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Comparison of serum magnesium level between asthmatic and healthy children

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ABSTRACT

Background and Objective: Hypomagnesemia can lead to bronchial smooth muscle contraction and is associated with wheezeing, airway hyperactivity and impairment of lung function. The aim of this study was to compare serum magnesium levels between asthmatic and healthy children.

Methods: This case-control study was performed from September 2018 to February 2019. Totally, 125 children (78 asthmatic and 47 healthy non-asthmatic children) aged 3-14 years referred to Amirkola Children's Hospital in Iran were entered to the study. Sampling was done using the available method based on inclusion criteria. Serum magnesium levels were measured in all children in the laboratory of Amirkola Children's Hospital. P<0.05 was considered a significant level.

Findings: The mean age of children was 81.21±35.45 months, among them, 77 (61.6%) and 48 (38.4%) were male and female, respectively. The mean serum magnesium level of children was 2.08 and 2.04 mg/dl in the control and asthma groups, respectively and there was no statistically significant difference between the two groups (p=0.49).

Conclusion: Based on the findings of this study, there is no significant difference between serum magnesium levels in asthmatic patients and the control group and it is not necessary to routinely measure magnesium levels in these patients.

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Introduction

Asthma is a chronic inflammatory disease of the airways that causes intermittent and periodic obstruction of airflow [1]. Asthma is one of the most common chronic diseases of childhood [2]. Approximately 7 million children <18 years have asthma in the United States [3, 4]. Reports have shown that in 2020, asthma is the leading cause of death among children [5]. According to recent studies, the prevalence of asthma symptoms in children and adolescents is about 12 % in Iran [6].

Pathophysiology of this disease involves a combination of obstructive processes including mucosal edema, bronchospasm and mucosal obstruction [7]. Contraction of the bronchial smooth muscle leads to narrowing of the airway and smooth muscle, results in bronchitis by narrows the airway, and also smooth muscle leads to bronchitis by secreting inflammatory mediators and activating inflammatory cells [8, 9]. Inflammation of the airways is the most common finding in all patients with asthma [10]. Chronic inflammation can lead to irreversible changes in the airways and progressive decline of lung function [3].

Magnesium is one of the main intracellular cations and plays an important role in regulating contraction and bronchial smooth muscle hyperresponsiveness [11]. Hypomagnesemia can lead to bronchial smooth muscle contraction [12] and is associated with wheeze, airway hyperreactivity and impairment of lung function [13]. Moreover, magnesium has anticholinergic, anti-inflammatory, mast cell-stabilizing, antioxidant and bronchodilator effects [14- 16].

Intravenous magnesium sulfate is used to treat moderate to severe asthma attacks in children and adults who do not respond well to initial treatment with bronchodilators and systemic steroids [17, 18]. Magnesium reduces bronchospasm by relaxing the smooth muscles of the bronchi, which ultimately declines asthma attacks [13, 19].

Several studies have been performed to determine the serum level of magnesium and prevalence of hypomagnesemia and its relationship with the severity of disease and control of symptoms in patients with asthma [2, 11, 14, 16].

Most of these studies have been conducted on the adult population and also the results of these studies were contradictory: In Iran, limited studies have been conducted in this field. The aim of this study was to compare serum magnesium levels between asthmatic and healthy children.

Methods

Study design and participant

This case-control study was performed from September to February 2019. Children with asthma referred to the Emergency Department and Lung Clinic of Amirkola Children's Hospital in Iran were included in the study as a case group. Healthy children without asthma, referred to the Endocrinology Clinic of Amirkola Children's Hospital for growth monitoring at the same time were considered as a control group.

Sampling and sample size

Sampling was done using the available method based on inclusion criteria. These criteria in the case and control groups were children aged 3-14 years, on the other hand, children with heart, kidney and metabolic disorders, patients receiving magnesium-containing drugs, and patients with malnutrition were not included in the study. Exclusion criteria were non-cooperation of parents or children to continue in the study .

