

## Assessment of adult patients with hypernatremia: A single center experience

### *Hipernatremili erişkin hastaların değerlendirilmesi: Tek merkez deneyimi*

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#### ABSTRACT

**Objective:** In the present study, determination of symptoms, clinical characteristics, prevalence and recovery rates was aimed in patients who applied to the emergency service and diagnosed with hypernatremia.

**Methods:** Patients who applied to Dicle University Medical School Emergency Service during January 2013-December 2014 and whose serum Na>148 mEq/L were included in the study. The study was conducted retrospectively.

**Results:** Hypernatremia prevalence was determined as 0.21% in the cases who applied to the emergency service. The average age in all patients was 69±22 and the median age was 72 years. The average hospitalization period was 13.3±10.9 days. The mortality rate was 75.7% and male gender domination (56%) was determined in patients who developed mortality. When mortality and recovery groups were compared statistically; significant difference was determined ( $p<0.05$ ) in terms of hospitalization period, glucose, urea, creatinine and calcium averages. The complaints of our patients who applied to the emergency service were changes in consciousness (92.7%), oral intake disorder (83.4%) and fever (48.6%) based on frequency order. The accompanying comorbid states were cerebrovascular illness (36.9%), Dementia/Alzheimer (32.4%) and hypertension (28.9%) based on frequency order.

**Conclusion:** Consequently, hypernatremia is a fluid-electrolyte disorder progressing with high mortality and could be observed in older patients and in patients whose oral intake is defective and who have cerebrovascular illness and dementia.

**Key words:** Hypernatremia, prevalence, mortality

#### ÖZET

**Amaç:** Bu çalışmada acil servise başvuran ve hipernatremi tespit edilen hastalarda semptomlar, klinik özellikler, prevalans ve sağ-kalım oranlarının belirlenmesi amaçlanmıştır.

**Yöntemler:** Çalışmaya, Ocak 2013-Aralık 2014 tarihleri arasında Dicle Üniversitesi Tıp Fakültesi acil servisine başvuran, serum Na>148 mEq/L üzerinde olan hastalar dahil edildi. Çalışma retrospektif olarak gerçekleştirildi.

**Bulgular:** Acil servise başvuran olgularda hipernatremi prevalansı %0,21 olarak tespit edildi. Tüm hastaların yaş ortalaması 69±22, median yaş 72 yıl idi. Ortalama hastanede kalma süresi 13,3±10,9 gün idi. Mortalite oranı %75,7 ve mortalite gelişen hastalarda erkek cinsiyet hakimiyeti (%56) tespit edildi. Mortalite ile şifa grubu istatistiksel olarak karşılaştırıldığında; hastanede kalma süresi, glukoz, üre, kreatinin ve kalsiyum ortalamaları açısından anlamlı fark tespit edildi ( $p<0.05$ ). Hastalarımızın acil servise başvuru yakınmaları sıklık sırasına göre bilinç değişikliği (%92,7), oral alım bozukluğu (%82,4), ateş (%48,6) idi. Eşlik eden komorbid durumlar ise sıklık sırasına göre serebrovasküler hastalık (%36,9), Demans/Alzheimer (%32,4), Hipertansiyon (%28,9) idi.

**Sonuç:** Sonuç olarak hipernatremi yaşlı, oral alımı bozuk, serebrovasküler hastalığı ve demansı olanlarda daha sık görülebilen ve yüksek mortaliteyle seyreden bir sıvı-elektrolit bozukluğudur.

**Anahtar kelimeler:** Hipernatremi, prevalans, mortalite

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## INTRODUCTION

Hypernatremia is defined as the determination of serum sodium (Na) value over 145 meq/L. It is an electrolyte disorder that could be observed in 0.3-3.5% of hospitalized patients and whose mortality and morbidity could be quite high (40-70%). Hypernatremia is observed in generally fallen patients and especially in old patients who has mental state disorder. Although many older patients who don't have any health problems can sustain normal water balance, in a stress situation, they tend to be hypernatremic [1-3]. The problem in hypernatremic dehydration is the accumulation of sodium in order to ensure adequate fluid volume in circulation as a result of incompetence [4].

