DO THE ETIOLOGY OF HYponATREMIA AND SERUM SODiUM LEVELS AFFECT THE LENGTH OF HOSPITAL STAY IN GERIATRIC PATiENTS WITH HYponATREMIA?

DA LI ETIOLOGIJA HIPONATREMIJE I NIVOI SERUMSKOG NATRIJUMA UTIČU NA DUŽINU BORAVKA U BOLNICI KOD GERIJATRIJSKIH BOLESNIKA SA HIPONATREMIjom?

Salih Baser1, Nuray Yılmaz Cakmak2, Emin Gemcioglu2

1Yıldırım Beyazıt University, Faculty of Medicine, Ankara City Hospital, Department of Internal Medicine, Ankara, Turkey
2Ankara City Hospital, Department of Internal Medicine, Ankara, Turkey

Summary

Background: Hyponatremia can lead to a prolonged hospital stay and increased morbidity and mortality rates in geriatric patients. This study aimed to evaluate the effects of hyponatremia etiology and serum sodium (Na) levels on hospitalisation time in geriatric patients hospitalised due to hyponatremia.

Methods: The demographic characteristics, laboratory data, etiology of hyponatremia, and length of hospital stay were retrospectively recorded for 132 patients over 65 years of age who were hospitalised for hyponatremia.

Results: Of the 132 patients, 90 were female (68.2%), and 42 were male (31.8%). The serum Na levels of 66 (50%) patients were <120 mmol/L, those of 64 (48.5%) patients were 120–129 mmol/L, and those of two (1.5%) patients were >130 mmol/L. One hundred nine (82.6%) patients had hypoosmolar hyponatremia, 14 (10.6%) patients had isoosmolar hyponatremia, and nine (6.8%) patients had hyperosmolar hyponatremia. Also, 19.7% of the patients were hypovolemic, 37.9% were euvoletic, and 42.4% were hypervolemic. Hyponatremia etiology was congestive heart failure in 38 (28.8%) patients, syndrome of inappropriate antidiuretic hormone in 29 (22.0%) patients, gastrointestinal fluid loss in 24 (18.2%) patients, renal pathologies in 20 (15.2%) patients, the presence of drugs in 20 (15.2%) patients, and hypocortisolism in one (0.8%) patient. The mean length of hospital stay for the patients was five (1–60) days. There was no statistically significant difference between the lengths of hospital stay for the patients.
based on hyponatremia etiology and serum Na levels (p=0.861 and p=0.076). It was observed that the lengths of stay for patients who developed hyponatremia during their hospitalisation in various clinics were longer than those for patients who presented to the emergency department (p<0.001).

Conclusions: In this study, it was determined that the length of hospital stay did not change with the etiology of hyponatremia and serum Na level at the time of admission, but patients who developed hyponatremia during their hospitalisation had longer hospitalisation times.

Keywords: hyponatremia, geriatrics, length of stay

Introduction

Hyponatremia is the most common electrolyte abnormality observed in clinical practice. It can be seen in about 30% of hospitalised patients and can lead to a wide range of clinical symptoms, from asymptomatic to severe and even life-threatening (1, 2).

In order to determine the diagnosis and treatment in patients presenting with hyponatremia, grouping is performed according to patients’ serum osmolality and volume status. Serum osmolality is grouped as hypoosmolar at <280 mmol/kg, isoosmolar at 280–295 mmol/kg, and hyperosmolar at >295 mmol/kg, with a further categorisation of hypovolemic, euvo with the Shapiro-Wilk test. Numerical data are indicated by median (minimum-maximum), and categorical data are indicated by numbers (percentage).

The demographic characteristics of the patients (age, gender) and their places of presentation (emergency room, other clinics), presenting complaints (nausea, vomiting, confusion, seizure, fever; dyspnea, edema, general condition disorder, fatigue, anorexia), physical examination findings, volume statuses (hypovolemic, euvo with the Shapiro-Wilk test. Numerical data are indicated by median (minimum-maximum), and categorical data are indicated by numbers (percentage).

