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Original Research Article

A Hospital Based Prospective Assessment of Serum Sodium Levels in Patients of Lower Respiratory Tract Infections (LRTI) in Children

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Abstract

Aim: The aim of this study was to find out the association among hyponatremia and LRTI in tertiary care center in Bihar region.

Methods: This was an observational, prospective and hospital-based study conducted in JLNMCH, BHAGALPUR, Bihar, India for the period of 18 months. The sample size was calculated to be a minimum of 70 subjects. All patients admitted in to the PICU and pediatric ward were included in the present study. Written and informed consent was secured from the parents participating in the study.

Results: The sample population consisted of children ≥ 2months -12 months (40, 57.14 percent), 1-5 years (20, 28.58%) and > 5-12 years (10, 14.28 percent). There were 42 (60%) male children and 28 (40%) female children in the present study population. Hyponatremia was found to be more among 1 year-5 years age group compared to ≥ 2months-12 months and > 5-12 years age groups. In the current study no significant difference in the allotment of hyponatremia in infancy period, 1-5 years and > 5-12 years was observed. In the present study mean haemoglobin value found to be lesser among subjects with hyponatremia however the variance was statistically insignificant (p=0.280). Mean TLC count found to be significantly more among subjects with hyponatremia compared to subjects without hyponatremia (p=0.036). Mean Neutrophils count were more among subjects with hyponatremia and mean Lymphocyte count was lesser among subjects with hyponatremia though the difference was statistically insignificant.

Conclusion: Hyponatremia is a significantly common association among hospitalized children with lower respiratory tract infections and it is mainly due to syndrome of inappropriate antidiuretic hormone secretion (SIADH).

Keywords: Hyponatremia, Pneumonia, Lower respiratory tract infections

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Introduction

Approximately 10% of the entire novel cases of pneumonia become serious and require hospital admission. One of the major varieties of heightened infection include electrolyte disturbances together with pneumonia, which worsens the prognosis and management of the disease. [1-3] The crucial mainstay in the conservation of body homeostasis is fluids

and electrolytes. Sodium is the most essential among electrolytes which is the major solute of the extracellular fluid. [4] The most common electrolyte in ICUs is hyponatremia, it considered to be indiscretion with an episode as high as thirst rate in some cases. Hyponatraemia is witnessed as a leading cause of acute meningitis, febrile convulsions, acute lower respiratory tract contagion, and Kawasaki illnesses in infants. [3,5]

Lower respiratory tract contagion like bronchiolitis and pneumonia are the most common ailments that are found Centrein children with severe hyponatraemia due to over secretion of antidiuretic hormone. [6-8] Due to SIADH in paediatric pneumonia, hyponatraemia is very common. SIADH consists of hyponatremia, inappropriately elevated urine osmolality, excessive urine sodium and decreased serum osmolality in a euvolemic patient without edema. [9] Gavage tube feeds, hypotonic intravenous fluids, and humidified air in the ventilator circuit are the sources of free water ingestion in these infants. [10] Heightened hyponatraemia in these patients can give vent to swift budge of liquid in central nervous system, resulting in brain oedema and other threatening results. [11]

Pneumonia, severe disease of respiratory tract which is one of the great cause of morbidity and death in young children specifically in the underdeveloped nations. Bronchiolitis, which is another common childhood problem caused by virus i.e. respiratory syncytial virus (RSV). However only 1% of affected youngster requires hospital admission mainly due to dehydration, improper oral intake, or respiratory distress. “The imminent respiratory failure would require intensive care of about 10-15 percent of hospitalized children." In various acute infections such as Pneumonia, Hyponatremia is a frequent electrolyte imbalance found which complicate the treatment and outcome. [12] Hyponatremia is characterized as a serum sodium value less than 135meq/L. [13] Most common type of hyponatremia is mild type and is asymptomatic whereas severe hyponatremia is found rarely and if not treated on time then causes high rates of morbidity and death with poor prognosis. [14,15] In Lower Respiratory Tract Infection, there are various factors such as foremost ailment, decreased water excretion, inappropriate vasopressin secretion (SIADH), use of low osmolality fluids, fluid and electrolyte imbalance, and use of numerous drugs may lead to the increase of hyponatremia. [16]

Thus, this study was conducted to determine frequency of hyponatremia in children and an attempt has been made to correlate the possible electrolyte disturbances in children suffering from severe pneumonia and their outcome and particularly correlation of hyponatremia with SIADH.