Hypernatremia causes could be classified into three categories according to their total body sodium levels. Low total body sodium in hypernatremia (hypovolemic); There are water and sodium loss. However, water loss is greater than sodium. The findings hypovolemia are significant in these patients. Water loss from the kidneys and gastrointestinal tract are the most common etiological causes. Normal total body sodium in hypernatremia (euvolemic); due to water loss in many hypernatremia patients with normal total body sodium. Hypernatremia is seen in babies, elderly patients and patients with neurological deficits due to insufficient water intake. High total body sodium in hypernatremia (hypervolemic) is the least frequent type of hypernatremia. The most common causes are intra-amniotic administration of hypertonic solutions such as 3% NaCl for therapeutic abortion and treatment with NaHCO<sub>3</sub> for metabolic acidosis and cardiopulmonary arrest with hyperkalemia [5,6].

There are only few studies conducted in our country about hypernatremia frequency and mortality in patients who apply to the emergency service [7]. In the present study, retrospective research of clinic and demographic characteristics of the patients who were diagnosed with hypernatremia during application to the emergency service was aimed.

## METHODS

The patients who applied to Dicle University Medical School emergency service during January 2013-December 2014 and whose serum Na>148 mEq/L (normally the upper limit for Na is 145

mEq/L and 2.8 mEq/L was added as a standard deviation) were included in the study. In the patients whose serum glucose value was 200 mg/dl, for each 100 mg Na in the glucose value, 1.6 mEq/L was added to the Na value [8]. The patients who were taking medication that could be related with hypernatremia (lactulose, sodium bicarbonate, lithium, dexamethasone, etc.), trauma patients and patients who were younger than 18 were excluded from the study. Patient data were accessed from the hospital registry system and the study was conducted retrospectively. Anamnesis and medical history of all patients during application to the emergency service, their physical examinations, accompanying illnesses, laboratory parameters, hospitalization periods and clinical outcomes (recovery, mortality) were recorded. The biochemical parameters (glucose, uric acid, sodium (Na<sup>+</sup>), potassium (K<sup>+</sup>), chloride (Cl<sup>-</sup>), calcium (Ca<sup>+2</sup>), total protein, albumin, aspartate aminotransferase (AST), alanine aminotransferase (ALT)) of the patients who were included in the study, and count blood (hemoglobin, hematocrit, white blood cell) value levels were investigated. The patients were divided into two groups as recovery and dead.

Statistical analysis was performed using SPSS 18.0 (Statistical Package for Social Science, Chicago, IL, USA). Data were tested for normality using the Kolmogorov-Smirnov normality test. The results were expressed as means ± SD or number of patients. Categorical data were analyzed using the chi-square test. A student's t-test was used for normally distributed data. Because the some numeric variables did not show a normal distribution, the Mann-Whitney U test was used. A p value of < 0.05 was considered significant.

## RESULTS

Hypernatremia was determined in 111 (0.21%) of 52.485 patients who applied to our emergency service during January 2013-December 2014. 73 (65.8%) of the cases were male. The average age of all patients was 69±22 (35-91) years, median age was 72 years. The number of patients who developed mortality was 84 (75.7%) and there was male gender dominance in patients who developed mortality. When the mortality and recovery groups were compared statistically; significant difference was

determined in terms of hospitalization period, average glucose, urea, creatinine and calcium values (respectively  $p=0.024$ ,  $p=0.043$ ,  $p=0.021$ ,  $p=0.030$ ,

$p=0.032$ ). The clinical and demographic characteristics, average laboratory parameters and statistical comparisons of both groups are shown in Table 1.

