

**Original Article****Electrolyte disturbances in patients with acute exacerbation of bronchial asthma**

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Email: sarangspatil1@gmail.com**Abstract****Introduction:** Abnormal electrolyte levels in patients with bronchial asthma can be attributed to either low dietary intake or to adverse effects of asthma medications. This study was aimed at assessing the levels of serum electrolytes in patients with acute exacerbation of bronchial asthma and comparing them against non-asthmatic controls.**Methodology:** This observational study was conducted on patients who presented with complaints of acute exacerbation of bronchial asthma in the Emergency Department of Dr. DY Patil Medical College, Navi Mumbai. Laboratory investigations for biochemical parameters like serum sodium, potassium, calcium, magnesium and chloride were measured by using automated chemistry analyzer. During the study period a total of 50 asthmatic patients were compared against age and gender matched non-asthmatic controls.**Results:** Mean age of the patients in asthmatic and non-asthmatic group were 37.0 ± 8.7 and 38.4 ± 7.5 years respectively. Significantly lower mean serum calcium level was observed among asthmatics as compared to non-asthmatics (8.68 ± 1.02 mg/dl vs 9.59 ± 0.55 mg/dl, p value = 0.002). Similarly, significantly lower mean serum magnesium levels were found among asthmatic patients as compared to non-asthmatic controls (1.91 ± 0.54 mEq/L vs 2.43 ± 0.53 , p value = 0.001). Furthermore, we observed a significantly higher proportion of patients with hypomagnesemia (62% vs 20%) and hypocalcemia (24% vs 2%) among asthmatics as compared to non-asthmatics.**Conclusions:** Calcium channel blockers and calcilytics may have a role in treatment of asthma and its symptoms.**Keywords:** Acute severe asthma; Hypocalcemia; Hypomagnesemia; Hyponatremia.**Introduction**

Abnormal electrolyte levels in patients with bronchial asthma can be attributed to either low dietary intake or to adverse effects of asthma

medications¹. Hypokalemia has been reported as an electrolyte disturbance in acute asthma by numerous authors, and it was related to the use of β 2-agonists and aminophylline. Recently,

hypomagnesemia, hypophosphatemia, and hypocalcemia have also been reported after administration of β 2-agonists in asthmatic patients and normal controls as well.² In acute asthma, an increase in the urinary excretion of calcium has also been reported in asthmatic patients treated with intravenous aminophylline. Magnesium and calcium play multiple roles in the pulmonary anatomy and physiological function. When magnesium is deficient, the action of calcium is enhanced, while an excess of magnesium blocks calcium and vice versa. These interactions are important for patients with respiratory tract diseases because the intracellular influx of calcium or decreased magnesium levels can result in hyperreactivity of bronchial smooth muscles. Additionally, the mortality rate in patients with asthma has also been linked to the adverse effects of agents given in the management. Hypokalemia, hypomagnesemia and hypocalcemia are well-known causes of cardiac arrhythmia³ and hypophosphatemia can worsen respiratory failure in severely ill asthmatic patients through impairment of respiratory muscle performance.⁴ This study was aimed at assessing the levels of serum electrolytes in patients with acute exacerbation of bronchial asthma and comparing them against non-asthmatic controls.

Methodology

This observational study was conducted on patients who presented with complaints of acute exacerbation of bronchial asthma in the Emergency Department of Dr. DY Patil Medical College, Navi Mumbai. The study was approved by the institutional ethics committee and was conducted according to the principles laid down by the bioethical committee of Indian Council of Medical Research, New Delhi. We excluded patients with respiratory complaints due to causes other than bronchial asthma, patients with a past medical history of cardiac diseases, renal disorders, malignancies, alcohol abuse, diuretic use or thyroid related disorders. Asthmatic patients were diagnosed according to the clinical

presentation of the patient, past medical history, physical examination by a senior consultant, and criteria specified by the American Thoracic Society as reversibility of Forced Expiratory Volume in one second or peak expiratory flow higher than 12% and ≥ 200 mL and diurnal variations of peak expiratory flow rate higher than 20%.⁵

While in the Emergency Department, demographic information of the patients like age, gender was obtained. Laboratory investigations for biochemical parameters like serum sodium, potassium, calcium, magnesium and chloride were measured by using automated chemistry analyzer. Two millilitres of blood samples were collected from each participant while taking care of standard infection control practices. The serum samples were then used to measure electrolyte levels using the Beckmann Coulter autoanalyser. Magnesium levels were measured by Xylidyl blue method and calcium levels by Arsenazo III method in the autoanalyser. Normal serum sodium level was taken as 135 to 145mEq/L, serum potassium level as 3.5 to 5.5mEq/L, normal serum ionized calcium level as 1.07 to 1.27 mg/dl and normal serum magnesium level as 1.9 to 2.5 mg/dl. The study procedure was explained to the patients and their attendants. During the study period a total of 50 asthmatic patients For comparison we took same number of age and gender matched controls from the outpatient clinic of Department of Pulmonary Medicine who were not asthmatics. The data collected were analyzed by SPSS version 16. Quantitative data were expressed as mean and standard deviation and were compared using t-test. Qualitative data were expressed as number and percentage and compared using chi-square test. All these tests were used as tests of significance at $P < 0.05$.

