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Research Article

Serum Sodium Level in Children with Lower Respiratory Infections

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Abstract

Objective: Hyponatremia is one of the most common electrolyte disorders among patients with lower respiratory tract infections, and occurs at a rate of 27% to 45%. This study was aimed to investigate the correlation between serum sodium level and laboratory tests, radiological findings, and clinical course among children hospitalized for lower respiratory tract infections.

Methods: We retrospectively analyzed the admission white blood cell count (WBC), absolute neutrophil count (ANC), C-reactive protein (CRP) level, serum osmolarity, blood urea nitrogen (BUN), creatinine, sodium, potassium, and chest X-Ray among children aged 1-17 years of age, who were diagnosed with lower respiratory tract infection and hospitalized between 01.06.2015 and 01.01.2017. Those with signs of alveolar infiltration on chest X-Ray were grouped as Group 1, those with interstitial infiltration as Group 2, and those without any infiltration as Group 3.

Results: This study included 399 patients with a mean age of 22.2 months. Ninety-one (23.2%) of the patients were hyponatremic. The mean age and serum sodium level of Group 1 was significantly lower compared to those of the two other groups ($p<0.05$). Group 1 had significantly greater CRP, WBC, ANC, urea, and creatinine levels than Group 2 and 3; similarly, patients in Group 1 had a significantly higher body temperature and a longer hospital duration than the other groups ($p<0.05$). There were no significant differences between the study groups with respect to heart rate, respiratory rate, and serum osmolarity ($p>0.05$). Patients with hyponatremia had a significantly greater CRP level (p:0.027), a significantly lower serum osmolarity ($p<0.05$), a significantly longer hospital stay (p:0.035), and a significantly higher body temperature (p:0.026).

Conclusions: Among children with alveolar infiltration on chest X-Ray, hyponatremia is a common laboratory finding, which is correlated to disease severity and duration of hospital stay.

Keywords: Sodium; Lower Respiratory Infection; Serum Electrolytes

Introduction

Hyponatremia is one of the most common electrolyte abnormalities of patients with lower respiratory tract infection, and occurs at a rate of 27% to 45% [1]. Hyponatremia is associated with a higher disease severity. The precise mechanism is unknown, but primary illness, impaired water excretion, "inappropriate" release of vasopressin, use of hypotonic fluids, redistribution of sodium and water, sickle cell syndrome, and several drugs may contribute to hyponatremia [2].

The number of studies investigating the incidence of hyponatremia and its impact on clinical presentation among children with lower respiratory tract infections is limited, and they have provided conflicting results [3,4].

The aim of the present study was to assess the correlation between serum sodium level and laboratory tests, radiological findings, and clinical course in children hospitalized for lower respiratory tract infections.

Materials and Methods

This study retrospectively analyzed the medical records of a total of 392 pediatric cases aged 1 to 17 years who were hospitalized for lower respiratory tract infections at Ministry of Health Ümraniye Training and Research Hospital, Pediatrics clinic between 01.06.2015 and 01.01.2017. This study was approved by the local ethics committee (Date XXXX, No: XXX). Patients with any chronic disorder with pulmonary involvement or potentially altering serum sodium level were excluded, as were those who had ben ad-

ministered fluids before the completion of laboratory tests and those admitted to intensive care unit.

Admission white blood cell count (WBC), absolute neutrophil count (ANC), C-reactive protein (CRP) level, serum osmolarity, blood urea nitrogen (BUN), creatinine, sodium, potassium, and chest X-Ray were recorded. Hyponatremia was defined as a serum sodium level <135 mmol/l. Serum osmolarity was calculated with the formula ''(2 x serum sodium) + (BUN)/2.8) + (serum glucose/18)''. Those with signs of alveolar infiltration on chest X-Ray were grouped as Group 1, those with interstitial infiltration as Group 2, and those without any infiltration as Group 3.

Descriptive statistics (mean, standard deviation, minimum, median, maximum) were used to express continuous variables. Kruskal Wallis test was used to compare more than 2 groups with continuous variables without normal distribution. Mann Whitney-U test was used to test 2 independent continuous variables without normal distribution. Categorical variables were compared using the Chi-square test (or Fisher's Exact test where appropriate). Statistical significance was set at p<0.05. All analyses were done with MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013).

Results and Discussion

A total of 392 patients (164 females, 41.8%; 228 males, 58.2%) were enrolled. The mean age of the study population was 22.2 ± 32.3 months. The baseline characteristics of the study participants were shown on Table 1. Two hundred and seventeen (55.4%) patients had a history of antibiotic use before hospital admission. Ninety-one (23.2%) patients had hyponatremia; 294 had normonatremia; and 7 (1.8%) had hypernatremia. When assessed in terms of chest X-Ray findings, 105 (26.8%) patients belonged to Group 1, 194 (495%) to Group 2, and 93 (23.7%) to Group 3. No significant difference existed between the groups with regard to the rate of antibiotic use or sex distribution (p>0.05). Group 1 had a significantly lower mean age than the other 2 groups (p<0.05). This group also had a significantly lower serum sodium level compared to the other two groups (p<0.05). On the other hand, that group had significantly greater CRP, WBC, ANC, urea, and creatinine levels compared with Group 2 and Group 3. Patients in Group 1 also had a significantly higher body temperature and a significantly longer hospital stay (p<0.05) (Table 2). No significant differences were found between the groups in terms of heart and respiratory rate, serum osmolarity, and serum K level (p>0.05). Hyponatremic patients had a significantly greater serum CRP level (p:0.027), a significantly lower serum osmolarity, (p<0.05), a significantly longer hospital stay (p:0.035), and a significantly higher body temperature (p:0.026) than the normonatremic patients (Table 3).

