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Prevalence of hypokalemia in patients with infections: Retrospective analysis of clinical profile and outcome

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Abstract
Aim: Study the prevalence of hypokalemia in patients admitted with infections; with an emphasis on clinical features, diagnostic and management issues in a major tertiary referral medical college hospital in Vijayapur.
Methods: Retrospective analysis of hypokalemia in admitted patients with infections at Al Ameen Medical College and Hospital from December 2018 till January 2020. All admitted patients with infections under the Department of General Medicine were included in this study. Serial blood samples for estimating serum potassium were analysed at the time of admission, during hospital stay and time of discharge.
Results: Out of 288 patients, 105 patients who had hypokalemia with infections were studied consisting of 61 males and 44 females. The age range was from 16 to 70 years. The most common infections were dengue 82 cases (78.1%), malaria 6 cases (5.7%), pneumonia 4 cases (3.8%), typhoid fever 3 cases (2.9%), cholecystitis 1 case (1%), viral infection 1 case (1%), tuberculosis 1 case (1%), diabetic foot ulcer 1 case (1%), cholecystitis 1 case (1%), urinary tract infection (UTI) 1 case (1%), and rickettsia 0 cases . Prevalence of hypokalemia among the in-patients on admission was 24 (23%) and during hospitalization was 39 patients (37%). The mean level of hypokalemia on admission was 3.11 + SD 0.37 mEq/L (range from 1.7 to 3.4 mEq/L) and during hospitalization was 3.13 + SD 0.25 mEq/L (range from 2.5 to 3.4 mEq/L). On admission, the ratio of mild: moderate: severe hypokalemia was 22: 2: 1 during hospital stay ratio it changed to 2: 22: 1. At discharge the ratio of mild to moderate hypokalemia was 19: 6.
Conclusion: Prevalence of hypokalemia in patients admitted with infections is rarely reported though it is one of the important electrolyte abnormalities. Hypokalemia is part of NORD- the Rare Disease Database; hence often overlooked. Hypokalemia is usually well tolerated in otherwise healthy people, but it can quickly become life-threatening if severe. Mild to moderate hypokalemia increases the risks of morbidity and mortality in patients with cardiovascular disease. As a result, when hypokalemia is identified, the underlying cause should be sought and the disorder treated.

Keywords: hypokalemia, infections

Introduction

Potassium plays a role in contraction of muscles (including the heart), and for the functioning of the many complicated proteins (enzymes). Potassium is found primarily within the striated muscle and bone, and participates with sodium to contribute to the traditional flow of body fluids between the cells within the body. The normal concentration of potassium within the body is regulated by the kidneys through the excretion of urine. When the kidneys are functioning normally, the quantity of potassium within the diet is sufficient to be used by the body and therefore the excess is typically excreted through urine and sweat. Body chemicals and hormones like aldosterone also regulate potassium balance. Secretion of the hormone insulin, which is generally stimulated by food, prevents a short lived diet-induced Hypokalemia by increasing cell absorption of potassium. When Hypokalemia occurs, there's an imbalance resulting from a dysfunction during this normal process, or the rapid loss of urine or sweat without replacement of sufficient potassium.

Potassium enters the body via oral intake or intravenous infusion, is essentially stored within the cells, then excreted within the urine. Thus, decreased intake, increased translocation into the cells, or, most frequently, increased losses within the urine, alimentary canal, or sweat can cause a discount within the serum potassium concentration.

Potassium intake is generally 40 to 120 mEq per day, most of which is then excreted within the urine. The kidney is in a position to lower potassium excretion to a minimum of 5 to 25 mEq per day within the presence of potassium depletion 1.Thus, decreased intake alone rarely causes significant hypokalemia. This was demonstrated during a study of normal individuals in whom lowering potassium intake to twenty mEq per day was related to a discount in serum potassium from 4.1 mEq/L at baseline to 3.5 mEq/L [2].

