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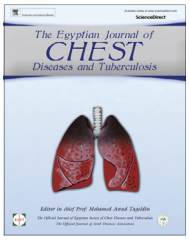

ORIGINAL ARTICLE

A study of electrolyte disturbances in patients with chronic stable asthma and with asthma attacks

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KEYWORDS

Chronic asthma;
Acute severe asthma;
Hypocalcemia;
Hypokalemia;
Hypomagnesemia;
Hyponatremia

Abstract *Study Objective:* To detect electrolyte disturbances in patients with chronic stable asthma and patients with asthma exacerbation and to assess the relation between serums electrolyte levels and pulmonary function parameters and therapeutic agents.

Design: Prospective, hospital-based, cross-sectional study.

Setting: Outpatient chest clinic and in-patient chest department; Alminya university hospitals Alminya-Egypt.

Patients: One hundred asthmatic patients.

Study methods: Patients were divided into two groups: group I that included 50 patients presented with chronic stable asthma and group II that included 50 consecutive patients presented with acute severe asthma. Data collected included sex, age, residence, medication used, clinical examination, serum level of electrolytes (Na, K, Ca, Mg), and chest X ray, Spirometer was used to assess pulmonary function according to ATS/ERS standards.

Conclusion: Hypomagnesemia and hypocalcemia were found to be the two most common electrolyte disturbances in patients with chronic stable asthma and also in those with acute asthma exacerbation. Therapeutic agents used to treat patients with chronic asthma have a role on abnormal electrolyte levels.

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Introduction

Asthma is a disease that has become increasingly common over the last century. It is characterized by chronic lung airway inflammation, increased airway responsiveness and variable airflow obstruction. In recent decades, there has been a marked increase in asthma prevalence, particularly in westernized countries [1]. Acute asthma attack or exacerbation can arise

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any time without any prodromal symptoms and can progress, either slowly or rapidly, to life-threatening severity [2].

Abnormal electrolyte concentrations in asthma patients can be attributed to low intake [3–5] or secondary to asthma medications [6,7]. Hypokalemia was the earliest electrolyte disturbance reported in acute asthma, and it was related to the use of β_2-agonists and aminophylline therapy [8]. Recently, hypomagnesemia, hypophosphatemia, and hypocalcemia have also been reported after administration of β_2-agonists in normal subjects and in asthmatic patients as well [9]. In acute asthma, an increase in the urinary excretion of calcium has also been reported in asthmatic patients treated with IV aminophylline [10].

Electrolyte levels directly influence excitability of airway smooth muscles (ASM) by influencing the state of ion exchangers and Na^+/K^+ pump. Possible hypotheses that may lead to airway reactivity include a direct effect of electrolytes on bronchial smooth muscle contractility as well as potential enhancement of the release of mast cell-derived inflammatory mediators, possibly through airway osmolarity changes [11].

Hypokalemia, hypomagnesemia, and hypocalcemia are well-known causes of cardiac arrhythmia [12,13]. In addition, hypophosphatemia can worsen respiratory failure in severely ill asthmatic patients through impairment of respiratory muscle performance [14].

This study aimed to detect the frequency of electrolyte (Na, K, Ca, and Mg) disturbances in asthmatic patients (chronic stable and acute exacerbation) and their effect on lung function parameters and to assess whether the therapeutic agents used to treat chronic asthma have an effect on abnormal electrolyte levels. Also it aimed to detect the efficacy of magnesium sulfate on clinical and spirometric parameters in patients with acute asthma exacerbation

Patients and methods

The study was approved by the human ethics committee of Alminya University Hospital and was conducted in strict compliance with their policy.

This clinical study was a prospective study that included patients with bronchial asthma who presented as out-patients or admitted to chest department of Al-Minya University Hospital over a period of 8 months from 1st of December 2008 to 31th of January 2010.

The following patients were excluded from the study: (1) patients with wheezy chest due to causes other than bronchial asthma, as patients suffering from acute bronchitis, (2) patients with a history of renal diseases, cardiac diseases, malignant diseases, hyperthyroidism or hypothyroidism, (3) asthmatic smokers, pregnant women, alcohol abuse and diuretic use.

Asthmatic patient was diagnosed by clinical history, physical examination and American Thoracic Society criteria of reversibility of FEV1 or peak expiratory flow $>12\%$ and $\geqslant 200$ mL and diurnal variations of peak expiratory flow rate $>20\%$ [15].

While attending the asthma clinic, information concerning age, sex, duration and severity of asthma, and details of current drug therapy used for management of asthma was obtained from each asthmatic patient.

Spirometry tests (PFTs) which, included forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), (FEV1/FVC) and peak expiratory flow rate (PEFR) were done for all patients using 2130 spirometer Vmax, Sensoromedicus. Laboratory investigations for biochemical parameters; serum K, Na, and Ca were measured by using automated chemistry analyzer (Thermo Electron, model Kone lab 20i, Finland). Magnesium level in serum was measured by magnesium kit liquicolor photometric colorimetric test. Contents of the kits include Reagent (RGT) and Standard (STD) magnesium 2.5 mg/dL.

Calculation of magnesium concentration = $2.50 \times$ Absorbed sample/Absorbed STD (mg/dl) [15]. Magnesium level was measured by using (SPEKOL 11, Germany). Normal serum Na level is 135-145 mEq/L. Normal serum K level is 3.5–5.5 mEq/L. Normal serum ionized Ca^{++} level is 1.07-1.27 mg/dl .Normal serum Mg level by the used kits is 1.9-2.5 mg/dl [16].

The patients in this work were divided into 2 groups according to the predominating signs and symptoms;

1. **Group I** [include 50 patients with stable bronchial asthma]. These patients were subdivided according to asthma severity into 3 groups based on the level of symptoms, airflow limitation and lung function [17]; group Ia includes 10 patients of mild persistent asthma with FEV1 $\geqslant 80\%$, group Ib includes 19 patients of moderate persistent asthma with FEV1 60-80%, group Ic includes 21 patients of severe persistent asthma with FEV1 $\leqslant 60\%$.
2. **Group II** with acute asthmatic attack includes 50 patients and have the criteria of severe asthma exacerbation according to GINA 2008 classification of asthma exacerbation severity. They received slow infusion of 2gm MgSo4 on 200 cc saline and 20 of them were re-evaluated clinically, by spirometry and laboratory investigations 1/2 hour after receiving the medication.

Statistical methodology

Analysis of data was done by IBM computer using SPSS (statistical program for social science version 20) as follows:

Description of quantitative variables as mean, SD

- *Description* of qualitative variables as number and percentage.
- *Chi-square* test was used to compare qualitative variables between groups.
- *Z test* of proportion was used to compare two percentages.
- *Unpaired t-test* was used to compare two groups as regards quantitative variables.
- *Paired t-test* was used to compare quantitative variables before and after treatment in one group, and P values less than 0.05 were considered significant.

Results

Table 1 summarizes the main characteristics of each group; group I that included 50 patients (16 males and 34 females) presented with stable bronchial asthma patients and group II that included 50 consecutive patients (19 males and 31 females)