

## Frequency, severity and risk factors of hypokalemia in patients admitted to pediatric hospital wards

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### Abstract

Low potassium level is classified as the most abnormality that occur in serum electrolyte in pediatric age group. Severe hypokalemia may lead to severely critical states (such as heart rhythm disturbances and respiratory problems). The aim of the study are: Determine how hypokalemia is frequent; discuss the degree of severity; discuss the risk factors.; estimate the mortality rate related to hypokalemia. We study hospital cases of 200 patients up to 11 years of age in the pediatric hospital wards of Al-Hussein hospital from January 2016 until January 2017. Patients with hypokalemia were treated by I.V fluids with different degrees of potassium content according to the degree of hypokalemia. Any ECG changes due to hypokalemia were treated with a concentrated potassium chloride solution until normalization of ECG findings. The frequency of hypokalemia was highest with diarrheal dehydration (57%) and acute renal failure (46.6%), followed by acute chest diseases, e.g. asthma (39.7%), then heart disease (e.g. Heart failure), septicemia, central nervous system diseases and Diabetic ketoacidosis. An important result of this study is: no clear relationship between ECG changes and potassium levels in the serum. In conclusion; hypokalemia is common among pediatric patients. Early diagnosis and correction improves the outcome. It may affect the electrical activity in all muscle types. Very low levels of serum potassium can lead to life threatening cases (arrhythmias are an example) .Moderate or severe hypokalemia must be managed as rapidly as possible because of the absence of a clear relationship between levels of serum potassium and abnormal ECG changes .

**Keywords:** Hypokalemia; Electrolytes; Electrolyte imbalance and Potassium

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### Introduction

In this study, we discuss the commonest electrolyte disturbance in pediatrics, hypokalemia. During hospitalization, hypokalemia may occur in many patients and may affect the electrical activity of the heart, skeletal muscles and smooth muscles .

Severe hypokalemia may lead to serious conditions, arrhythmias and respiratory failure are some examples [1, 2]. This study deals with hypokalemia in those patients who admitted to a pediatric hospital with reference to associated risk factors, frequency, severity and mortality.

**Patients and Method**

This is a retrospective study of 200 children up to 11 years of age, who admitted to the pediatric hospital wards of Al-Hussein hospital in Diwanya/ Iraq from January 2016 to January 2017. From their records, any related details (about age, body weight,

gender, the primary illness, the related findings in clinical examination, important investigations and treatment) were obtained. The serum potassium was measured by electrolyte analyzer. The results are classified as the following:

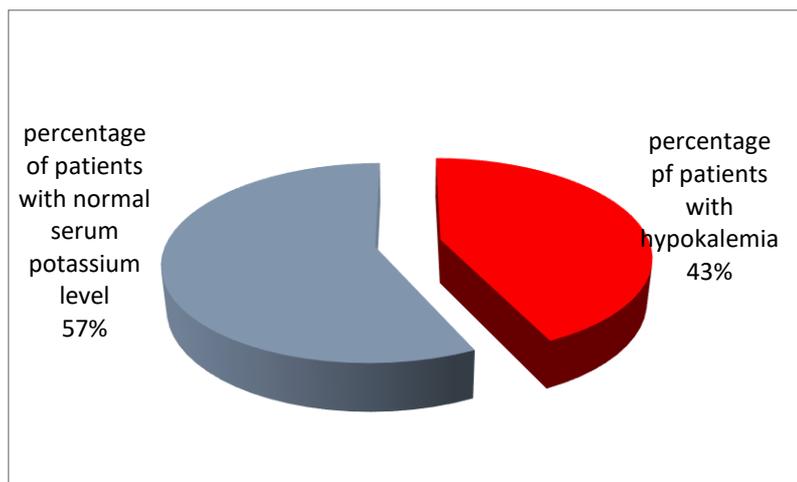
Serum potassium level (mmol/L)	Degree of hypokalemia
3 to 3.4	Mild Hypokalemia
2 to 2.9	Moderate
< 2	Severe

All hypokalemic children treated with I.V fluids with increased potassium content. Highly concentrated potassium chloride solutions are given to patients with ECG abnormalities caused by hypokalemia (under ECG monitoring until the ECG findings became normal).(3)

Chi-square test, and the odds ratio calculation were applied (4).

