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Low Serum Potassium Level and Its Effects on the Severity and the Rate of Hospitalization in Asthmatic Adults

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KEYWORDS

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ABSTRACT: Bronchial asthma is a prevalent issue with significant medical and economic repercussions. Potassium (K) unbalance is associated with airway hyperreactivity, wheezing, and lung function impairment. Forty patients suffering from bronchial asthma, with regular follow-ups in an asthma clinic of the General Qurna Hospital, were investigated in this study. Each individual was questioned and evaluated clinically. Serum (K^+) concentration and asthma severity were measured. The used drugs were documented. The total number of hospitalizations owing to asthma exacerbation was determined for the six months preceding the day of testing serum (K^+) level. Nineteen patients (48%) had low K^+ levels with a mean of 1.52 ±0.92 mmol L^{-1}, while 21 patients (52%) had normal K levels (4.3±0.21 mmol L^{-1}) ($P<0.05$). The study found that hypokalemia was common in younger patients (mean aged 22.5±1.3 years) Asthmatics females tend to have a significant of hypokalemia than males (58%) ($P<0.05$).

INTRODUCTION

Asthma is an inflammatory disease that causes repeated bouts of shortness of breath and wheezing [1]. Asthma is equally common in older and younger people as it is in children and young adults [2]. The natural course of electrolyte imbalance in asthmatic patients is poorly understood [3]. Senior asthmatic patients are more likely to be hospitalized, have a poorer quality of life, and are more likely to die as a result of their condition [4]. Considerably less attention has been paid to monovalent cation metabolism in medicine; this may be attributable to the earlier simple methods of measurement of the metals rather than to their relative biological importance and the increased number of diseases today that may be associated with mineral deficiency [5]. Because of its link to acute asthma, serum potassium has sparked a lot of research into electrolyte imbalances in asthma patients [6]. With more wheezing, over-reactivity of the airways, and decreased lung function [7]. There are numerous ways in which (K^+) affects respiratory airways, including bronchodilation, anticholinergic impact, and smooth muscle relaxation [8]. Although the cause of hypomagnesemia in asthmatics was not entirely understood, it was thought that therapy for the condition (β-agonist, steroids, and xanthines) was partially to blame for the increased urine excretion of K [9]. Although hypokalemia in asthmatics has been documented, there is unclear evidence linking chronic asthmatics' occurrence to an increased rate of hospitalizations or asthma severity [10]. Potassium is thought to be essential to the defense against pathologic bacteria based on increased responsibility for infection of deficient in many organizations [11]. Hence, this study aims to determine if bronchial asthmatics with low K^+ levels have a greater frequency of hospitalization and the

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prevalence of hypo and hyperkalemia in bronchial asthmatics.

MATERIALS AND METHODS

This research was conducted after obtaining approval from the local ethics committee of the Basrah Health administration. Furthermore, all participants provided their written, informed permission. It was conducted from July 2008-2009 in the asthma clinic at the general Qurna hospital.

In the asthma clinic, 40 patients with bronchial asthma who were being followed up regularly were examined. Patients were diagnosed based on clinical history, and reversibility of peak expiratory flow rate (PEFR) (>80% of the predicted value). The inclusion criteria included a signed consent form, being under the age ≥20, not smoking, and having no history of kidney illness, diabetes, hypertension, and heart disease, diarrhea, using diuretics, or being pregnant.

Patients with bronchial asthma were interviewed, clinically assessed, and had their PEFR values taken. For each individual, a questionnaire with information on the patient's age, sex, length of the illness, nocturnal symptoms, and a number of hospitalizations (if any) was gathered and compared to their medical records.

Each subject's levels of serum potassium (K^+), urea, and creatinine were assessed in asthmatics. The amount of serum (K^+) was determined via flam photometry. Standard enzymatic kits were used to assess the amounts of urea and creatinine. PEFR measurements were made using a Wrights peak flowmeter. SPSS 10.0 was employed for the statistical analysis.

RESULTS AND DISCUSSION

The study was carried out on 40 bronchial asthmatics. 65% of the patients were female. Overall age was recorded as 40.8± 13.1 years (minimum, 20 years; maximum, 70 years). They were divided into 2 groups, 19 bronchial asthmatics with low serum (K^+) level (1.52±0.09 mmol L^{-1}), and 21 bronchial asthmatics with normal serum (K^+) with a (4.3±0.21 mmol L^{-1}) (Table 1).

The number of hospitalizations in bronchial asthmatics with low (K^+) (53%) was significantly higher than that found in bronchial asthmatics with normal (K^+) (23%), ($P< 0.05$). All patients showed normal serum creatinine and urea levels. The mean duration of asthma in bronchial asthmatics with low (K^+) was (10.2 ± 7.3 yrs) slightly shorter than in bronchial asthmatics with normal (K^+) (9.7 ± 8.1 yrs) however, this was not significant (Table 1).

In patients with hypokalemia, mild asthmatics were more likely to be hospitalized compared to moderate and severe asthmatics ($P < 0.05$). (Table 1, Figures 1 and 2).

Table 1. Features of bronchial asthmatics (BA) in patients with normal and low serum potassium (K) levels.