**Table 1.** Clinical, demographic characteristics and laboratory parameters of the patients

	All patients (n=111)	Survive (n=27)	Not-survive (n=84)	p value
Age (year) (Mean±SD)	69±22	76±13	62±11	0.061
Gender n (%)	Female	10 (37)	28 (33.3)	0.442
	Male	73 (65.8)	56 (66.7)	
Hospitalization period (day)	13.3±10.9	17.4±9.7	12.1±11.0	0.024
Hemoglobin (g/dL)	11.1±3.3	11.8±4.7	10.8±2.6	0.173
Hematocrit (%)	33.0±11.1	32.9±7.8	33.1±8.9	0.938
White blood cells ( $10^3$ /ML)	13.9±10.4	13.7±9.9	14.0±10.5	0.875
Glucose (mg/dL)	162.4±105.3	173.9±162.7	158.7±79.7	0.043
Blood urea nitrogen (mg/dL)	137.9±81.6	105.8±81.3	148.3±79.3	0.021
Creatine(mg/dL)	1.9±1.5	1.4±0.9	2.1±1.7	0.030
Uric acid (mg/dL)	7.1±4.2	6.2±3.2	6.8±4.3	0.074
Total protein (g/dL)	5.6±0.9	5.9±0.9	5.5±0.9	0.121
Albumin (g/dL)	2.2±0.4	2.3±0.5	2.2±0.4	0.432
AST (U/L) (Median,(min-max))	35 (6-2145)	43 (6-269)	59 (8-2145)	0.085
ALT (U/L) (Median, min-max)	23 (6-1478)	45 (6-367)	61 (6- 1478)	0.160
Na (mmol/L)	162.7±8.5	161.3±6.0	163.2±9.1	0.313
K (mmol/L)	4.1±2.7	4.7±5.3	3.8±0.8	0.140
Cl (mmol/L)	123.1±15.3	119.2±22.8	124.4±11.9	0.131
Ca (mmol/L)	8.2±1.9	8.9±2.6	8.0±1.5	0.032

AST: aspartate aminotransferase, ALT: alanine aminotransferase, Na: sodium, K: potassium  
Cl: chloride, Ca:calcium

**Table 2.** The complaints and accompanying comorbid illnesses of the patients during application

	Total (n=111) n (%)	Survive (n=27) n (%)	Not-survive (n=84) n (%)	p value
Oral intake defect	91 (82.4 )	28 (25.2 )	63 (57.2 )	0.005
Headache	26 (23.4)	16 (14.4)	10 (9 )	0.641
Nausea and vomiting	28 (25.2)	17 (15.3)	11 (9.9)	0.501
Fever	54 (48.6)	35 (31.5 )	19 (17.1 )	0.432
Edginess	16 (14.4)	9 (8.1)	7 (6.3)	0.411
Diarrhea	9 (8.1)	7 (6.3)	2 (1.8)	0.326
Consciousness change	103 (92.7)	56 (50.4)	47 (42.3)	0.542
Unconsciousness	33 (29.7)	9 (8.1)	24 (21.6)	0.001
Convulsion	4 (3.6)	1 ( 0.9)	3 (2.7)	0.431
Drowsiness/confusion	66 (59.4)	52 (46.8)	14 (12.6)	0.005
Dementia/Alzheimer	36 (32.4)	23 (20.7)	13 (11.7)	0.008
Cerebrovascular illness	41 (36.9)	27 (24.3)	14 (12.6)	0.041
Malignity	14 (12.6)	6 (5.4)	8 (7.2)	0.063
Diabetes mellitus	13 (11.7)	11 (9.9)	2 (1.8)	0.084
Hypertension	32 (28.9)	17 (15.3)	15 (13.6)	0.334
Coroner arterial illness	6 (3.6)	3 (2.7)	1 (0.9)	0.121
Heart failure	6 ( 5.4)	4 (3.6)	2 (1.8)	0.722
Prostate hypertrophy	5 (4.5)	1 (0.9)	4 (3.6)	0.214
Chronic obstructive lung disorder	6 (6.3)	4 (3.6)	3 (2.7)	0.632

When the patients were evaluated in terms of complaints and comorbid illnesses accompanying hypernatremia during application to the emergency service; mortality rates were statistically significant and higher in patients whose oral intake were defective, who were unconsciousness and tend to be drowsy, who had dementia and cerebrovascular defect (respectively  $p=0.005$ ,  $p=0.001$ ,  $p=0.005$ ,  $p=0.008$ ,  $p=0.041$ ). The complaints of our patients during emergency service application were consciousness changes (92.7%), oral intake defect (82.4%) and fever (48.6%) based on the frequency order. The accompanying comorbid states were cerebrovascular illness (36.9%), Dementia/Alzheimer (32.4%) and hypertension (18.9%) based on the frequency order.

