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ELECTROLYTE IMBALANCE IN PATIENT WITH ASTHMA EXACERBATION IN SULAYMANIYAH CITY

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Abstract

Asthma exacerbating is a common respiratory disorder in which the patient experiences severe asthma symptoms airways will be narrowed or swollen, making breathing difficult. As a result, the asthmatic patient uses many medications. To detect electrolyte disturbance in patients with severe asthma and determine its association with the medications used. A cross-sectional study was conducted in the Sulaimaniyah Internal Emergency Hospital from June 2020 to December 2021 on fifty patients between sixteen and eighty years old who were previously diagnosed with asthma. The patients were sampled using Cochran's formula. Research tools consisted of venous blood tests and demographic information of the patients, including the medications they used. Ethical Community College of Medicine, University of Sulaimani approved the study protocol.

Fifty patients were surveyed in this study; their age range was 18 to 80 years old, %40 of patients were males, 60% were females, the youngest was 18, and the oldest was 80 years old. Chi-square test results show that asthmatic patients who used oral steroid hyponatremia associated with electrolyte imbalance were 35%, and those who used oral steroid hypokalemia were 58% patients ($p<0.05$). The most significant electrolyte imbalance among patients was hyponatremia (23%), in which 739% of patients used aminophylline, and 87% of patients used montelukast. Electrolyte disturbances were more common in patients with severe asthma. The most frequent electrolyte disorders in asthmatic patients were hypomagnesemia, hypocalcemia, and hypokalemia, hyponatremia.

Keywords: Exacerbated asthma; Electrolyte disturbance; Medications, Cross-sectional study.

INTRODUCTION

Severe asthma is a chronic respiratory illness that burdens patients, families, and society. During asthma attacks worsens new symptoms include coughing, wheezing, chest tightness. It currently affects more than 300 million people worldwide, including all age groups. The prevalence of asthma exacerbation is increasing in many developing countries. The outbreak could reach up to 400 million worldwide[(1)]. The frequency is 8 to 10 times higher in developed countries (USA, Great Britain, Australia, and New Zealand) than in developing countries.

On the other hand, the prevalence is lower in urban, low-income populations than in other groups[(2)]. The commonness of asthma is also higher in minorities (blacks, Hispanics) than in other groups. Some study findings showed that the recent increase in the prevalence of severe asthma in white people is relatively higher. In black people, death due to severe asthma is higher than in white people[(3)]. In addition, many people, especially in low and middle-income countries (LMICs), cannot access the quality-assured essential asthma medicines and care they need[(4)].

In the last two decades, exacerbation of asthma-related morbidity and mortality have increased. Besides the prevalence, the cost of diagnosis and treatment has increased in recent decades as well. The prevalence ranges between less than 5% and 40% in various countries. Overall, approximately 4.3% of the world's population suffers from this disease; for young people aged 12 to 17, this rate increases to 4.4 new cases per 1000 people per year. The incidence of asthma in women in adulthood is 1.8 times higher than that of men (4.9 out of 1000 versus 2.8 per 1000)[(5)]. This increase corresponds to the increase in urban life. In the United States, mortality from exacerbation asthma has increased at all ages, classes, races, and sexes. The mortality rate due to severe asthma is more than 17 deaths per 1 million population (5000 annual deaths)[(6)]. Thus, this study aimed to detect electrolyte imbalance and its association with the effects of using some drugs in severe asthma.

Patients and Methods

This study is an analytical, cross-sectional, prospective study performed in the chest department of Sulaimaniyah Internal Emergency Hospital from June 2020 to June 2021 on fifty subjects aged eighteen to eighty years old who were previously diagnosed with an asthma attack.

Fifty patients with severe asthma attacks constitute the sample group of this study as they were sampled by the availability method and according to the patient admission and exclusion criteria.

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Research tools consist of venous blood tests to determine the serum electrolyte levels of sodium, potassium, magnesium, calcium, and chlorine. Also, the demographic information forms including the patients' age, gender, occupation, smoking habits, residency, and medications regularly used.

