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The Relation between Serum Magnesium Level and Acute Exacerbation of Asthma in Children Admitted to Rapareen Teaching Hospital in Erbil city

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Abstract

Background and objectives: Asthma is a common disease caused by chronic information and increased responsiveness of pulmonary airways with airflow obstruction. Magnesium in extracellular fluid is crucial for normal neuromuscular activities, and its deficiency is associated with increased contractility of smooth muscle cells including bronchiolar wall leading to bronchospasm. The aim of this study is to detect the prevalence of hypomagnesemia among asthmatic children and to find out any significant correlation of hypomagnesemia with asthma in children. **Methods:** A case control study performed in Erbil city, from January 2017 to January 2018. One hundred asthmatic patients aged (3-13) years were examined, all of them had acute asthmatic attacks with respiratory distress for which they were admitted to (Rapareen Pediatric Teaching Hospital). The control group included 100 healthy non asthmatic children who visited the hospital with their parents. Blood samples were taken to measure serum magnesium level. Statistical analysis performed by statistical package for the social sciences (SPSS19). **Results:** the mean serum magnesium in patients group was (1.91± 0.33) mg/dl and it was significantly lower than control group it (2.03± 0.33) mg/dl. Serum magnesium level decreased with increasing severity of asthma symptoms. **Conclusions:** Serum magnesium level is significantly lower in asthmatic children as compared to the control group, serum magnesium level decreased as the duration of asthma is longer but not significantly, there was an inverse relation between serum magnesium and the severity of asthma, no significant change in its serum level was found when steroids and bronchodilators are used.

Keywords: Serum magnesium; Childhood asthma; Erbil city

Introduction

Asthma is an increasingly common disease over the last century. It is caused by chronic inflammation of lung airways with increased airway responsiveness and airflow obstruction. In the last decades, its prevalence has been markedly increased especially in western countries.

The rise in asthma and allergic diseases among children is a matter of worldwide concern[1]. Many authors have argued that the changes in diet may have been an important determinant of increased susceptibility to asthma[2]. Magnesium [Mg] is the fourth most common cation in the body and the major intracellular divalent cation. Magnesium in extracellular fluid is crucial for normal neuromuscular activities; intracellular magnesium forms a key complex with ATP and is an important cofactor for a wide range of enzymes, transporters, and nucleic acids needed for normal cellular function, replication, and energy metabolism. Total body magnesium is about 25 g (1000 mmol). About 50% of which is in the bones, just 1% of body Mg is present in the fluid outside cells, and the rest is within the cells. Albumin binds around 30% of the magnesium in the serum. Magnesium has several actions on rabbit bronchial airways including relaxation of airway smooth muscle, bronchodilation, anticholinergic effects, and stabilization of mast cells[3]. Since magnesium intervenes in calcium transport mechanisms and intracellular phosphorylation reactions, it constitutes an important determinant of the contraction and relaxation state of bronchial smooth muscle[4]. Deficiency of Magnesium is associated with increased contractility of smooth muscle cells. Since contractility of bronchial smooth muscle is important in patients with asthma, magnesium deficiency could lead to bronchial smooth muscle contraction or lack of bronchial muscle relaxation.

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Magnesium deficiency exerts significant effects on asthma and its clinical presentations so that hypomagnesaemia increases hospitalization[5].

Magnesium [Mg] stabilizes mast cell which is important in airway responsiveness to allergic stimuli; so its deficiency results in bronchoconstriction as a result of increasing airway hyper responsiveness by increasing acetylcholine production at cholinergic nerve ending; thereby improving pulmonary functions[6]. Although the cause of hypomagnesaemia in patients with chronic asthma was unknown[7], it may be related to either low magnesium intake in asthmatics or increased loss of magnesium in urine.

