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Research Article

Hyponatremia in lower respiratory tract infections

Chaitra K. M., Mohan Kumar N., Saipraneeth Reddy G.*

Department of Pediatrics, Kempegowda institute of medical sciences, Bangalore, India

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***Correspondence:**
Dr. Saipraneeth Reddy G.,
E-mail: saipraneeth1114@gmail.com

ABSTRACT

Background: Hyponatremia is the most common electrolyte abnormality seen in PICU. The main Objective is to characterize the relationship between hyponatremia within 2 hours of admission to the intensive care unit, in the setting of lower respiratory tract infections, and to investigate whether there is a link between hyponatremia and the severity and outcome of LRTI.
Methods: This was a prospective medical chart review of all children admitted to the PICU with a diagnosis of lower respiratory tract infections such as pneumonia, bronchiolitis, wheezing, empyema. Between Jan 1, 2015, and june 30, 2015. Severity of Hyponatremia was defined as mild= serum sodium concentration 131-135 mmol/L, moderate = 126-130 mmol/L, and severe HNa = less than 125 mmol/L (the normal values for serum sodium at our institution are 135-145 mmol/L).
Results: The present study showed that hyponatremia was a frequent finding in children with bronchopneumonia 28 (46.7%). Lobar pneumonia which was next common respiratory infection in our study had hyponatremia in 6 cases (50%) In our study it was found that all cases with empyema had hyponatremia (100%). Bronchiolitis and wheeze associated LRTI relatively had less incidence of hyponatremia in our study. on the whole, it was found that among all hyponatremia cases in lower respiratory tract infection, mild hyponatremia was common (70.7%), followed by moderate and only 3 cases were having severe hyponatremia.
Conclusions: Our study suggests that all cases of empyema develop hyponatremia is a new association derived. Patients with lobar segmental pneumonia and bronchopneumonia are at higher risk of developing moderate or severe Hyponatremia. Thus the appropriate fluid therapy must be carefully arranged in children with lower respiratory tract infection.

Keywords: Hyponatremia, LRTI, Pneumonia, Empyema

INTRODUCTION

Lower respiratory tract infection (LRTI) is one of the serious illnesses especially in less than 5 years of age requiring hospitalisation and attributes to 30 % of deaths annually worldwide especially due to pneumonia as the leading cause. LRTI is infection below the level of the larynx and may be taken to include: Bronchiolitis, Bronchitis, Pneumonia and empyema. It is inflammation of the airways/pulmonary tissue, due to viral or bacterial infection, below the level of the larynx.

Pneumonia is the leading cause of serious illness and death in children accounting for 20-25 % in under 5 age group worldwide and it can be generally defined as inflammation of the lung parenchyma.

Bronchiolitis is a common childhood illness and its most common etiologic agent is respiratory syncytial virus (RSV). Hospitalization is required in approximately 1% of affected children, primarily because of dehydration, inadequate oral intake, or respiratory insufficiency. Between 10-15% of hospitalized children will require intensive care due to impending respiratory failure.[1]

Fluids and electrolytes are the main pillars in the maintenance of body homeostasis. The most important among electrolytes is sodium 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 incidence as high as 30% in some reports.[2,3] Hyponatremia often develops in acute inflammatory diseases such as meningitis, respiratory tract infections, febrile convulsions, and Kawasaki disease in children.[4-7] Patients with pneumonia and bronchiolitis, the most common diseases encountered in pediatric general practice, are at particular risk of developing hyponatremia due to antidiuretic hormone (ADH) oversecretion.[8-11]

Hyponatremia associated with paediatric pneumonia is most commonly due to the syndrome of inappropriate antidiuretic hormone secretion (SIADH).[12] This syndrome is characterized by Hyponatremia and hypoosmolality and results from the inappropriate and continued secretion and/or action of antidiuretic hormone despite normal or increased plasma volume.[13] Hyperinflation of the lungs, a hallmark of the bronchiolitis, wheezing, asthma, reduces blood flow to the right atrium and stimulates the release of AVP from the posterior pituitary.[3,8]

Arginine vasopressin release is triggered by os-motic stimuli such as hyperglycemia or uremia, and by non-osmotic stimuli such as hypovolemia, hypercapnia, pain, and anxiety.[14] Sources of free water intake in this population include hypotonic intravenous fluids, gavage tube feeds, and humidified air in the ventilator circuit.[14,15] These factors are common in children admitted to the ICU with respiratory diseases.

