in pneumonia.

## Methodology

This was a hospital based cross sectional study of pneumonia with special reference to hyponatremia conducted among children aged between 1-5 years who were admitted in pediatric wards of Assam Medical College Dibrugarh, Assam, during the period April 2012 to March 2013.

**Source of data:** Study population was children between 1-5 years of age who were admitted in the Pediatrics ward, Assam Medical College with clinical diagnosis of pneumonia as per WHO criteria during April 2012 to March 2013. During this period 530 cases of pneumonia were admitted and 300 cases were enrolled in the study which met inclusion criteria. The patients were included in the study after taking an informed consent from the parents/guardians.

**Inclusion Criteria:** Children with pneumonia between 1-5 years of age

**Exclusion Criteria:** Children with severe malnutrition, Diarrhea, Congestive heart failure, Meningitis, Nephrotic/Acute Glomerular Nephritis.

**Ethical standard:** A necessary ethical clearance was obtained from the Institutional Ethics Committee (H) of Assam Medical College & Hospital, Dibrugarh, Assam.

### Case definition

1. A case of pneumonia is defined as per ARI control programme "presence of cough with fast breathing of 60 breaths per minute or more in less than 2 months of age, 50 breaths per minute or more in 2 months to 12 months of age and 40 breaths per minute or more in 12 months to 5 year or age." The presence of lower chest wall indrawing was taken as evidence of severe pneumonia. The presence of refusal of feeds, central cyanosis, lethargy or convulsions was taken as evidence of very severe pneumonia.
2. Serum sodium concentration of ≤130mEq/L was considered as hyponatremia.

### Case Taking

1. A definite schedule of case taking was followed. A detailed examination of each child including anthropometry was carried out.
2. During the general physical examination, emphasis was laid on assessing general condition of the child, respiratory rate (counted over 1 minute), presence of fever and other signs such as cyanosis and pallor.
3. Detailed systematic examination of the respiratory, cardiovascular and central nervous system was done. Any associated illness such as septicemia, meningitis and congestive cardiac failure if present was noted and they were excluded from the study.

A thorough clinical examination and investigations were carried out as described in the proforma below:

**Clinical study:** A thorough history was taken and an examination was done. Assessment of severity of pneumonia was done according to ARI control programme.

**ARI control programme:** For the child age 2 months- 5 yrs with cough or difficult breathing clinical classification of pneumonia according to ARI control programme

**Table-1: Classification of pneumonia [2]**

| Signs and symptoms | Classification |
|---|---|
| Cough or cold,<br>No fast breathing,<br>No chest in drawing or indicators of severe illness | No Pneumonia |
| Cough or cold with fast breathing. fast breathing is defined as:<br>RR/minute ; Age<br>60 or more ;<2Months<br>50 or more ; 2-12 months<br>40 or more ; 12-60 months | Pneumonia |
| Chest in drawing | Severe Pneumonia |
| Cyanosis, severe chest in drawing, inability to feed | Very Severe Pneumonia |

Nutritional Status was assessed as recommended by the Indian Academy of Pediatrics, into PEM grade I (70 to 80% of expected weight), grade II (60 to 70% of expected weight), grade III (50 to 60% of expected weight) and grade IV (less than 50% of expected weight).

**Collection of Blood:** All the patients in the study group were subjected to measurement of serum sodium concentration. Blood is collected by venipuncture into an empty sterile vial. The test tube was centrifuged unopened and the serum separated. The serum was analyzed for serum sodium.

**Determination of Sodium:** Sodium in the sample of the study group was assessed by ion selective electrode method.

**ION Selective Electrodes [9]:** Analyzers fitted with ion selective electrodes usually contain sodium electrodes with glass membranes and potassium electrodes with liquid ion exchange membranes that incorporate valinomycin. The principle of potentiometry can be simply stated as determination of change in electromotive force in the potential measuring circuit between a measurement electrode and a reference electrode, as the selected ion interacts with the membrane of the ion selective electrode.

Two types of ISE methods can be distinguished. In the indirect methods, sample is introduced into the measurement chamber mixed with a rather large volume of diluents of high ionic strength. Indirect methods were developed earlier in the history of ISE technology when dilution was needed to present a small sample in a volume large enough to adequately a large electrode surface. In direct methods, sample is presented to the electrodes without dilution. This approach became possible with the miniaturization of electrodes. Direct method has been used in our study. Errors observed in the use of ISE's are errors due to lack of selectivity (For Eg: many chloride electrodes lack selectivity against other halide ions), errors introduced by repeated protein coating of the ion selective membrane or to contamination of the membrane or salt bridge by ions that compete or react with the selected ion and thus alter electrode response to the selected ion. Normal values of serum sodium: 136-145 m mol/L.