The IBM SPSS 21.0 statistical software package for Windows was used for the statistical analysis of the data. For all data, the normality assumption was evaluated via the Shapiro-Wilk test. Numerical data are indicated by median (minimum-maximum), and categorical data are indicated by numbers (percentage). The Mann-Whitney U test was used to compare numerical data between two groups, and the Kruskal-
Wallis test was used to compare more than two groups. Values of $p<0.05$ were considered statistically significant.

**Results**

Of the 132 patients, 90 were female (68.2%), 42 were male (31.8%), and the mean age was 74.97±7.14 years. Severe hyponatremia (Na of <120 mmol/L) was detected in 66 (50%) patients.

While 97 (73.5%) patients presented to the emergency department with complaints related to hyponatremia, 35 (26.5%) patients were found to have developed hyponatremia during their hospitalisation in various clinics. Dyspnea and edema were observed in 28 (21.2%) patients, nausea/vomiting in 26 (19.7%) patients, confusion in 26 (19.7%) patients, fatigue and anorexia in 15 (11.4%) patients, seizures in eight (6.1%) patients, fever in eight (6.1%) patients, and general condition disorder in five (3.8%) patients, whereas 16 (12.1%) patients were asymptomatic. The median systolic blood pressure of the patients was 120 (68–250) mmHg, and the mean diastolic blood pressure was 70 (39–130) mmHg. The physical examination findings of the patients at the time of admission are presented in Table I. Hypovolemic hyponatremia was detected in 26 (19.7%) patients, euvolemic hyponatremia in 50 (37.9%) patients, and hypervolemic hyponatremia in 56 (42.4%) patients.

Serum Na level was 119.50 (99–131) mmol/L at the time of admission, 125 (105–139) mmol/L at the 24th hour of treatment, and 128.50 (108–144) mmol/L at the 48th hour of treatment ($p<0.001$). The serum Na levels of 66 (50%) patients were <120 mmol/L, of those of 64 (48.5%) patients were 120–129 mmol/L, and of those of two (1.5%) patients were >130 mmol/L. One hundred nine (82.6%) patients had hypoosmolar hyponatremia, 14 (10.6%) patients had isoosmolar hyponatremia, and nine (6.8%) patients had hyperosmolar hyponatremia (Table II).

The etiology of hyponatremia was congestive heart failure in 38 (28.8%) patients, syndrome of inappropriate anti-diuretic hormone (ADH) secretion (SIADH) in 29 (22.0%) patients, gastrointestinal fluid loss in 24 (18.2%) patients, renal pathologies in 20 (15.2%) patients, the presence of drugs in 20 (15.2%) patients, and hypocortisolism in one (0.8%) patient. In 51.7% of patients with SIADH, the cause was an infection, with the most common (66.7%) reason being pneumonia.

Sixty-eight (51.5%) patients were treated with hypertonic saline, 20 (15.2%) with isotonic saline, 24 (18.2%) with water restriction and diuretics, and 20 (15.2%) with only water restriction. It was observed that seven (5.3%) patients required ultrafiltration.

The mean length of hospital stay for the patients was 5 (1–60) days. There was no statistically significant difference between the lengths of hospital stay in terms of hyponatremia etiologies ($p=0.861$). In addition, serum Na levels at the time of presentation did not show a statistically significant difference in terms of hyponatremia etiologies ($p=0.065$). It was observed that the lengths of hospital stay and serum Na levels at the time of presentation were similar in female and male patients ($p=0.440$ and $p=0.230$).