The purpose of this study was to characterize the relationship between hyponatremia within 2 hours of admission to the intensive care unit, in the setting of lower respiratory tract infections, and clinical outcomes including mortality, duration of PICU stay and to investigate whether there is a link between hyponatremia and the severity and outcome of LRTI. We hypothesized that hyponatremia at the time of admission or hyponatremia that developed within 2 hours of admission in children is associated with worse outcomes.

METHODS

This was a prospective medical chart review of all children admitted to the PICU with a diagnosis of lower respiratory tract infections such as pneumonia, bronchiolitis, wheezing, empyema. Between July 1, 2014, and December 31, 2014.

Children were included in this study if they:

1. Were admitted to the PICU with LRTI,
2. Had a serum sodium concentration measured on the first day of hospital admission?

To eliminate the effects of chronic diseases affecting sodium concentrations, subjects were excluded if they carried a diagnosis of cystic fibrosis, hypothyroidism, pan-hypopituitarism, renal failure, metabolic disease, chromosomal disorder, genetic disorder, or any recent surgery. Any child with a previous diagnosis of syndrome of inappropriate antidiuretic hormone syndrome also was excluded.

Pneumonia was defined as the presence of infiltration on the chest X-ray. The diagnosis of bronchiolitis was made by the primary critical care physician at time of admission on the basis of clinical signs of tachypnea, hypoxia, rhinorrhoea, cough, wheeze, subcostal or intercostal retractions, nasal flaring, and grunting.

Severity of Hyponatremia was defined as mild = serum sodium concentration 131-135 mmol/L, moderate = 126-130 mmol/L, and severe HNa = less than 125 mmol/L (the normal values for serum sodium at our institution are 135-145 mmol/L). Gender, age, history of prematurity, intravenous fluid intake, and initial severity of illness were analysed as independent risk factors for the development of hyponatremia.

RESULTS

The study population consisted of 91 children suffering from LRTI admitted to PICU at KIMS, Bangalore. Among them boys contribute to the maximum 54 (59.3%). The study group is divided into two groups: hyponatremic group and normonatremic group.

Hyponatremic group

Total number of cases with serum sodium less than 136meq/l and fulfilling the inclusion criteria are 41 cases (45%). Mean age of patients in this group are 2years, age group ranging from 2 months to 16 years (Table 1).

Table 1: Age distribution in hyponatremic and normonatremic group.

	Hyponatremic group	Normonatremic group
Age	Number of cases (total=41)	Number of cases (total=50)
< 12months	26 (63%)	32 (64%)
1-3yrs	10 (24%)	12 (24%)
3-6yrs	2 (5%)	4 (8%)
6-10yrs	1 (3%)	1 (2%)
11-18yrs	2 (5%)	1 (2%)

Sex ratio

Both in hyponatremic and normonatremic groups boys are predominant comprising 54 (59%) of total cases. In hyponatremic group, 22 boys and 19 girls. In normonatremic group, 32 boys and 18 girls (Figure 1).

Table 2: Hyponatremia in different types of lower respiratory tract infections, grading of severity of hyponatremia according to serum sodium levels at admission.

Type of LRTI	Total no. of cases	Mild hyponatremia (131-135meq/l)	Moderate hyponatremia (126-130meq/l)	Severe hyponatremia (</= 125meq/l)	Cases with hyponatremia
Broncho - pneumonia	60	20	06	02	28 (46.7%)
Lobar pneumonia	12	05	-	01	06 (50%)
Wheeze associated LRTI	08	01	-	-	01 (12.5%)
Bronchiolitis	06	01	-	-	01 (16.7%)
Empyema	05	02	03	-	05 (100%)
Total	91 cases	29 (31.8%)	09 (9.9%)	03 (3.2%)	41(45%)

