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Impact of serum sodium levels on Helicobacter pylori infection

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ABSTRACT

Objective: Excessive salt consumption could play a role for developing gastric cancer as well as Helicobacter pylori (HP) infection. However, there is no report about the connection between serum sodium levels and HP infection. This study aimed to investigate the relationship between serum sodium disorders and HP infection.

Material and Methods: In this single-center, retrospective, descriptive study, we evaluated the presence of HP infection by enzyme-linked immunosorbent assay (ELISA) among patient with serum sodium disturbances. Patients were divided into two groups as to their serum sodium levels (hypernatremia: Sodium level above 145 mmol/l, and hyponatremia: Sodium level below 135 mmol/l).

Results: In total, 54 patients, half of them were hypernatremic (27), included in the study. At total, 15 (55.6%) patients tested positive for HP immunoglobulin G (Ig G) by ELISA method in hyponatremic patients, 17 (63%) patients tested positive for HP Ig G in hypernatremic patients. There was no difference between groups in terms of HP Ig G seropositivity (p=0.58). Other hand, 9 (33%) patients tested positive for HP Ig A among hyponatremic patients, 19 (70%) patients tested positive for HP Ig A in hypernatremic patients (p=0.029).

Conclusion: According to our results, Hypernatremic patients have high risk for HP infection. Other hand, the presence of HP infection could be a driven-factor in the development of hypernatremia among elderly patients. Larger-scale studies are needed to reveal the relationship between hypernatremia and gastroenteritis.

Keywords: Helicobacter pylori, Hypernatremia, Hyponatremia

INTRODUCTION

Helicobacter pylori (HP) is a gram-negative, spirally-shaped bacterium, impacting over 10% of people globally. It causes a wide range of gastric diseases, including chronic atrophic gastritis, peptic ulcer, mucosa-associated lymphoid tissue lymphoma, and gastric cancer. Thus early diagnosis and screening of HP have potentially toreduce the rates of progression to gastric cancer (1).

Impact of lifestyle and environmental factors on further progression toward gastric cancer due to HP infection are smoking cigarettes, alcohol abuse, salt consumption, and consuming lower quantities of vegetables (2).

Prior studies which examining risk factors associated with HP infection, have demonstrated that high dietary salt intake is a significant risk factor for gastric cancer development. Furthermore, this association was reportedly getting stronger in the presence of HP infection with atrophic gastritis (3, 4).

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Natremia displays the body's hydration status, which is closely regulated by thirst, arginine vasopressin, and the kidneys (5). Hypernatremia is accepted as 145 mmol/l or higher levels of sodium, hyponatremia is accepted as 135 mmol/l or lower levels of sodium in medical textbooks. As an impermeable solute, sodium gives rise to the influx and efflux of water through the cell membranes. In this way, sodium is the main solute to manage water homeostasis (6). The water transport, driven by sodium, gives rise to cell shrinkage in hypernatremia and cell swelling in hyponatremia. The changes of the cell volume may lead to severe symptoms which related with primarily central nervous system, including headache, nausea, vomiting, altered consciousness, seizure even death. Patients with serum sodium disturbances are also under high risk for a wide range of infections, which are associated with higher health costs (7).

Thus, we investigated whether serum sodium disorders are associated with HP infection and whether other laboratory tests are associated with those disturbances in elderly patients.

MATERIAL and METHODS

This is a single-center, retrospective chart review study. We assessed the rate of HP infection by enzyme-linked immunosorbent assay (ELISA) method among patients who had either hypernatremia or hyponatremia. Charts were reviewed from patients who were referred to the internal medicine clinic for treatment of hypernatremia. Demographic data, medical history, laboratory parameters, and HP status were reviewed. Routine laboratory test results and HP tests were obtained during hospitalization. Patients were divided into two groups according to the below and above cut-off values of serum sodium levels. Patients with hypernatremia were defined as having a serum sodium level above 145 mmol/l, and hyponatremia was defined as having a serum sodium level below 135 mmol/l. The primary objective was to assess the rate of HP seropositivity status in hypernatremic and hyponatremic patients by the serum ELISA test. Secondary objectives included HP-associated laboratory parameters in patients with sodium disturbances. We compared the rate of HP infection using by ELISA method.

The data were obtained from the clinical records and were analyzed with student t-test and chi-square test for continuous or categorical variables, respectively. The results are expressed as means with standard deviation, accepted as significant value of $p < 0.05$. SPSS 11.5 statistical program was used. Ethical consent was obtained from Van Yuzuncu Yil University School of Medicine.