The sample size of the study was calculated as the other similar studies using Cochran's formula. Hypomagnesemia means low magnesium level <1.8 mmol, while low potassium means hypokalemia when serum potassium was <3.5 mmol. Hypocalcemia means low serum calcium level ≤2.1 mmol, and hyponatremia means low serum sodium level <135 mmol.

Results

Table 1 shows the demographic characteristics of patients with severe asthma among 50 cases in which 60% were female, most of these were students (24%), while 22% were housewives followed by18% teachers and employees. Additionally, 46% of the patients had never smoked, 32% had a university degree, and 20% were illiterate. Regarding the residency, 60% of the participants were from urban areas and 40% from rural regions. Precisely, 58% of them were married, and 38% were single.

Table 2 displays the mean age and duration of severe asthmatic patients. The mean age is 35.40 ± 17.04 years. The youngest was 18, and the oldest was 80 years old. The mean duration of asthma was 9.84 ± 9.31 years.

Table 3 focused on sodium levels in the serum and its relationship with medications used during an asthma exacerbation. According to the chi-square test results, patients who used oral steroids were associated with a higher incidence of hyponatremia (35). A total of 6 patients were used oral steroids in severe asthma ($p < 0.05$). There is no significant association between electrolyte disturbance and the other drugs used.

Table 4 illustrates the relationship between chloride levels and the drugs used during asthma attacks. Again, there is no significant association between serum chloride levels and the medications used.

Table 5 explains the association between serum potassium levels and medications used in severe asthma. The use of oral steroids was significantly associated with a change in potassium level in 58.1% of patients ($p<0.05$). There is no significant relationship between potassium levels and the other drugs used ($p>0.05$).

Table 6 explores the relationship between serum magnesium level and drugs used in severe asthma. Chi-square test results show a significant association between serum magnesium level and aminophylline in 73.9% of patients who used aminophylline, while87% were used montelukast in asthma attacks ($p<0.05$).

Table 7 demonstrates the relationship between calcium levels and drugs used in asthma attacks. The results showed a significant association between serum calcium level and steroid LABA and montelukast ($p<0.05$), in which 65.9% of patients were used steroid LABA and 70% were used montelukast. Meanwhile, serum calcium level had no significant association with the other medications used.

Discussion

In this study, 50 patients with severe asthma were studied in which their prevalence of electrolyte disturbances was 96%. In this study, the most commonly used drugs in patients with asthma attacks were Montelukast, ICS/LABA, and aminophylline combination spray. The electrolyte disturbances are potassium magnesium and sodium levels, while was chloride not disturbed. We determined that the overall prevalence of electrolyte disorders was 96% in patients with asthma exacerbation. In Egypt, a survey by Mohammad et al. showed that the pervasiveness of electrolyte disturbances in patients with severe asthma was 96%[8, 9]. Another study of electrolyte disturbances was performed in patients with asthma attacks by Minya, 2014 in Egypt[10]. The most frequent electrolyte disorders were hyponatremia (38%), hypokalemia (64%), hypomagnesemia (68%), and hypocalcemia (60%). In the current study, hypomagnesemia was the most common electrolyte disorder in severe asthma, which is consistent with some other conducted studies [11].

A study by Ibrahim and Yousery (2010) examined 60 patients with severe asthma showed that the prevalence of electrolyte disorders was 58.3%. Among them, 51.4% showed one electrolyte disorder, 31.4% showed two electrolyte disorders, and 17.1% showed three. The most typical electrolyte disturbance was low levels of potassium (45%) followed by low levels of magnesium (31.7%) and hyponatremia (18.3%), while there was no hypocalcemia among patients[12]. In the present study, the most common electrolyte disturbance in patients with severe asthma was low magnesium level, which was 73.9% in those who used steroids LABA and (26.1%) in those not used steroid LABA. Also, we found hypokalemia in patients that were used oral steroids (58.1%) and in 41.9% among those who not used oral steroids. Additionally, hypocalcemia was found in 65.9% of patients that used steroid LABA, 34% in those who not used steroid LABA, 70% used montelukast, 29% not used montelukast. Regarding the hyponatremia in asthmatic patients, 35.6% of patients were used not oral steroids, while 64.4% were used oral steroids. These findings were not consistent with the outcomes of Goyal et al., 2016[13].