Materials and Methods

This was an observational, prospective and hospital-based study conducted in JLNMCH, Bhagalpur, Bihar, India for the period of 18 months. The sample size was calculated to be a minimum of 70 subjects.

Inclusion criteria:

Children of age >2 months to 12 years with a diagnosis of LRTI were involved in this work

Exclusion criteria:

1. Infants < 2 months of age.
2. Children >12 years of age.
3. Children who are on drug therapy which can cause hyponatremia such as diuretics.
4. Children with diagnosed case of tuberculosis and asthma are excluded.
5. Children who are having hyperlipidemia, hyperproteinemia, hyperglycemia are also excluded
6. All children whose parents or guardian refused to give consent.

All patients admitted in to the PICU and pediatric ward were included in the present

study. Written and informed consent was secured from the parents participating in the study. The clinical profile of all patients were studied in detail i.e. history and clinical examination. Based on clinical signs and symptoms (as defined by WHO) and infiltrates present on chest X-ray diagnosis of LRTI such as Pneumonia and Bronchiolitis was made. Then patients were subjected to routine investigations such as: Complete blood count, Serum electrolyte (serum sodium) at the time of admission, on day 2 and day 3 by Ion selective electrodes. Hyponatremia is characterized as mild serum sodium concentration =131-134 meq/ L, moderate hyponatremia = 126-130 meq/ L and severe hyponatremia = less than 125 meq/ L. Presence of severity of hyponatremia was compared with type of pneumonia and other lower respiratory tract infections based on x-ray findings. The data were collected regarding duration of hospital stay in PICU or Ward, need of oxygen, need of ventilator support and duration of mechanical ventilator and the final outcome of the patient in terms of complications, discharge and death and will be assessing hyponatremia in terms of morbidity and mortality in pneumonia patients in comparison to patients of pneumonia with normonatremia.

Statistical analysis: The data was entered into the Microsoft excel and the statistical analysis was performed by statistical software SPSS version 21.0. The p-value was considered to be significant when less than 0.05.

Results

Table 1: Allotment of sample group according to age group and Hyponatremia

Age	Hyponatremia		Total %	P Value
	Absent %	Present %		
≥ 2months-12	25 (62.5%)	15 (37.5%)	40	0.720
1-5 years	13 (65%)	7 (35%)	20	
> 5-12 years	7 (70%)	3 (30%)	10	
Total	45 (64.28%)	25 (35.72%)	70	

The sample population consisted of children ≥ 2months -12 months (40, 57.14 percent), 1-5 years (20, 28.58%) and > 5-12 years (10, 14.28 percent). There were 42 (60%) male children and 28 (40%) female children in the present study population. Hyponatremia was found to be more among 1 year-5 years age group compared to ≥ 2months-12 months and > 5-12 years age groups. In the current study no significant difference in the allotment of hyponatremia in infancy period, 1-5 years and > 5-12 years was observed.

Table 2: Comparison of mean Laboratory values between subjects with and without hyponatremia

Laboratory values	Hyponatremia Mean ± SE	Normonatremia Mean ± SE	p-value
Hemoglobin (gm/dl)	9.54±1.55	10.09±2.09	0.280
TLC (cells /cumm)	17513.23±8970.94	15744.77±6198.42	0.036
Neutrophils (%)	61.68±17.63	57.07±20.19	0.350
Lymphocyte (%)	30.82±16.13	35.51±19.46	0.334
Platelet count (lakh/cumm)	3.72±1.67	4.13±1.44	0.302
ESR (mm/hr)	20.41±7.21	18.91±8.19	0.470

In the present study mean haemoglobin value found to be lesser among subjects with hyponatremia however the variance was statistically insignificant (p=0.280). Mean TLC count found to be significantly more among subjects with hyponatremia

compared to subjects without hyponatremia (p=0.036). Mean Neutrophils count were more among subjects with hyponatremia and mean Lymphocyte count was lesser among subjects with hyponatremia though the difference was statistically insignificant. In the current study mean Platelet count was lesser among subjects with hyponatremia though the difference was not statistically significant. Mean ESR value was more among subjects with hyponatremia though the difference was not statistically significant.