Results

Table 1 summarises the distribution of baseline characteristics of the patients included in the study. Mean age of the patients in asthmatic and non-asthmatic group were 37.0 ± 8.7 and $38.4 \pm$

7.5 years respectively. There were 24% females in the asthmatic group and 40% in the non-asthmatic group. Mean serum sodium levels were 138.6 ± 6.74 and 142 ± 7.51 mEq/L among asthmatics and non-asthmatics respectively. Significantly lower mean serum calcium level was observed among asthmatics as compared to non-asthmatics (8.68 ± 1.02 mg/dl vs 9.59 ± 0.55 mg/dl, p value = 0.002). Similarly, significantly lower mean serum magnesium levels were found among asthmatic patients as compared to non-asthmatic controls (1.91 ± 0.54 mEq/L vs 2.43 ± 0.53 , p value = 0.001). Mean serum potassium were comparable among patients in the two groups (4.29 ± 1.05 vs 4.17 ± 0.72 mEq/L, p value 0.60) and so were mean serum chloride levels (96.7 ± 14.3 vs 93.9 ± 21.6 mEq/L, p value = 0.59). Furthermore, we observed a significantly higher proportion of patients with hypomagnesemia (62% vs 20%) and hypocalcemia (24% vs 2%) among asthmatics as compared to non-asthmatics. There were 4% of the asthmatics with hyponatremia, 28% with hypokalemia and 10% with hypochloremia, while there were 2% of the controls with hyponatremia, 24% with hypokalemia and 8% with hypochloremia.

Table 1 Distribution of baseline characteristics of the patients included in the study

	Group I (Asthmatics) N=50	Group II (Non- asthmatics) N=50	p value
Age in years (mean \pm SD)	37.0 ± 8.7	38.4 ± 7.5	
Gender distribution			
Males	38	30	
Females	12	20	
Serum electrolytes			
Serum sodium (mEq/L)	138.6 ± 6.74	142 ± 7.51	0.09
Serum calcium (mg/dl)	8.68 ± 1.02	9.59 ± 0.55	0.002
Serum magnesium (mEq/L)	1.91 ± 0.54	2.43 ± 0.53	0.001
Serum potassium (mEq/L)	4.29 ± 1.05	4.17 ± 0.72	0.60
Serum chloride (mEq/L)	96.7 ± 14.3	93.9 ± 21.6	0.59

Table 2 Distribution of patients according to the type of electrolyte disturbance

	Group I (Asthmatics) N=50	Group II (Non-asthmatics) N=50
Hyponatremia	2 (4%)	1 (2%)
Hypocalcemia	12 (24%)	1 (2%)
Hypomagnesemia	31 (62%)	10 (20%)
Hypokalemia	14 (28%)	12 (24%)
Hypochloremia	5 (10%)	4 (8%)

Discussion

The present study found that patients with acute asthma had a significantly lower mean serum magnesium and calcium levels as compared to non-asthmatic controls. Additionally, hypomagnesemia and hypocalcemia was found in higher proportion among patients with acute asthma as compared to non-asthmatic controls. Concurring with results of the present study, Alamoudi⁶ and Oladipo et al⁷ showed that serum magnesium levels were significantly decreased in asthmatic patients compared to their controls. The authors further observed that hypomagnesemia was a common disorder in patients with chronic asthma. Although the cause of hypomagnesemia in patients with chronic asthma is unclear, it may be linked to either low dietary intake of magnesium asthmatics or increased urinary loss of magnesium because of long term use of β 2-agonist, corticosteroid and theophylline.⁸ Additionally, Ahmed et al observed that magnesium levels were significantly decreased in patients with exacerbation than in stable asthmatics. This was demonstrated previously by Mohammad et al as well.⁹

Alamoudi, further observed that serum magnesium levels were found to be low in both stable as well as acute exacerbations of bronchial asthma and found serum magnesium levels to be significantly correlated with severity of asthma (p value < 0.04). The authors explained this as an association between magnesium deficiency and an increased airway hyperreactivity. Studies have shown that magnesium ions play a role in various biochemical and physiological processes which influence the lung function and respiratory

symptoms. These mechanisms include altering airway smooth muscle function, immune function and oxidative stress. Furthermore, hypomagnesemia may make patients susceptible to bronchial spasms by increasing the neuromuscular irritability.¹⁰ One possible explanation for this is that hypomagnesemia may increase influx of calcium into the smooth muscle cells of the airway. Alternatively hypomagnesemia may increase responsiveness of the bronchial smooth muscles through increased histamine release from mast cells.**Error! Bookmark not defined.**⁶ Replacement of magnesium has not found to be effective in chronic asthmatic patients in previous studies. Britton et al found that reduced intake of magnesium was associated with hyperreactivity to methacholine and the authors concluded that decreased intake of magnesium may therefore be involved in the etiology of asthma.¹¹ Additionally, magnesium sulphate was shown to improve pulmonary function in severe asthma.¹² In the present study, only one control had hypocalcemia, while there were 24% of the asthmatics with hypocalcemia. Emad et al¹³ and Alamoudi⁶ reported normal serum calcium levels among stable asthmatic. The authors further explained this observation by the absence of β 2-agonists or aminophylline that are known to cause an increased urinary excretion of calcium. Additionally, excess of magnesium blocks the action of calcium, and this may further explain these interactions. Proportion of hypokalemic patients were similar in both the groups in our study. Studies have observed that hypokalemia is common among patients with acute asthma exacerbations and that there was a significant decrease in potassium level in these patients than those with stable bronchial asthma.¹⁴ Whang et al reported that magnesium depletion causes impaired Na/K ATPase activity, impaired K–Na–Cl-co-transport and increased efflux through K channels, which in turn lead to an increased renal potassium loss, resulting in hypokalemia.¹⁵

Conclusion

The present study showed that there was a significant decrease of magnesemia and calcemia levels during exacerbations in asthmatics. However, no statistical decrease in serum sodium, potassium and chloride levels were observed. Thus calcium channel blockers and calcilytics may have a role in treatment of asthma and its symptoms. Further multicentric Indian studies are required to establish the therapeutic benefit of these drugs in the management of bronchial asthma.

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