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Previous studies have shown that hypomagnesemia in patients with exacerbation asthma is caused by repeated use of inhaled beta-agonists [11, 14]. In the present study, aminophylline, montelukast, is associated with a higher incidence of hypomagnesemia in severe asthma. There is no association between LABA and SABA sprays due to the low number of LABA users in the present study (only three people). The research by Zitek et al. (2016) aimed to investigate the effect of albuterol nebulizer on serum lactate and potassium levels in healthy individuals. A study conducted by Zitek et al., 2016 shows that the administration of 10 mg of inhaled albuterol reduced serum potassium levels [15]. They examined blood samples 10 minutes after receiving salbutamol spray, and changes in potassium levels were recorded. However, in our study, there was no significant association between decreased potassium levels and SABA intake. Thus, in our study, the criterion for analysis was abnormal potassium levels in patients. On the other hand, a study performed by Lorensia et al. 2016 to compare the electrolyte disturbances in patients with asthma attacks who received inhaled Salbutamol and intravenous aminophylline showed no significant difference in the electrolyte levels. Comparison of electrolyte disturbances using intravenous aminophylline in this study is consistent with the outcomes of some other studies[16, 17].

In a study by Ibrahim and Yousery (2010), a significant association was found between the use of inhaled corticosteroids and the incidence of electrolyte disturbances. LABA was associated with hypokalemia, while theophylline was associated with hypomagnesemia. In this study, aminophylline is associated with the development of hypomagnesemia, and oral steroids cause hyponatremia or hypokalemia, which is consistent with the findings of other studies [12, 16].

Conclusion

Electrolyte disturbances are more common in patients with severe asthma. Most electrolyte disturbances observed in patients with asthma exacerbation are hypocalcemia, hypokalemia, hyponatremia, and hypomagnesemia. The most typical electrolyte disturbances in patients with severe asthma were hypomagnesemia, hyponatremia, hypocalcemia, and hypokalemia.

Suggestions

Further research should be performed on a larger sample size to investigate the prevalence of electrolyte disturbances in patients with stable and persistent asthma and should compare them with the results of patients having acute and severe asthma. Additionally, The relationship between electrolyte disturbances and pulmonary function indices in patients with asthma should also be investigated.

References

Table 1. Demographic characteristics of patients with severe asthma.

Demographic data		Frequency	Number in %
Gender	Male	20	40
	Female	30	60
Occupational status	Jobless	0	0
	Housewife	11	22
	Teacher	9	18
	Student	12	24
	Employee	9	18
	Retired	4	8
	Farmer	5	10
Smoking	Never	23	46
	passive smoker	8	16
	ex-smoker	6	12
	Current smoker	13	26
Education	No	10	20
	Primary	8	16
	Secondary	16	32
	College	16	32
Residence	Urban	30	60

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	Rural	20	40
marital status	Single	19	38
	Married	29	58
	Divorced	2	4

Table 2. Mean age and duration of severe asthma in patients.

	Mean	**Standard deviation**	**Minimum**	**Maximum**
Age	35.4	17.04	12	80
Duration of asthma	9.84	9.31	1	55

Table 3. Relationship between serum sodium level and medications used for asthma exacerbation.