The complaints of all patients in the study during emergency service application, the number of accompanying comorbid states and statistical comparisons are shown in Table 2.

## DISCUSSION

Clinical manifestations of hypernatremia vary fully depending on the underlying reason. For example, orthostatic hypotension and oliguria are widespread among patients with extracellular fluid volume decrease, whereas the initial presentation of diabetes insipidus is polyuria, polydipsia, and dilute urine that insists despite dehydration and thirst. Neurologic manifestations of hypernatremia typically become prominent when plasma sodium pass 160 mEq/L and are extremely due to osmotic efflux of fluid and constricting of cells in the brain, resulting in cerebral dehydration and mental situation changes [9]. The intensity of symptoms depends on the magnitude and rapidity of onset, with the most intense symptoms manifesting in patients with acute severe hypernatremia (plasma sodium  $>160$  mEq/L). Early indications and symptoms are frequently subtle and nonspecific, such as thirst, oliguria or polyuria, nausea, vomiting, restlessness, irritability, headache, disorientation, weakness, confusion, muscle spasticity, hyperreflexia, and lethargy, whereas later symptoms can be more profound, such as severe mental status changes, seizure, coma, and cardio-pulmonary arrest [10,11].

Hypernatremia is an electrolyte disorder progressing with high mortality rates and encountered

relatively frequently in patients who admitted to the emergency clinics. The observance frequency in hospitalized patients ranges between 0.3-3.5% [10]. Palevsky et al., determined hypernatremia in 18 patients who applied to the hospital in their study conducted on 103 hypernatremic patients in England. Hypernatremia frequency among all of these applications was found to be 0.2% [2]. The number of studies conducted on the patients who apply to emergency clinics in this country is scarce. Yücel et al. determined in a study hypernatremia frequency in patients who applied to the emergency service as 0.34% [7]. The emergency service application frequency in the present study was determined as 0.21 ratio.

Hypernatremia is observed in advanced age patients in general. It was reported that more than half of the patients who applied with hypernatremia were over 65 years of age [13]. In an adult who had normal osmoregulatory mechanism and could intake sufficient fluid, Na concentration was below 150 mEq/L. Hypernatremia, based on water loss, occurs generally in adults who have defective mental functions and insufficient oral intake. The adults who develop hypernatremia out of hospital are mostly over 60 years of age. Other than having the accompanying illnesses and defective mental functions, advanced age may cause decreased osmotic stimulation against thirst even if ADH secretion is normal, and this may lead to hypernatremia [14]. The median age in the present study was 72 years and the accompanying complaint during application was oral intake defect.

It can be detected in acute and chronic renal failure patients decreased albumin and calcium levels and elevated creatinine levels [15,16]. In our study, we detected that albumin and corrected calcium levels were low, creatinine values were high in non-survival group. We think that it may be associated with impaired renal function due to our patients were older.

Hypernatremia progresses with high mortality rates. It was reported that the mortality rate due to hypernatremia in hospitalized patients was approximately 40%. High mortality rates are reported to be related with the underlying illness (cerebrovascular illnesses, ketoacidosis, polyuric situation, etc.) generally [17]. Yücel et al. determined the mortal-

ity rate as 75.7%. This situation illustrates that more extensive studies are needed in order to determine mortality rates in hypernatremic patients [7].

In our study it was observed in male patients with a higher mortality rate than female. Although there is no relationship between sex and mortality in patients with hypernatremia in literature, it may be related to the number of male patients higher than the number of female patients.

