

CORRELATION OF HYPONATREMIA WITH SEVERITY OF ACUTE LOWER RESPIRATORY INFECTIONS IN CHILDREN

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Abstract

Introduction: Hyponatremia is a common electrolyte condition that occurs in hospitalised children, occurs often on admission in patients with pneumonia, and is considered to have a worse outcome.

Aims & objectives: Our research aims to compare the level of sodium with the incidence of acute lower respiratory infections and their prognosis.

Material & Methods: This was a hospital-based prospective study of 300 children aged 6 months to 5 years admitted with acute lower respiratory infections confirmed by chest x-ray. Both clinical results have been reported and serum sodium levels and other investigations have been requested. To determine their role in predicting the seriousness and prognosis of the disease, the relationship of hyponatremia with other clinical and laboratory parameters was studied.

Results: Our analysis showed that 48% of admitted children in the study group had hyponatremia at admission, 34% had mild hyponatremia, 13% had moderate hyponatremia. The most consistent symptom was cough (98%), 60% of subjects in the sample had mild to moderate pneumonia, and 40% had extreme pneumonia. There was hyponatremia for 71 percent of consolidation, 59 percent of bronchopneumonia and 100 percent of empyema cases. Initial high temperature, tachycardia, leukocytosis, enhanced neutrophil count with large p values were correlated with hyponatremia. The majority of hyponatremic cases of extreme pneumonia (60 percent) and hyponatremia were associated with extended hospital stay and mechanical ventilation requirements (91 percent) and higher mortality.

Conclusion: Our research shows that there is a greater risk of developing hyponatremia for serious pneumonia, bronchopneumonia, lobar pneumonia and empyema. In acute lower respiratory infections, hyponatremia has been associated with increased morbidity and mortality. Thus, fluid control in children with acute lower respiratory infections must be handled properly.

Key Words: Hyponatremia, Pneumonia, Empyema.

Introduction

One of the most frequent infections found in children is acute respiratory tract infections. Pneumonia, a serious type of ALRTI (acute infection of the lower respiratory tract), is one of the most significant causes of morbidity and mortality in children, especially in developing countries. Pneumonia is associated with pulmonary parenchymal inflammation. The term pneumonia originates from the Greek word 'pneumon'-the body that pushes air in and out of the body. The pneumos- containing inflammation is pneumonia^{1,2}. Due to both infectious and non-infectious causes, pneumonia may occur. Pneumonia can occur in many forms and can result in many complications as well. Pneumonias can be caused by both viruses and bacteria. Streptococcus pneumonia (pneumococcus), Haemophilus influenza, mostly type b (Hib), Staphylococcus aureus and group A Streptococci are some of the causes of bacterial pneumonia. Atypical pneumonia is caused by Mycoplasma pneumonia and Chlamydia pneumonia³. In acute inflammatory diseases such as meningitis, respiratory tract infections, febrile convulsions, and Kawasaki disease in infants, hyponatremia frequently occurs. Patients with pneumonia and bronchiolitis, the most common diseases

experienced in general paediatric practise, are especially at risk of developing antidiuretic hormone (ADH) hyponatremia over secretion⁴. Pneumonia is the leading infectious killer that takes more lives than any other disease in children under 5. In developed countries, the burden is greater. The single largest infectious cause of death in children worldwide is pneumonia. The two countries that led to the plurality of cases are India and Nigeria. South Asia and sub-Saharan Africa are areas with a high prevalence of the disease⁵. Pneumonia-associated hyponatremia is predominantly attributed to insufficient Anti Diuretic Hormone secretion syndrome despite normal/increased plasma volume in response to increased release of arginine vasopressin due to lung hyperinflation, osmotic stimuli such as hyperglycaemia or uraemia, non-osmotic stimuli such as hypovolemia, hypercapnia, pain, and anxiety⁶.

The aim of the study: To study the prognosis and outcome in acute lower respiratory infection in relation to hyponatremia on admission.

Material and Method

Children between 6 months and 5 years were admitted to the indoor paediatric ward and met the WHO concept of LRTI in a hospital-based comparative study conducted for two years. The parents of the research subjects received informed written consent. Routine blood tests such as complete blood count, renal function tests, serum electrolytes, etc. were collected from the patient and submitted on the day of admission without delay before beginning any treatment. By the ISE (ion selective electrode) process, serum sodium was measured. Hyponatremia was graded with the collected serum sodium values according to the description. For all children with hyponatremia, fluid maintenance was reduced to two thirds. Compared to the severity of pneumonia, all the other criteria were graded according to British Thoracic Society guidelines. Ethical approval from the institutional review board was received.

