ECRONICON OPEN ACCESS

EC CLINICAL AND MEDICAL CASE REPORTS

Case Report

Management of Severe Intraoperative Hypernatremia and Hypokalemia During Hepatic Hydatid Cyst Resection

Elizabeth Hong* and Hall Wu

Department of Anesthesiology, LAC+ USC Medical Center, Los Angeles, CA, USA

***Corresponding Author:** Elizabeth Hong, Department of Anesthesiology, LAC+ USC Medical Center, Los Angeles, CA, USA.

Received: March 29, 2023; **Published:** April 08, 2023

Abstract

This is an interesting case of a 50-year-old female with no significant past medical history who presented to the ED with right upper quadrant abdominal pain and a distended abdomen. She was found to have two significant large hepatic cyst lesions measuring 20 cm and 12 cm, which were concerning for hydatid cysts. Serology was positive echinococcus antibodies and the patient was treated with albendazole for presumed hydatid cysts. Hepatobiliary surgery was consulted for definitive treatment and resection of large cysts. Intraoperatively, the larger cyst was found to be very adherent to the diaphragm and therefore, the surgeon decided to perform the PAIR (percutaneous puncture, aspiration, injection, and respiration) method. They aspirated the cyst and injected 20% hypertonic saline as a scolicidal agent. The hypertonic saline was left in the cyst for fifteen minutes. Immediately after irrigation, the patient's sodium increased from 137 mmol/L to 171 mmol/L and her potassium dropped to 2.8 mmol/L in roughly 35 minutes. Rapid efforts to correct the hypernatremia and hypokalemia were made with free water and potassium repletion. Electrolyte corrections were continued with free water. Once electrolytes normalized, she was extubated on post-operative day 2 with no neurologic deficits. Pathology later revealed that this was not in fact echinococcal hydatid cysts but rather a neuroendocrine tumor. She was then treated with octreotide. This is a rare case of severe hypernatremia and hypokalemia after scolicidal irrigation with hypertonic saline for presumed hydatid cyst infections. Perioperatively, management should focus on both rapid hypernatremia correction, and or concomitant free water administration; as well as proactive potassium repletion to prevent potential life-threatening sequelae.

Keywords: *Intraoperative Hypernatremia; Hypokalemia; Hepatic Hydatid Cyst Resection*

Introduction

Hypernatremia is caused by a net water loss or sodium gain [1]. Intraoperative hypernatremia is a rare occurrence; and most of its management focuses on the preoperative or postoperative setting. Hypernatremia is a known complication of hypertonic irrigation for treatment of hydatid cysts during surgery. Mortality for adult patients with severe and acute episodes of hypernatremia (serum sodium > 160 mmol/L) is reportedly greater than 75%, with the survivors often suffering from neurologic sequalae [2]. Nevertheless, there are rare cases of patients emerging unscathed after severe hypernatremia [3]. Hypokalemia is often seen with hypernatremia, which, if left unchecked, can lead to lethal cardiac arrhythmias. This case report discusses recommendations to treat and manage acute intraoperative hypernatremia and hypokalemia, which can occur with the scolicidal hypertonic saline irrigation of hydatid cysts.

This manuscript adheres to the applicable EQUATOR guidelines.

The patient herself has provided verbal and written consent to publish this case report and written HIPAA authorization has been obtained.