### Table I: Demographic features, complaints, and physical examination findings of the patients.

| Feature                          | n (%)  |
|---------------------------------|--------|
| **Gender**                      |        |
| Female                          | 90 (68.2) |
| Male                            | 42 (31.8) |
| **Place of application**        |        |
| Emergency department            | 97 (73.5) |
| Different clinics               | 35 (26.5) |
| **Complaints**                  |        |
| Dyspnea/edema                   | 28 (21.2) |
| Nausea/vomiting                 | 26 (19.7) |
| Confusion                       | 26 (19.7) |
| Asymptomatic                    | 16 (12.1) |
| Fatigue/anorexia                | 15 (11.4) |
| Seizures                        | 8 (6.1) |
| Fever                           | 8 (6.1) |
| General condition disorder      | 5 (3.8) |
| **Physical examination**        |        |
| Rales in the lung               |        |
| Present                         | 42 (31.8) |
| Absent                          | 90 (68.2) |
| Ascites                         |        |
| Present                         | 5 (3.8) |
| Absent                          | 127 (96.2) |
| Pretibial edema                 |        |
| Present                         | 36 (28.3) |
| Absent                          | 91 (71.7) |
| **Volume**                      |        |
| Hypovolemic                     | 26 (19.7) |
| Euvolemic                       | 50 (37.9) |
| Hypervolemic                    | 56 (42.4) |
In addition, there was no statistically significant difference between the duration of hospital stay in patients with serum Na levels of <120 mmol/L and 120–129 mmol/L at the time of admission (p=0.076). It was observed that the lengths of hospital stay for patients who developed hyponatremia during their hospitalisation in various clinics was longer than those of patients who presented to the emergency department (p<0.001), but serum Na levels were higher in patients who developed hyponatremia during hospitalisation (p<0.001) (Table III).

**Table II** Laboratory values of the patients.

|                         | Median (min–max) |
|-------------------------|------------------|
| Glucose (mmol/L)        | 5.44 (3.77–6.72) |
| Urea nitrogen (mmol/L)  | 7.32 (0.51–36.03) |
| Creatinine (µmol/L)     | 79.56 (13.26–739.9) |
| Potassium (mmol/L)      | 4.40 (2.30–6.70)  |
| TSH (mIU/L)             | 1.1 (0.92–5.2)    |
| Serum cortisol (nmol/L) | 317.2 (110.5–717.2) |
| Hemoglobin (g/L)        | 112 (62–179)      |
| Serum Na level at the time of admission (mmol/L) | 119.50 (99–131) |
| Serum Na level at the 24th hour of treatment (mmol/L) | 125 (105–139) |
| Serum Na level at the 48th hour of treatment (mmol/L) | 128.50 (108–144) |
| Serum osmolality (mmol/kg) | 259 (212–309)   |
| Urine osmolality (mmol/kg) | 224 (36–782)    |
| Urine Na (mmol/L)       | 45.5 (4–321)     |
| Na groups               | n (%)            |
| <120 mmol/L             | 66 (50)          |
| 120–129 mmol/L          | 64 (48.5)        |
| 130–135 mmol/L          | 2 (1.5)          |
| Osmolality groups       | n (%)            |
| Hypoosmolar             | 109 (82.6)       |
| Isoosmolar              | 14 (10.6)        |
| Hyperosmolar            | 9 (6.8)          |

TSH: Thyrotropin, Na: sodium

**Table III** Duration of hospitalisation and sodium levels at the time of patients’ admission according to gender, etiology, place of application, and patients’ duration of hospitalisation according to sodium groups.

|                         | Duration of hospitalisation | p     | Na levels at the time of admission | p     |
|-------------------------|-----------------------------|-------|-----------------------------------|-------|
| Gender                  |                             |       |                                   |       |
| Female                  | 4 (1–60)                    | 0.440 | 119 (101–131)                     | 0.230 |
| Male                    | 7 (1–43)                    |       | 121 (99–129)                      |       |
| Etiology                |                             |       |                                   |       |
| Congestive heart failure| 4 (1–30)                    |       | 119 (99–128)                      |       |
| SIADH                   | 6 (1–59)                    | 0.861 | 121 (109–129)                     | 0.065 |
| Gastrointestinal fluid loss | 4 (1–36)                  |       | 119 (101–126)                     |       |
| Renal pathologies       | 7 (1–60)                    |       | 122.5 (105–129)                   |       |
| Drugs                   | 4 (1–43)                    |       | 120.5 (108–131)                   |       |
| Place of application    |                             |       |                                   |       |
| Emergency department    | 3 (1–59)                    | <0.001| 118 (99–130)                      | <0.001|
| Different clinics       | 10 (2–60)                   |       | 124 (111–131)                     |       |
| Na groups               |                             |       |                                   |       |
| <120 mmol/L             | 4 (1–59)                    | 0.076 | -                                 | -     |
| 120–129 mmol/L          | 6 (1–60)                    |       | -                                 | -     |