The sample size was taken based on the Altman nomogram with 95% confidence, test with 80% power and standardized difference of 0.85. The number of samples for each group was estimated to be 40 individuals. Totally, 80 patients in the asthma group (40 patients with an acute asthma attack and 40 patients with stable asthma), as well as 40 healthy non-asthmatic children in the control group were selected through convenience sampling.

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Data collection

Generally, 125 children (78 asthmatic and 47 healthy non-asthmatic children) aged 3-14 years, referred to Amirkola Children's Hospital were entered the study. The diagnosis of asthma in children was made by the pediatric pulmonologist or immunology and allergy specialist based on the GINA 2018 guideline [20].

Given that, it seems the level of serum magnesium to be different between children with an asthma attack and with stable asthma; therefore, the asthmatic patients were divided into two groups in the current study.

Group 1 included 40 asthmatic patients, hospitalized in the Emergency, Pulmonology, or Allergy-Immunology Divisions due to an acute asthma attack (periods of increased symptoms including shortness of breath, cough and wheezing that indicated a change in the patient's usual condition and needed to change the treatment). Group 2 was 38 asthmatic children treated with control medications, whose asthma was stable (they had no acute asthma attack in the last 6 weeks).

The control group consisted of 47 healthy non-asthmatic children, referred to the Endocrinology Clinic of Amirkola Children's Hospital for routine examination and growth monitoring. They had normal physical examinations and normal laboratory results which are measured for growth assessment.

For assessment of Serum magnesium levels, 2 cc of intravenous blood was taken from all children in the present study. Serum magnesium levels were measured using an Audit Mg2 + Biochemical Autoanalyzer made in China in the laboratory of Amirkola Children's Hospital. The normal range of magnesium was 1.7-2.4 mg/dl [21].

Demographic (age, sex) and disease information (the duration of asthma diagnosis, number of hospitalizations due to the asthma attack during the last year and patient's current treatment) were recorded in the patient's information registration form.

Data analysis

Data were analyzed using SPSS-18. Chi-square, Mann Whitney, Kruskal Wallis and Spearman tests were used, too. $P<0.05$ was considered a significant level.

Results

In total, 125 children 47 (37.6%) as a control group and 78 (62.4%) as an asthmatic group) were entered into the current study. Out of 78 asthmatic patients, 38 (48.7%) and 40 (51.3%) children had stable asthma and asthma attacks, respectively.

Among them, 77 (61.6%) and 48 (38.4%) were male and female, respectively. The mean age of children was 81.21±35.45 months (min: 36, max: 162 months).

The mean age of children was 85.53, 76.42 and 80.70 months in the control, stable asthma and asthma attack groups, respectively. There was no significant difference between age (p= 0.70) and gender (p=0.62) among different study groups.

The mean serum magnesium level of children was 2.08, 2.07 and 2.01 mg/dl in the control, stable asthma and asthma attack groups, respectively and There was no statistically significant difference between the three groups (p=0.29), (table 2). Moreover, evaluation of serum magnesium levels between groups in pairs showed that no significant difference was observed between control and stable asthma groups (p=0.65), control and asthma attack groups (p=0.09) as well as stable asthma group and asthma attack group (P=0.42).

In the present study, the correlation between quantitative variables was analyzed using Spearman's test. In the stable asthma group, the duration of asthma diagnosis did not have a significant negative correlation with serum magnesium levels (r=-0.080 and p=0.60) and There was no significant positive correlation between hospitalization frequency and serum magnesium level (r=0.020 and p=0.88). Also in the asthma attack group, the duration of diagnosis of asthma did not have a significant negative correlation with serum magnesium level (r= -0.160 and p = 0.31) and the number of hospitalizations did not have a significant positive correlation with serum magnesium level (r=0.002 and p=0.98).

