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A Study of Serum Electrolytes Abnormality in Asthmatics

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Abstract:
Introduction: *Bronchial asthma is characterized by airways inflammation and hyper reactivity of bronchial tissues.*
Aim of the study*: To assess the electrolyte status in asthmatic patients and compare the serum electrolytes (Potassium, Magnesium, Calcium, Phosphate and Sodium) between Intermittent and Persistent asthmatic patients.*
Materials and Methods:*This was a case-control study which was performed on patients with asthma. Forty-four consecutive volunteer patients with asthma according to the definite criteria where divided into intermittent and persistent asthma groups with twenty-two each in each group and healthy sex and age-matched subjects were chosen.Secondary causes of electrolyte disturbances were ruled out. Serum sample for measuring Sodium, Potassium, Magnesium, Calcium and Phosphorus value was obtained.*
Results& Discussion:*Significant difference between intermittent and persistent groups was noted (P<0.001). Hypomagnesemia and hypokalemia was detected in the asthmatic patients and was significant among the intermittent and persistent asthma groups. Findings of Hyponatremia, Hypocalcemia and Hypophosphatemia were insignificant.*
Conclusion*:The study showed that asthmatic patients presented with Hyponatremia, Hypokalemia, Hypomagnesaemia, Hypocalcemia or Hypophosphatemia. The association of hypomagnesemia and hypokalemia was seen strongly in asthmatic patients. Between the asthmatic groups serum potassium, serum sodium and serum magnesium of the intermittent asthmatic group is found to be better compared to the persistent group.*
Keywords*:Asthma, Hyponatremia, Hypocalcemia, Hypokalemia, Hypomagnesemia*

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I. INTRODUCTION

Long standing inflammatory condition of the airways is commonly known as asthma which affects people of all ages. It exerts a sizeable burden on the patients, their families, and the community. [1]It's an illness due to the complementary action between factors that affect at molecular level and the external soundings. The most commonly quoted hostile factors are airborne pollutants which can be indoor or outdoor, high salt intake, indoor allergens, drugs and vaccines. [2] Respiratory symptoms are characterized with severe attacks that require immediate first aid, if not can lead to death. The burden of asthma is enormous, about 300 million people are currently suffering from asthma worldwide, and about 30 million are living in India. [1,3]Asthma is associated with limitations in day to day activities, absence from school and work days, impairment of lung function, quality of life is reduced, and an unfavourable socioeconomic burden.150 lakh years are lost every year because of asthma, which is approximately 1% of the whole worlds burden of disease. [1]

About 3-38% in children and 2-12% in adults, is currently estimated to be the prevalence of asthma, which is one of the commonest chronic disorder among children. [4] An Indian Study put the prevalence of asthma in India to be around 2.05% among those aged >15 years, with an approximate national burden of 18 million asthmatics. [5]A large number of asthma patients are over confident about their control level. Exacerbations (67%) have been reported by Indian asthmatics, with a good amount of functional and emotional limitations.[6]This on the whole shows how poorly asthma is controlled and reflects how inadequately treatment is taken up by the patients. The use of bronchodilators, inhaled corticosteroids, and influenza vaccinations is seen in low-income countries like India. [7]

Acidosis and hypoxemia can result due to the use of beta- adrenoceptor agonists and other sympathomimetic bronchodilators, during acute episodes of bronchospasm, which can increase the risk of cardiac arrhythmias. [8]It's commonly seen and expected that a derangement exists in the serum potassium levels in asthmatic patients undergoing beta 2- agonist therapy.[9,10] The first electrolyte that was found to be

deranged and subsequently reported in cases of acute asthma was Hypokalemia and was due to beta 2-agonists and aminophylline therapy. [11,12,13]The long-term implications of using beta 2 -agonists are tremors, tachycardia, palpitation, and anxiety which are commonly seen.[14] Later, asthmatic patients treated with beta 2 agonist were also been reported with hypomagnesemia, hypophosphatemia, and hypocalcaemia. [15,16]

The adverse effects of beta 2 -agonists caused while managing acute asthma is one of the main reasons for the increase in mortality rate and which is still on the rise.[17] The use of non-selective beta 2 -agonists (Isoproterenol) and Fenosterol for the treatment of asthma saw increased death incidence in the 1970's.[18]Cardiac arrhythmias can be precipitated by Hypokalemia, Hypomagnesemia and Hypocalcaemia.[19,20] The possibility of worsening of respiratory failure during acute severe asthma by the impairment of respiratory muscle performance is seen when there is Hypophosphatemia.[21]According to Global Initiative for Asthma (GINA) classification of asthma, Intermittent asthma will have <1symptom per week with <2 nocturnal symptoms per month. In Persistent asthma will have >1 symptoms per week with >2 nocturnal symptoms per month. [1]

There are only few studies related to above subject and its clinical relevance. This study is done to verify the hypothesis that the electrolyte values among the intermittent asthmatic patients will be found to be better than those of persistent asthmatic patients.

