Syncope & Seizure due to Exercise-Associated Hyponatremic Encephalopathy

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Introduction

Exercise associated hyponatremia is defined as an acute fall in serum sodium (Na) below 135 mmol/L within 24 hours of prolonged physical exertion[1].
Pronounced hyponatremia (<120 mmol/L) leads to cerebral edema and development of CNS symptoms, such as headache, vomiting, confusion, and seizure with elevated intracranial pressure[2]. Respiratory failure develops when serum Na drops below 110-115 mmol/L[2].
Uncommon for exercise associated hyponatremia to be symptomatic but can be deadly[1]. There is a possible reporting bias, as it commonly affects highly trained athletes, who commonly fail to report symptoms that may cause them to miss events, rapidly leading to CNS symptoms and death[1].
Occurs in the setting of extreme water intake, most commonly with extreme endurance sports, such as the ultramarathon and triathlon[2]. It is also more common in setting of high heat and humidity. Hyponatremia <135 mmol/L was discovered in 51.2% of athletes following an endurance race with temperatures as high as 40 degrees C[2]. In another location with similar endurance races, but moderate temperatures, 0 cases of EIH were detected[2].

Case Presentation

HPI: 19 y.o. male patient presented to the emergency department on 11/11/2022 with chief complaint of vomiting with syncope following. The patient described recently beginning fire-fighting school, and the syncopal event occurred while training outdoors on a hot Floridian day.
Past Medical History: No significant past medical history.
Social History: Recently began intensifying endurance & strength training.
Physical Exam: Patient appeared pale and diaphoretic with difficulty breathing. Became epileptic after triage and was given 1 mg Ativan twice and seizing resolved. Placed on a non-rebreather due to his airway risk and poor responsiveness. Also given IV 3% Normal Saline. Multiple diagnostic tests ran, as described below, with Acute Hypoxemic Respiratory Failure, Metabolic Acidosis, and Rhabdomyolysis.
With bedrest and normal saline, patient's mental state gradually returned to baseline. Na levels were initially 117 mmol/L, improved to 135 mmol/L four days later and 138 mmol/L a week later. (Normal Range: 135-145 mmol/L).
With returning mental status, patient admitted to drinking 3 gallons of isotonic water on the day of his syncopal event.
Complete Metabolic Panel 11/11: Na 117 mmol/L, K 4.0, Cl 85, Glucose 139, BUN 14, Cr 0.7, pH 7.24, CO_2 36, HCO_3 15.5
Blood Culture-Pulmonary Aspiration 11/11: Normal respiratory flora, few WBC, no organisms.
Chest X-Ray 11/13: (See Figure 1). Severe Bilateral Pneumonia with pulmonary edema and fluid overload,
Electroencephalogram 11/11: No seizure activity detected
CT Head/Brain w/o contrast 11/11: (See Figure 2). No acute intracranial hemorrhage or cerebral edema. No midline shift or mass effect identified. No significant white matter disease. No accelerated cerebral atrophy.
MRI Brain 11/12: (See Figure 3). Negative brain MR. No cerebral edema or mass. No abnormal parenchymal gradient, hemorrhage, or calcification.

Imaging

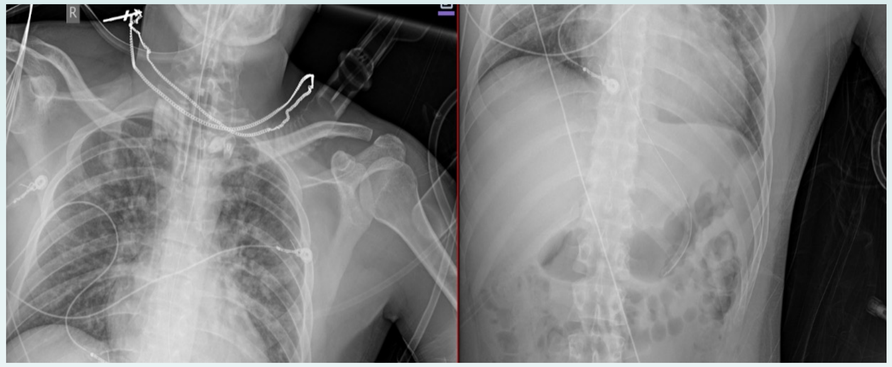

Figure 1. Chest XR.