Prevalence of hypokalemia in patients admitted with infections is rarely reported1. Hypokalemia is part of NORD (National organisation for rare disorders) Rare Disease Database, hence often overlooked 3.

Hypokalemia is defined as a plasma K+ concentration below 3, 5 mmol/L 4. Moderate hypokalemia may be a serum level of 2.5-3 mEq/L. Severe hypokalemia is a level less than 2.5 mEq/L [5, 6]. Patients with mild hypokalemia are generally asymptomatic (3.5-3 mEq/L). In severe hypokalemia, nonspecific symptoms, generalized weakness, lassitude, constipation and even muscle necrosis can occur; at serum concentrations lower than 2.0 mmol per liter, an ascending paralysis can develop, with eventual impairment of

respiratory function. 6 Potassium intake varies according to age, sex, ethnic background, and socioeconomic status. Whether these differences in intake produce different degrees of hypokalemia or different sensitivities to hypokalemic insults are unknown. Up to 21% of hospitalized patients have serum potassium levels lower than 3.5 mEq/L, with 5% of patients achieving potassium levels lower than 3 mEq/L.6 Inelderly patients, 5% demonstrate potassium levels lower than 3 mEq/L. Comparable data are not available for outpatients, but a low serum potassium concentration has been found in 10 to 40 percent of patients treated with thiazide diuretics [8].

Methods

Retrospective analysis study of hypokalemia in patients admitted with infections in Al Ameen Medical College and Hospital from December 2018 till January 2020. All patients admitted with infections fulfilling inclusion criteria were studied. Blood samples for estimating serum potassium level were analysed at the time of admission, during hospital stay and at time of discharge.

Patients admitted with infections above 14 years of age were included. Exclusion criteria included shock, congestive heart failure, renal insufficiency, diarrhea, and diuretic usage. Serum potassium examination was performed serially, at admission, during hospital stay and at discharge.

Results

Out of 105 patients who matched inclusion criteria, there were 61 men (58.1%) and 44 women (41.9%), with age range between 16 to 70 years. Stay in hospital varied between 1 day to 15 days. The common infections included dengue 82 cases (78.1%), malaria 6 cases (5.7%), pneumonia 4 cases (3.8%), typhoid fever 3 cases (2.9%), cholecystitis 1 case (1%), viral infection 1 case (1%), tuberculosis 1 case (1%), diabetic foot ulcer 1 case (1%), cholecystitis 1 case (1%), and urinary tract infection (UTI) 1 case (1%) and rickettsia 0 cases .31 patients had already had underlying diseases before the infections. Hepatobiliary disorders in 25 cases (80.6%), hypertension 2 cases (6.5%), urinary tract disorders 1 case (3.2%), diabetes mellitus 1 case (3.2%), combination of hypertension and diabetes mellitus 1 case (3.2%), and combination of hypertension and chronic obstructive pulmonary disease (COPD) 1 case (3.2%). All of 105 patients received IV fluids and corrections. 96 received Ringer Lactate (RL) (91.4%), 8 patients received normal saline (NS) (7.6%), and 1 patient received oral potassium (RA) (1%). On the day of admission 81 patients (77.1%) had normal serum potassium level, while 24 patients (22.9%) were hypokalemic. In those who had normal potassium level on the day of admission, 39 patients became hypokalemic during hospitalization, while others remained normal. Those with hypokalemia on the day of admission, 16 patients remained hypokalemic at the end of hospitalization, while others became normal. In this study, no patient was found in hyperkalemic state.