II. MATERIALS AND METHODS

This study was conducted at our Institute, after getting approval from ethical committee. Informed consent taken from the subjects after explaining the procedure. The data was collected using an organised pro forma. Baseline data including age, gender, occupation, detailed medical history including number of symptoms per week and number of nocturnal symptoms per month, clinical examinations and relevant investigations were included as part of the methodology.

The following parameters were collected: age, gender, religion, blood pressure and clinical chemistry parameters. Blood samples (2ml) was collected in clot activated tube from each participant while employing standard infection prevention procedures. The serum was obtained after centrifuging the blood for 10 min at 2500 rpm. The serum samples were then used to determine the concentrations of Sodium, Potassium, Magnesium, Calcium and Phosphorus. The Sodium and Potassium was carried out using the ISE of Au480 BECKMANN COULTER autoanalyser. Magnesium done by Xylidyl blue method, Calcium done by Arsenazo III method and Phosphorus by Phosphomolybdate/UV method was carried out using the Au480 BECKMANN COULTER autoanalyser.

III. TABLES

Table 1 - Distribution of Electrolyte parameters

	Hyponatremia		Hypokalemia		Hypomagnesemia		Hypocalcaemia		Hypophosphatemia	
	n	%	n	%	n	%	n	%	n	%
Control (44)	13	29	0	0	1	0	21	95	0	0
Intermittent (22)	18	81	12	54	22	100	22	100	22	100
Persistent (22)	21	95	21	95	22	100	20	90	21	95

Table 2 .1 - Comparison of serum Sodium between controls and cases

	N	Mean	Standard Deviation (±)	P value
Control	44	136.54	2.56	
Case - I	22	134.63	0.9	0.0001
Case – P	22	132.72	1.93	<0.0001

Table 2.2 - Comparison of serum Sodium among cases

	N	Mean	Standard Deviation (±)	P value
Case - I	22	134.63	0.9	
Case – P	22	132.72	1.93	<0.0001

Table 3.1 - Comparison of serum Potassium between controls and cases

	N	Mean	Standard Deviation (±)	P value
Control	44	4.37	0.53	
Case - I	22	3.89	0.89	0.008
Case - P	22	3.22	0.19	<0.001

Table 3.2 - Comparison of serum Potassium among cases

	N	Mean	Standard Deviation (±)	P value
Case - I	22	3.89	0.89	
Case - P	22	3.22	0.19	0.001

Table 4.1 - Comparison of serum Magnesium between controls and cases

	N	Mean	Standard Deviation (±)	P value
Control	44	1.96	0.22	
Case - I	22	1.44	0.15	<0.0001
Case - P	22	1.32	0.62	<0.0001

Table 4.2 - Comparison of serum Magnesium among cases

	N	Mean	Standard Deviation (±)	P value
Case - I	22	1.44	0.15	
Case - P	22	1.32	0.62	0.392

Table 5.1 - Comparison of serum Calcium between controls and cases

	N	Mean	Standard Deviation (±)	P value
Control	44	8.55	0.69	
Case - I	22	7.7	0.67	<0.001
Case - P	22	8.01	0.74	0.005

Table 6.1 - Comparison of serum Phosphorus between controls and cases

	N	Mean	Standard Deviation (±)	P value
Control	44	4.24	0.57	
Case - I	22	2.29	0.1	<0.001
Case - P	22	2.29	0.27	<0.001

Table 5.2 - Comparison of serum Calcium among cases

	N	Mean	Standard Deviation (±)	P value
Case - I	22	7.7	0.67	
Case - P	22	8.01	0.74	0.152

Table 6.2 Comparison of serum Phosphorus among cases

	N	Mean	Standard Deviation (±)	P value
Case - I	22	2.29	0.1	
Case - P	22	2.29	0.27	1

Table 7 - Distribution of electrolytes between cases

	Hyponatremia		Hypokalemia		Hypomagnesemia		Hypocalcaemia		Hypophosphatemia	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Intermittent	18	4	14	8	22	0	22	0	22	0
Persistent	21	1	21	1	22	0	20	2	21	1
p-value	0.196		0.021		1		0.488		1	