Case Description

This case details a 50-year-old, 44-kg woman with no significant past medical history, who presented with a two-month history of vague right-upper-quadrant pain and distention. During that time, she had progressively worsening symptoms of abdominal pain and distention, dyspnea, and a 3-kg weight loss. She presented to the emergency department with labs significant for thrombocytosis of 598 k/cumm, hemoglobin of 10.8 g/dL, and elevated alkaline phosphatase to 383 U/L. A computed tomography scan showed a partially calcified, large right hepatic cyst measuring 20 x 17 x 13 cm^3, and a mixed cystic solid left hepatic cyst measuring 12 x 11 x 8 cm^3 (Figure 1 and 2). Of note, the patient had lived in Mexico for several years. The infectious disease service was consulted by the primary team; and she was immediately started on albendazole for a presumed hydatid cyst infection (19 days prior to surgery). Hepatobiliary surgery was also consulted for surgical management given the size of the lesions. The infectious work up was significant for positive echinococcal antibody IgG. During her hospitalization, she had a drain placed by the interventional radiology department in the right hepatic cyst with one liter of green purulent output. Fluid analysis revealed no evidence of cysts. Findings were significant for amorphous material and numerous bacterial colonies, but no parasites or malignancy was identified. However, Streptococcus Mitis grew from her cyst fluid; and ceftriaxone was added to her antibiotic regiment. Fifteen days later, she underwent an open left segmentectomy and right pericystectomy. Intraoperatively, the left hepatic cyst was resected with minimal difficulty. However, the right cyst proved more challenging. There was an estimated 2-liter blood loss during the resection of the right hepatic cyst, during which the patient received five units of packed red blood cells. The cyst was extremely adherent to the diaphragm, so the decision was made to dissect into the cyst and inject one liter of 20% hypertonic saline for 15 minutes. The arterial blood gas after the irrigation showed a sodium level of 169 mmol/L, elevated from her baseline of 137 mmol/L. Immediate efforts to correct her sodium were made - initially dextrose 5% in water (D5W) was started at 10 cc/kg/hr. During the treatment of her hypernatremia, subsequent blood gases indicated that the patient's potassium had dropped precipitously to 2.8 mmol/L. Electrocardiogram (ECG) changes were noted on the monitors, showing numerous premature ventricular contractions (PVCs) and short runs of ventricular tachycardia. Magnesium and calcium were administered rapidly with resolution of frequent PVCs. Rapid potassium repletion was started initially at 40 mEq infused over 30 minutes, followed by 60 mEq infused over one and a half hours. She received a total of 100 mEq of potassium by the end of the surgery. The patient was given 40 mg of furosemide when her potassium levels had normalized. An intraoperative nephrology consult was obtained; and it was recommended to run the D5W at 250 cc/hr to quickly correct the sodium deficit. This recommendation was initiated intraoperatively and continued for four more hours postoperatively in the intensive care unit (ICU). Her hypernatremia was corrected by the end of postoperative day (POD) 1; and she was following commands. She was extubated on POD 3. She did not have any seizures or other neurologic symptoms during her admission. Of note, her final pathologic diagnosis returned as metastatic neuroendocrine carcinoma for which she was started on octreotide.

Discussion

Hydatid cyst removal is a relatively rare surgical procedure. Surgical excision with hypernatremic irrigation is the standard of care, especially with larger hydatid cysts. In the literature, there is some variation on the salinity of the hypertonic irrigation (15% vs 20%), as well as the duration for which it has to sit in the cyst [4-6]. Special care from both the surgical team and anesthesia team should be given to the subsequent iatrogenic hypernatremia that may follow scolicidal treatment [7,8]. In some case reports, there has been success in the pretreatment of hypernatremia with hypotonic fluids and furosemide administration in anticipation of electrolyte changes [8]. However, there are instances of patients with normal or corrected sodium levels from acute hypernatremia, who still suffer from neurologic sequelae with morbid consequences [9]. Our patient's baseline sodium was 137 mmol/L, which steadily increased throughout the case. The most rapid change happened within 30 minutes from 148 mmol/L to 171 mmol/L after hypertonic irrigation (Figure 3). Our initial