Na: Sodium, SIADH: syndrome of inappropriate antidiuretic hormone secretion

**Discussion**

Hyponatremia is the most common electrolyte disorder in hospitalised patients and society. Hyponatremia prevalence in society is ~8%, and this prevalence increases significantly with age (3, 4). Hyponatremia is reported to be associated with an increased risk of mortality and poor prognosis in older individuals (3, 12).

The higher rate of hyponatremia in the elderly is related to the deterioration of the water excretion capacity associated with aging and the more frequent exposure of this group to drugs and diseases associated with hyponatremia (2, 13). The decrease in the glomerular filtration rate due to aging causes impaired water excretion capacity. In addition, the decrease in intrarenal prostaglandin production seen at older ages may cause impaired water excretion.
capacity (14). Another factor contributing to hyponatremia in this group is the fact that the age-related decrease in total body water percentage causes further fluctuations in serum Na concentration. Higher sensitivity to osmotic stimuli can be seen in the geriatric population (15, 16). Elderly individuals frequently use drugs known to cause hyponatremia (such as thiazide diuretics, selective serotonin reuptake inhibitors, and nonsteroidal anti-inflammatory drugs), and they often suffer from diseases that may be associated with hyponatremia (for example, diabetes mellitus, infections, heart failure, liver diseases, malignancies, and endocrinopathies) (17, 18). Many elderly patients with hypertension or heart failure maintain a low-salt diet, which can cause a low serum Na concentration. In this population, a decrease in protein intake due to overlapping diseases may play a role in the development of hyponatremia by impairing water excretion (19, 20).

Diuretics and SIADH are among the most common causes of hyponatremia in the elderly (20, 21). In one prospective study that included only elderly hospitalised patients, the most common causes of hyponatremia were SIADH and diuretics. In the same study, the two most common causes of SIADH were lower respiratory tract infection and stroke (22). In the study of Chatterjee et al. (23), gastrointestinal fluid loss, cerebrovascular accident, and pulmonary sepsis were found to be the most frequent causes of hyponatremia. In the work of Babaliche et al. (24), SIADH was also the most common cause of hyponatremia in 46% of patients, followed by renal pathologies in 13%, gastrointetinal compromise in 11%, cardiac causes in 10%, cirrhosis in 10%, and drugs in 10%. In addition, Ishikawa et al. (25) reported that 40% of patients presenting with hyponatremia aged 65 and above had hypothalamic-pituitary-adrenal dysfunction. Although congestive heart failure was reported in other studies as a less common cause of hyponatremia than diuretics and SIADH, the most common cause of hyponatremia in our study was congestive heart failure, the second most common cause was SIADH (23, 24). Contrary to the study of Ishikawa et al. (25), hyponatremia due to hypopituitarism was very rare in our study group. This may be because patients with hypopituitarism are asymptomatic for long periods, and their need for hospitalisation is less than those of other patients. Because only hospitalised patients were included in our study, the rate of hypopituitarism may be lower than expected.

The importance of early recognition of hyponatremia and prompt intervention is critical (26). In a large multicenter trial with 151,486 patients, it was shown that all types and grades of dysnatremias were related to increased risk-adjusted and raw hospital mortality rates. The odds ratios for mild, moderate, and severe hyponatremia were 1.52, 1.89, and 1.81, respectively (27). Moreover, in addition to mortality, hyponatremia prolongs the hospitalisation time remarkably and increases medical care costs (11). In our study, the length of hospital stay due to hyponatremia was observed to be 5 (1–60) days, and this duration did not change according to the etiology of hyponatremia or the patient’s gender or initial serum Na levels. It was observed that patients who applied to the emergency department had lower Na levels but shorter hospital stays than patients who developed hyponatremia during their hospitalisation in other clinics.