IV. RESULTS

The study was to evaluate the significance of possible electrolyte abnormality in asthmatic patients. 44 Asthmatic patients divided into 2 groups of 22 each intermittent and persistent were considered with 44 healthy individuals chosen as controls.Table1 shows the general distribution of the abnormal electrolytes between the cases and the control group. 95% of the persistent group is said to have Hyponatremia followed by the intermittent and control group. Persistent group shows high distribution 95% for Hypokalemia, followed by intermittent with 0% for control. 100% hypomagnesemia is seen in both intermittent and persistent group. About 90% of the study population is seen to have hypocalcaemia. 100% hypophosphatemia is seen in the intermittent group followed by 95% in persistent group and nil in control.Table 2.1 shows the difference in mean Serum sodium levels between (intermittent and persistent) cases and controls is statistically significant ($P<0.05$). More over the difference in mean Serum sodium levels between intermittent and persistent cases is also statistically significant is seen in Table 2.2.Table 3.1 showsthe difference in mean Serum Potassium levels between (intermittent and persistent) cases and controls is statistically significant ($P<0.05$). More over the difference in mean Serum Potassium levels between intermittent and persistent cases is also statistically significant as seen in Table 3.2.Table 4.1 showsthe difference in mean Serum Magnesium levels between (intermittent and persistent) cases and controls is statistically significant ($P<0.05$). But Table 4.2 shows that the difference in mean Serum Magnesium levels among intermittent and persistent cases is not statistically significant.Table 5.1 shows the difference in mean Serum Calcium levels between (intermittent and persistent) cases and controls is statistically significant. The difference in mean Serum Calcium levels between intermittent and persistent cases is not statistically significant a seen in Table 5.2.Table 6.1 showsthe difference in mean Serum Phosphorus levels between (intermittent) cases and controls is statistically significant ($P<0.05$). The difference in mean Serum sodium levels between intermittent and persistent cases is not statistically significant as seen in Table 6.2.Table7 shows the distribution of electrolytes between the intermittent and persistent asthmatic groups. The distribution of hypernatremia, hypomagnesemia, hypocalcaemia and hypophosphatemia between the intermittent and persistent group was found to be insignificant. The distribution of Hypokalemia is found to be significant.

V. DISCUSSION

Bronchial asthma is one of the most common respiratory disorder that can start at any age and is seen to affect children as well as adults. It is a complex disorder that is characterized with episodes of breathlessness, wheeze and cough. The cough might be seen usually only at night or after an intensive exercise or exposure to an irritant. All the symptoms may be due to multiple factors producing responses differently in different individuals. The individual may have some respite from the symptoms in between episodes of bronchial attack. Although bronchial asthma is produced by multiple factors, they are all share one common thing- the ability to cause inflammation of the airways leading to airway obstruction further leading to difficulty to breathe normally. Remission is seen during the early childhood (puberty). Zein JG et al in their study reported that age is a risk factor for the severity of asthma between 18yrs to 45 yrs implying that the severity of asthma will be less during early childhood compared to those who become symptomatic during adulthood. [22]

The GINA classification serves as a basic guide line to treat asthma symptomatically rather than cure it completely. Treatment may include beta agonists, cortico steroids which may be inhaled or taken orally to relive

the symptoms. Early detection and proper medication can help in decreasing the severity of the disease. This study was done to evaluate the electrolyte abnormality in asthmatic patients with a possibility of noting a difference in electrolyte levels among the persistent and intermittent asthmatic cases.

The mean values of Serum sodium of intermittent and persistent asthmatic patients is 134.63± 0.9 mEq/L and 132.72 ± 1.93 mEq/L respectively. Both the mean values of serum Sodium are found to be lower than the control mean 136.54± 2.56 mEq/L. The mean of serum Sodium in intermittent patients is closer to the control mean stating it is better than the persistent patient's serum sodium. Statistically the difference in mean values were found to be significant, that is hyponatremia seen in intermittent and persistent groups with respect to the control group. The association between the two groups intermittent and persistent was found to be insignificant. The reference range being Na+: 136 – 145 mEq/L. The reason for hyponatremia could be the use of theophylline which can cause an elevated excretion of electrolytes and water suggested in the study done by Amin R. [23]The mean values of Serum potassium of intermittent and persistent asthmatic patients is 3.89 ± 0.89 mEq/L and 3.22 ± 0.19 mEq/L respectively. The mean value of serum potassium of the control patients is 4.37 ± 0.53 mEq/L which is more than that of intermittent asthmatic patients and persistent asthmatic patients. The reference range is 3.5 – 5.1 mEq/L. The mean of serum potassium levels of intermittent is found to be closer to the control groups mean serum potassium than the persistent groups mean of serum potassium hence better. The association between the two groups was found to be statistically significant. Whyte KF reported the presence of decreased serum potassium in asthmatic patients. [10]