**Results**

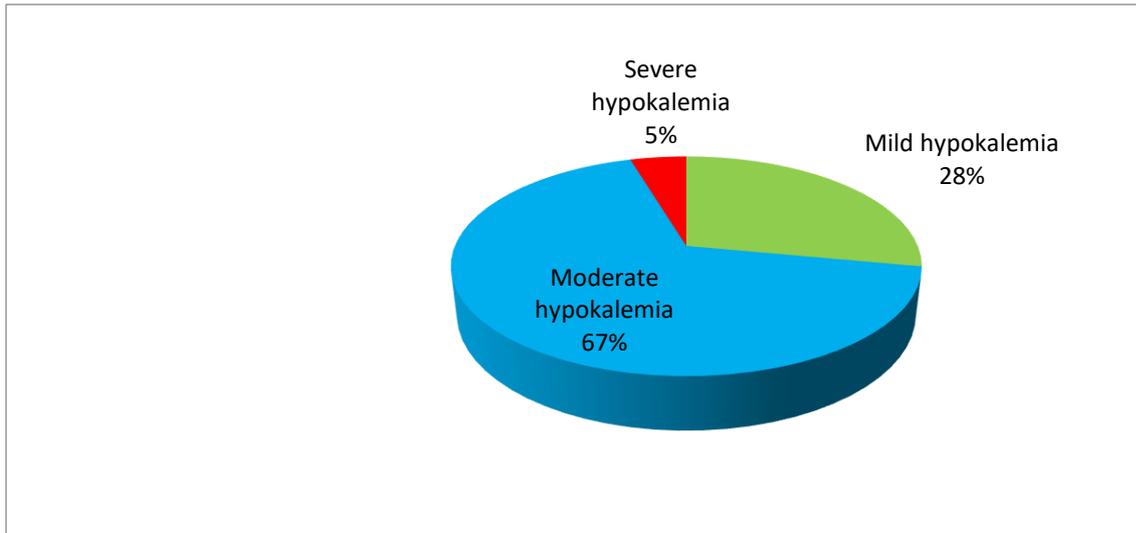
Hypokalemia is recognized in 86 (43%) out of 200 cases who admitted to pediatric hospital wards (Figure 1).



**Figure 1**

Frequency of hypokalemic patients in total number of patients admitted to pediatric wards  
The 86 cases with hypokalemia were classified according to the degree of severity of hypokalemia as the following table:

Degree of severity of hypokalemia	Number of cases	Percentage
Mild	24	28%
Moderate	58	67.4%
Severe	4	4.6%