There are lower levels of serum magnesium in asthmatic children than normal children according to some studies. While in other case-control studies showed no significant difference in serum magnesium between patients with asthma and controls. Intravenous infusion of magnesium sulfate has been found to have a beneficial response in lung function tests while treating acute exacerbation of asthma in several studies[8]. Although clinical trials using magnesium as an adjunct to treating asthma exacerbation have been conducted in children, no work has yet been done to determine whether serum magnesium levels in asthmatic children differ from those of controls and whether asthma exacerbation in children is associated with low serum magnesium levels. We conducted this study to detect the prevalence of hypomagnesaemia among asthmatic children and to show any significant correlation of hypomagnesaemia with asthma in children.

Patients and methods

A case control study conducted in Erbil city, Kurdistan region, north Iraq within the period between January1st 2017 and January1st 2018. One hundred asthmatic patients their age range between 3 and 13 years were studied. The participants were those who suffered from acute attacks for which they were admitted to (Rapareen Pediatric Teaching Hospital) to receive treatment.

The patients had positive history of asthma, and features of respiratory distress. Some had history of treatment with controller long acting inhaled bronchodilators and others have been treated with controller inhaled steroids. Some of them were not on any of these medications and were treated for the acute attacks only. Diagnosis of asthma and its severity was identified based on the Global Initiative for Asthma (GINA) guideline criteria9 that classifies asthma severity by clinical features before treatment into:1-intermittent , 2-mild persistent, 3-moderate persistent and 4-severe persistent .

Exclusion criteria in this study were any patient with localized wheezing, dehydration, fever, pneumonia, renal, hepatic or cardiac dysfunction.

The cases were all studied according to age, gender, duration of asthma, drugs used for treatment, severity of asthma and the patients, growth as measured by body mass index. Control group included 100 children who were healthy non asthmatic and visited the hospital with their parents.

A written consent was obtained from parents of both patients and controls. The study was approved by the Ethical Committee in (Kurdistan Board for Medical Specialties). Venous blood samples were taken under standard conditions in order to measure the serum magnesium levels and immediately sent to laboratory before administration of any medication. Samples were centrifuged and the extracted serum samples were analyzed with atomic absorption spectrophotometry (cobas C) to measure serum magnesium level. Serum level of <1.5 mg/dl was considered as hypomagnesemia.

Statistical analysis was performed by using the SPSS and type of the test is Chi-sequare. Mean, standard deviation and p-values of both groups were measured for comparison of serum magnesium levels between patients and controls and to assess the significance of the variables above in affecting serum magnesium level among patients.

Results

Male gender predominated in both case and control groups (68 % and 61% respectively) and the most common age among cases was (3- 5) years representing 62%. While among controls; the age group (5-10) years was the most common, representing 36% as shown in Table 1. Serum magnesium level decreases by the increase in the duration of asthma attack but this is not statistically significant (p value =0.1).

Table (1): Age and gender distribution of asthmatic patients and controls

Age (years)	Asthmatic patients No. (%)			Control Group No. (%)		
	Total	Male	Female	Total	Male	Female
3 - 5 years	62(62%)	43(43%)	19(19%)	39 (39%)	27(27%)	12(12%)
5 - 10 years	29(29%)	19(19%)	10(10%)	36(36%)	19(19%)	17(17%)
10-13 years	9(9%)	6(6%)	3(3%)	25(25%)	15(15%)	10(10%)

Hypomagnesemia was found in 9(9%) of patients and in 1 (1%) of controls. Serum magnesium levels were lower in the asthmatic patients as compared to the control and this was statistically significant (p value is 0.01) as shown in Tables 2 and 3.

Table (2): Mean Serum Magnesium levels in Asthmatic and control group.

Groups	No. (%)	Serum Mg level (mg/dl) Mean (±SD.)	p-value
Asthmatic patient	100	1.91± 0.33	0.01
Control group	100	2.03±0.33	0.01

Table (3): Serum Magnesium level in both Asthmatic and control group.

Serum Magnesium	Asthmatic patients	Control group	Total
Low S. Mg (<1.5 µg/dl)	9(9%)	1(1%)	10(5%)
Normal S. Mg (1.5-2.3 mg/dL)	91(91%)	99(99%)	190(95%)

X2=8.36, df=2, P=0.01

Serum magnesium level was found to be not significantly related to the body mass index of asthmatic patients (p value= 0.3), though the overweight patients had the lowest level. Serum magnesium level decreased with increasing severity of asthma symptoms with (p value=0.05) as shown in Table 4.