Figure 1: *Coronal view of hepatomegaly and cyst.*

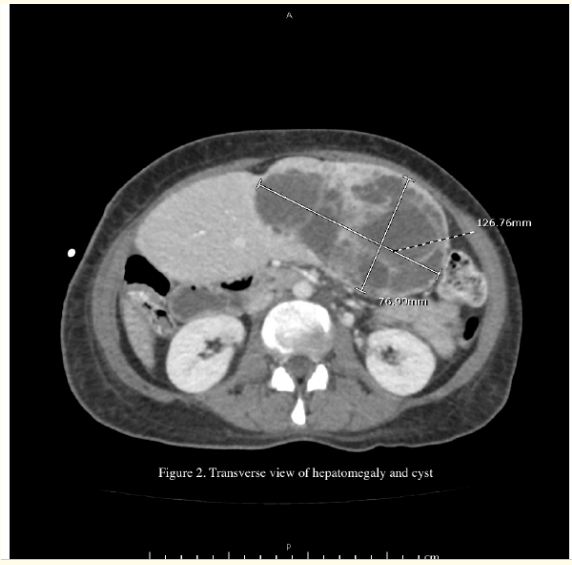

Figure 2: *Transverse view of hepatomegaly and cyst.*

thought was to use hypotonic fluid to slowly correct the sodium, as is often cited by traditional literature; however, we made little headway over the course of an hour. Our nephrology department's recommendation was to quickly correct the sodium. There are several journal articles that discuss the utility behind this practice, especially considering the initial rapid onset of hypernatremia [10]. One particular article even details the dangers in slow (< 0.25 mEq/L/hr) correction in the setting of acute hypernatremia [11]. Many of the modern review articles on the current management of hypernatremia that recommend a maximum sodium correction of 0.5 mmol per liter/hr primarily are focused on the treatment in the pediatric population [12,13]. As pediatric patients are more sensitive than adults to extreme swings in electrolytes, this may mean that the maximum sodium correction rate for adults is currently being underestimated.

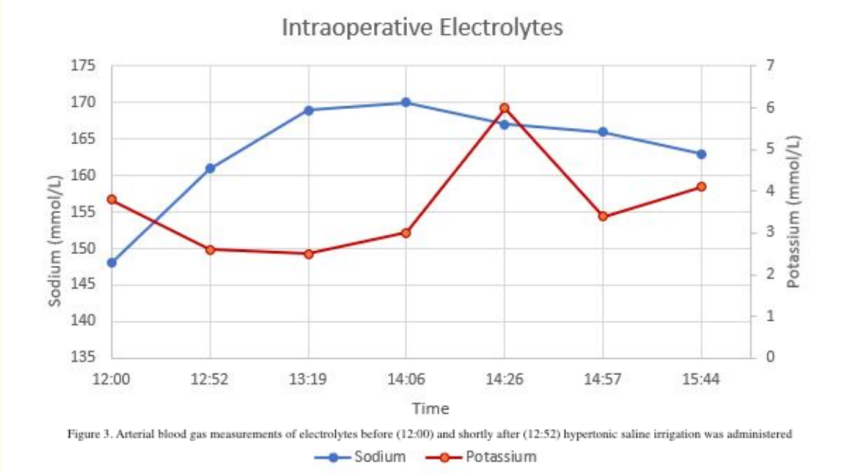

Figure 3: *Arterial blood gas measurements of electrolytes before (12:00) and shortly after (12:52) hypertonic saline irrigation was administered.*

While there are several case reports of significant hypernatremia after scolicidal agent administration, none focus on the importance of potassium repletion. Hypernatremia draws out free water from the tissues into the intravascular space, thereby decreasing potassium. Furthermore, the addition of free water administration can exacerbate the dilution of potassium. There is at least one case report that attributes hypernatremia to a lethal cardiac arrythmia [14]. However, the presentation - the described prolonged QT with ST segment deviations that progressed into unstable ventricular tachycardia - is much more classically seen with hypokalemia. Hypokalemia can be a life-threatening condition leading to arrhythmias and rapid cardiovascular compromise. Vigilant monitoring of this electrolyte is essential in the setting of acute hypernatremia and its treatment.

We feel that one of the critical portions of our management that likely contributed to our patient's favorable outcome was the decision to correct both sodium and potassium proactively. The massive administration of free water (10 cc/kg/hr) caused a dilutional hypokalemia resulting in appreciable ECG changes. A total of 100 mEq of potassium was given intraoperatively and an additional 40 mEq of potassium in the ICU postoperatively. The overall infusion rate of potassium administered centrally as an infusion in the operating room was averaged at 50 mEq/hr. Most sources cite 20 mEq/hr as the upper limit for potassium infusion [15]. However, Murthy., *et al*. treated a patient with hypokalemia secondary to severe diabetic ketoacidosis with upwards to 40 mEq/hr, indicating that in some settings, the benefit of higher potassium infusion may outweigh the risk [16]. Similarly, we felt that the patient's profound and precipitous hypokalemia forced us to infuse potassium at a rate higher than the accepted standard rate of infusion. We also felt that we could do this safely in

the operating room setting, as the patient was being monitored closely with continuous ECG and hourly arterial blood gases to ensure that the pendulum did not swing too far in the other direction.

