ASSESSMENT OF SERUM MAGNESIUM LEVELS IN PATIENTS WITH ACUTE SEVERE BRONCHIAL ASTHMA ADMITTED IN A TERTIARY CARE HOSPITAL

AHSAN R[1], ISLAM MK[2], ISLAM MM[3], GOMES LC [4], RAHMAN F[5], AHMAD MM[6]

Abstract

Background: *Hypomagnesaemia has been associated with diminished respiratory muscle power, which maintains the work of breathing. However, the effect of magnesium on asthma has yet to be examined in our country. Therefore, assessing the serum magnesium level in acute severe asthma patients in a tertiary-level hospital was the study's objective.*

Methods: *The study was a hospital-based descriptive cross-sectional study conducted at the Department of Medicine and Department of Respiratory Medicine in DMCH. Each patient performed serum magnesium ion (Mg2+) during admission with other necessary investigations.*

Results: *Fifty-seven percent of participants had hypomagnesemia, and 43% of patients had normal magnesium levels. Mean serum magnesium was 1.57±0.22 mg/dl [range: 1.25-2.23 ng/dl]. Although a higher proportion of patients with severe attacks (64.8%) had hypomagnesemia than those who had moderate-severity attacks (47.8%), the difference is not statistically significant (p >0.05). About 23% of patients stayed at the hospital for >3 days; among them, 73.9% had hypomagnesemia. Hypomagnesaemia patients had higher odds of staying at the hospital for >3 days, but the relation is not statistically significant (OR 2.62, 95% CI 0.93 -7.36, p >0.05).*

Conclusion: *Hypomagnesaemia is present in half of the patients with acute severe bronchial asthma and is not associated with the severity of the disease and duration of hospital stay.*

Introduction:

Bronchial Asthma is characterized by airway inflammation and hyperreactivity of the tracheobronchial tree[1], which leads to recurrent wheezing, dyspnoea, chest tightness, and coughing. Symptom episodes are generally associated with widespread but variable airflow obstruction within the lungs, usually reversible spontaneously or with appropriate asthma treatment.[1]

Studies show that bronchial asthma affects people of all races and ethnic groups worldwide, from infancy to age. About 300 million are affected worldwide.

Despite the persistently high prevalence of disease, the most recently available data indicate improved outcomes decreased the necessity of hospitalizations for asthmatic attacks and fewer asthma-related deaths.[3]

Asthma is associated with atopy, various allergic and non-allergic triggers that produce a cascade of immune-mediated events leading to chronic airway inflammation and immunoglobulin E (IgE) production by mast cells. All of that

1. Dr Ragib Ahsan, Medical officer, Dhaka Medical College Hospital. E-mail: ragibahsan84@gmail.com
2. Dr Md Khairul Islam, Junior consultant medicine, Dhaka medical college hospital
3. Dr Md. Maidul Islam, Registrar medicine department , Dhaka Medical College Hospital, Dhaka
4. Dr Lilian Catherene Gomes, Medical officer, Department of Physical Medicine and Rehabilitation, BSMMU, Dhaka
5. Dr Farzana Rahman, Assistant professor, Dhaka medical college hospital
6. Prof. (Dr.) Md. Mohiuddin Ahmad, Department of Respiratory Medicine, Dhaka Medical College& Hospital

Correspondence : Md Khairul Islam, Junior consultant medicine, Dhaka medical college Hospital. Phone: 01717696207, Khairul0696207@gmail.com

cytokines trigger the release of inflammatory mediators, such as histamine, that cause bronchospasm, edema, and mucous hypersecretion, leading to the characteristic symptoms of asthma.[4] Evidence suggests that there may be a genetic predisposition for the development of asthma.[5]

Besides those triggers mentioned above for tracheobronchial obstruction, Magnesium is another neglected element.