Table (4): Comparison between mean Serum Magnesium levels and the severity of the asthma attack.

Severity of Asthma	No. (%)	Serum Mg level (mg/dl) Mean (±SD.)	p-value
Intermittent	67(67%)	1.96±0.33	
Mild persistent	20 (20%)	1.85±0.26	
Moderate persistent	10 (10%)	1.79±0.42	0.05
Severe persistent	3(3%)	1.50±0.10	
Total	**100 (100%)**	**1.91±0.33**	

Serum magnesium level is slightly higher in those asthmatic patients who were on inhaled steroids than those who were not. Also those who used long acting inhaled bronchodilators had a bit higher serum magnesium level than those who did not used them with no clinical significance as shown in Table 5.

Table (5): Comparison between mean Serum Magnesium levels & use of medications (controller) in Asthmatics

Drugs	No. (%)	Serum Mg level (mg/dl) Mean (±SD.)	p-value
Steroid as controller medications			
Used steroid	20 (20%)	1.92±0.37	0.7
Not used steroid	80 (80%)	1.90±0.30	
Bronchodilators as controller medications			
Used	31 (31%)	1.91±0.34	0.9
Not used	59 (59%)	1.90±0.31	
Total	**100(100%)**	**1.91±0.33**	

Discussion

In this study serum magnesium level was found to be significantly lower in asthmatic children as compared to the control group. The mean serum magnesium level in the asthmatics was 1.91± 0.33 mg/dl while in the control group it was 2.03± 0.33 mg/dl, this shows that serum Magnesium values in asthmatic group were significantly lower than the controls. Hypomagnesemia in this study was present in 9% of the subjects; while Agin[6] and Almoudi[7] found hypomagnesemia in 40.5% and 26.9% this is much higher than our study. Lia[10] and Picado[11] have found no significant difference in serum level between

asthmatics and controls but the intracellular magnesium in erythrocytes to be lower in asthmatics.

This finding may be of a therapeutic benefit. It suggests that magnesium supplementation for asthmatic patients may improve the clinical condition as suggested by Hill[12]. Medications used in treatment of asthma include anti-inflammatory agents as glucocorticoid and bronchodilator agents as beta-2 agonists. Long term use of these drugs by the patients may cause depletion of Mg through urinary excretion and intracellular shift[13]. Studies have shown no effect of the regular daily controller inhaled beta-2 agonists and glucocorticoid steroids asthmatic therapy on Mg status[13, 14]. Similar result was found in our study where the use of controller medication do not lower Mg level in the serum of asthmatics but rather the level was found eventually higher in those on controller therapy while many other studies have shown significant lowering of serum Magnesium with the use of such medications[3, 9, 15,16] . This is possibly explained by the poor compliance of our patients with use of these controller medications.

The serum magnesium in this study inversely correlates with the duration of asthma but this is statistically not significant. Similar result was found in a study by Pellegrino et al[17]; this may be due to a multifactorial nature of the cause of hypomagnesemia in asthma. The body weight and the body mass index are not significantly related to serum magnesium. Similar results were found in other studies[18-20] and this can preclude any direct role of nutritional status as a determinant of the magnesium in the body. There is inverse correlation between serum magnesium and severity of asthma. Similar results were also seen in other studies[3,21,22] that prove the role of magnesium deficiency in potentiating bronchial smooth muscles contractility. Unlike that, two other studies had been performed but could not find such a correlation[23, 24].

Conclusions

In regard to the findings in this study, we can conclude that there is significant lower level of Serum magnesium in asthmatic children as compared to the control group, and there is an inverse relation between serum Magesium and the severity of asthma, and Serum magnesium level inversely correlates with the duration of asthma but not significantly. Lastly; there is no significant change in serum magnesium level with the use of steroids and bronchodilators or asthma controllers in treatment of asthma.

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