Inclusion criteria: Children between the ages of 6 months to 5 years with LRTI as specified by the WHO.

Criteria for exclusion: Infants under 6 months and over 5 years of age. Those with diarrhoea, allergic disorders or asthma, CHD, tuberculosis and other comorbid states of clinical diagnosis. For current illness, those with reported parenteral antibiotic consumption prior to indoor admission.

In hyponatremia, the serum sodium level is less than 135 mEq/L. Hyponatremia severity is graded as MILD (131 to 134); MODERATE (126 TO 130); SEVEREREMA (126 TO 130); (125 and less). The presence of infiltration on the chest X-ray was identified as pneumonia.

Statistical Analysis:

Data was entered into Microsoft Excel (Windows 7; 2007 version) and analyses were performed using the Social Sciences Statistical Kit (SPSS). For categorical variables, descriptive statistics such as mean and standard deviation (SD) for continuous variables, frequencies, and percentages were measured. For categorical variables, the relationship between variables was evaluated using the Chi-Square test.

Results

Table 1: Association between Sodium and Gender (N = 300)

Gender	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
Male	100 (57 %)	62 (35 %)	12 (7 %)	2 (1 %)
Female	56 (45 %)	40 (32 %)	28 (23 %)	0

The variations in the distribution of hyponatremia due to sex are not statistically important.

Table 2: Association between Sodium and severity of pneumonia (British Thoracic Society Classification) (N = 300)

BTS Classification	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
Mild to Moderate	110 (61 %)	54 (30 %)	16 (9 %)	0
Severe	46 (38 %)	48 (40 %)	24 (20 %)	2 (2 %)

Table 2 indicates that 61 percent had normal sodium levels of mild to severe pneumonia, 30 percent had mild hyponatremia, and 9 percent had moderate hyponatremia. 38% of extreme pneumonia had normal levels of sodium, 40% had mild hyponatremia, 20% had moderate hyponatremia, and 2% had severe hyponatremia. Hyponatremia has been linked in children to serious pneumonia.

Table 3: Association between Sodium and Shock (N = 300)

shock	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
Present	10 (23 %)	16 (36 %)	16 (36 %)	2 (5 %)
Absent	146 (57 %)	86 (34 %)	24 (9 %)	0

Of 22 cases of pneumonia with shock, table 3 and diagram indicate that 23 percent had normal sodium levels and 36 percent had mild, 36 percent had moderate and 5 percent had extreme hyponatremia.

Table 4: Association between Sodium and Mechanical Ventilation (N = 300)

Mechanical Ventilation	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
yes	2 (9 %)	8 (36 %)	12 (55 %)	0
no	154 (55 %)	94 (34 %)	28 (10 %)	2 (1 %)

Table 4 and diagram indicate that 36% had mild hyponatremia, 55% had severe hyponatremia, out of 22 cases requiring mechanical ventilation.

Table 5: Association between Sodium and Chest X Ray (N = 300)

Chest x ray	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
Pneumonitis	102 (67 %)	44 (29 %)	6 (4 %)	0
Bronchopneumonia	46 (40 %)	42 (36 %)	26 (22 %)	2 (2 %)
Consolidation	8 (29 %)	14 (50 %)	6 (21 %)	0
Empyema	0	2 (50 %)	2 (50 %)	0

Out of 152 cases of pneumonitis, table 5 reveals that 67% had normal sodium levels, 29% had mild hyponatremia, and 4% had severe hyponatremia. Of the 116 cases of bronchopneumonia, 40% had normal levels of sodium, 36% had mild hyponatremia, 23% had moderate hyponatremia, and 2% had extreme hyponatremia. Of the 28 cases of consolidation, 29% had normal sodium, 50% had mild hyponatremia, and 21% had severe hyponatremia. Out of 4 cases of empyema, 2 (50%) had mild and 2 (50%) had severe hyponatremia. Consolidation and bronchopneumonia are more generally associated with hyponatremia.

