Serum Sodium Levels in Children with Lung Infections

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Abstract

Objective: Serum sodium levels change in patients with lung infections. This study aimed to evaluate serum sodium levels in patients who were admitted to the hospital with a lower respiratory tract infection (LRTI) and to assess its association with C-reactive protein (CRP) levels.

Material and Methods: A cross-sectional study was designed. A total of 549 inpatients (207 females, 37.7%; 342 males, 62.3%) aged 1–15 years who were diagnosed with LRTI (pneumonia, bronchitis, and bronchiolitis) at the Kars State Hospital's pediatric ward between 01.01.2011 and 30.06.2014 were included in the study. The records of these patients were retrospectively reviewed. Age, gender, white blood cell (WBC) count, absolute neutrophil count (ANC), sodium levels, and CRP levels were recorded. The patients were classified into five groups according to serum sodium levels as severe hyponatremia, moderate hyponatremia, mild hyponatremia, normonatremia, and hypernatremia.

Results: There was no significant difference for age or gender between the hyponatremia and normonatremia groups. There was one patient with severe hyponatremia (≤125 mmol/L), nine with moderate hyponatremia (126–130 mmol/L), 90 with mild hyponatremia (131–134 mmol/L), 446 with normonatremia (135–145 mmol/L), and three with hypernatremia (≥146 mmol/L). There was a negative correlation between serum sodium levels and CRP levels (r=-0.178; p<0.001), WBC counts (r=-0.121; p=0.004), and ANC (r=-0.100; p=0.048).

Conclusion: There was a statistically significant negative correlation between serum sodium levels and acute-phase reactants in patients with pneumonia. Serum sodium levels must be closely monitored in these patients, particularly when acute-phase reactant levels are high. *(J Pediatr Inf 2016; 10: 10-3)*

Keywords: Hyponatremia, pneumonia, acute-phase reactants

Received: 02.12.2015

Accepted: 22.02.2016

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DOI: 10.5152/ced.2016.2232

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). A Ministry of Health study from our country found that LRTIs are responsible for 14% of deaths in children aged 0–14 years (3).

Hyponatremia is defined as a serum sodium level below 135 mmol/L. It is the most common clinical electrolyte imbalance (4). The hyponatremia rate in inpatients is 15%–30% (5). Hyponatremia can be classified into three groups as mild (131–135 mmol/L), moderate (126–130 mmol/L), and severe (≤125 mmol/L) (6). 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 (7, 8). 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 (9). Several lung disorders, including pneumonia, can cause SIADH through unknown mechanisms (10). This study aimed to evaluate serum sodium levels in patients with LRTI.

Material and Methods

We conducted a cross-sectional study and retrospectively evaluated the records of 549 (207 females, 37.7%; 342 males, 62.3%) patients with LRTI aged 1–15 years who were admitted for treatment to and monitoring at the Kars State Hospital Pediatrics Ward between 01.01.2011 and 30.06.2014. This study was approved by the Kars State Hospital (02.10.2014-42288353/8213).

Patients who were suffering from acute gastroenteritis, urinary tract infection, cardiac failure, chronic lung disease (asthma, bronchiectasis, and bronchopulmonary dysplasia), immune deficiency, or malignancy along with LRTI or who were using medication for chronic disorders were excluded from the study. The age, gender, hemogram parameters of white blood cell (WBC) counts and absolute neutrophil count (ANC), biochemistry parameter of serum sodium levels, and C-reactive protein (CRP) levels at the time of admission were recorded. Hemogram parameters were measured using a hematology analyzer BC-5800, Mindray, and biochemistry parameters were analyzed using Architect c16000, Abbott. The patients were divided into five groups according to serum sodium levels: group 1 (severe hyponatremia; ≤125 mmol/L), group 2 (moderate hyponatremia; 126–130 mmol/L), group 3 (mild hyponatremia; 131–134 mmol/L), group 4 (normonatremia; 135–145 mmol/L), group 5 (hypernatremia; ≥146 mmol/L).

Statistical analysis

Data analysis was performed with the SPSS 16.0 software, and a p value of <0.05 was accepted as statistically significant. The Kolmogorov–Smirnov test was used to determine whether the groups demonstrated normal distribution. The chi-square test was used to determine the gender distribution difference and the Mann–Whitney U test to determine the differences of ages and CRP levels, WBC count, and ANC among the groups, while the correlation between the serum sodium levels and WBC count, ANC, and CRP levels was evaluated using the Spearman test.

Results

The 549 patients (342 males, 62.3%; 207 females, 37.7%) had a mean age of 1.86±2.6 years and the range of age was 1–15 years. There was one patient in group 1, nine in group 2, 90 in group 3, 446 in group 4, and three in group 5 (Table 1).

The mean age was 1.6±2.3 years in the three hyponatremia groups and 1.84±2.7 years in group 4. There was no difference between the hyponatremia and normonatremia groups for mean age. The 100 hyponatremic patients comprised 39 females and 61 males. The 446 normonatremic patients comprised 167 females and 279 males. There was no statistically significant difference between the hyponatremic and normonatremic groups with respect to gender distribution (Table 2).