Magnesium deficiency often leads to airway hyper-reactivity that provokes broncho-constriction, particularly in Asthma patients.[6,7,8,9] Magnesium is essential in regulating bronchial tone, inhibits intracellular Ca++ release[10], and is often associated with airway hypersensitivity.[11] Moreover, they stabilize mast cells and smooth muscle[12,13] and cause wheeze manifestation and lung function impairment.[14]

Study shows magnesium deficiency in asthma occurs due to multifactorial causes, ranging from genetically determined syndromes 15 to some acquired factors like low magnesium intake in asthma individual or increased urinary loss of Magnesium as a side-effect of therapy with ß2 -agonist, corticosteroid, and theo-phylline.[16, 17,9]

Magnesium is an essential microelement of the human body. Only 0.3% of total body Mg exists in serum.[10] It is the fourth most abundant ion in the human body, of which 50% is stored in the bones, 49% in cells, and the remaining 1% in the serum. It is involved in the structure of many enzymes in the body and plays a role in intracellular reactions. It is used in acute severe asthma attacks owing to its bronchodilator effect by reversing bronchospasm.[18]

Some studies suggested a 40% magnesium deficiency in total body stores of asthmatic patients,[19] associated with increased wheezing and bronchial hyper-reactivity[20]. Another study has shown a high prevalence of hypomagnesemia (27%) in stable asthmatics. The study also reveals that hypomagnesemia

has a significantly higher incidence of acute asthma attacks and hospitalization.18 based on that scientific information, later studies reported improvement in bronchial responsiveness and quality of life with magnesium therapy in adults.[21,22]

However, some studies found Mg levels low in these patients, and some did not corroborate these findings18. Such a study is not much in the research era in Bangladesh, so it is crucial to find out the relationship between serum magnesium levels and asthma status in our setting.

Methodology:
This cross-sectional observational study was conducted at the Department of Medicine & Department of Respiratory Medicine in Dhaka Medical College Hospital from September 2017 to March 2018.

The study aims
To assess serum magnesium levels in acute severe asthma patients admitted to a tertiary-level hospital.

Sampling Method:
We used a convenient Purposive sampling method, and our study included those older than 18 years with acute severe bronchial asthma admitted to Dhaka medical college hospital. A total of 100 cases were enrolled. Previous good documentation about the Diagnosis of bronchial asthma was considered for inclusion as bronchial asthma, and in case of lacking documentation, we performed spirometry. We included asthma patients aged >18 who attended the outpatient and emergency departments. We diagnosed asthma based on symptoms and spirometry evaluation depicting reversible airflow obstruction (postbro-nchodilator forced expiratory volume in the 1st s (FEV1) >12% and 200 ml). We excluded pregnant women, alcoholics, those on diuretics, having diarrhea, smokers, and those who underwent gastric resection or abdominal surgery. Respiratory distress due to other

diseases were excluded from history, examinations, and appropriate lab tests. In addition, pregnant ladies or multiple co-existing respiratory diseases, Bronchogenic, heart failure, or carcinoma, were excluded.

Acute severe asthma was defined[22] as "asthma which requires treatment with high dose inhaled corticosteroids (ICS) plus a second controller (and systemic CS) to prevent it from becoming "uncontrolled" or which remains "uncontrolled "despite this therapy" and diagnosed by following criteria:

- PEF 33-50% predicted (<200ml/min)
- Respiratory rate ≥25 breaths/min
- Heart rate ≥110 beats/min
- Inability to complete one sentence in 1 breath

Normal serum magnesium[23] level was considered between 0.75-1 mmol/L or 1.82-2.43mg/dl. Less than 0.75 mmol/L was considered hypomagnesemia. Diagnosed hypomagnesemia due to another disease, either primary or secondary causes, was excluded from our study.

2.4 Data collection:

The emergency medical officer diagnosed patients attending the medicine and respiratory medicine department of DMCH with bronchial asthma, and a dedicated physician then treated the patients. He reviewed his file about the documentation of the disease regarding the duration of the disease, exacerbating factors, and co-morbid illness and assessed the disease severity. After the primary selection of the patients according to the inclusion and exclusion criteria, we took the informed written consent. Next, a face-to-face interview was conducted using a semi-structured questionnaire containing socio-demographic parameters and other relevant investigations. After resuscitation and initial management, we requested them to perform serum magnesium levels. With all aseptic precautions, 5 ml of venous blood was collected by a sterile disposable syringe after cleaning the puncture area of the skin with 2% iodine and 70% alcohol. Collected blood was then labeled and sent to the biochemistry lab of DMCH for estimation of serum magnesium level.