Conclusion

In the perioperative setting of acute hypernatremia in hydatid cyst removal, aggressive sodium correction rather than gradual correction may improve prognosis and prevent the detrimental neurological sequelae often seen with hypernatremia. Pre-emptive hypotonic solution administration such as D5W before and during hypertonic irrigation can help mitigate the degree of hypernatremia. Importantly, as the correction of hypokalemia is often the rate-limiting step, vigilant electrolyte monitoring and proactive potassium repletion can help expedite the rate of hypernatremia correction while preventing any potentially devastating cardiac arrhythmias that may complicate management further.

Ethics Approval and Consent to Participate

The patient has provided verbal and written informed consent to publish this case report and written HIPAA authorization has been obtained.

Consent for Publication

The patient has provided verbal and written informed consent to publish this case report and written HIPAA authorization has been obtained.

Availability of Data and Materials

Not applicable as this is a case report.

Competing Interests

None.

Funding Support

Not applicable as this is a case report.

Authors' Contributions

Dr. Elizabeth Hong: This author helped compile and edit the manuscript.

Dr. Hall Wu: This author compiled the data and drafted the manuscript.

Manuscript Implication Statement

This case report delves into the treatment and management of acute intraoperative severe hypernatremia that can be occasionally seen with hydatid cyst removal. There is also a special focus on management of the concomitant critical hypokalemia, which has not been discussed in prior literature.

Bibliography

1. Horacio J Adrogué., *et al*. "Hypernatremia". *The New England Journal of Medicine* 342.20 (2000): 1493-1499.

2. Joshua M Thurman and Tomas Berl. "Chapter 29 - Therapy of Dysnatremic Disorders". In: Editor(s): Christopher S. Wilcox. Therapy in Nephrology and Hypertension (Third Edition), W.B. Saunders (2008): 337-352.

3. Albi A., *et al*. "Severe hypernatremia after hypertonic saline irrigation of hydatid cysts". *Anesthesia and Analgesia* 95.6 (2002): 1806-1808.

4. Nunnari G., *et al*. "Hepatic echinococcosis: clinical and therapeutic aspects". *World Journal of Gastroenterology* 18.13 (2012): 1448-1458.

5. Georgios K Georgiou., *et al*. "Surgical management of hydatid liver disease". *International Journal of Surgery* 20 (2015): 118-122.

6. Balik AA., *et al*. "Surgical Treatment of Hydatid Disease of the Liver: Review of 304 Cases". *The Archives of Surgery* 134.2 (1999): 166-169.

7. Krige JE., *et al*. "Fatal hypernatraemia after hypertonic saline irrigation of hepatic hydatid cysts". *Pediatric Surgery International* 18.1 (2002): 64-65.

8. Zeng Rujun MD., *et al*. "The association of hypernatremia and hypertonic saline irrigation in hepatic hydatid cysts". *Medicine* 96.37 (2017): 7889.

9. Kuzmanovska B., *et al*. "Hypernatremia-induced Neurologic Complications After Hepatic Hydatid Cyst Surgery: Pretreat to Prevent". *Medical Archives* 73.5 (2019): 356-358.

10. Kinsuk Chauhan., *et al*. "Rate of Correction of Hypernatremia and Health Outcomes in Critically Ill Patients". *Clinical Journal of the American Society of Nephrology* 14.5 (2019): 656-663.

11. Alshayeb HM., *et al*. "Severe hypernatremia correction rate and mortality in hospitalized patients". *The American Journal of the Medical Sciences* 341.5 (2011): 356-360.

12. Kahn A., *et al*. "Controlled fall in natremia and risk of seizures in hypertonic dehydration". *Intensive Care Medicine* 5.1 (1979): 27-31.

13. Blum D., *et al*. "Safe oral rehydration of hypertonic dehydration". *Journal of Pediatric Gastroenterology and Nutrition* 5.2 (1986): 232-235.

14. Arambewela MH., *et al*. "Extreme hypernatremia as a probable cause of fatal arrhythmia: a case report". *Journal of Medical Case Reports* 10.1 (2016): 272.

15. Sur M and Mohiuddin SS. Potassium (2022).

16. Murthy K., *et al*. "Profound hypokalemia in diabetic ketoacidosis: a therapeutic challenge". *Endocrine Practice* 11.5 (2005): 331-334.

Volume 6 Issue 5 May 2023