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Decrease of Consciousness Due to Severe Hypokalemia: A Case Report

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ABSTRACT

Severe electrolyte imbalances can present with a wide range of clinical manifestations, and hypokalemia, or low levels of potassium in the blood, is one such condition that can have profound effects on the human body. Hypokalemia can directly impact the brain's function, leading to a range of neurological manifestations. This electrolyte imbalance can have severe and life-threatening consequences, including the development of coma. This case report aims to identify whether the decrease of consciousness in patients is related to the condition of severe hypokalemia.

Keywords: hypokalemia; consciousness; severe hypokalemia.

INTRODUCTION

Potassium is the most prevalent cation inside cells. In humans, the intracellular potassium concentration is approximately 150 mEq/L, while the extracellular concentration ranges between 3.5-5 mEq/L [1]. Hypokalemia is common with its prevalence reaching 14% in the community setting and 20% among hospitalized patients [2]. Hypokalemia is a common electrolyte disorder encountered in clinical practice. Serum potassium levels are categorized into three levels based on their concentration: mild is 3-3.4 mmol/L, moderate is 2.5-3 mmol/L, and severe is less than 2.5 mmol/L [3]. Hypokalemia can be caused by reduced potassium intake or excessive potassium loss through urine or the gastrointestinal tract. Potassium loss through the gastrointestinal tract is usually caused by prolonged diarrhea or vomiting, chronic use of laxatives, bowel obstruction, or infection [4]. Reduced intake should always be suspected in patients whom are ill with evidence of malnutrition, having eating disorders, or alcohol abuse. Excessive potassium loss may occur from the gastrointestinal tract, as seen in diarrhea, malabsorption, colonic diseases such as inflammatory bowel disease, disease, hypersecretory adenomas [2], and also through vomiting [5].

Hypokalemia primarily presents with neuromuscular symptoms, which can range from mild fatigue to more severe conditions like paraparesis and generalized muscle weakness. The severity of hypokalemia is often linked to potassium levels, with muscle weakness typically occurring when serum potassium falls below 2.5 mmol/L. This muscle weakness usually starts in the lower limbs and can extend to the trunk and upper limbs, often accompanied by pain. In rare instances, hypokalemia can cause respiratory muscle weakness, leading to respiratory paralysis. Muscle weakness in the gastrointestinal tract is infrequent. Cardiovascular issues, such as arrhythmias, may also arise, though they are less common than in hyperkalemia. The impact of hypokalemia on the central nervous system remains unclear, despite potassium's essential role in nerve signal transmission [6].

CASE REPORT

A 39-year-old patient was brought to the emergency department (ED) after being referred from a primary care facility, presenting with unconsciousness. According to the history, the patient had experienced frequent episodes of nausea and vomiting and complained of nonspecific abdominal pain radiating to the back. There was no previous medical history. Upon arrival at the ED, the patient was unconscious with a Glasgow Coma Scale (GCS) score of E1V1M1. Vital signs were as follows: blood pressure 127/74 mmHg, pulse 73 beats per minute, respiratory rate 22 breaths per minute, temperature 36.2°C, and SpO2 97% with nasal cannula. Physical examination revealed no abnormalities. Laboratory tests showed leukocytosis at 26,800/µL, a slight increase in urea and creatinine, and hypokalemia at 1.6 mmol/L, while sodium was within the normal range, and chloride and calcium were slightly increased. The blood glucose test showed normal. The electrocardiography examination showed a prominent U wave. The chest x-ray showed no abnormalities.

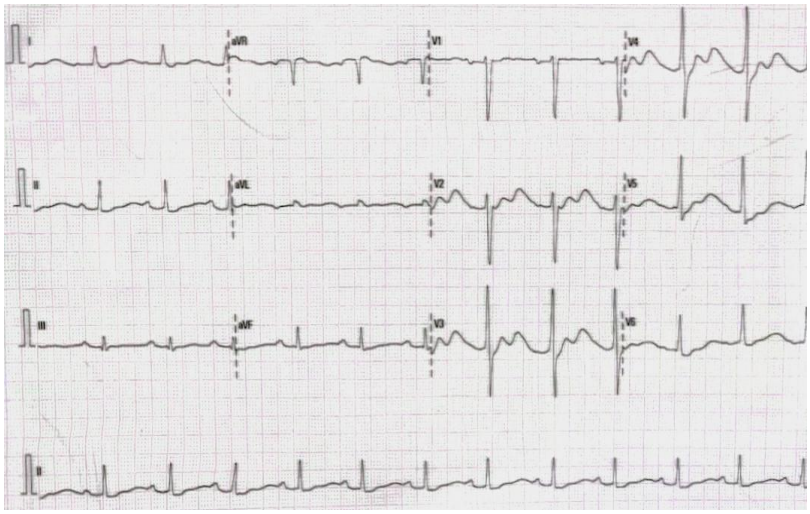

FIGURE 1: The electrocardiography from the patient showed a prominent U wave.

TABLE 1: Patient's laboratory studies.