**Statistical Analysis:** The Statistical software namely SPSS 15.0, Stata 8.0, Med Calc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc. Descriptive statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Statistical significance of the comparisons was determined by either chi-square or t-test, whichever was appropriate. **Significant Figures:**

Suggestive significance ($p$ value: $0.05<P<0.10$)
moderately significant ($p$ value: $0.01<p \leq 0.05$)
strongly significant ($p$ value: $p \leq 0.01$)

## Results

**Table–2: Distribution of Study Subjects According To Age Group.**

| Age group *(in years)* | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | *N* | *%* | *N* | *%* | *n* | *%* |
| 1—2 | 138 | 57.26 | 103 | 42.74 | 241 | 80.33 |
| 3—4 | 33 | 70.21 | 14 | 29.79 | 47 | 15.67 |
| 5 | 4 | 33.33 | 8 | 66.67 | 12 | 4.00 |
| **Total** | **175** | **58.33** | **125** | **41.67** | **300** | **100.00** |

In the present study, majority of the cases (80.33%) were between one to two years of age.

In the present study, majority of cases (58.13%) were males. Male to female ratio was 1.4:1.
In our study, hurried breathing (100%), cough (96.6%), fever (99.67%) were the most common symptoms. Refusal of feeds was present in 5.3% of cases, altered mental status was present in 2% of cases, cyanosis was present in 0.33% of cases, chest retractions were present in 70.33% of cases, crepitations were heard in95%and abnormal breath sounds (bronchial breathing diminished breath sounds) in 1.33% of cases.

**Table–3: Distribution of study subjects according to who classification of ARI programme.**

| Classification | Number | Percentage |
|---|---|---|
| Pneumonia | 91 | 30.33 |
| Severe Pneumonia | 190 | 63.33 |
| Very Severe Pneumonia | 19 | 6.33 |
| **Total** | **300** | **100.00** |

In the present study, according to ARI control programme, 30.33% had pneumonia and 63.33% has severe pneumonia and 6.33% very severe pneumonia.

**Table–4: Distribution of study subjects according to frequency of hyponatremia.**

| Severity of pneumonia | With hyponatremia | | Without hyponatremia | | Total *(n)* |
|---|---|---|---|---|---|
| | *n* | *%* | *n* | *%* | |
| Pneumonia | 9 | 9.89 | 82 | 90.11 | 91 |
| Severe Pneumonia | 51 | 26.84 | 139 | 73.16 | 190 |
| Very Severe Pneumonia | 18 | 97.84 | 1 | 5.26 | 19 |
| **Total** | **78** | **26.00** | **222** | **74.00** | **300** |

In present study out of total 300 cases of pneumonia 78 (26%) cases were hyponatremic. Hyponatremia was present in 9(9.9%) cases of 91 simple pneumonia patients and 51(27%) cases of 190 severe pneumonia patients. Almost all (95%) very severe cases of pneumonia had hyponatremia i.e. 18out of 19 patients. ($p$ valve is $< 0.01$), chi square-test between pneumonia (1) cases and very severe pneumonia (3) cases and between pneumonia (1) cases and severe pneumonia (2) cases was significant.

**Table–5: Distribution of pneumonia cases by their range of serum sodium.**

| Serum Sodium (mEq/L) | Number *(n)* | Percentage *(%)* |
|---|---|---|
| 120—125 | 3 | 1.00 |
| 126—130 | 75 | 25.00 |
| 131—135 | 117 | 39.00 |
| 135—140 | 105 | 35.00 |
| **Total** | **300** | **100.00** |

In majority of pneumonia cases (39%) the range of serum sodium was 131-135 mEq/L followed by 135-140 mEq/L among 35% pneumonia cases.

**Table–6: Distribution of study subjects showing electrolyte status with mean duration of hospital stay**

| Electrolyte status | Hospital stay | | |
|---|---|---|---|
| | ***Mean ± SD*** | ***Range*** | ***Median*** |
| Hyponatremia (*n* = 78) | 9.54± 2.63 | 6—18 | 9 |
| Normonatremia (*n* = 222) | 6.43± 1.16 | 4—9 | 6 |

Mean duration of hospital stay of patient with hyponatremia with pneumonia is 9.54 ± 2.63 and those with normonatremia with pneumonia are 6.43 ± 1.16. p valve is <0.01.

**Table–7: Distribution of study subjects according to outcome of hyponatremia in pneumonia patients**

| Patients with pneumonia | Number of death | Percentage |
|---|---|---|
| With Hyponatremia (*n* = 78) | 4 | 5.13 |
| Without Hyponatremia (*n* = 222) | 0 | 0.00 |
| **Total (*n* = 300)** | **4** | **1.33** |

In our study 4 cases are expired and all of them are having very severe pneumonia with hyponatremia.

## Discussion

Pneumonia continues to pose a threat to health of the children in developed and developing countries despite improvements in socioeconomic status, immunization and early diagnosis and treatment.