Methods of data processing and statistical analysis:

After collecting all the required data, these were checked, verified for consistency, and tabulated into the computer using the SPSS/PC 22 software. Statistical significance was set at <0.05.

Patients' characteristics were reported as percentages or mean ± standard deviation. We determined the association of serum magnesium level with the severity of an acute attack of asthma with a chi-square test. Moreover, univariate logistic regression was done to find the association between a hospital stay and serum magnesium level. Differences were considered significant at the P<0.05 level for all these tests.

2.6 Ethical measures: the Institutional ethical review committee of DMCH approved the protocol. In all cases, informed written consent from the patients was taken following describing the study's aim, objectives, and purpose. They had the right to withdraw from the study whenever they wanted and were ensured their information would be kept confidential. Researcher himself did all physical examinations and took history regarding drugs use, particularly the use of drugs and their types. The interview was in less than 30 minutes in duration. Patients unwilling to participate in the study were excluded, and new patients were included to fill the total sample population.

Result

Most of the patients were at the age of 36-45 years (28%), and male were more affected by severe asthma than female.

Among all 60% came from urban area and 40% patients came from rural area.

Table I

Socio-demographic characteristics of asthma patients

Characteristics	Number	Percentage
Age		
18-25	13	13
26-35	26	26
36-45	28	28
46-55	14	14
56-65	10	10
66-75	6	6
>75	3	3
Sex		
Male	45	45
Female	55	
Religion		
Islam	95	95
Hindu and others	5	5
Residence		
Urban	60	60
village	40	40
Married	84	84
unmarried	16	16
Occupation		
Housewife	38	38
Service holder	19	19
Student	14	14
Farmer	12	12
Businessmen	9	9
Day labour	5	5
Retired	3	3
Monthly income		
<10000	13	13
10000-20000	37	37
20000-40000	29	29
>40000	21	21
Smoker	11	11
Ex-smoker	5	5
Non-smoker	84	84

Forty two percent patients used inhaled short acting bronchodilator regularly, 38% used irregularly and 20% never used. Table II

Table-II

Drug history of patients (n=100)

Drug	Percentage
Inhaler	
Inhaled short acting bronchodilator	
Regular	42
Irregular	38
None	20
Inhaled corticosteroid	
Regular	5
Irregular	17
None	78
Inhaled corticosteroid+ long acting bronchodilator	
Regular	10
Irregular	29
None	61
Oral	
Leukotriene inhibitor	50

The most common symptom was dyspnea (100%), which occurred on walking in 46% patients and on rest in 54% patients. Wheeze was the most common sign.

Table-III

Clinical presentation and duration of Asthma (n=100)

Clinical presentation	Percentage
Dyspnoea	100
On walking	46
On rest	54
Cough	32
Wheeze	100
Cyanosis	10
Use of accessory muscle of respiration	62
Cannot complete sentence in one breath	41
Respiratory rate	
< 25 breaths /min	30
≥ 25 breaths /min	70
Heart rate	
< 110 beats/min	36
≥ 110 beats/min	74
Duration of illness	
< 6month	10
6 month – 1 year	12
1 year – 5 year	22
> 5 year	56