RESULTS

At total, 54 patients with sodium disturbances were included for the study. Half of them were hypernatremic and the others were hyponatremic. The mean age of the hypernatremic patients was 79.9±7 years and 15 of them were female. The mean age of the hyponatremic patients was 76,8±6 years and 12 of them were female. There were no significant differences between groups in terms of age and gender (p=0.103 and p=0,414, respectively). In the hypernatremic patients, the mean levels of serum sodium and serum chlorine were higher than those patients with hyponatremia (154±7 versus 121±7 mmol/L and 114±8 versus 89±8 mmol/L all p values below than 0.001, respectively) and the mean potassium level was lower than patients with hyponatremia (3.9±0,6 mmol/L versus 4.7±0,9 mmol/L, p=0.001). Compared to the hyponatremic group, the hypernatremic group had higher levels of liver transaminases, including aspartate aminotransferase and alanine aminotransferase (99±216 U/L versus 85± 256 U/L, p= 0.013 and 66±131 U/L versus 62±181 U/L, p= 0.042, respectively). The overall analysis also showed that levels of serum thyroid stimulating hormone (TSH) and free thyroxine were significantly higher in hyponatremic group compared to hypernatremic counterparts (8.79±24,47 mmol/L versus 1.2±1,49 mmol/L, p=0.013 and 1.3±0,31 mmol/L versus 1.09±0,24 mmol/L, p= 0.019, respectively). Finally, 15 (55.6%) patients tested positive for HP Ig G by ELISA method in hyponatremic patients, 17 (63%) patients tested positive for HP Ig G in hypernatremic patients. There were no significant differences between groups in terms of HP Ig G seropositivity (p=0.58). Otherhand, 9 (33%) patients tested positive for HP Ig A among hyponatremic patients, 19 (70%) patients tested positive for HP Ig A in hypernatremic patients (p=0.029). **Table 1** and **Table 2** has shown the general blood parameters and demographic data of the patients.

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Table 1: Baseline characteristics of the patients.

Variable	n	Hyponatremia Mean ± SD	n	Hypernatremia Mean ± SD	P
Age (years)	27	76,8 ± 6	27	79,9 ± 7	0,103
Hemoglobin (g/dL)	27	10,8 ± 1,9	27	11 ± 1,7	0,972
Hematocrit (%)	27	31,8 ± 5	27	34,4 ± 5,7	0,104
MCV (fL)	27	89 ± 9	27	91,2 ± 7,2	0,164
MCHC (g/dL)	27	34 ± 1,3	27	31,6 ± 1,3	**0,001**
Leukocyte ($x10^9$/L)	27	10,08 ± 5,12	27	11,56 ± 4,41	0,073
Neutrophil ($x10^9$/L)	27	8,25 ± 5,27	27	9,57 ± 4,48	0,130
Lymphocyte ($x10^9$/L)	27	1,09 ± 0,69	27	1,38 ± 1,11	0,478
Thrombocyte ($x10^9$/L)	27	277 ± 153	27	214 ± 113	0,146
Glucose (mg/dL)	27	143 ± 73	27	178 ± 88	**0,035**
Urea (mg/dL)	27	83 ± 60	27	142 ± 78	**0,002**
Creatinine (mg/dL)	27	1,56 ± 1,57	27	1,96 ± 1,63	0,401
AST (u/L)	27	85 ± 256	27	99 ± 216	**0,013**
ALT (u/L)	27	62 ± 181	27	66 ± 131	**0,042**
Albumin (g/L)	27	31,2 ± 8,8	24	29,6 ± 6,8	0,206
ALP (u/L)	25	152 ± 193	21	100 ± 56	0,559
GGT (u/L)	25	116 ± 227	22	62 ± 94	0,932
Sodium (mmol/L)	27	121 ± 7	27	154 ± 7	**0,001**
Potassium (mmol/L)	27	4,7 ± 0,9	27	3,9 ± 0,6	**0,001**
Chlorine (mmol/L)	27	89 ± 8	27	114 ± 8	**0,001**
Calcium (mg/dL)	27	8,8 ± 0,7	27	8,6 ± 0,9	0,143
PT (second)	27	11,15 ± 3,03	27	11,33 ± 3,32	0,646
TSH (mU/L)	22	8,79 ± 24,47	22	1,2 ± 1,49	**0,003**
Free T4 (ng/dL)	23	1,3 ± 0,31	22	1,09 ± 0,24	**0,019**
pH	25	7,37 ± 0,09	25	7,42 ± 0,07	**0,036**

n: Number of patients, SD: Standard deviation, MCV: Mean corpuscular volume, MCHC: Mean erythrocyte hemoglobin concentration, AST: Aspartate aminotransferase, ALT: Alanine aminotransferase, ALP: Alkaline phosphatase, GGT: Gama glutamyl transferase, PT: Prothrombin time, TSH: Thyroid stimulating hormone,
T4: Thyroxine

