10.5152/turkjnephrol.2023.2215285

Case Report

Turkish Journal of Nephrology

Persistent Hyponatremia due to Sodium Wasting via External Biliary Drainage

Cihan Uysal[1], Tuğba Yılmaz[1], Rıfkı Sarıca[2], Hafsa Koçyiğit[3], Güven Kahriman[4], Oktay Oymak[1]

[1]Department of Nephrology, Erciyes University Faculty of Medicine, Kayseri, Türkiye
[2]Department of Internal Medicine, Erciyes University Faculty of Medicine, Kayseri, Türkiye
[3]Department of Internal Medicine, Kayseri State Hospital, Kayseri, Türkiye
[4]Department of Radiology, Erciyes University Faculty of Medicine, Kayseri, Türkiye

ABSTRACT

Hyponatremia is the most common disorder of body fluid and electrolyte balance encountered in clinical practice. It can lead to a broad spectrum of clinical symptoms and is associated with increased mortality, morbidity, and length of hospital stay. A 76-year-old female patient was referred to the nephrology department for kidney dysfunction and hyponatremia. She has an external biliary drainage catheter due to an inoperable Klatskin tumor. Initially, she was treated with isotonic fluid because of vomiting-related hypovolemic hyponatremia. Kidney dysfunction had recovered, but targeting sodium levels were not achieved and remained below 125 mM. Controlled urine sodium level remained below 20 mM. Thus, we considered a sodium loss to third spaces and the biliary drainage was the first presumption. Daily sodium wasting was calculated as 164 mmol/24 h (3.8 g sodium) via biliary drainage fluid. So, we added biliary sodium decrement count to the patient's diet as oral salt supplementation; 10 g salt (sodium chloride) per day was equal to daily sodium wasting. The follow-up sodium levels remained around 135 mM, and the patient is asymptomatic since discharge.

Keywords: Hyponatremia, biliary drainage, sodium wasting.

Corresponding author: Cihan Uysal ✉ drcihanuysal@hotmail.com

Received: January 28, 2022 **Accepted:** March 18, 2022
Publication Date: January 1, 2023

Cite this article as: Uysal C, Yılmaz T, Sarıca R, Koçyiğit H, Kahriman G, Oymak O. Persistent hyponatremia due to sodium wasting via external biliary drainage. *Turk J Nephrol.* 2023;32(1):81-85.

INTRODUCTION

Hyponatremia is the most common disorder of body fluid and electrolyte balance encountered in clinical practice. Hyponatremia, defined as a serum sodium concentration below 135 mM, is usually caused by a failure to excrete water normally.[1] It can lead to a broad spectrum of clinical symptoms, from subtle to severe or even life-threatening, and is associated with increased mortality, morbidity, and length of hospital stay in patients presenting with a range of conditions.[2] In healthy individuals, water ingestion does not lead to hyponatremia because the suppressed release of antidiuretic hormone (ADH), also called vasopressin, allows excess water to be excreted in dilute urine. The prevalence and clinical management of hyponatremia vary in numerous conditions. Here, we present a case of hyponatremia due to bilary sodium wasting.

CASE PRESENTATION

A 76-year-old female was transported to the emergency because of vomiting and lethargy. The patient was referred to the nephrology department for kidney dysfunction and hyponatremia. According to her history, 20 years ago, she had undergone surgery for gallbladder stone. She was diagnosed with type 2 diabetes mellitus, Klatskin tumor, and portal vein thrombosis. Six months ago, she was evaluated for abdominal pain, and an approximately 35 mm mass was detected at the junction of the right and left hepatic ducts. Due to obstructive jaundice and an inoperable tumor, a drainage catheter was placed into the biliary duct. She underwent a short period of chemoradiotherapy. For the last 3 months, she was followed without therapy for her malignancy. Two months ago, she was hospitalized in a hospital oncology inpatient service for hyponatremia and oral intake disturbance.

She frequently vomited for the last 2 days, and her oral intake was impaired. Her medication included ursodeoxycholic acid, insulin, enoxaparin, paracetamol, and hyoscine butyl bromide.

