International Journal of Medical Research Professionals
P-ISSN: 2454-6356; E-ISSN: 2454-6364
DOI: 10.21276/ijmrp

IJMRP

Original Research Article

Assessment of Electrolyte Disturbance in Asthmatic Patients: A Tertiary Care Hospital Based Study

Ajeet Sawhney

**Assistant Professor, Department of General Medicine,
Rajshree Medical Research Institute & Hospital, Bareilly, Uttar Pradesh, India.**

ABSTRACT

Aggressive administration of nebulizer during the emergency treatment of acute bronchospasm is associated with statistically significant decreases in serum potassium, magnesium, and phosphate. Hence, present study was undertaken to evaluate the serum electrolyte concentration disturbances among asthmatic patients in comparison to control. The present prospective study was undertaken among 50 asthmatic patients and 50 controls. Serum levels of electrolytes: sodium, potassium, magnesium, calcium and phosphorus of both asthmatics and control group were observed using fully auto analyzer machine. The statistical significance between the electrolytes of the two groups was calculated using Chi-square test. In the present study, among asthmatic patients, 28 patients were having hypomagnesemia, 22 patients were having hypophosphatemia, 25 patients were having hypocalcemia, 16 patients were having hypokalemia and 11 patients were having hyponatremia. Data was statistically significant with p-value <0.05 between magnesium, phosphorous and potassium disturbances. In conclusion, electrolyte disturbances are common in asthma. Hypomagnesemia and hypocalcaemia were found to be the most common electrolyte disturbance in our study. Henceforth, serum electrolytes should be checked during admission of the patient.

Keywords: Asthma; Electrolytes; Hypocalcemia; Hypomagnesemia; Hypophosphatemia.

***Correspondence to:**

Dr Ajeet Sawhney
Assistant Professor,
Department of General Medicine,
Rajshree Medical Research Institute & Hospital,
Bareilly, Uttar Pradesh, India.

Article History:

Received: 10-08-2016, **Revised:** 01-09-2016, **Accepted:** 22-09-2016

Access this article online	
Website: www.ijmrp.com	Quick Response code
DOI: 10.21276/ijmrp.2016.2.5.055	

INTRODUCTION

Abnormal electrolyte concentrations i.e. Hypokalemia, hypomagnesemia, hypophosphatemia, and hypocalcemia are reported in asthma patients which is attributed secondary to use of β2-agonists and aminophylline therapy.[1-3]

Bodenhamer J et al[4] carried out a study to evaluated use of nebulized β-agonists for asthma and its effects on serum electrolytes and reported that Aggressive administration of nebulized albuterol during the emergency treatment of acute bronchospasm is associated with statistically significant decreases in serum potassium, magnesium, and phosphate. Hence, present study was undertaken to evaluate the serum electrolyte concentration disturbances among asthmatic patients in comparison to control.

MATERIALS AND METHODS

The present prospective study was undertaken among 50 asthmatic patients and 50 controls taken from outpatient Department of General Medicine, Rajshree Medical Research Institute & Hospital, Bareilly, Uttar Pradesh (India) within 18 to 60 years age group. All patients were subjected to detailed history after taking written and informed consent and detailed systemic examination was carried out.

Patients with clinical findings and spirometry interpretations consistent with the diagnosis of bronchial asthma as per guidelines were included in the study.

Patients with any other respiratory and systemic disorders and pregnant and lactating females were excluded from the study. Routine investigations included complete blood count & chest X-ray. Baseline values of pulmonary function tests were measured before including the patient into the study. Serum levels of electrolytes: sodium, potassium, magnesium, calcium and phosphorus of both asthmatics and control group were observed. Patients were investigated after overnight fasting. 10ml of blood sample was taken by venous puncture and then centrifugation was done to separate the serum. After this the serum was assessed for the various investigations. The investigations were carried out by fully auto analyzer machine. The levels of electrolytes were studied among asthmatic patients and controls group and the statistical significance between the electrolytes of the two groups was calculated using Chi-square test.

RESULTS

Table 1 shows disturbed electrolytes. Magnesium, calcium and phosphorus was found decreased in most of the cases.

In the present study, among asthmatic patients, 28 patients were having hypomagnesemia, 22 patients were having hypophosphatemia, 25 patients were having hypocalcemia, 16 patients were having hypokalemia and 11 patients were having hyponatremia. Among control group, 4 patients were having hypomagnesemia, 2 patients were having hypophosphatemia, 14 patients were having hypocalcemia, 3 patients were having hypokalemia and 2 patients were having hyponatremia. Data was statistically significant with p-value <0.05 between magnesium, phosphorous and potassium disturbances.