Many acute and chronic illnesses that lead to defect of general states of patients, neurologic defects (like dementia, etc.), infancy and depending on mechanical breathing are facilitative factors for hypernatremia development [18]. As parallel to the literature, comorbid illnesses such as cerebrovascular events, dementia and hypertension accompanying hypernatremia were present in the majority of our patients. Therefore, it must be considered that patients who have this type of comorbid illness would be more prone to hypernatremia.

In conclusion, hypernatremia is an electrolyte disorder that is observed more frequently in older patients, and patients who have oral intake defect, cerebrovascular illness and dementia and progresses with high mortality. Early diagnosis and treatment of hypernatremia is important due to high mortality rates.

## REFERENCES

1. Liamis G, Tsimihodimos V, Doulas M, et al. Clinical and laboratory characteristics of hypernatraemia in an internal medicine clinic. *Nephrol Dial Transplant* 2008;23:136-143.
2. Palevsky PM, Bhargava R, Greenberg A, et al. Hypernatremia in hospitalized patients. *Ann Intern Med* 1996;124:197-203.
3. Aiyagari V, Deibert E, Diringer MN, et al. Hypernatremia in the neurologic intensive care unit: How high is too high? *J Crit Care* 2006;21:163-172.
4. Tayman C, Tanbul A, Aydemir S, et al. Anne sütüne bağlı hipernatremik dehidratasyonun klinik bulguları ve tedavi önerileri. *Dicle Tıp Dergisi* 2010;37:254-262.
5. Adroge HJ, Madias NE. Hypernatremia. *N Engl J Med* 2000;342:1493-1499.
6. Brenner B, Singer G. Fluid and electrolyte disturbances. In: Kasper D, Braunwald E, Fauci A, et al, eds. *Harrison's principles of internal medicine*. 16th ed. New York: Mc-Graw-Hill; 2005:251-263.
7. Yucel N, Sahin I, Akgun FS, et al. Hypernatremia in The Emergency Department. *Turk Neph Dial Transpl* 2012;21:124-129.
8. Çağlar Ş, Süleymanlar G, Eceder T, et al. Sıvı, elektrolit ve asit-baz dengesi bozuklukları. *İç Hastalıkları*. Ankara Gün-eş Kitabevi, 2003;1251-1285.
9. Verbalis JG. Disorders of body water homeostasis. *Best Pract Res Clin Endocrinol Metab* 2003;17:471-503.
10. Palevsky PM. Hypernatremia. In: Greenberg A, Cheung A, Coffman T, et al, eds. *Primer on kidney diseases*. 4th ed. Philadelphia: Elsevier Saunders; 2005:58-65.
11. Parikh C, Berl T. Disorders of water metabolism. In: Feehally J, Floege J, Johnson R, eds. *Comprehensive clinical nephrology*. 3rd ed. Philadelphia: Mosby Elsevier; 2007:93-110.
12. Liamis G, Milionis HJ, Elisaf M, et al. A review of drug-induced hypernatremia. *NDT Plus* 2009;2:339-346.
13. Mandal AK, Saklayen MG, Hillman NM, et al. Predictive factors for high mortality in hypernatremic patients. *Am J Emerg Med* 1997;15:130-132.
14. Fried LF, Palevsky PM, et al. Hyponatremia and hypernatremia. *Med Clin North Am* 1997;81:585-609.
15. O'hare AM, Bertenthal D, Covinsky KE, et al. Mortality risk stratification in chronic kidney disease: one size for all ages? *J Am Soc Nephrol* 2006;34:126-132.
16. Ismail N, Becker BN. Treatment options and strategies in uremia: current trends and future directions. *Semin Nephrol* 1994; 14:292-299.
17. Borra SI, Beredo R, Kleinfeld M, et al. Hypernatremia in the aging. *J Natl Med Assoc* 1995;87:220-224.
18. Achinger SV, Moritz ML, Ayus JC. Dysnatremias: Why are patients still dying? *South Med J* 2006;99:353-362.