Parameters	BA with normal K level	BA with low K level
Patients no.	21	19
Sex M/F	10/11	7/12
Age years	40.8 ± 13.1	34.7 ± 8.21
Duration of asthma yrs	9.7 ± 8.1	10.2 ± 7.3
Serum K level ($mmol^{-1}$ L)	4.3 ± 0.21	1.52 ± 0.92
Serum creatinine mg dI	1.0 ± 0.8	1.6 ± 0.9
Serum urea mg dI	24 ± 6.0	26 ± 8.0
No. of hospitalization	5/21 (23%)	10/19(53%)
	Severity of asthma	
Mild asthma	12(57%)	10(53%)
Moderate asthma	7(33%)	8(42%)
Severe asthma	2(10%)	1(5%)
Peak expiratory flow rate (PEFR)	321.5 ± 98.4	310.4 ± 112.2

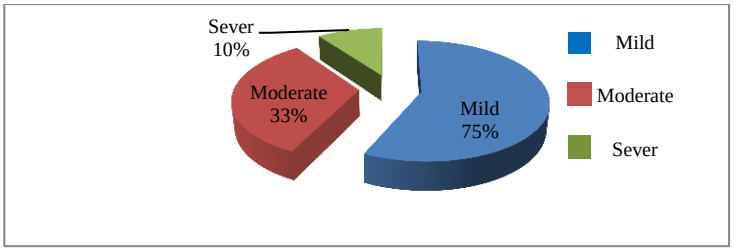

Figure 1. Severity of asthma in BA with normal (K) level.

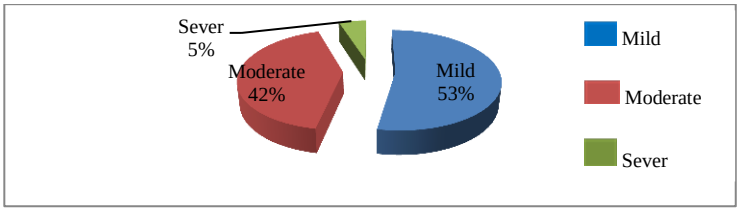

Figure 2. Severity of asthma in BA with low (K) level.

Bronchial asthma is a chronic inflammatory condition of the airways that is marked by sporadic attacks of bronchospasm. It is caused by a number of cells and cell parts [1]. In this study, which was done on 40 people with bronchial asthma, those with a low level of K were more likely to be hospitalized, even though they had more mild symptoms.

The effect of hypokalemia (serum level < 3.5 mmol L^{-1}) on asthmatics has not yet been well defined. Most studies have mainly focused on magnesium and calcium as electrolytes altered in patients with chronic asthma [12]. There are limited studies on animals that revealed that K^+ protectively affects respiratory airways through different mechanisms and causes the relaxation of airway smooth muscle and bronchodilatation of the asthmatic airway [13].

Hypokalemia is the most frequent electrolyte disorder that goes undiagnosed. As in this study, Mathias (1990) also demonstrated changes in serum potassium in asthmatics patients [14].

The prevalence of Hypokalemia is different in patients who are hospitalized, ranging from 46-47%, which depends on the type of population studied. It has been reported that the highest prevalence of hypokalemia is observed in patients hospitalized in the ICU (intensive care units), with a prevalence rate of up to 65%. Its incidence among people with respiratory illnesses such as asthma is unknown. In the present study, the prevalence of hypokalemia was unexpectedly high which was consistent with the study of Haury et al. who reported a higher prevalence of hypokalemia of 50% in 26 patients with acute asthma who had hypomagnesemia and the normal value of potassium levels [15]. A low serum level of K may make airways more sensitive, which makes people with chronic asthma who have low K more likely to have bronchoconstriction and acute asthma attacks [10]. This could happen when cholinergic nerve endings make more acetylcholine [16], when mast cells release more histamine [13], or when Ca^{+2} flows into smooth muscle cells in the airways [17]. Hypokalemia may enhance bronchoconstriction and increase asthmatic hospitalizations through unknown processes. In the current study, the serum level of K was significantly associated with mild asthma. Reviewing the literature showed that there is no study investigating the relationship between low serum levels of K and the severity of asthma. Patients with asthma have lower amounts of red blood cells Mg than healthy people, according to a study by Emelyanove and colleagues [18].

In our study we have shown, that hypokalemia was especially linked to therapy with β2 – agonists during the management of asthma exacerbations. Administration of β2 – agonists can cause hypokalemia through the increased cellular influx of potassium [19, 20]. Hypokalemia can also happen when K^+ secretion in the cortical collecting tubules is stopped. Stimulation of membrane Na^+-K^+-dependent adenosine triphosphatase raises cellular membrane potential [21].

Despite the fact that this is a substantial clinical trial, there are numerous drawbacks, such as the lack of a control group and the limited sample size, that prevent us from conducting a complete analysis of the medication's effect

on asthmatic patients with low potassium levels. While electrolyte problems have been linked to bronchial asthma in the past, this was not the focus of our study.

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Not applicable.

Conflicts of interest

There are no conflicts of interest

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