We found a statistically significant negative correlation between serum sodium levels and CRP levels, WBC counts, and ANC (Table 3).

C-reactive protein levels, WBC counts, and ANC of the hyponatremic and normonatremic patients are shown in Table 4.

Discussion

Pneumonia is one of the most common infectious causes of death in children worldwide (11). However, early diagnosis and intervention can effectively reduce the morbidity and mortality rates (12). The management of

Table 1. Patient distribution with respect to serum sodium level

Patient group	Serum sodium level (mmol/L)	Number (%)
Group 1	≤125	1 (0.2)
Group 2	126–130	9 (1.6)
Group 3	131–134	90 (16.4)
Group 4	135–145	446 (81.2)
Group 5	≥146	3 (0.6)

Table 2. Age and gender distribution of hyponatremic and normonatremic patients

	Hyponatremic (Groups 1, 2, and 3)	Normonatremic (Group 4)	
Age [median (min–max)]	1 (0–11)	1 (0–15)	p=0.495
Total number of patients	100	446	
Male	61 (61%)	279 (62.6%)	X^2=0.109
Female	39 (39%)	167 (37.4%)	df=2, p=0.947
Min: minimum; max: maximum			

Table 3. Relationship between serum sodium levels and acute-phase reactants

	CRP	WBC	ANC
Sodium Level	r=-0.178	r=-0.121	r=-0.100
	p<0.001	p=0.004	p=0.048

ANC: absolute neutrophil count; CRP: C-reactive protein; WBC: white blood cell

Table 4. CRP, WBC, and ANC values of hyponatremic and normonatremic patients.

	Hyponatremic (Groups 1, 2, and 3)	Normonatremic (Group 4)	
CRP [median (min–max)]	9.5 (1–85.0)	5.5 (1–83.1)	p=0.007
WBC [median (min–max)]	13.95 (5–37)	12 (3–32)	p=0.007
ANC [median (min–max)]	8 (2–21)	6 (1–20)	p=0.029

ANC: absolute neutrophil count; CRP: C-reactive protein; WBC: white blood cell; min: minimum; max: maximum

LRTI in children requires the use of laboratory tests either for detecting the etiology agent, for planning the treatment, or for predicting prognosis of the disease (13).

Hyponatremia is one of the most commonly diagnosed electrolyte disorders in clinical medicine (14). Because it is often an indicator of an underlying disease, the diagnosis of hyponatremia is important in preventing morbidity and mortality (15). Pediatric hyponatremia is usually caused by an excess of ADH (16). Recent studies have demonstrated that ADH secretion increases during inflammation (17). In our study, 18.2% of patients with LRTI had hyponatremia. In previous studies, the hyponatremia frequency in these patients has been reported to be 16%–45% (18-20). The hyponatremia was mild in 90% of hyponatremic patients, and this is consistent with the literature (18, 20).

We found a statistically significant negative correlation between serum sodium levels and WBC counts, ANC, and CRP levels, which reflect the severity of LRTI. Almirall et al. (21) found that CRP levels in hospitalized patients with pneumonia were significantly higher than in outpatients and high CRP levels were suggestive of the severity of pneumonia. Similarly, Bircan et al. (22) determined that the severity of pneumonia was correlated with CRP levels and WBC count. Recent studies have demonstrated that inflammatory cytokines (such as IL-1β and IL-6) may result in hyponatremia that is associated with various inflammatory conditions such as pneumonia, meningitis, and malaria (17, 23). Moreover, increasing evidences suggest that these cytokines may increase the secretion of ADH (17, 24). These findings suggest that increased inflammatory cytokine levels result in nonosmotic secretion of ADH, and thus, the development of hyponatremia. On basis of these data, we may reveal that serum sodium levels can be used as a marker of disease severity in LRTI.

Conclusion

In conclusion, it may be beneficial to closely monitor serum sodium levels in pediatric patients who are admitted for LRTI, particularly when the acute-phase reactant levels are high.

Ethics Committee Approval: Ethics committee approval was not obtained due to the retrospective nature of this study.

Informed Consent: Written informed consent was not obtained from patients due to the retrospective nature of this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - Y.Y., F.K.; Design - Y.Y., T.C., F.K.; Supervision - E.A., M.D.; Funding - Y.Y., T.C.; Materials - Y.Y., T.C., F.K., S.U., D.U.U., E.A., M.D.; Data Collection and/or Processing - Y.Y., T.C., F.K., S.U., D.U.U., E.A., M.D.; Analysis and/or Interpretation - Y.Y., T.C., F.K.; Literature Review - Y.Y., T.C., F.K.; Writing - Y.Y., T.C., F.K.; Critical Review - T.C., S.U., D.U.U., E.A., M.D.; Other - E.A., M.D.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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