On physical examination, she was lethargic, disoriented, and uncooperative; her mouth was dry, her skin turgor decreased, her blood pressure was 100/60 mmHg, her heart rate was 88/min, respiratory rate was 14/min, an abdominal examination was usual, a biliary drainage catheter was observed, costovertebral angle tenderness was detected on the right side and, edema was not determined on the legs. On ultrasonographic examination, bilateral kidney sizes and echogenicities were normal, pelvicaliectasis were not observed. No significant radiologic pathology was detected on central nervous system imaging.

The initial laboratory test results were as follows: glucose: 236 mg/dL, blood urea nitrogen (BUN): 71 mg/dL, creatinine: 2.1 mg/dL, sodium: 108 mM, chloride: 71 mM, potassium: 5.1 mM, calcium: 10.0 mg/dL, phosphorus: 6.2 mg/dL, magnesium: 1.2 mg/dL, uric acid: 11.2 mg/dL, bilirubin: 1.4 mg/dL, alanine aminotransferase (ALT): 21 IU/L, aspartate transaminase (AST): 43 IU/L, gamma-glutamyl transferase (GGT): 290 IU/L, alkaline phosphatase (ALP): 125 IU/L, lactate dehydrogenase (LDH): 290 IU/L, protein: 8.2 g/dL, albumin: 3.8 g/dL, cholesterol: 186 mg/dL, triglyceride: 112 mg/dL, leukocyte: 9290 per µL, hemoglobin: 11.5 g/dL, platelet: 328 10^3/µL, and serum osmolality 248 mosmol/kg H_2O. Thyroid and cortisol hormone levels were normal. Urine analysis result was as follows: sodium: 8 mM, creatinine: 125 mg/dL, protein: 53 mg/dL, urea: 448 mg/dL, fractional excretion of sodium %0.12, and osmolarity: 130 mosmol/kg H_2O.

She was diagnosed with acute severely symptomatic hyponatremia and prerenal azotemia. We administered 300 mL 3% hypertonic saline rapid infusion. The plasma sodium level was 114 mM after the infusion was completed, and her confusion was improved. She was consistent with clinically hypovolemic hyponatremia and was admitted to the nephrology service for treatment maintenance.

Subsequently, she was treated with isotonic fluid (0.9% NaCl). Kidney dysfunction recovered, and serum creatinine level decreased to 0.8 mg/dL. However, targeting sodium levels were still not achieved. Plasma sodium levels did not rise above 125 mM. Controlled urine sodium level remained < 20 mM.

We thought about a sodium loss to a third space and external biliary drainage as the first presumption of wasting. Therefore, we measured consecutive and concurrent plasma, urine, and external drainage fluid sodium levels, as summarized in Table 1.

There was 1150 mL drainage fluid on the first assessment day, and sodium concentration was 143 mM. We calculated 164 mmol/24 h (3.8 g sodium) daily sodium decrement via external biliary drainage. As a result of these assessments, sodium loss via biliary drainage fluid was obvious. We should have closed external drainage for withdrawal of wasting, but we could not manipulate the catheter due to biliary obstruction. Hence, we revised the patient's diet, and oral salt supplementation was added to the routine diet; 10 g salt (sodium chloride) tablet per day was equivalent to daily biliary sodium wasting. Consequently, the follow-up sodium levels remained around 135 mM, and the patient is asymptomatic since discharge. Sodium measurements are demonstrated in Figure 1.

DISCUSSION

We present in this article a severe hyponatremia case manifesting with neurological symptoms developed secondary to sodium loss. There was no hyponatremia-related drug such as diuretic in the patient's medication. The patient had a hypovolemic condition. Initially, we suspected gastrointestinal sodium loss due to vomiting, and urine sodium concentration was less than 20 mmol/L. Hyponatremia did not respond to fluid replacement, despite treatment-responsive vomiting, yielded to a loss to third spaces. Also, urine sodium concentration should have been increased due to sodium-containing fluid replacement; however, it did not. The drainage fluid assessment results have supported the presumption of external sodium wasting. Unfortunately, we could not shut the external drainage down owing to malign biliary obstruction, shown in Figure 2. Maybe we would have spontaneously attained sodium levels without oral salt supplementation after removing the drainage catheter.

Hyponatremia was listed among the rare complications of the percutaneous transhepatic biliary drainage procedure.[3] Bile is a unique and vital aqueous liver secretion formed by the hepatocytes and modified by the bile duct epithelium.