	Result	Unit	Reference Range
Hemoglobin	18.4	g/dL	13.5 - 18.0
Leukocyte	26.8	10^3/uL	4.0 - 10.5
Platelet	272	10^3/uL	150 - 450
Hematoc-rit	54.7	%	42.0 - 51.0
Erythroc-yte	6.33	mil/uL	3.50 - 4.76
Serum electrolyte			
Sodium	141	mmol/L	135-145
Potassi-um	1.6	mmol/L	3.5 - 5.3
Chloride	107	mmol/L	98 - 106
Calcium	1.41	mmol/L	1.14 - 1.30
Renal function			
Ureum	61.0	mg/dL	15.0 - 45.0
Creatin-in	1.8	mg/dL	0.9 - 1.3
Liver function			
SGOT	50.7	U/L	10.0 - 40.0
SGPT	45.9	U/L	10.0 - 50.0
Albumin	4.2	g/L	3.1 - 4.4

The patient was treated with antibiotics (Meropenem and Metronidazole) and potassium correction. After 24 hours of observation, the patient's condition improved, with GCS increasing to E3V5M6; however, potassium levels dropped to 1.3 mmol/L after administration of KCl 50 mEq twice, diluted in normal saline over 12 hours.

Additionally, the patient developed hypernatremia, hyperchloremia, and hypercalcemia, and experienced an episode of atrial fibrillation with a rapid ventricular response, which resolved spontaneously. Potassium levels were corrected again with 75 mEq dissolved in D5% over 8 hours.

Following this correction, the patient's condition further improved, consciousness was restored, and repeat blood tests showed potassium levels increased to 3.0 mmol/L and leukocytes decreased to 13,000. However, the patient also showed a decrease in glomerular filtration rate and hypoalbuminemia. At the time this case report was written, the patient was still receiving care in the intensive monitoring unit.

DISCUSSION

Hypokalemia, a condition characterized by an abnormally low concentration of potassium in the body, can have significant consequences on an individual's level of consciousness.

Potassium is a critical electrolyte that plays a vital role in maintaining the proper functioning of the cardiovascular system, and its depletion can lead to serious complications, including life-threatening arrhythmias and sudden cardiac death [7]. Severe hypokalemia, defined as a serum potassium level below 2.5 mmol/L, can profoundly impact the central nervous system, leading to a decrease in consciousness. The underlying mechanisms involve alterations in the transmembrane potential of neurons, which can disrupt normal neuronal firing patterns and impair the brain's ability to maintain wakefulness and responsiveness [8]. A case report describes that severe hypokalemia can present symptoms resembling brain death. Severe hypokalemia may lead to complete loss of muscle contractions, mimicking brain death, making timely and accurate diagnosis and management crucial for a favorable outcome [9]. In addition to the direct effects on the brain, hypokalemia can also indirectly impact brain function through its impact on the cardiovascular system. Changes in the extracellular potassium level have profound influences on the function of the cardiovascular system, which can lead to life-threatening arrhythmias, QT prolongation, and even cardiac arrest [8]. These cardiac events can result in cerebral hypoxia or hypoperfusion, further compromising brain function and potentially leading to permanent neurological deficits. The most feared complication associated with hypokalemia is cardiac arrhythmia, especially in patients with hypertension, myocardial infarction/ischemia, or heart failure [10].

Hypokalemia can alter cardiac membrane potentials and delay repolarization, increasing the risk of cardiac arrhythmias such as ventricular ectopic beats, atrial fibrillation, and potentially dangerous ventricular tachycardia or fibrillation [3], [11]. Electrocardiographic findings in hypokalemia may include ST segment depression, flattened T waves, T wave inversion, and the presence of U waves [10]. On the initial electrocardiography examination, the patient exhibited with prominent U-wave presence. Additionally, the patient had an episode of atrial fibrillation, which resolved spontaneously.

Leukocytosis in patients is associated with Systemic Inflammatory Response Syndrome (SIRS), a condition characterized by the body's excessive defensive response to stressors. SIRS caused by an infection confirmed by culture is referred to as sepsis [12]. A severe neurological syndrome characterized by widespread brain dysfunction caused by sepsis is called septic encephalopathy [13]. A case study reported that the leading causes of decreased consciousness in the emergency department were systemic infections (28.6%), metabolic conditions (22.4%), stroke (13.4%), and other causes [14]. The pathology of sepsis is still not fully understood. Sepsis is associated with various abnormalities in body systems and functions, including the cardiovascular, neuronal, metabolic, and coagulation systems, as well as the early activation of both pro-inflammatory and anti-inflammatory responses [15]. However, it is possible that hypokalemia may trigger a systemic infection. This is consistent with clinical reports that have linked hypokalemia to an increased general susceptibility to bacterial infections, as a significant serum potassium deficiency can impair the innate immune system by disrupting the cellular mechanisms necessary for inflammasome activation and function [16].

A retrospective cohort study revealed that both low and high serum potassium levels are connected to a greater risk of death within 28 days for patients with sepsis. Additionally, the presence of U waves in hypokalemia cases is associated with an elevated 28-day mortality rate among sepsis patients [17]. Another study found that patients with hypokalemia have a higher risk of death due to cardiovascular disorders (1.49 times greater), infections (1.93 times greater), and overall mortality, particularly in those with low serum potassium levels [18].

Determining whether the patient's unconscious state is due to hypokalemia or another condition such as sepsis requires further analysis.

CONCLUSION

In this case report, the patient presented with severe hypokalemia and unconsciousness, highlighting the critical impact of low potassium levels on both cardiovascular and neurological functions. The patient's condition was marked by serious complications, including arrhythmias and a significant drop in consciousness, which necessitated immediate intervention. The clinical findings underscore the potential for hypokalemia to mimic life-threatening conditions such as brain death and septic encephalopathy. Additionally, the case emphasizes the importance of timely potassium correction and monitoring in preventing further deterioration and improving patient outcomes. Further investigation is required to fully understand the interplay between hypokalemia and systemic infections, particularly sepsis, in contributing to altered mental states.

CONFLICTS OF INTEREST

No competing interests were declared.

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