Table 2: Helicobacter pylori status of the patients

Variable		Hyponatremia (n=27)	Hypernatremia (n=27)	P
Gender	Female	12 (44,4)	15 (55,6)	0,414
	Male	15 (55,6)	12 (44,4)	
Dementia	No	25 (92,6)	23 (85,2)	0,386
	Yes	2 (7,4)	4 (14,8)	
HP Ig A	Negative	18 (67)	8 (30)	**0,029**
	Positive	9 (33)	19 (70)	
HP Ig G	Negative	12 (44,4)	10 (37)	0,580
	Positive	15 (55,6)	17 (63)	

n: Number of patients, HP: Helicobacter pylori, Ig: Immunoglobulin

DISCUSSION

This research allowed us to understand the effect of serum sodium levels on the rate of HP infection in routine tertiary care practice and probably was the first in the literature.

Population-based studies demonstrated that, there was a robust link between higher prevalence of gastric cancer and increased salt intake among all genders (8).

In addition, collected data points to high salt consumption as one of the most important habitual key mechanisms underlying HP infection, in a Chinese study conducted by ELISA method to detect HP infection showed that a family history of gastric cancer, consumption of pickled vegetables more than twice a month, and a high monthly salt consumption (more than 500 g/month) were also connected with HP infection (9).

A recent study on higher salt consumption also demonstrated an increased rate of atrophic gastritis and gastric adenocarcinoma among higher salt-consumer subjects compared to those with a normal diet. However, hypernatremia-linked HP infection has not been reported yet (10). Thus, we conducted the current study. Disturbances of serum sodium levels in the hospital setting could cause increased morbidity and mortality even in small ranges (11). Hypernatremia is also a common medical condition among hospitalized elderly patients. The elderly patient population with hypernatremia is frequently experienced with costly complications, including disturbances in mental status, an increased rate of mechanical ventilation, and a higher demand for both of inotropic and vasopressor agents and prolonged intensive care treatment, as well as higher mortality. (12).

Furthermore, an ecological study conducted in aquatic environments during the first years of discovery of HP infection showed that HP strains survived for longer periods in physiological saline (0-15M) than in 0-05M or 0-6M saline solution and optimal pH range for its survival was determined as between pH 5-8 and 6-9 (13). At this perspective, we postulated that most eligible conditions for developing HP infection are both salty and alkaline mediums. We also hypothesized that hypernatremia could be a key factor in supporting the HP infection. A retrospective cohort study involving 51 septic intensive care unit patients also showed that hypernatremia strongly correlated with higher mortality rates (14).

In the current study, we found a strong association between hypernatremia and HP infection, and this contamination may have been due to hypernatremia-related infections. On the other hand, in the presented study, we also found that hypernatremic patients had higher serum TSH levels than hyponatremic patients. It is well-known that hypothyroidism could lead to hyponatremia and some kind of systemic infections (15, 16). In line with classical data revealing hypothyroidism-linked hyponatremia, we found lower TSH levels among patients with hypernatremia. However, we concluded that higher rates of HP Ig A in hypernatremic patients could be seen even in euthyroid status, and hypernatremia was a stronger factor for developing HP infection than hypothyroidism.

Limitations include lack of specific clinical details (e.g. use of proton pump inhibitors and antibiotics before the enrollment of the study) and risk for confounders, including concomitant diseases. Although the presented research was the first in the literature, the overall predictive value could have been limited due to its small sample size.

CONCLUSION

Hypernatremic patients are at high risk for HP infection. This risk has correlated with the prolongation of the hypernatremic status. Otherhand, HP infection could be a driven-factor in developing hypernatremia among elderly patients.

Our results show that hypernatremia is also associated with HP infection, similar to higher dietary salt consumption. More research is needed to explore this unique pathophysiology further.

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Conflict of interest: The authors declare no competing interests.

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Ethical approval: All procedures performed in studies involving human participants were in accordance with the institutional and/or national research committee's ethical standards and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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