MAIN POINTS

- Hyponatremia can lead to an increased length of hospitalization.
- External biliary drainage procedures can lead to hyponatremia due to sodium wasting.
- Sodium wasting induced by any external drainage is often not tolerated in malnourished patients.

Table 1. Values of Concurrent Measurement of Sodium in Plasma, Urine, and Drainage Fluid

	Measured Sodium Level (mM)		
Assessment	Plasma	Urine	Drainage Fluid
First	125	5	143
Second	124	4	133
Third	120	7	131

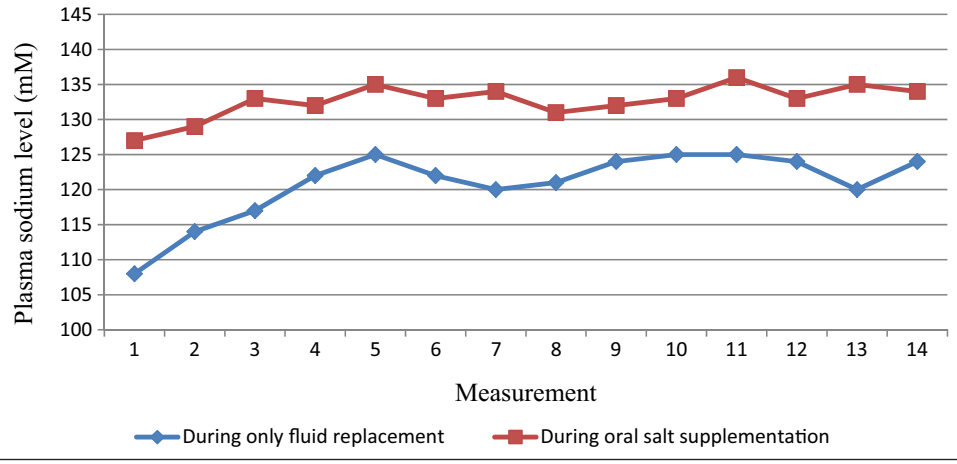

Figure 1. The course of plasma sodium levels for each period.

The composition of bile consists of water (97%), bile salts, bilirubin, fats, and 200 mM inorganic salts.[4] Approximately 1000 mL of bile is formed from the active secretion of organic and inorganic solutes into the canalicular space per day in healthy individuals. The concentration of inorganic solutes (sodium, potassium, calcium, and bicarbonate) in bile is similar to plasma and accounts for the bile osmolality of approximately 300 mOsm/kg.[5] In the systematic review of the sodium ingredient of different body fluids, sodium level ranges from 44 to 185 mM, and bile has the highest sodium concentration (averaging 185 mM) among tested fluids. Sequestration of sodium is essential for bile's hypertonicity.[6]

Hyponatremia-related symptoms primarily occur with acute and marked reductions in the serum sodium concentration, also reflecting neurologic dysfunction induced by cerebral edema.[7] Rapid reductions in the serum sodium concentration, usually less than 24 h, induce cerebral edema. Decreased serum osmolality leads to water movement into the cells by generating an osmolality gradient.[8] Consequently, the severity of symptoms in patients with acute hyponatremia is generally related to the degree of hyponatremia.[9] The major clinical manifestations of acute hyponatremia include headache, lethargy, and eventually, seizures or coma can occur if the serum sodium concentration falls below 115-120 mM. Virtually nausea, vomiting, and malaise are the earliest evidence of hyponatremia when the serum sodium concentration drops below 125-130 mM.[9]

In chronic hyponatremia, clinical manifestation is less severe, even asymptomatic, due to improved protective response against cerebral edema. This adaptation occurs in 2 steps: brain cells lose inside organic solutes leading to osmotic movement of water out of the cells and extracellular fluid movement out of the brain throughout cerebrospinal fluid.[10] These alterations lead to fewer symptoms in chronic hyponatremia despite a serum sodium level below 120 mmol/L. Furthermore, these symptoms are relatively nonspecific and include fatigue, nausea, dizziness, vomiting, gait disturbances, forgetfulness, confusion, and muscle cramps. The occurrence of seizure or coma is indicator of an acute exacerbation of the hyponatremia and being rare in chronic hyponatremia.[11]