Table 3: Distribution of study population according to cause of Hyponatremia

Cause of Hyponatremia	N%
Other	5 (20%)
SIADH	20 (80%)
Total	25 (100%)

SIADH was found among 20 (80%) and other causes among 5 (20%) patients.

Table 4: Comparison of complications and mortality between subjects with severity of hyponatremia

Complications	Hyponatremia		Total %	P Value
	Absent %	Present %		
Complication	2 (4.45%)	0	2	0.350
Death	3 (6.67%)	3 (12%)	6	
Discharged	40 (88.88%)	22 (88%)	62	
Total	45	25	70	

After using the chi-square test the complications and mortality were compared between subjects with severity of hyponatremia. Complications and mortality was found to be significantly more among subjects with moderate and severe hyponatremia.

Discussion

Lower respiratory tract infections, such as pneumonia, atypical pneumonia, bronchitis, and bronchiolitis, threaten children's health worldwide, particularly in developing nations where inadequate nutrition and healthcare are scarce. [12] Acute lower respiratory tract infection is the most significant cause of morbidity in children under the age of five, with about 156 million new episodes each year globally, and the majority of which occur in India. The annual mortality rate is 1.9 million, with India accounting for roughly 400 thousand deaths. [17] Many acute illnesses, including Pneumonia, have been linked to electrolyte abnormalities, particularly hyponatremia. [16] Other electrolyte problems reported in Pneumonia are hypokalemia and hyperkalemia. [18] Impairment of the intrarenal mechanism of urine dilution due to extracellular fluid volume depletion and inappropriate antidiuretic hormone secretion has been offered as explanations for electrolyte abnormalities in pneumonia and bronchiolitis. [19,20] Hyponatremia is the most common electrolyte imbalance found in clinical practice and critically unwell children. Hyponatremia (HN) affects about 3% of hospitalized patients. [14]

The study population contained 42 (60 percent) males and 28 (40 percent) females in the present study. The similar data was obtained in the study done by Attri et al. [21] where there were 70% male children and 30% female children and Mhatre et al [22] notes that males with hyponatremia were twice as often affected in acute lower respiratory tract infections as females.

This was quite similar to the article by Mhatre et al. [22] which revealed that from

36 children who were diagnosed hyponatremia with lower respiratory tract disorders, 25 children (69.4%) had mild decrease in sodium levels, eight children (22.2%) had moderate hyponatremia and 3 cases (8.3%) had severe hyponatremia, whereas in Chaitra K M et al, were noted that out of 41 cases of hyponatremia related with lower respiratory tract disorders, twenty nine cases (70.7%) had mild decrease in sodium levels, nine (21.9%) had moderate hyponatremia and 3 (7.3%) had severe hyponatremia. [23]

A study done by Channawar K S, states that out of 54 diagnosed hyponatremia cases, 10 cases (18.5 percent) had moderate type of hyponatremia and three (5.5 percent) had severe hyponatremia. [24] In study done by Sakellaropoulou A et al. out of 54 cases, 18 patients (33.3 percent) had mild and one patient (1.9 percent) had moderate hyponatremia.12 Positive CRP was found to be significantly more among subjects with hyponatremia as compared to subjects without hyponatremia. Kanai et al [25] reported that during admission severity of fever and CRP levels both are early features of hyponatremia.

In patients with respiratory tract infections, inflammation itself causes SIADH. New researches revealed that endogenous cytokines such as interleukin−1β and interleukin 6 also play a key role in the formation of inflammatory hyponatremia and might be linked with ADH secretion. [26,27] A number of other studies showed similar observations. A prospective study done by Singhi et al [28] concluded that presence of severe hyponatremia is associated with a threefold increase in the risk of death. Another prospective study done by Dhawan and associates16 also noticed a 3.5 times higher mortality in patients with hyponatremia when compared to those with normonatremia. [29]

Conclusion

It can be concluded that, in two months to five years of age group, hyponatremia is a significantly common association among hospitalized children with lower respiratory tract infections and it is chiefly due to inappropriately excessive antidiuretic hormone secretion (SIADH). Children suffering from LRI's should be evaluated not only clinically but also for serum sodium levels at the time of admission. Careful fluid management especially in the form of fluid restriction therapy in addition to the specific treatment of the underlying cause can prove very useful in lowering the morbidity and complications in these children.

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