Table 1: Electrolytes disturbance level in Asthmatic patients

Electrolytes	Number of cases (n=50)
Magnesium	28
Phosphorus	22
Calcium	25
Potassium	16
Sodium	11

Graph 1: Electrolytes disturbance level in Asthmatic patients

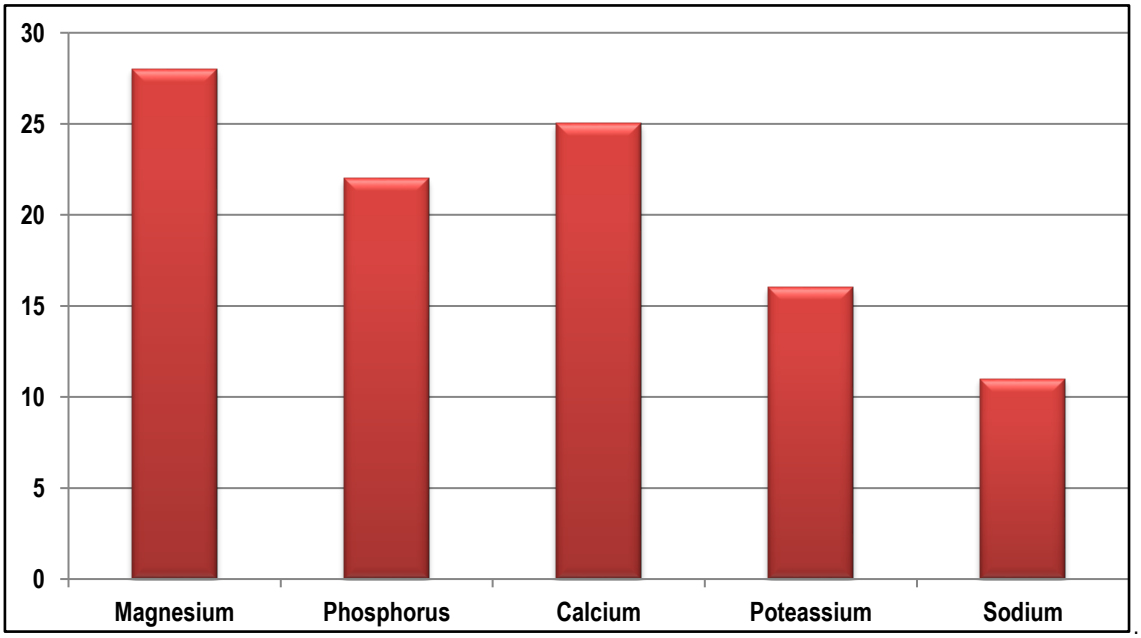

Table 2: Serum electrolyte level in asthmatic cases and controls

Serum electrolyte	Decreased		p-value
	Asthmatic Cases (n=50)	Controls (n=50)	
Magnesium (Hypomagnesemia)	28	4	<0.000 (S)
Phosphorus (Hypophosphatemia)	22	2	<0.000 (S)
Calcium (Hypocalcemia)	25	14	>0.000 (NS)
Potassium (Hypokalemia)	16	3	<0.000 (S)
Sodium (Hyponatremia)	11	2	>0.000 (NS)

DISCUSSION

The present study found that Hypomagnesemia, hypocalcemia and hypophosphatemia were found to be the most common electrolyte disturbances among asthmatic patients. Alamoudi OSB et al[5] found electrolyte disturbances in 43% of the patients; 85% of the patients had one electrolyte disturbance, 10% had two electrolyte disturbances, and 5% had three electrolyte disturbances. The highest proportions were for magnesium (26.9%) and phosphorus (15.1%), the lowest proportions were for potassium (5.4%) and sodium (4.3%), and no patient had a calcium disturbance. Logistic regression analysis showed no statistically significant association between the therapy used and electrolyte disturbances. It concluded that hypomagnesaemia and hypophosphatemia were found to be the two most common electrolyte disturbances in patients with chronic, stable asthma.

Knutsen R et al[6] stated that theophylline given intravenously to 10 females with recurrent asthmatic attacks increased total mean

urinary excretion of magnesium and sodium. Theophylline i.v. and an inhaled beta 2-agonist (albuterol) both increase the normal morning-till-noon serum concentration difference in phosphorus. Disproportional changes in serum and urinary levels of magnesium and calcium by theophylline i.v. is suggestive of magnesium depletion of intracellular stores and a negative calcium balance. Dickens GR et al[7] evaluated the metabolic and cardiopulmonary effects of nebulized albuterol in patients suffering from moderate to severe exacerbations of asthma or chronic obstructive pulmonary disease and serum potassium, heart rate and rhythm, blood pressure and pulmonary functions were measured before treatment and every 15 minutes for 2 hours after treatment. Serum potassium concentrations decreased significantly ($p < 0.05$) within 75 minutes after initiation of treatment.