Several cases mentioned that hyponatremia was caused by various biliary drainage procedures in the literature. In a recently reported case, attention was called to the unusual etiology of

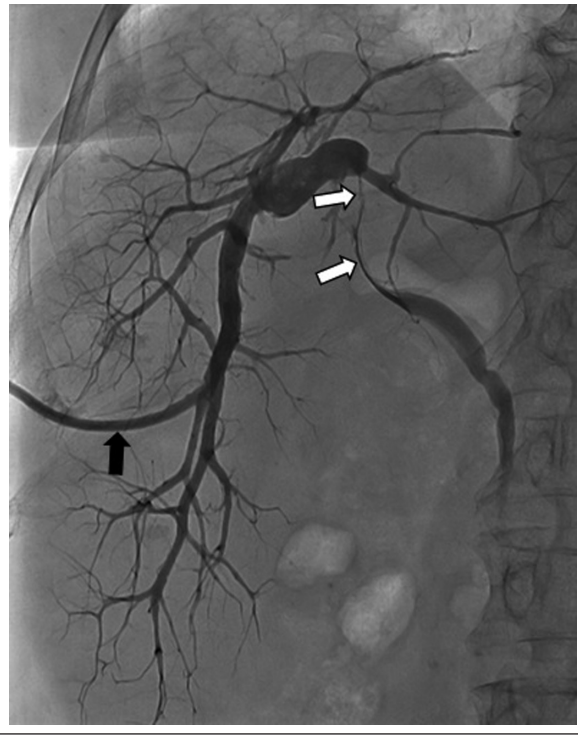

Figure 2. Percutaneous transhepatic cholangiography and biliary drainage. Cholangiography obtained via an 8-F external biliary drainage catheter (black arrow) shows strictures of the main hepatic duct (white arrows), with intrahepatic bile ducts dilatation.

hypotonic hyponatremia due to biliary drainage. Persistent hyponatremia emerged after placement of a cholecystostomy tube for acalculous cholecystitis. In the presented case, initially baseline serum sodium level was around 135 mM and then decreased to 116 mM. Urine osmolality was 111 mOsm/kg and low urine sodium excretion (<20 mM) was measured. Despite repletion with sodium-containing fluids, hyponatremia continued. In the assessment of biliary fluid, sodium concentration was 154 mM and there was of bile drainage of 2000 mL daily, which accounted for approximately 290 mEq or 6.5 g sodium per day. These findings considered hyponatremia because of biliary fluid loss. Sodium level recovered after removing the cholecystostomy tube.[12]

Severe hyponatremia was reported as a rare complication of choledochotomy and T tube drainage for common bile duct stones. In a study, in the 208 patients included, hyponatremia was investigated after choledochotomy and T tube drainage operation. Hyponatremia developed in 46 patients (22.1%) and 30 patients (14.4%) became symptomatic. Large amounts of daily bile drainage volume were determined as the most common factor associated with hyponatremia.[13]

A patient presented with advanced liver disease and hepatocellular carcinoma in another case. Due to an obstructive mass on the biliary ducts, a biliary drain was placed. Initially, serum sodium level was average on admission; however, sodium level gradually decreased. The electrolyte composition of the patient's biliary output was measured, and sodium concentration was detected at 112 mM. Like the previous case, hyponatremia was unresponsive to fluid replacement. Additionally, in this case, continuous sodium losses via biliary drain accompanied the increased fluid intake secondary to the persistent ADH stimulus. Afterward, a biliary drain was entirely capped, and hyponatremia was resolved.[14]

Unlike biliary drainage, another intervention-related hyponatremia is described after transurethral resection, hysteroscopy, or procedures involving electrolyte-free irrigation. These procedures utilize large volumes of irrigating/distension solutions. Three primary nonconductive fluids (most commonly glycine, sorbitol, and mannitol) are used for these procedures due to electrosurgery devices having a monopolar design and cannot be used with electrolyte-containing irrigation fluids. These solutions have caused hyponatremia and a variable degree of hypoosmolality. The severity of hyponatremia is directly related to the volume of irrigation fluid that is retained.[15,16]

In contrast with mentioned cases before, hyponatremia did not occur acutely in our patient after the biliary drainage procedure. The patient has presumably asymptomatic chronic hyponatremia due to chronic sodium losses via external biliary drainage. A hyponatremia attack 2 months ago supports this supposition. In healthy individuals, bile salt reabsorption in the gut prevents sodium wasting. Especially among the senile and malignancy population, oral intake impairs and the patient cannot tolerate external sodium wasting with a routine daily diet. Salt supplementation was provided to maintain sodium levels in the normal range in this case.