Universality, vulnerability and frequency of occurrence of ALRTI in children are well recognized all over the world. Hyponatremia is common among hospitalized patients with pneumonia and was associated with not only prolongation of hospitalization, but also an increase in hospital mortality.

**Age distribution:** Table–2 shows that Age is an important predictor of morbidity and mortality in pediatric pneumonias.In the present study, majority (80.33%) were in 1-2 year of age group. In contrast, in studies done by Reddaiah VP *et al*and Sehgal V *et al*, pneumonia was common in age group of less than one year, with 63.2% and 52.2% respectively [10,11].

**Sex Distribution:** In our study, male (58.13%) study subjects were more than females (41.67%). Male: female ratio was 1.4:1. This was similar in comparison with studies done by Sehgal V *et al* (58.25) and Drummond P *et al* (58%) [12,13].

**Symptomatology:** The ARI control programme puts forward two signs as the basis for examining a child below five years of age for possible pneumonia: cough and difficult breathing.

In the present study, fever was present in 99.6%, cough was present in 97%, fast breathing in 100% and refusal of feeds in 6%. Kabra*et al* reported fever in 82%, cough in 98%, fast breathing in 100% and refusal of feeds in 42%. Another study by Kumar N *et al* stated fever in 88%, cough in 100%, fast breathing in 100% and refusal of feeds in 22% [14,15].

The incidence of presenting symptoms in our study is comparable with studies conducted by Kabra SK *et al*and Kumar N *et al*except for refusal of feeds [14,15].

**Signs:** Tachypnoea is a sensitive and specific indicator of the presence of pneumonia. Also the traditional method of making a clinical diagnosis of pneumonia has been by the recognition of auscultatory signs, in particular crepitations, in a child with cough.In our study, tachypnea (100%) and chest retractions (73.33%) were important signs for making a clinical diagnosis of pneumonia. Crepitations (95%) and abnormal breath sounds (1.33%) were the other associated signs. Margolis P *et al*, Palafox M *et al* and Gadomski AM *et al* have observed that tachypnea and chest retractions were highly specific signs in detecting pneumonia [6,17,18]. Reddaiah VP *et al*, have reported that crepitations were found in 76% of patients with pneumonia [19].

**Hyponatremia in Pneumonia:** Hyponatremia is a common complication present at the time of admission for pneumonia.

In the present study (table-4) incidence of hyponatremia in pneumonia patient was found to be 26% which isin comparison with study done by Zilberger*et al* (8.1%) and S. Singhi and A. Dhawan *et al* (27%) [20,21].

Hyponatremia with pneumonia was associated with more severe illness, increased mortality risk and extended hospital stays.

The mean duration of hospital stay in this study in patient with pneumonia with hyponatremia was 9.54 ± 2.63 when compare to pneumonia with normonatremia which is 6.43 ± 1.16 (table 6).

In hyponatremic children average duration of hospital stay was increased by 66% which is in comparison with study done by S. Singhi and A. Dhawan *et al*where mean duration of hospital stay in children with pneumonia with hyponatremia was 7.1 ± 0.8 when compare to pneumonia with normo-natremia which was 5.5 ± 0.3, with increase in mean duration of hospital stay by 60% in children with pneumonia with hyponatremia [21].

Table–7 revealed that in the present study four patients (5.13%) died. All of them were having severe pneumonia with hyponatremia, which is in comparison with study done by S. Singhi and A. Dhawan *et al*where 9.8% children died due to pneumonia with hyponatremia [21].

Pneumonia has remained a major health problem and constitutes a major portion of patients admitted in the Department of Paediatrics, Assam Medical College & Hospital, Dibrugarh.

## Conclusion

Pneumonia is one of the major causes of morbidity and mortality in children. Incidence of pneumonia in preschool children is very high. Symptoms and signs mentioned in the WHO ARI control programme were very sensitive and can be applied to hospitalized children. Incidence of hyponatremia in pneumonia is common and its incidence is more common in cases of very severe pneumonia.

Hyponatremia is common among hospitalized patients with pneumonia and independently associated with worsened clinical outcomes. Hyponatremia in pneumonia significantly affect the outcome in terms of prolonged duration of hospitalization, and increase in mortality. Therefore we recommend estimation of serum sodium concentration and osmolality of plasma and urine in all severe pneumonia cases to guide appropriate fluid and electrolyte management of these children. It is also recommended to estimate sodium levels in those, who are not improving in usual expected time. There is need to investigate the therapeutic benefit of fluid restriction alone in correcting hyponatremia.

Future research needs to focus not only on how hyponatremia may affect children with pneumonia, but also how severity of hyponatremia impacts hospital outcomes. Studies are needed to evaluate the role of currently available therapies aimed at correction of hyponatremia in improving the outcomes of patients with pneumonia.

**Key message**: Hyponatremia is very common in severe pneumonia in children. There is increased risk of morbidity and mortality in pneumonia that also have hyponatremia.

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