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Table 1. Comparison of children's gender and age between three study groups

Groups / Variable	Control group	Stable asthma group	Asthma attack group	P-value
Gender (male)	27	23	27	0.62
Age (month) (M±SD)*	85.53±41.63	32.25±76.42	30.31±80.70	0.70

* Mean±Standard Deviation

Table 2 Comparison of Serum magnesium level between three groups

Variable / Groups	Serum magnesium level (mg/dl)			P-value
	N	Mean	SD	
Stable asthma group	47	2.07	0.16	0.29
Asthma attack group	38	2.01	0.12	
Control group	40	2.08	0.20	

Discussion

The results of the study showed that there is no difference between serum magnesium levels in children with asthma attacks, stable asthma and healthy children. The results of the ongoing study were in line with those of Chitamanni et al. from India [16], Sein et al. from Malaysia [11] and Kakish et al. from Jordan [12].

Chitamanni et al., evaluated the serum magnesium levels and their association with symptom control were in 6-12-year-old children with mild persistent asthma. In their study, there was no relationship between serum magnesium levels and control of asthma symptoms [16]. Sein et al. in a study on 100 asthmatic children aged 6-12 years concluded that intracellular magnesium level was not significantly related to disease duration, symptom control levels, peak expiratory flow rate (PEFR) and current asthma treatment [11]. In addition, Kakish et al. studied on 500 subjects aged 6-18 year. Their study group was divided into three groups: asthma attack (n=174), stable asthma (n=94) and control (n=232). Moreover, their serum magnesium levels were measured. The results of their study demonstrated that the serum magnesium level in asthmatic patients during the attack and in patients with stable asthma was not significantly different, compared to the control group [12].

On the other hand, the results of some other researches such as Hatipoğlu et al. [2] and Sedighi et al. [22] were inconsistent with the results of the present study. Hatipoğlu et al. performed a study on 150 patients aged 5-17 years, in 2014 in Turkey. They measured the serum magnesium level was assessed in 50 patients with acute asthma attacks, 50 patients treated for stable asthma and 50 patients referred for reasons other than asthma. Their study represented that the serum magnesium level was significantly lower in the group of patients with asthma attacks, compared to the groups of patients with stable asthma and non-asthmatic patients (2). A study was carried out by Sedighi et al. (2006) in Iran on 63 children aged 2-11 years children (29 cases with acute asthma attacks and 34 non-asthmatic children). They found that intracellular magnesium level was lower in children with acute asthma attacks than in non-asthmatic children [22]. This difference may be due to that Sedighi et al. evaluated intracellular magnesium levels while the present study assessed serum magnesium levels [23].

In the studies of Killic et al. in 2018 [24] and Sopnajothi et al. in 2017 [25] on adults, there was an association between hypomagnesemia and lower pulmonary function test parameters and prognostic outcomes in patients with chronic asthma. Hashimoto et al.'s study revealed that lower magnesium intake was associated with increased airway reactivity and that patients with acute asthma often had lower levels of serum magnesium [26], compared to healthy individuals [25]. Differences in age groups of the study subjects could explain the difference between the results of their study and the present study.

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Limitation

In this study, serum magnesium levels were measured; while measuring intracellular magnesium along with serum levels leads to more accurate results. Also in the present study, the number of children with asthma attacks was limited, so it was not possible to divide the patients with asthma attacks into groups with mild, moderate and severe attacks.

Conclusion

Based on the findings of the present study, there was no significant difference between serum magnesium levels between asthmatic children (stable asthma or asthma attack) and healthy control. So, it does not seem necessary to measure serum magnesium levels or take magnesium supplements routinely in asthmatic patients. However, further studies are needed.

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Ethical Code

The importance of the project was explained to all children or their parents, and the written consent was obtained from all of them. This study was also approved by the Ethics Committee of Babol University of Medical Sciences with the ethical code of IR.MUBABOL.HRI.1398.223.

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Conflict of interest

The authors declare that there is no conflict of interest.

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