CONCLUSION

We want to emphasize that sodium deficiency can occur due to a cumulative count of long time wastings, especially in a malnourished population. In conclusion, physicians should be alert about hyponatremia after external biliary drainage procedures.

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer-Review: Externally peer-reviewed.

Author Contributions: Concept – C.U., T.Y.; Design – C.U., H.K.; Supervision – O.O., G.K.; Materials – G.K., R.S.; Data Collection and/or Processing – T.Y., R.S.; Literature Review – R.S., H.K.; Writing – R.S., T.Y.; Critical Review – O.O.,C.U.

Declaration of Interests: The authors have no conflicts of interest to declare.

Funding: The authors declared that this study has received no financial support.

REFERENCES

1. Adrogué HJ, Madias NE. Hyponatremia. *N Engl J Med*. 2000;342(21):1581-1589. [CrossRef]
2. Spasovski G, Vanholder R, Allolio B, et al. Clinical practice guideline on diagnosis and treatment of hyponatraemia. *Nephrol Dial Transplant*. 2014;29(suppl_2):i1-i39.
3. Riemann J. Complications of percutaneous bile drainage. *Nonsurgical Biliary Drainage*. Berlin: Springer;1984:29-35.
4. Hall JE, Guyton AC. Textbook of medical Physiology. Philadelphia, PA, USA: Saunders;2011:784.
5. Blumgart LH, Belghiti J. *Surgery of the Liver, Biliary Tract, and Pancreas*; vol 2. Philadelphia, PA: Saunders Elsevier; 2007.
6. Kaptein EM, Sreeramoju D, Kaptein JS, Kaptein MJ. A systematic literature search and review of sodium concentrations of body fluids. *Clin Nephrol*. 2016;86(10):203-228. [CrossRef]
7. Sterns RH. Disorders of plasma sodium--causes, consequences, and correction. *N Engl J Med*. 2015;372(1):55-65. [CrossRef]
8. Strange K. Regulation of solute and water balance and cell volume in the central nervous system. *J Am Soc Nephrol*. 1992;3(1):12-27. [CrossRef]
9. Rose BDPTW. Clinical physiology of acid-base and electrolyte disorders. 2001;716:761.
10. Melton JE, Patlak CS, Pettigrew KD, Cserr HF. Volume regulatory loss of Na, Cl, and K from rat brain during acute hyponatremia. *Am J Physiol*. 1987;252(4 Pt 2):F661-F669. [CrossRef]
11. Chow KM, Kwan BC, Szeto CC. Clinical studies of thiazide-induced hyponatremia. *J Natl Med Assoc*. 2004;96(10):1305-1308.
12. Kichloo A, Zain EA, Khan MZ, Wani F, Singh J. Severe persistent hyponatremia: a rare presentation of biliary fluid loss. *J Investig Med High Impact Case Rep*. 2019;7. [CrossRef]

13. Furey AT. Hyponatremia after choledochotomy and T tube drainage. *Am J Surg*. 1966;112(6):850-855. [CrossRef]
14. Portales Castillo IP, Thomas T, Shah A. A simple case of hyponatremia? *Am J Kidney Dis*. 2018;72(6):A12-A14. [CrossRef]
15. Istre O, Skajaa K, Schjoensby AP, Forman A. Changes in serum electrolytes after transcervical resection of endometrium and submucous fibroids with use of glycine 1.5% for uterine irrigation. *Obstet Gynecol*. 1992;80(2):218-222.
16. Istre O, Bjoennes J, Naess R, Hornbaek K, Forman A. Postoperative cerebral oedema after transcervical endometrial resection and uterine irrigation with 1.5% glycine. *Lancet*. 1994;344(8931):1187-1189. [CrossRef]