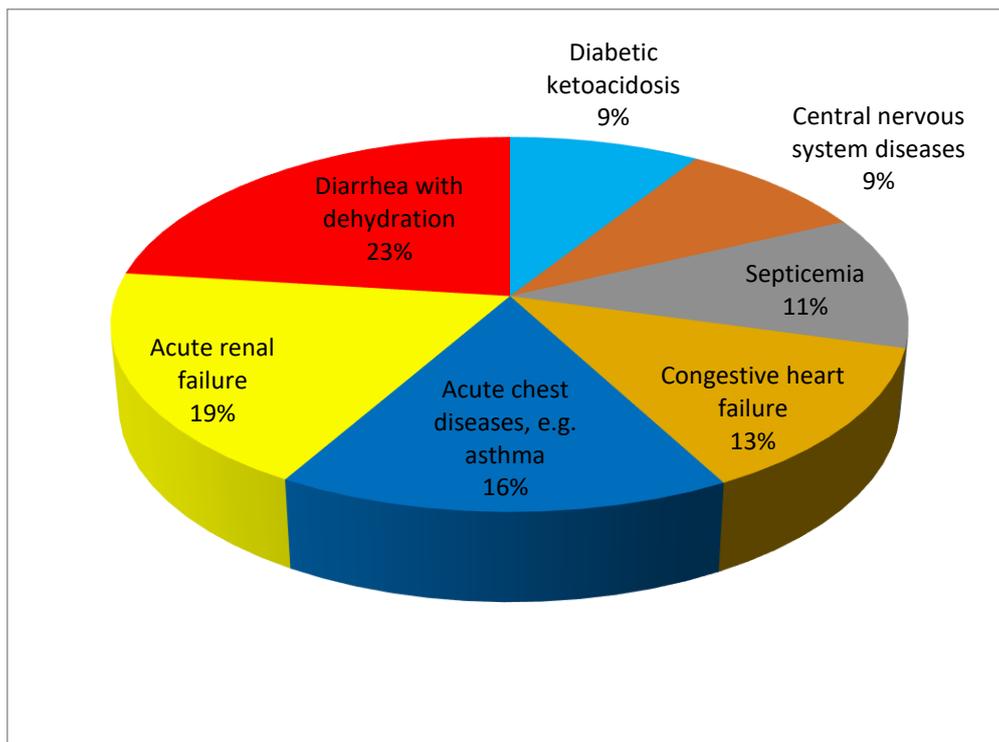
**Figure 2**  
Classification of hypokalemic patients, according to severity

The frequency of hypokalemia was highest with diarrheal dehydration (57%) and acute renal failure (46.6%), followed by acute chest diseases, e.g. asthma (39.7%), then heart disease, e.g. heart failure, septicemia, central nervous system diseases and Diabetic ketoacidosis (Table I) (Figure 3).

**Table I**

Risk factors of Hypokalemia in pediatric hospital wards:

Diagnosis	Number of patients	
	Total (n=200)	Hypokalemia (n=86)
Diarrhea with dehydration	65	37 (57%)
Acute renal failure	15	7 (46.6%)
Acute chest diseases, e.g. asthma	73	29 (39.7%)
Congestive heart failure	22	7 (31.8%)
Septicemia	7	2 (28.5%)
Central nervous system diseases	9	2 (22.2%)
Diabetic ketoacidosis	9	2 (22.2%)



**Figure 3**

Risk factors of Hypokalemia in pediatric hospital wards

In spite of no clear cause in 32% of cases, the majority of patients have an obvious cause of Hypokalemia. The most predisposing factors are the excessive

gastrointestinal losses, upper gastrointestinal losses, excessive potassium loss in urine (in patients with renal disease or on diuretic therapy), and the drugs with

hypokalemia as a side effect (like diuretics and corticosteroids). Severe cases may have one or more predisposing factor. The mortality in hypokalemic patients was

19.8% (17/86), in contrast to 4.4% (5/114) among remaining pediatric hospital ward patients.

Odd ratio	4.5
P- value	< 0.005

### Discussion

This study discusses how the hypokalemia cases are widespread in children with acute illness and how it may be a cause of significant mortality. The following table explains the most important factors which may attribute to hypokalemia:

Factors	The mechanism by which hypokalemia occurs
The underlying disease or associated use of drugs (such as diuretics, glucocorticoids or mineralocorticoids [5] and antiasthma medications [6])	By loss of potassium through GIT or urinary tract [5, 6].
Massive endogenous release of epinephrine because of the stress of the illness [8]	High levels of circulating epinephrine cause a shift of potassium from extracellular to intracellular fluid which might have contributed to hypokalemia
Diabetic ketoacidosis	Hypokalemia could be attributed to correction of acidosis [9] and use of insulin [10].
Acute respiratory distress secondary to pneumonia, congestive heart failure, and central nervous system diseases	Associated inappropriate secretion of ADH may have an important role in the development of Hypokalemia because ADH increase the secretion of potassium in the distal tubules [11].

