

Serum Sodium Levels in Children with Lung Infections

Akciğer Enfeksiyonu Olan Çocuklarda Serum Sodyum Seviyesi

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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

Öz

Amaç: Serum sodyum seviyesi, akciğer enfeksiyonu olan hastalarda değişebilir. Bu çalışmanın amacı, alt solunum yolu enfeksiyonu (ASYE) ile hastaneye başvuran hastaların serum sodyum seviyesini ve C-reaktif protein (CRP) ile ilişkisini değerlendirmektir.

Gereç ve Yöntemler: Kesitsel bir çalışma dizayn edildi. 01.01.2011-30.06.2014 tarihleri arasında Kars Devlet Hastanesi Pediatri Servisi'nde ASYE (pnömoni, bronşit, bronşiolit) tanısı almış, 1-15 yaş arası toplam 549 yatan hasta (207 kız, %37,7; 342 erkek, %62,3) çalışmaya dahil edildi. Hastaların kayıtları retrospektif olarak gözden geçirildi. Yaş, cinsiyet, beyaz küre (WBC), mutlak nötrofil sayısı (ANC), sodyum ve CRP değerleri kaydedildi. Hastalar, serum sodyum seviyesine göre, şiddetli, ılımlı, hafif hiponatremi; normonatremi ve hipernatremi olmak üzere 5 gruba ayrıldı.

Bulgular: Hiponatremi ve normonatremi grupları arasında yaş ve cinsiyet açısından anlamlı bir farklılık yoktu. Şiddetli hiponatremili (≤ 125 mmol/L) 1 hasta, ılımlı hiponatremili (126-130 mmol/L) 9 hasta, hafif hiponatremili (131-134 mmol/L) 90 hasta, normonatremili (135-145 mmol/L) 446 hasta ve hipernatremili (≥ 146 mmol/L) 3 hasta vardı. Serum sodyum seviyesi ile CRP ($r=-0,178$; $p<0,001$), WBC ($r=-0,121$; $p=0,004$) ve ANC ($r=-0,100$; $p=0,048$) değerleri arasında negatif bir korelasyon tespit edildi.

Sonuç: Pnömonide serum sodyum seviyesi ve akut faz reaktanları arasında istatistiksel olarak anlamlı negatif bir korelasyon vardı. Serum sodyum seviyeleri böyle hastalarda, özellikle akut faz reaktanları yüksek olduğu zaman, yakından takip edilmelidir. (*J Pediatr Inf* 2016; 10: 10-3)

Anahtar kelimeler: Hiponatremi, pnömoni, akut faz reaktanları

Received/Geliş Tarihi:
02.12.2015

Accepted/Kabul Tarihi:
22.02.2016

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web sayfasından ulaşılabilir.

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

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%)	$\chi^2=0.109$
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			

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 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-1 β 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.

Etik Komite Onayı: Çalışmanın retrospektif tasarımından dolayı etik komite onayı alınmamıştır.

Hasta Onamı: Çalışmanın retrospektif tasarımından dolayı hasta onamı alınmamıştır.

Hakem Değerlendirmesi: Dış bağımsız.

Yazar Katkıları: Fikir - Y.Y., F.K.; Tasarım - Y.Y., T.C., F.K.; Denetleme - E.A., M.D.; Veri Toplanması ve/veya İşlemesi - Y.Y., T.C., F.K., S.U., D.U.U., E.A., M.D.; Analiz ve/veya Yorum - Y.Y., T.C., F.K.; Literatür Taraması - Y.Y., T.C., F.K.; Yazıyı Yazan - Y.Y., T.C., F.K.; Eleştirel İnceleme - T.C., S.U., D.U.U., E.A., M.D.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

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