	Median±	SD	Min.	Max.
Age(months)	22.2	32.3	2	225
CRP	2,56	3,69	0,02	28
WBC	12,19	5,48	3,13	44,4
MPV	7,14	0,94	5,1	11,8
ANC	48,2	24,0	1,4	95,1
Na	136,9	2,65	126	148
K	4,47	0,54	3,2	5,7
Urea	17,88	7,53	4	46
CRE	0,41	0,08	0,2	0,8
Glucose	103,9	19,7	11	173
ALT	21,6	14,78	6	163
AST	37,4	19,5	167	156
Osmolarity	285,9	6,36	263	310
SS	32,26	7,8	16	64
HR	111,8	16,85	75	200
Body temperature	37,1	0,73	36	39
Duration of hospital stay	6,3	3,4	1	32

Table 1: Baseline characteristics of the study subjects (n=392).

	Group 1 Mean ± SD	Group 2 Mean ± SD	Group 3 Mean ± SD	p
Age (months)	34,8 ± 40,1	19,7 ± 27	12,9 ± 28,2	<0,05
CRP	4,6 ± 5,0	2,16 ± 2,9	1,08 ± 1,9	<0,05
WBC	14,2 ± 6,3	12,2 ± 5,3	9,9 ± 3,7	<0,05
MPV	7,0 ± 0,9	7,1 ± 0,8	7,3 ± 1,1	0,152
ANC	55,4 ± 23,9	49,8 ± 23,5	36,7 ± 21,2	<0,05
Na	136,2 ± 2,6	137,1 ± 2,8	137,7 ± 2,2	<0,05
K	4,5 ± 0,6	4,5 ± 0,5	4,4 ± 0,6	0,466
Urea	19,1 ± 8,0	17,9 ± 7,5	16,5 ± 6,8	0,042
CRE	0,43 ± 0,1	0,41 ± 0,1	0,4 ± 0,1	<0,05
Osmolarity	284,9 ± 6,4	286,2 ± 6,6	286,3 ± 5,7	0,051
Body temperature	37,7 ± 0,7	37,0 ± 0,6	36,7 ± 0,5	<0,05
Duration of hospital stay (days)	7,1 ± 3,6	6,2 ± 3,6	5,8 ± 2,6	0,02

Table 2: Comparison of the parameters by study groups.

	Hyponatremia Mean ± SD	Normonatremia Mean ± SD	Hypernatremia Mean ± SD	p
Age (months)	21,0 ± 30,1	22,2 ± 32,7	33 ± 43,2	0,968
CRP	3,4 ± 4,9	2,3 ± 3,2	2,5 ± 2,6	0,040
WBC	12,7 ± 5	12,1 ± 5,7	9,8 ± 1,1	0,225
MPV	7,1 ± 0,9	7,1 ± 0,9	7,9 ± 1,2	0,150
ANC	46,2 ± 23	48,9 ± 24,4	45,5 ± 23,9	0,625
Na	133,7 ± 1,9	137,8 ± 1,6	145,9 ± 1,2	<0,05
Urea	17,8 ± 7,7	17,8 ± 7,4	21,6 ± 9,5	0,504
CRE	0,41 ± 0,1	0,41 ± 0,1	0,4 ± 0,1	0,868
Osmolarity	279,3 ± 4,4	287,5 ± 5	302,4 ± 4,5	<0,05
Body temperature	37,3 ± 0,8	37,1 ± 0,7	37,4 ± 0,9	0,041
Duration of hospital stay (days)	7,2 ± 4,3	6,1 ± 3,0	5,1 ± 1,7	0,077

Table 3: Comparison of the parameters by serum sodium.

Hyponatremia is a common electrolyte disturbance among patients with lower respiratory tract infections [5]. Studies have indicated that it is associated with increased inflammatory markers, disease severity, duration of hospital stay, and mortality [6].

It has been reported that the possible cause of increased incidence of hyponatremia among patients with lower respiratory tract infections is increased release of the antidiuretic hormone (ADH) [7]. It has been indicated that increased ADH release may have 3 possible reasons, which include a reduced effective arterial blood volume, reduced extracellular fluid, and volume-independent diuresis. In lower respiratory tract infections, reduced fluid intake, excessive sweating, and vomiting may lead to a reduced extracellular fluid volume. It has been reported that a reduced arterial blood volume may result in hypoalbuminemia and depressed myocardial contractility, both common among patients with pneumonia [8]. Furthermore, it has also been reported that inflammatory cytokines such as tumor necrosis factor, interleukin 1 β, and interleukin-6 increase ADH secretion independently of volume status [9].