Low potassium levels may lead to serious complications like arrhythmias or muscular paralysis [5, 7].

According to severity and underlying disease, treatment of cases with hypokalemia are decided. Really, not recommended for treatment of mild

hypokalemia [12], but oral supplements can be used according to the case [5, 13]. Potassium chloride solution rectally can be used in some mild cases too [14]. For severe

hypokalemia, infusion with I.V potassium is recommended [5, 12-14], and rapid correction is needed if ECG changes (which are characteristic of hypokalemia) are present [3]. Oral supplements as a preventive measure for any patient with any predisposing factor (such as those on diuretic therapy) is recommended. Rapid correction is useful in hypokalemia with ECG abnormality [15].

**In conclusion;** hypokalemia is common among pediatric hospital ward patients. Early detection and correction helps in improving the outcome. Direct effects on electrical activity in the heart, smooth muscles and skeletal muscles and may lead to life threatening conditions such as arrhythmias, respiratory failure, paralytic ileus and muscle paralysis [1, 2]. There is no clear relation between serum potassium level and the ECG changes, so that, rapid correction should be done in severe and even moderate cases despite no ECG abnormalities.

#### Declaration of interest

None

#### References

1. Knochel JP. Neuromuscular manifestations of electrolyte disorders. *Am J Med* 1982;72: 521-535.
2. Cannon P. Recognizing and treating cardiac emergencies due to potassium imbalance. *J Cardiovasc Med* 1983;4:467-476.
3. Singhi S, Gautam KS, Lal A. Safety and efficacy of concentrated potassium chloride solution infusion for rapid correction of hypokalemia. *Indian Pediatr* 1994;31:565-569.
4. Morris JA, Gardner MJ. Calculating a confidence interval for relative risks (odds ratio) and standardized ratios and rates. *Brit Med J* 1986;286:1313-1316.
5. Linshaw MA. Potassium homeostasis and hypokalemia. *Pediatr Clin North Am* 1987;34: 49-678.
6. McClure RJ, Prasad VK, Brocklebank JT. Treatment of hyperkalemia using I.V and nebulized salbutamol. *Arch Dis Child* 1994;70:126-128.
7. Khilnani P. Electrolyte abnormalities in critically ill children. *Crit Care Med* 1992;20:241-250.
8. Browmen MJ, Brown DC, Murphy MB. Hypokalemia from beta-2-receptor Stimulation by circulating epinephrine. *N Engl J Med* 1983;309:1414-1419.
9. Adrogué HJ, Madias NE. Changes in plasma potassium concentration during acute acid base disturbances. *Am J Med* 1981;71:456-467.
10. Defronzo RA, Sherwin RS, Dillingham M, *et al.* Influence of basal insulin and glucagon secretion on potassium and sodium metabolism. *J Clin Invest* 1978;61:472-479.
11. Gozal D, Colijn AA, Jaffe M, Hochberg Z. Water, electrolyte and endocrine homeostasis in infants with bronchiolitis. *Pediatr Research* 1990;27:204-209.
12. Brem AS. Disorders of potassium homeostasis. *Pediatr Clin North Am* 1990;37:419-427.
13. Satlin LM, Schwartz CJ. Disorders of potassium metabolism. In: *Pediatric Text Book of Fluids and Electrolytes*, Ed. Ichikawa I. Baltimore, Williams and Wilkins, 1990, pp 218-236.
14. Goldberger E. Metabolic alkalosis syndromes: hypokalemia. In: *A Primer of Water, Electrolyte and Acid Base Syndromes*, 7th edn. Philadelphia, Lea and Febiger, 1986, pp 277-289.
15. Paice BJ, Paterson KR, Onyang-Omara F, Donnelly TI, Gray JMB, Lawson DH. Record linkage study of hypokalemia in hospitalized patients. *Postgrad Med J* 198.