Medication in asthma exacerbation		**Serum sodium level**			**Total**	**P-value**
		Normal	low	High		
SABA	No	1(50.0)	26(57.8)	2(66.7)	29(58.0)	1
	Yes	1(50.0)	19(42.2)	1(33.3)	21(42.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
LABA	No	2(100.0)	42(93.3)	3(100.0)	47(94.0)	1
	Yes	0(0.0)	3(6.7)	0(0.0)	3(6.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
Steroid Inhaler	No	2(100.0)	43(95.6)	3(100.0)	48(96.0)	1
	Yes	0(0.0)	2(4.4)	0(0.0)	2(4.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
Steroid LABA	No	1(50.0)	19(42.2)	0(0.0)	20(40.0)	0.38
	Yes	1(50.0)	26(57.8)	3(100.0)	30(60.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
Aminophylline	No	1(50.0)	20(44.4)	2(66.7)	23(46.0)	0.79
	Yes	1(50.0)	25(55.6)	1(33.3)	27(54.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
Montelukast	No	1(50.0)	16(35.6)	1(33.3)	18(36.0)	1
	Yes	1(50.0)	29(64.4)	2(66.7)	32(64.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
Oral steroid	yes	2(100.0)	29(64.4)	0(0.0)	31(62.0)	0.03
	No	0(0.0)	16(35.6)	3(100.0)	19(38.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	
Anti-histamine	No	2(100.0)	38(84.4)	2(66.7)	42(84.0)	0.6
	Yes	0(0.0)	7(15.6)	1(33.3)	8(16.0)	
Total		2(100.0)	45(100.0)	3(100.0)	50(100.0)	

P value = 0.03

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Table 4. Relationship between serum chloride level and medications used for severe asthma

Medications in severe asthma		Serum chloride level			Total	P-value
		Low	Normal	High		
SABA	No	11(57.9)	16(57.1)	2(66.7)	29(58.0)	1
	Yes	8(42.1)	12(42.9)	1(33.3)	21(42.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
LABA	No	18(94.7)	27(96.4)	2(66.7)	47(94.0)	0.22
	Yes	1(5.3)	1(3.6)	1(33.3)	3(6.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
Steroid Inhaler	No	19(100.0)	26(92.9)	3(100.0)	48(96.0)	0.57
	Yes	0(0.0)	2(7.1)	0(0.0)	2(4.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
Steroid LABA	No	7(36.8)	11(39.3)	2(66.7)	20(40.0)	0.72
	Yes	12(63.2)	17(60.7)	1(33.3)	30(60.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
Aminophylline	No	7(36.8)	14(50.0)	2(66.7)	23(46.0)	0.59
	Yes	12(63.2)	14(50.0)	1(33.3)	27(54.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
Montelukast	No	6(31.6)	11(39.3)	1(33.3)	18(36.0)	0.89
	Yes	13(68.4)	17(60.7)	2(66.7)	32(64.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
Oral steroid	No	12(63.2)	17(60.7)	2(66.7)	31(62.0)	1
	Yes	7(36.8)	11(39.3)	1(33.3)	19(38.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	
Anti-histamine	No	16(84.2)	23(82.1)	3(100.0)	42(84.0)	1
	Yes	3(15.8)	5(17.9)	0(0.0)	8(16.0)	
Total		19(100.0)	28(100.0)	3(100.0)	50(100.0)	

Table 5. Relationship between serum potassium level and medications used for asthma exacerbation.

Medication in asthma exacerbation		Serum potassium level		Total	P-value
		Normal	Low		
SABA	No	5(71.4)	24(55.8)	29(58.0)	0.68
	Yes	2(28.6)	19(44.2)	21(42.0)	
Total		7(100.0)	43(100.0)	50(100.0)	
LABA	No	7(100.0)	40(93.0)	47(94.0)	1
	Yes	0(0.0)	3(7.0)	3(6.0)	
Total		7(100.0)	43(100.0)	50(100.0)	
Steroid Inhaler	No	7(100.0)	41(95.3)	48(96.0)	1
	Yes	0(0.0)	2(4.7)	2(4.0)	