In their study, including 100 patients with moderate to severe hyponatremia who were monitored in the intensive care unit, Babaliche et al. (24) reported that 59% of the patients were male and 41% were female, with a slight dominance of the male gender. In the work of Sood et al. (28), the male-to-female ratio was 1.25:1. In other studies in the literature, male gender dominance is observed in patients with hyponatremia (23, 29). Contrary to these studies, in our study, 68.2% of patients with hyponatremia were female. Since our study consists of randomly recruited patients for a certain period of time, the gender result may be due to this.

In the study of Sood et al. (28), including 106 hyponatremic patients, 90% were hypoosmolar, 9% hyperosmolar, and 1% were isoosmolar, while 40% were euvoletic, 31% were hypervolemic, and 29% were hypovolemic. In the study of Chatterjee et al. (23), 50.74% of the patients were euvoletic, 26.86% were hypervolemic, and 22.4% were hypovolemic, while in the study of Babaliche et al. (24), 50% were euvoletic, 33% were hypervolemic, and 17% were hypovolemic. In our study, 42.4% of the patients were hypervolemic, 37.9% were euvoletic, and 19.7% were hypovolemic while 82.6% had hypoosmolar hyponatremia, 10.6% had isoosmolar hyponatremia, and 6.8% had hyperosmolar hyponatremia.

In their study, Sood et al. (28) reported that 42% of patients had severe hyponatremia, 48% had moderate hyponatremia, and 10% mild hyponatremia. Similarly, in our study, severe hyponatremia was detected in 50% of the hospitalised geriatric patients. It was observed that Na levels were 120–129 mmol/L in 48.5% and 130–135 mmol/L in 1.5% of the patients.

Pillai et al. (30) observed that among intensive care unit admissions, the symptoms attributed to hyponatremia included nausea (69.3%), malaise (80%), drowsiness (61.3%), confusion (41.3%), lethargy (24%), frequent falls (1.3%), convulsions (2.7%), altered sensorium (41.3%), and delirium (9.3%). Krishnamurthy and Srinivas (31) reported that the symptoms found in hyponatremia patients were vomiting (29.6%), giddiness (2.4%), altered sensorium (8.5%), headache (9.2%), chest pain (6.4%), generalized weakness (8.4%), fever (12.3%), cough (15.2%),
loss of consciousness (0.7%), nausea (22.5%), loose stools (5%), increased fatigability (10.4%), breathlessness (17.8%), abdominal pain (8.8%), difficulty in micturition (0.9%), lower limb swelling (3.6%), and seizures (6.4%) (31). In our study, dyspnea and edema were observed in 28 (21.2%) patients, nausea/vomiting in 26 (19.7%) patients, confusion in 26 (19.7%) patients, fatigue and anorexia in 15 (11.4%) patients, seizures in eight (6.1%) patients, fever in eight (6.1%) patients, and general condition disorder in five (3.8%) patients, whereas 16 (12.1%) patients were asymptomatic.

In acute symptomatic hyponatremia, hypertonic saline solution is commonly used to acutely increase serum Na levels and prevent serious neurological symptoms. Hypovolemic hyponatremia is treated with adequate fluid resuscitation to reduce ADH secretion stimulation. Normal saline is often used to suppress the hypovolemic stimulus that causes ADH release (32, 33). In patients with SIADH, careful administration of hypertonic fluids may be required, along with discontinuation of suspicious drugs and reduced water consumption. In these cases, furosemide can also be administered to prevent circulatory overload, especially if elderly patients have concomitant cardiac dysfunction. Furosemide increases free water excretion and leads to higher serum Na. Our study observed that 51.5% of the patients were treated with hypertonic saline, 15.2% with isotonic saline, 18.2% with water restriction and diuretics, and 15.2% with only water restriction. It was also observed that 5.3% of the patients required ultrafiltration.