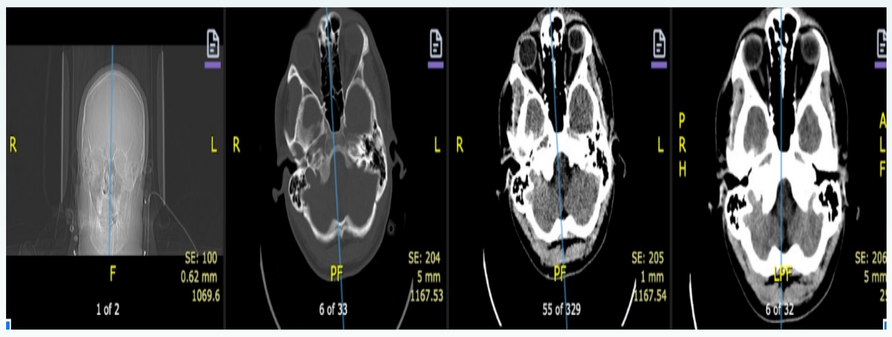

Figure 2. CT Head/Brain.

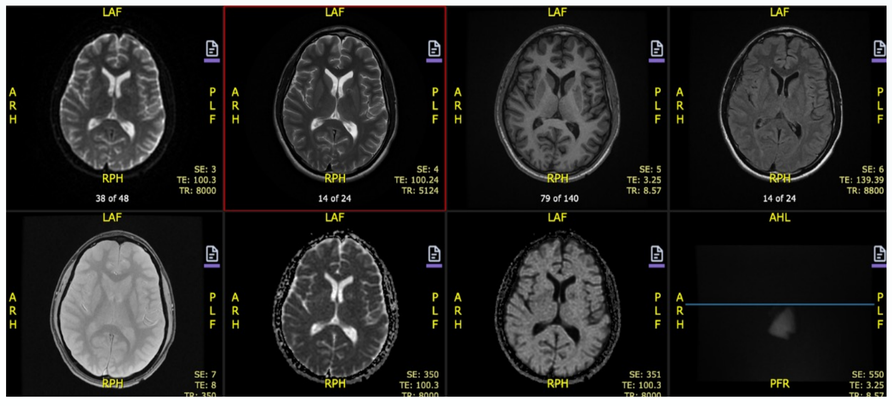

Figure 3. MRI Brain.

Pathophysiology

Exercise-Associated Hyponatremia is due to an excess of fluid (most commonly isotonic water) intake, leading to impaired urinary excretion of water due to persistently elevated anti-diuretic hormone (ADH)[2].
Normally, excess H20 suppresses ADH, leading to a large volume of dilute urine, and maintaining proper body sodium and other electrolyte levels. However, it is hypothesized that with extreme fluid intakes, ADH is not properly suppressed, leading to poor secretion of H20 and excess fluids in the body[2]. This leads to dilutional hyponatremia in the body, with an increase in total body water to amount of sodium that can be properly exchanged. This excess water permeates all body tissues, most importantly crossing the Blood Brain Barrier, and can lead to rapid encephalopathy and resultant headache, severe mental status change, seizure, and death[2].

Discussion

Encephalopathy in the context of Exercise Induced Hyponatremia (EIH) is a condition with continuing research on proper treatment.
Prior to 1981, the American Academy of Sports Medicine (ACSM) advised endurance athletes to not drink many fluids during exercise, which then lead to a high prevalence in hypernatremia. Following this discovery, the ACSM then advised to drink as much as possible, which then lead to an increase in EIH[2]. A proper middle-ground is still yet to be determined, but a common guideline is to monitor the athlete's body weight during the event, and should weight gain be discovered, fluid intake should be reduced[1].
There is no evidence that sports drinks lower the incidence of EIH, as they commonly contain an Na content of about 20-30 mEq/L, which is considered hypotonic to Total Body Water and will not prevent EIH in the case of excess consumption of fluids[1].
Symptoms of EIH can appear similar to dehydration, and proper assessment and differentiation between the two must be established. Treatment for dehydration involves consumption of fluid, which could be fatal in the setting of misdiagnosis in EIH.
Athletes should be advised to drink fluids only when feeling thirsty, and education should be provided on the risks and dangers of EIH[2].
Should an athlete develop symptoms of EIH, they should have a rapid neurological assessment, with fluids immediately restricted and given salty snacks[1].
If neurologic symptoms develop, the athlete should be given a 100 mL IV bolus of 3% hypertonic saline, which is associated with normalizing Na concentration to a higher degree than the same dose given orally[1].

References

1. Rosner MH. EXERCISE-ASSOCIATED HYPONATREMIA. *Trans Am Clin Climatol Assoc*. 2019;130:76-87.
2. Knechtle B, Chlibková D, Papadopoulou S, Mantzorou M, Rosemann T, Nikolaidis PT. Exercise-Associated Hyponatremia in Endurance and Ultra-Endurance Performance–Aspects of Sex, Race Location, Ambient Temperature, Sports Discipline, and Length of Performance: A Narrative Review. *Medicina*. 2019; 55(9):537. https://doi.org/10.3390/medicina55090537