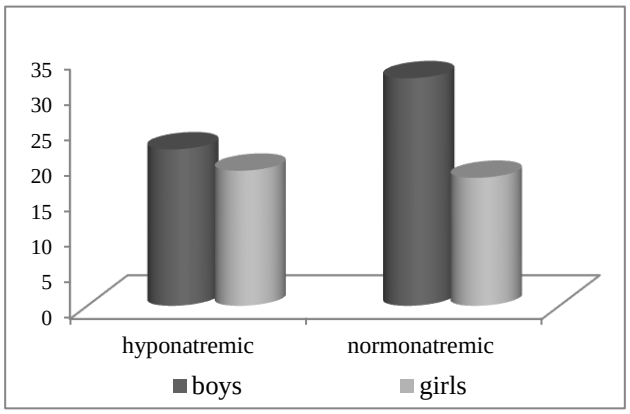

Figure 1: Sex distribution in both hyponatremic and normonatremic group.

Based on the serum sodium levels at admission and the clinical and radiological diagnosis, hyponatremia was assessed according to the serum levels and grouped into mild, moderate and severe hyponatremia and its correlation with different types of lower respiratory tract infections was assessed (Table 2).

On the whole, in our study it was found that among all hyponatremia cases in lower respiratory tract infection, mild hyponatremia was common (70.7%), followed by moderate and only 3 cases were having severe hyponatremia which were bronchopneumonia and lobar pneumonia (Table 3).

Table 3: Severity of hyponatremia in lower respiratory tract infection.

Mild (131-135meq/l)	**29 (70.7%)**
Moderate (126-130meq/l)	9 (21.9%)
Severe (</= 125meq/l)	3 (7.3%)
Total	41 cases (100%)

DISCUSSION

Hyponatremia is the most common electrolyte abnormality. The etiology of hyponatremia in the critically ill child may reflect an endogenous state of sodium dysregulation, iatrogenic causes, or both. Children admitted to the critical care unit for respiratory insufficiency or respiratory failure due to lower respiratory tract infections have been recognized as having increased risk for developing hyponatremia possibly due to dysregulation of arginine vasopressin, antidiuretic hormone, excessive free water administration, or deficient sodium intake.

The present study showed that hyponatremia was a frequent finding in children with bronchopneumonia 28 (46.7%). Fortunately, in the majority of cases, hyponatremia was mild i.e., 20 (71%), 6 (21.4%) had moderate and only 2 (7%) had severe hyponatremia. Patients with mild hyponatremia are almost always asymptomatic. Lobar pneumonia which was next common respiratory infection in our study had hyponatremia in 6 cases (50%), out of which 5 had mild and 1 had severe hyponatremia.

In our study it was found that almost all cases with empyema had hyponatremia (100%), the cause of hyponatremia in these cases might be due to prolonged course of the disease, delayed treatment of the underlying pneumonia component which is now presented as empyema, due to prolonged effect on ADH which further leads to hyponatremia in these cases. Bronchiolitis and wheeze associated LRTI relatively had less incidence of hyponatremia in our study, only 1 case in each type. Almost all cases of moderate to severe hyponatremia had a longer duration of Intensive care stay with average of 4.5 days. In our study, among 91 cases, mortality was 5, among which 3 experienced hyponatremia, but it itself a risk factor or other factors influencing the mortality were not elicited. Over all morbidity associated with hyponatremia was clearly understood from our study by

duration of hospital stay, mortality, frequency of intubation was also more in hyponatremic group.

Hyponatremia occurring in children with pneumonia comprises part of the syndrome of inappropriate antidiüretic hormone secretion (SIADH). ADH is generally secreted by the pituitary gland in response to high plasma osmolality (high serum sodium concentration); however, in various clinical conditions, including fever, hypoxia, hypercarbia, pain, nausea, and vomiting, nonosmotic stimulation of ADH secretion can lead to hyponatremia. Also, 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.[16]

CONCLUSION

Our findings confirm that mild hyponatremia is common among children hospitalized with lower respiratory tract infections. Thus, serum electrolytes should be measured in children hospitalized for lower respiratory infections; and serum sodium concentration should be monitored regularly. Our study suggest that almost all cases of empyema develop hyponatremia is a new association derived from our study and patients with lobar segmental pneumonia and bronchopneumonia are at higher risk of developing moderate or severe Hyponatremia. Thus the appropriate fluid therapy must be carefully arranged in children with lower respiratory tract infection.

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