In conclusion, there is an increasing tendency for hyponatremia to occur with increased age, comorbidities, and the use of drugs. In our study, congestive heart failure and SIADH were determined to be the most common causes of hyponatremia in geriatric patients. Nausea, vomiting, and dyspnea were the most common symptoms. It was determined that the length of hospital stay did not change with the etiology of hyponatremia, gender, or serum Na level at the time of admission. However, patients who developed hyponatremia during their hospitalisation had longer hospitalisation times.

Funding
The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of interest statement
All the authors declare that they have no conflict of interest in this work.

References
1. Beukhof CM, Hoorn EJ, Lindemans J, Zietse R. Novel risk factors for hospital-acquired hyponatremia: a matched case-control study. Clin Endocrinol (Oxf) 2007; 66(3): 567–72.
2. Upadhyay A, Jaber BL, Madias NE. Epidemiology of hyponatremia. Semin Nephrol 2009; 29(3): 227–38.
3. Liamis G, Rodenburg EM, Hofman A, Zietse R, Stricker BH, Hoorn EJ. Electrolyte disorders in community subjects: prevalence and risk factors. Am J Med 2013; 126(3): 256–63.
4. Hawkins RC. Age and gender as risk factors for hyponatremia and hypernatremia. Clin Chim Acta 2003; 357(1–2): 169–72.
5. Lindner G, Pfortmüller CA, Leichtle AB, Fiedler GM, Exadaktylos AK. Age-related variety in electrolyte levels and prevalence of dysnatremias and dyskalemias in patients presenting to the emergency department. Gerontology 2014; 60(5): 420–3.
6. Renneboog B, Musch W, Vandenemergel X, Manto MU, Decaux G. Mild chronic hyponatremia is associated with falls, unsteadiness, and attention deficits. Am J Med 2006; 119(1): 71.e1-8.
7. Hoorn EJ, Rivadeneira F, van Meurs JB, Ziere G, Stricker BH, Hofman A, et al. Mild hyponatremia as a risk factor for fractures: the Rotterdam Study. J Bone Miner Res 2011; 26(8): 1822–8.
8. Renneboog B, Sattar L, Decaux G. Attention and postural balance are much more affected in older than in younger adults with mild or moderate chronic hyponatremia. Eur J Intern Med 2017; 41: e25–e26.
9. Gosch M, Joosten-Gstrein B, Heppner HJ, Lechleitner M. Hyponatremia in geriatric inhospital patients: effects on results of a comprehensive geriatric assessment. Gerontology 2012; 58(5): 430–40.
10. Hoorn EJ, Liamis G, Zietse R, Zillikens MC. Hyponatremia and bone: an emerging relationship. Nat Rev Endocrinol 2011; 8(1): 33–9.
11. Callahan MA, Do HT, Caplan DW, Yoon-Flannery K. Economic impact of hyponatremia in hospitalised patients: a retrospective cohort study. Postgrad Med 2009; 121(2): 186–91.
12. Altunas A. Hyponatremia: Is it related to the seasons? J Med Biochem 2021; 40(4): 407–13.
13. Mannesse CK, Vondeling AM, van Marum RJ, van Solinge WW, Egberts TC, Jansen PA. Prevalence of hyponatremia on geriatric wards compared to other settings over four decades: a systematic review. Ageing Res Rev 2013; 12(1): 165–73.
14. Clark BA, Shannon RP, Rosa RM, Epstein FH. Increased susceptibility to thiazide-induced hyponatremia in the elderly. J Am Soc Nephrol 1994; 5(4): 1106–11.
15. Shapiro DS, Sonnenblick M, Galperin I, Melkonyan L, Munter G. Severe hyponatraemia in elderly hospitalised patients: prevalence, aetiology and outcome. Intern Med J 2010; 40(8): 574–80.

16. Helderman JH, Vestal RE, Rowe JW, Tobin JD, Andres R, Robertson GL. The response of arginine vasopressin to intravenous ethanol and hypertonic saline in man: the impact of aging. J Gerontol 1978; 33(1): 39–47.