Table 1: Comparison of Serum Potassium Level at Admission and Discharge

Patients	Status	
	Admission %	Discharge %
Normokalemia	81 (77.1)	50 (47.6)
Hypokalemia	24 (22.9)	55 (52.4)
Total	105 (100)	105 (100)

The level of hypokalemia on admission ranged from 1.7 to 3.4 mEq/L (mean + SD: 3.11 + 0.37) and during hospitalization from 2.5 to 3.4 mEq/L (mean + SD: 3.13 + 0.25. Further data from 24 hypokalemic patients at the time of admission the the ratio of mild: moderate: severe hypokalemia was 22: 2: 1. During hospital stay ratio was 2: 22: 1. At the time of discharge the ratio of mild to moderate hypokalemia becomes 19: 6.

Discussion

Mild- Moderate hypokalemia is asymptomatic. However, symptoms of hypokalemia may include attacks of muscle weakness, sometimes severe especially involving smooth muscles. Muscular dysfunction can cause paralysis of the bowel, low blood pressure, muscle twitches and calcium deficiencies (tetany) and possibly respiratory failure. Severe hypokalemia may also lead to disruption of striatal muscle cells, particularly during exercise. Physical response to exercise requires the local release of potassium from muscle. In potassium depleted muscle, the lack of potassium prevents necessary dilatation blood vessels, resulting in decreased muscle blood flow, cramps and the destruction of striatal muscle. Hypokalemia can impair ability of the kidneys to concentrate urine, causing excessive urination (polyuria) and excessive thirst (polydipsia). Loss of appetite, nausea and vomiting are common causes of hypokalemia. There may also electrocardiograph changes, confusion, distention of the abdomen, a decrease in mental activity. At serum potassium concentrations < 3 mEq/L one can see cardiac effects of hypokalemia in the form of sagging of the ST segment, depression of the T wave, and elevation of the U wave. In severe hypokalemia, T wave becomes progressively smaller and the U wave becomes increasingly larger. Sometimes, flat or positive T waves merge with positive U waves. Premature ventricular and atrial contractions, ventricular and atrial tachyarrhythmias, 2nd- or 3rd-degree atrioventricular blocks become more severe with increasingly severe hypokalemia; eventually, ventricular fibrillation may occur. Patients with significant preexisting heart disease and patients receiving digoxin are at risk of cardiac conduction abnormalities as a result of even mild hypokalemia.

Hypokalemia may affect both males and females. However, it occurs more commonly in female. This was different in our study wherein there were 61 men (58.1%) and 44 women (41.9%) affected by hypokalemia of varying degrees.

Studies show upto 21% of hospitalized patients have hypokalemia, with 5% of patients achieving potassium levels lower than 3 mEq/L. In our study, the prevalence of hypokalemia was higher. Factors contributing to hypokalemia in our study were a decreased intake due to patient feeling unwell due to fever and anorexia. Increased losses in the urine, from the gastrointestinal tract in the form of vomiting, or severe sweating in malaria were other causes. These were similar to studies by other researchers [9, 10, 11].

There was possibly increased translocation into the cells due to the inflammatory states resulting in tissue breakdown which mitigated some effects and did not result in severity becoming life threatening. The usage of lactate-containing solutions could promote metabolic alkalosis worsening hypokalemia which is also supported as a view in other studies [12]. In this condition potassium shifts intracellularly, thus results in low level of potassium in serum. For these reasons, majority of patients in this study developed asymptomatic mild hypokalemia. Patients with moderate

hypokalemia were also asymptomatic. 1 patient who developed severe hypokalemia had paralytic ileus.
The limitations of this study were the small sample size and cross reference studies which consider a larger populations are older and recent references are fewer. Hypokalemia in infections is rarely studied though it can be helpful in prognosis and treatment.

Conclusion
Hypokalemia is one of the problems that should be considered in patients admitted with infections. The prevalence of hypokalemia in patients with infections on admission is on an average 23%. Hypokalemia is usually well tolerated in otherwise healthy people, but it can quickly become life-threatening if severe. Mild to moderate hypokalemia increases risks of both morbidity and mortality in patients with cardiovascular disease. Ideally maintenance fluids should be chosen with right ratio of sodium and potassium should be used instead of ad hoc fluids being used currently.

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