Mean serum magnesium was 1.57±0.22 mg/dl, ranging from 1.25 ng/dl to 2.23 ng/dl. Among all 57% patients had hypomagnesaemia and 43% patients had normal magnesium level.
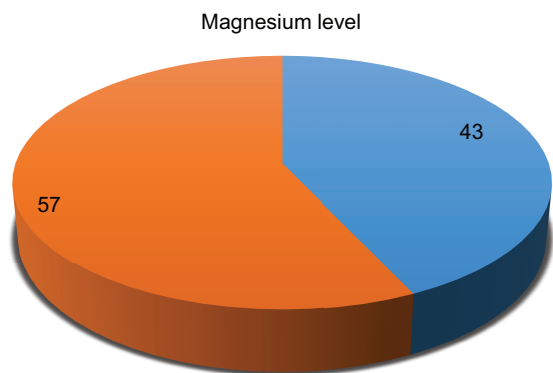
Magnesium level

Fig.-1: *Serum magnesium level of patients (n=100)*

Severity of attack was assessed clinically. Fifty four percent patients had severe attack and 46% had moderately severe attack. Higher proportion of patients with severe attack (64.8%) had hypomagnesaemia than those who had moderate severity attack (47.8%). Although, the difference was not significant (p >0.05).

Table IV

Relationship of serum magnesium level with severity of acute attack of asthma (n=100)

Serum magnesium level	Severity of Acute asthma		p value
	Moderate N (%)	Severe N (%)	
Normal	24 (52.2)	19 (35.2)	0.08
Hypomagnesaemia	22 (47.8)	35 (64.8)	

P determined by Chi-square test

Twenty three percent patients stayed at hospital for more than 3 days. Among them 73.9% had hypomagnesaemia. Univariate logistic regression analysis showed that patients who had hypomagnesaemia had higher odds (OR 2.62, 95% CI 0.93 – 7.36, p >0.05) of staying at hospital for more than 3 days.

Table-V

Univariate logistic regression for hospital duration more than 3 days (n=23)

Serum magnesium level	Duration of hospital stay ≥ 3 daysN (%)	OR (95% CI)	P value
Normal	6 (26.1%)	62 2.(0.93-7.36)	0.06
Hypomagnesaemia	17 (73.9%)		

Discussion

In clinical practice, the management of severe acute Asthma is challenging. The respiratory muscle becomes exhausted during an asthma attack, and hypo magnesia makes this situation worse. The relationship between Mg and Asthma has been well-established over the years. Among these, the most well-known association is the therapeutic utility of MgSO4 in acute severe Asthma. Mg takes part in smooth and skeletal muscle contraction and synaptic function. It has an inhibitory effect on acetylcholine secretion.

The prevalence of hypomagnesemia in Asthma is variable. Most of the asthmatic patients in our study showed hypomagnesemia. The mean serum magnesium was 1.57±0.22 mg/dl. This finding corroborates the findings of recent studies.[24] Ali and colleagues measured serum magnesium levels in chronic stable asthma patients, asthma patients with acute exacerbations, and healthy control. They found a significantly lower level of serum magnesium asthma group compared to the control (1.55±0.34 vs. 2.12±0.20 mg/dl) and a substantially lower value in the acute asthma group compared to the stable asthma group (1.37±0.24 vs. 1.74±0.33 mg/dl). In addition, Bai and colleagues found that 30% of cases with hypomagnesemia at admission with acute exacerbations dropped to 14% after 90 min with treatment.

Alamoudi 9 studied serum magnesium levels in chronic, stable asthma patients and the correlation of serum magnesium levels with the severity of Asthma. He found that severe asthma patients had a higher proportion (28%) of hypomagnesemia, although it was non-significant (p >0.05). However, on multiple

logistic regressions, it was found that severe Asthma had significantly higher odds of developing low magnesium levels (p <0.05). The present study also found a non-significant positive relationship between the severity of acute Asthma with hypomagnesemia (p >0.05). In addition, a unique finding in this study was that hypomagnesemia patients had higher odds of staying more than >3 days at the hospital (OR 2.62, 95% CI 0.93- 7.36, p >0.05) after initiation of treatment.

It is a single-centered cross-sectional study with a small sample size. It requires a case-control study with a larger sample size.

Conclusion
In this study, patients in the third-fourth decade more frequently suffered from hypo-magnesemia. So it is practical to perform serum magnesium levels in case of severe bronchial Asthma and correction; this may help the patient's early recovery.

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