Whang et al. reported that when magnesium is depleted, side by side there is a corresponding decrease in serum potassium which is caused by the decreasing serum magnesium in impairing Na/K ATPase activity, along with increased efflux through K channels resulting in potassium loss through urine. [24] The mean values of Serum Magnesium of intermittent and persistent asthmatic patients is 1.44 ± 0.15 and 1.32 ± 0.62 mg/dl respectively. The mean value of serum magnesium for the control group is 1.96 ± 0.22 mg/dl. The normal reference range for serum Magnesium is 1.7-2.4 mg/dl. The mean serum magnesium of the intermittent group is found to be closer to the control group than the persistent group. This is statically significant also. All of the 44 asthmatic patients had hypomagnesaemia. Alamoudi OS reported that hypomagnesemia and hypophosphatemia are the two most common electrolytes disturbed in asthma. [25]The mean values of Serum Calcium among the intermittent and persistent asthmatic patients is 7.7 ± 0.67 mg/dl and 8.01 ± 0.74 mg/dl. Statistically there is significance when intermittent and persistent asthmatic group is compared with the control group individually. Although statistically insignificant, hypocalcemia was seen in both the groups. The reference range being 8.6-10.3 mg/dl. Healthy subjects administered with IV β 2-agonists were reported with Hypocalcemia with an increase in the urinary excretion of calcium. [26]The mean values of Serum Phosphorus among the intermittent and persistent asthmatic patients is 2.29 ± 0.1 mg/dl and 2.29 ± 0.27 mg/dl respectively. The mean of the control group was 4.24 ± 0.57 mg/dl. The mean values of the control group has significance to the mean values of the persistent asthmatic patient group and intermittent patient groups individually. The association was insignificant among the asthmatic groups. The reference range being 2.5-4.5 mg/dl. Alamoudi OS reported that hypomagnesemia and hypophosphatemia are the two most common electrolytes disturbed in asthma. [25]A study in Emergency medical services of Denver General Hospital with 23 patients with a history of asthma or chronic pulmonary disease showed that aggressive administration of nebulized Salbutamol during emergency treatment of acute bronchospasm was associated with significant decreases in serum Potassium, Magnesium and Phosphorus. [27]Another study done at Calcutta National Medical College, Kolkata with 50 asthmatic patients selected randomly who were attending the outpatient department of respiratory medicine showed 14 having hypomagnesaemia with tachypnoea who used long acting beta agonist, inhaled corticosteroids. [28]A study done on 60 asthmatic patients in Adichunchanagiri Institute of Medical sciences and Hassan Government Medical college, Karnataka on their serum electrolytes levels during nebulised salbutamol therapy showed that serum electrolytes like magnesium, potassium and phosphorus decreased significantly in patients with acute severe asthma who were on treatment with nebulised salbutamol. [29]

VI. CONCLUSION

The parameters that were taken into consideration were serum sodium, potassium, magnesium, phosphorus and calcium. As expected there was derangement of serum electrolytes in the asthmatic patient such as Hypokalemia, Hypomagnesaemia, Hyponatremia, and Hypophosphatemia. The study showed the probable existence of hypernatremia which was not statistically significant and probably warrants the need for a study involving a larger sample population to verify the significance if any. A similar finding of insignificance is to be noted with respect to hypocalcemia. Various studies suggested the existence of serum electrolytes abnormality as a single entity or in combinations. This study was done to compare the electrolyte abnormality among the intermittent and persistent asthmatic cases with the hypothesis that as the intermittent patients required occasional medication their electrolytes would be better when compared with the persistent asthmatic group. The study showed that asthmatic patients presented with Hyponatremia, Hypokalemia, Hypomagnesaemia, Hypocalcemia or Hypophophatemia. The association of hypomagnesium and hypokalemia

was seen strongly in asthmatic patients. Between the asthmatic groups serum potassium, serum sodium and serum magnesium of the intermittent asthmatic group is found to be better compared to the persistent group.

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