Table 6: Association between Sodium and Duration of Hospital Stay (N = 300)

Duration of Hospital Stay (in Days)	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
<7	134 (86 %)	62 (61 %)	16 (40 %)	0
8-14	18 (12 %)	34 (33 %)	18 (45 %)	2 (100 %)
>14	4 (3 %)	6 (6 %)	6 (15 %)	0

Table 6 indicates 86 percent, 12 percent, 3 percent had fewer than 7, 8 to 14, more than 14 days of hospital stay out of 156 cases with normal sodium levels. 61%, 33%, 6% had less than 7, 8 to 14, more than 14 days of hospital stay, respectively, out of 102 cases of moderate hyponatremia.

Table 7: Association between Sodium and Outcome (N = 300)

outcome	Hyponatremia grade			
	Normal	Mild	Moderate	Severe
Death	0	2 (2 %)	6 (15 %)	0
Improved	154 (99 %)	92 (90 %)	32 (80 %)	2 (100 %)
DAMA/Referred	2 (1 %)	8 (8 %)	2 (5 %)	0

Out of 156 cases with normal sodium levels, Table 7 indicates a 99 percent increase. Of 102 cases of moderate hyponatremia, 90% had healed and 2% had expired. Of the 40 cases of mild hyponatremia, 80% have healed and 15% have expired.

Discussion

In developing countries, such as India, acute lower respiratory tract infections are one of the most prevalent infectious diseases and are of great significance as a cause of preventable mortality in children. The most common finding in children with respiratory tract infections is hyponatremia, since the correlation of hyponatremia with pneumonia was first recorded by Stormant and Waterhouse in 1962. In our research, age and sex had no connection with the incidence of pneumonia and electrolyte imbalances. This was comparable to Don M et al's study⁶ of gender distribution of pneumonia in age. Our research showed that cough (98%) is the most common symptom, followed by hurried breathing (75%), feeding problems (69%) and fever (23%), which are comparable to other

studies, and cough is the most common symptom, followed by hurried breathing. In this report, 48% of kids had hyponatremia. The majority of the cases, however, had only moderate hyponatremia. In this study, the frequency (48%) of hyponatremia is comparable to the above reports, 45% Chaitra km et al⁷ and 35% Sakellaropoulou et al⁸. The present study found that hyponatremia in children with bronchopneumonia was a common finding (59 percent). Fortunately, in most cases, 36% of hyponatremia was mild, 22% had moderate, and 2% had extreme hyponatremia. In our study, consolidation was the next common respiratory infection in 71 percent of cases that had hyponatremia. In our study, it was found that almost all cases of empyema had hyponatremia (100%) comparable to the studies of Chaitra km et al⁷. In these cases, the cause of hyponatremia may be due to the long course of the disease. Idences with hyponatremia had longer hospital stay durations relative to cases of normo-natremia. 86%, 12%, 3% of cases with usual sodium levels had less than 7, 8 to 14, or more than 14 days of hospital stay. 61%, 33%, 6% of cases of hyponatremia had fewer than 7, 8 to 14, or more than 14

days of hospital stay. 91 percent of mechanically ventilated children had hyponatremia. In our research, hyponatremia and 17 percent of hyponatremia with acute lower respiratory infections all died out of a total of 8 deaths and are comparable to Partha et al⁹ (33 percent). Pneumonia-related hyponatremia is mostly due to the syndrome of inadequate Anti Diuretic Hormone production despite normal/increased plasma volume in response to increased release of arginine vasopressin due to lung hyperinflation, osmotic stimuli such as hyperglycemia, non-osmotic stimuli such as loss of volume, hypercapnia, extreme pain, and anxiety.

Conclusion

In our sample, the majority of LRTI cases were males. No gender preponderance was found in cases of pneumonia. The most common symptom in our cases is coughing. In our cases, moderate hyponatremia was prevalent. There was hyponatremia in the majority of LRTI cases, and hyponatremia was more associated with extreme groups of pneumonia than mild to moderate pneumonia. Bronchopneumonia, lobar pneumonia and empyema were more prevalent in hyponatremia. In LRTI admission cases, hyponatremia was associated with increased morbidity and mortality, such as the need for ventilator help and a prolonged hospital stay. Due to the daily usage of hypotonic fluid as maintenance, the hospital acquired hyponatremia also normal in clinical practise and measures should be taken in the management of acute respiratory infections and fluids and electrolytes should be closely monitored.

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