17. Liamis G, Miliou N, Elisaf M. A review of drug-induced hyponatraemia. Am J Kidney Dis 2008; 52(1): 144–53.

18. Liamis G, Filippatos TD, Elisaf MS. Electrolyte disorders associated with the use of anticancer drugs. Eur J Pharmacol 2016; 777: 78–87.

19. Frenkel NJ, Vogt L, De Rooij SE, Trimpert C, Levi MM, Deen PM, et al. Thiazide-induced hyponatraemia is associated with increased water intake and impaired urea-mediated water excretion at low plasma antidiuretic hormone and urine aquaporin-2. J Hypertens 2015; 33(3): 627–33.

20. Liamis G, Filippatos TD, Elisaf MS. Thiazide-associated hyponatraemia in the elderly: what the clinician needs to know. J Geriatr Cardiol 2016; 13(2): 175–82.

21. Anpalahan M. Chronic idiopathic hyponatraemia in older people due to syndrome of inappropriate antidiuretic hormone secretion (SIADH) possibly related to aging. J Am Geriatr Soc 2001; 49(6): 788–92.

22. Rao MY, Sudhir U, Anil Kumar T, Saravanan S, Mahesh E, Punith K. Hospital-based descriptive study of symptomatic hyponatraemia in elderly patients. J Assoc Physicians India 2010; 58: 667–9.

23. Chatterjee N, Sengupta N, Das C, Chowdhuri AR, Basu AK, Pal SK. A descriptive study of hyponatraemia in a tertiary care hospital of Eastern India. Indian J Endocrinol Metab 2012; 16(2): 288–91.

24. Babaliche P, Madhani S, Kamat S. Clinical profile of patients admitted with hypotension in the medical intensive care unit. Indian J Crit Care Med 2017; 21(12): 819–24.

25. Ishikawa Se, Saito T, Fukagawa A, Higashiyama M, Nakamura T, Kusaka I, et al. Close association of urinary excretion of aquaporin-2 with appropriate and inappropriate arginine vasopressin-dependent antidiuresis in hyponatraemia in elderly subjects. J Clin Endocrinol Metab 2001; 86(4): 1665–71.

26. Whyte M, Down C, Miell J, Crook M. Lack of laboratory assessment of severe hyponatraemia is associated with detrimental clinical outcomes in hospitalised patients. Int J Clin Pract 2009; 63(10): 1451–5.

27. Funk GC, Lindner G, Druml W, Metnitz B, Schwarz C, Bauer P, et al. Incidence and prognosis of dysnatremias present on ICU admission. Intensive Care Med 2010; 36(2): 304–11.

28. Sood N, Sharma KN, Himral P, Sharma T, Kapoor D. Clinical profile of patients with hyponatraemia in a tertiary care hospital in the sub-Himalayan region. J Family Med Prim Care 2020; 9(2): 834–8.

29. Rahil AI, Khan FY. Clinical profile of hyponatraemia in adult patients admitted to Hamad General Hospital, Qatar: Experience with 53 Cases. J Clin Diag Res 2009; (3): 1419–25.

30. Pillai KS, Trivedi TH, Moulick ND. Hyponatraemia in ICU. J Assoc Physicians India 2018; 66(5): 48–52.

31. Krishnamurthy H, Srinivas K. »The Hyponatraemia.« A real masquerader in emergency medicine. Int J Contemp Med Res 2015; 4: 515–9.

32. Liamis G, Filippatos TD, Elisaf MS. Correction of hypovolemia with crystalloid fluids: individualising infusion therapy. Postgrad Med 2015; 127(4): 405–12.

33. Spasovski G, Vanholder R, Alloio B, Annane D, Ball S, Bichet D, et al. Hyponatraemia Guideline Development Group. Clinical practice guideline on diagnosis and treatment of hyponatraemia. Nephrol Dial Transplant 2014; Suppl 2: i1–i39.

Received: January 19, 2021
Accepted: May 28, 2021