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Total		7(100.0)	43(100.0)	50(100.0)	
Steroid LABA	No	1(14.3)	19(44.2)	20(40.0)	0.22
	Yes	6(85.7)	24(55.8)	30(60.0)	
Total		7(100.0)	43(100.0)	50(100.0)	
Aminophylline	No	2(28.6)	21(48.8)	23(46.0)	0.43
	Yes	5(71.4)	22(51.2)	27(54.0)	
Total		7(100.0)	43(100.0)	50(100.0)	
Oral steroid	No	0(0.0)	18(41.9)	18(36.0)	0.04
	Yes	7(100.0)	25(58.1)	32(64.0)	
Total		7(100.0)	43(100.0)	50(100.0)	
Montilokast	No	4(57.1)	27(62.8)	31(62.0)	1
	Yes	3(42.9)	16(37.2)	19(38.0)	
Total		7(100.0)	43(100.0)	50(100.0)	
Anti-histamine	No	6(85.7)	36(83.7)	42(84.0)	1
	Yes	1(14.3)	7(16.3)	8(16.0)	
Total		7(100.0)	43(100.0)	50(100.0)	

Table 6. Relationship between serum magnesium level and medications used for asthma exacerbation.

Medication in asthma exacerbation		**Serum magnesium level**		**Total**	**P-value**
		Low	Normal		
SABA	No	16(69.6)	14(51.9)	30(60.0)	0.20#
	Yes	7(30.4)	13(48.1)	20(40.0)	
Total		23(100.0)	27(100.0)	50(100.0)	
LABA	No	29(93.5)	18(94.7)	47(94.0)	1
	Yes	2(8.7)	1(5.3)	3(6.0)	
Total		31(100.0)	19(100.0)	50(100.0)	
Steroid Inhaler	No	21(91.3)	24(88.9)	45(90.0)	1,00
	Yes	1(8.7)	3(11.1)	5(10.0)	
Total		23(100.0)	27(100.0)	50(100.0)	
Steroid LABA	No	6(26.1)	18(66.7)	24(48.0)	0.15#
	Yes	17(73.9)	15(55.6)	32(64.0)	
Total		23(100.0)	27(100.0)	50(100.0)	
Aminophylline	No	6(26.1)	18(66.7)	24(48.0)	0.00#
	Yes	17(73.9)	9(33.3)	26(52.0)	
Total		23(100.0)	27(100.0)	50(100.0)	
Montelukast	No	3(13.0)	13(48.1)	16(32.0)	0.01#
	Yes	20(87.0)	14(51.9)	34(68.0)	
Total		23(100.0)	27(100.0)	50(100.0)	
Oral steroid	No	17(73.9)	21(77.8)	38(76.0)	0.75#
	Yes	6(26.1)	6(22.2)	12(24.0)	
Total		23(100.0)	27(100.0)	50(100.0)	
Anti-histamine	No	20(87.0)	20(74.1)	40(80.0)	,0.31
	Yes	3(13.0)	7(25.9)	10(20.0)	
Total		23(100.0)	27(100.0)	50(100.0)	

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Table 7. Relationship between serum calcium level and medications used for asthma exacerbation.

Medication in asthma exacerbation		Serum calcium level		Total	P-value
		Low	Normal		
SABA	No	27(61.4)	2(33.3)	29(58.0)	0.22
	Yes	17(38.6)	4(66.7)	21(42.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
LABA	No	42(95.5)	5(83.3)	47(94.0)	0.32
	Yes	2(4.5)	1(16.7)	3(6.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
Steroid Inhaler	No	43(97.7)	5(83.3)	48(96.0)	0.23
	Yes	1(2.3)	1(16.7)	2(4.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
Steroid LABA	No	15(34.1)	5(83.3)	20(40.0)	0.03
	Yes	29(65.9)	1(16.7)	30(60.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
Aminophylline	No	20(45.5)	3(50.0)	23(46.0)	1
	Yes	24(54.5)	3(50.0)	27(54.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
Montelukast	No	13(29.5)	5(83.3)	18(36.0)	0.02
	Yes	31(70.5)	1(16.7)	32(64.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
Oral steroid	No	28(63.6)	3(50.0)	31(62.0)	0.66
	Yes	16(36.4)	3(50.0)	19(38.0)	
Total		44(100.0)	6(100.0)	50(100.0)	
Anti-histamine	No	37(84.1)	5(83.3)	42(84.0)	1
	Yes	7(15.9)	1(16.7)	8(16.0)	
Total		44(100.0)	6(100.0)	50(100.0)	