Our study showed that patients with alveolar infiltration had a lower mean age and serum sodium level than the other two groups whereas they had a higher body temperature, CRP, WBC, ANC, urea, and creatinine levels, as well as a significantly longer hospital stay. We considered that the increased levels of urea and creatinine likely resulted from an inadequate oral intake, as well as a greater fluid loss due to tachypnea, and sweating. Similarly, we hypothesized that a higher body temperature and an increased CRP level among patients with alveolar infiltration and hyponatremia may have resulted from increased inflammatory cytokine levels.

Wrotek., *et al.* [10] studied 312 children with community acquired pneumonia (CAP) and found a hyponatremia incidence of 33.3%. They also reported that, among patients with hyponatremia, CRP and PCT levels were higher, They showed that those with hyponatremia had a higher body temperature and a longer hospital stay as compared to patients with normonatremia. Our study determined a lower incidence of hyponatremia (23%) than the literature data, and the hyponatremia severity of our patients was mild. In our study, patients with hyponatremia had a significantly greater serum CRP level (p:0.027), a significantly lower serum osmolarity ($p<0.05$), a significantly longer hospital stay (p:0.035), and a significantly higher body temperature compared to the normonatremic ones.

While the levels of acute phase reactants were greater in those with alveolar infiltration on chest X-Ray, serum sodium level was lower. Although serum osmolarity was lower in this group, the difference did not reach statistical significance.

Another study dated 2008 reported that patients with hyponatremia had a higher body temperature, heart rate, and respiratory rate at admission, as well as a longer duration of hospital stay [11]. We found a higher body temperature and a longer hospital stay among patients with hyponatremia but we failed to demonstrate any significant difference between hyponatremic and normonatremic subjects with respect to heart rate and respiratory rate.

A study on adult patients dated 2007 demonstrated a hyponatremia incidence of 27.0%. It also demonstrated that those with hyponatremia had a higher heart rate, white blood cell count, and pneumonia severity index [12].

Zilberberg., *et al.* [13], reported that pneumonia patients with hyponatremia needed intensive care unit care and mechanical ventilator support to a greater rate. The authors also added that patients with hyponatremia had a longer hospital stay and a greater mortality. This study has some limitations, including its retrospective design and the lack urinary osmolarity and urinary sodium level measurements as well as the identification of LRST agents.

Conclusion

Hyponatremia is a common laboratory finding among pediatric patients with alveolar infiltration on chest X-Ray. It is correlated with disease severity and duration of hospital stay.

Conflict of Interests

All authors declare neither financial nor conflict of interest.

Bibliography

1. Vinay Nair., *et al.* "Hyponatremia in Community-Acquired Pneumonia". *American Journal of Nephrology* 27 (2007): 184–190.

2. Moritz ML and Ayus J. "Disorders of water metabolism in children: hyponatremia and hypernatremia". *Pediatrics in Review* 23.11 (2002): 371–380.

3. Kaneko K and Kaneko KI. "Hyponatremia in children with respiratory tract infection". *Pediatric Nephrology* 24.8 (2009): 1595.

4. Luu R., *et al.* "Hyponatremia in children with bronchiolitis admitted to the pediatric intensive care unit is associated with worse outcomes". *The Journal of Paediatrics* 163.6 (2013): 1652-1656.

5. Sakellaropoulous A., *et al.* "Hyponatraemia in cases of children with pneumonia". *Archives of Medical Science* 6.4 (2010): 578–583.

6. Lavagno C., *et al.* "Hyponatremia in children with acute respiratory infections: A reappraisal". *Pediatric Pulmonology* 52.7 (2017): 962-967.

7. Aylwin S., *et al.* ""Dos and don'ts" in the management of hyponatremia". *Current Medical Research and Opinion* 31.9 (2015): 1755–1761.

8. Thorbum K., *et al*. "Right ventricular function in children with severe respiratory syncytial virus (RSV) bronchiolitis". *Minerva Anestesiol*ogy 77.1 (2011): 46-53.

9. Bertini A., *et al*. "Na+, K+, Cl−, acid-base or H_2O homeostasis in children with urinary tract infections: narrative review". *Pediatric Nephrology* 31 (2016): 1403–1409.

10. Wrotek A and Jackowska T. "Hyponatremia in children hospitalized due to pneumonia". *Advances in Experimental Medicine and Biology* 788 (2013): 103–108.

11. Don M., *et al.* "Hyponatremia in pediatric community-acquired pneumonia". *Pediatric Nephrology* 23.12 (2008): 2247-2253.

12. Nair V., *et al.* "Hyponatremia in community-acquired pneumonia". *American Journal of Nephrology* (2007): 184-190.

13. Zilberberg MD., *et al.* "Hyponatremia and hospital outcomes among patients with pneumonia: a retrospective cohort study". *BMC Pulmonary Medicine* 8 (2008): 16.

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