Gustafson T et al[1] studied magnesium and potassium levels in skeletal muscle biopsies, serum and urine in 20 asthmatics before and 2 months after withdrawal of long-term oral beta 2-agonists, and for comparison in 10 healthy subjects. Skeletal muscle magnesium in the asthmatics was lower both before and after withdrawal of oral beta 2-agonists compared with controls. Skeletal muscle potassium and serum magnesium did not differ between the groups. Serum potassium was significantly lower both before and after the withdrawal of oral beta 2-agonists compared with the control group. The asthmatics had lower skeletal muscle magnesium and lower serum potassium than the healthy controls, both with and without oral beta 2-agonists.

Fantidis P et al[8] conducted a study in which polymorphonuclear magnesium content and serum electrolytes including sodium, calcium and magnesium were measured in 21 healthy volunteers and 50 patients with different types of asthma in the interval between attacks. In this study the polymorphonuclear magnesium content measured was lower than in the control group ($p < 0.001$) while the magnesium levels in erythrocytes and serum and other electrolytes levels in erythrocytes and serum were normal. Role of magnesium as natural calcium channel blocker and the importance of magnesium deficiency in plasma histamine concentration was established.

Study was done by Whyte K et al[9] and it was concluded that theophylline significantly increases salbutamol induced hypokalemia and tachycardia and that the addition of adrenaline does not further increase hypokalemia. Intensive bronchodilator therapy with these two agents in acutely ill, hypoxic patients with asthma or chronic obstructive lung disease may increase the risk of serious cardiac arrhythmias secondary to hypokalemia.

Dominguez LJ et al[10] investigated the relationship between bronchial reactivity and magnesium concentrations both at extracellular and intracellular levels measured by spectrophotometry. A strong positive correlation between bronchial reactivity and the level of intracellular magnesium ($p<0.0001$) was found. Intracellular magnesium concentrations in the asthmatics were significantly lower when compared with levels in rhinitis subjects. This study concluded that intracellular magnesium levels are important determinant of bronchial hyperreactivity. In addition to the bronchodilator effects of magnesium in asthma, this study confirms the proposed role of magnesium in the pathogenesis and treatment of asthma.

Hashimoto Y et al[11] assessed the status of magnesium in patients with bronchial asthma and demonstrated magnesium deficiency, and that the low magnesium concentration in erythrocytes reflects decreased magnesium stores in patients with bronchial asthma.

Neto AC et al[12] conducted a descriptive study to determine the relative frequency of hypomagnesemia among patients with chronic airflow limitation treated as outpatients. Correlation of hypomagnesemia with hypoxia, other electrolyte disturbances and with severity of airflow limitation was also determined. The prevalence of hypomagnesemia was 27.8%.

Tan KL et al[13] conducted a retrospective, observational, hospital-based case-series study. Results were electrolyte disturbance was present in 45.3% of the admissions. Among these, 70.6% had one electrolyte disturbance, 25% had 2 electrolyte disturbances and 4.4% had 3 electrolyte disturbances. Logistic regression analysis showed significant association between steroid therapy and hypokalaemia ($p=0.046$), and between steroid therapy and the number of electrolyte disturbances ($p=0.005$). Zervas E et al[14] studied the role of intracellular magnesium concentration in patients with acute asthma and their correlation with parameters expressing the disease severity. Initial magnesium content in erythrocytes was significantly lower in patients with acute asthma compared to normal subjects and patients with stable asthma [$p < 0.0001$], and it increased significantly after the resolution of the exacerbation. No correlation was observed between parameters of disease severity and the magnesium concentrations in erythrocytes and plasma. This study proposed that decrease in intracellular magnesium content occurs regardless of the severity of the exacerbation and returns to normal values after control has been achieved.

Agin K et al[15] conducted a prospective case control study. 42 consecutive volunteer patients with chronic stable asthma according to the definite criteria and healthy age and sex matched subjects were chosen. Secondary causes of hypomagnesemia were ruled out by the questionnaire. Blood serum magnesium values obtained in the asthmatic patients were compared with those of healthy volunteers. A significant difference was noted between two groups (p value <0.001).

CONCLUSION

In conclusion, electrolyte disturbances are common in asthma. Hypomagnesemia and hypocalcaemia were found to be the most common electrolyte disturbances in our study. Henceforth, serum electrolytes should be checked during admission of the patient.

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Source of Support: Nil. **Conflict of Interest:** None Declared.

Cite this article as: Ajeet Sawhney. Assessment of Electrolyte Disturbance in Asthmatic Patients: A Tertiary Care Hospital Based Study. Int J Med Res Prof. 2016; 2(5):254-57.