Serum Magnesium Levels in Asthmatic Children During and Between Exacerbations

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Objective: To determine, if possible, whether magnesium deficiency exists in children with asthma during acute attacks and between exacerbations.

Setting: Emergency Department Clinic and Outpatient Pediatric Clinic of Jordan University of Science and Technology, Irbid.

Methods: A total of 174 known asthmatic children who presented to the emergency department in acute attack (group 1) and 94 asthmatic children who presented to outpatient clinics for follow-up of asthma (group 2) had their serum magnesium levels assayed and compared with 232 patients without asthma (controls; group 3). Exclusion criteria were history of renal disease, cardiac disease, malabsorption, diuretic use, alcoholism, and pregnancy.

Results: There were no differences between study groups, although male patients had a slightly lower level of magnesium than female patients.

Conclusion: After removing the confounder of sex, serum magnesium levels in asthmatic children during acute attacks and between exacerbations are not significantly different from those of controls.


MAGNESIUM is the fourth most abundant cation in the body and the second most common intracellular cation. 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. Magnesium deficiency 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.

Haury reported significantly lower levels of serum magnesium in asthmatic adults compared with the general population. In this study, cases were compared with healthy medical students. Other case-control studies conducted on asthmatic adults failed to demonstrate a significant difference in serum magnesium between patients with asthma and controls. Several clinical trials reported a beneficial response of pulmonary function tests to intravenous infusion of magnesium sulfate in the treatment of acute exacerbation of asthma. 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. Therefore, we undertook this study to assess whether magnesium deficiency exists in asthmatic children between attacks and during exacerbations.

RESULTS

A total of 275 asthmatic children and 245 controls were entered into the study. Of the asthmatic group, 7 were excluded for not meeting the diagnostic criteria of asthma. Thirteen of the controls were excluded for having a history of renal disease and malabsorption. Of the 268 asthmatic patients enrolled, 174 presented in acute exacerbation (group 1) and 94 presented between exacerbations (group 2).

There were no differences between the study groups for age, parental education, place of residence, and monthly income. However, there was a statistically significant difference for sex (P=.008). Serum magnesium levels were significantly lower among group 2 than the other 2 groups (Table). The influence of several patients’ characteristics (the regular use of
SUBJECTS AND METHODS

This study was conducted from June through December 1999. Patients between the ages of 6 and 18 years who presented to the emergency department with acute exacerbation of asthma (group 1) and those who presented to outpatient pediatric clinics for follow-up of asthma (>6 weeks after the last attack) (group 2) were entered into our study as long as the asthma diagnosis was made by a physician based on the criteria set by the Expert Panel Report 2.10 A sample of blood was drawn through a standard venipuncture technique and analyzed for a serum magnesium level, using spectrophotometry and calorimetric determination based on the reaction of calmagite at pH of 11 and wavelength of 520 nm (bioMerieux Vitek Inc, St Louis, Mo). Normal reference values for serum magnesium ranged from 0.66 to 1.05 mmol/L (1.60 to 2.55 mg/dL) in our laboratory. For each asthmatic patient enrolled in the study, the next available patient who visited the outpatient pediatric clinic or emergency department for reasons other than asthma was enrolled as a control, provided he/she met our admission criteria. Serum magnesium levels were also analyzed for this randomly chosen control group of nonasthmatic children (group 3) as they presented to the emergency department and the outpatient clinics for other reasons.

All determinations were made in duplicate. Informed consent was obtained from the parents or legally authorized representatives. Peak expiratory flow rate using a flowmeter (True Zone Peak Flow Meter; Trudell Medical, Quebec, Canada), respiratory rate, air exchange, wheezing, and speech production were recorded for all asthmatic children in exacerbation to assess the severity of the acute attack according to the guidelines set by the Expert Panel Report 2.10 Further data were also collected on the asthmatic groups of children, including the regular use and type of medication and the number of times they received oral corticosteroids during the last year. Data collected on all 3 study groups of children included sex, number of schooling years completed by parents, total monthly income of the family, and place of residence. Exclusion criteria for the 3 study groups included a history of renal disease, cardiac disease, malabsorption, diuretic use, alcoholism, and pregnancy.

Data were entered and analyzed using Epi Info version 6 software (Centers for Disease Control and Prevention, Atlanta, Ga). The 3 study groups were compared regarding a number of sociodemographic characteristics. Observed differences were assessed for statistical significance using the \( \chi^2 \) test. The 2-sample \( t \) test was used to assess the statistical difference between 2 means, and analysis of variance was used to assess the statistical significance between more than 2 means. Multivariate linear regression was used to assess for the difference in serum magnesium levels among the 3 study groups while adjusting for sex, the only variable that was significantly different among the 3 groups.

inhaled corticosteroids, the number of oral courses of prednisolone, the age groups of studied population, the parents’ education, the place of residence, and the total monthly income of the family) on the serum magnesium level was examined consecutively and showed no significant correlation. When the relation between sex and serum magnesium level was examined, male patients had significantly lower levels of serum magnesium than female patients \((0.91 \pm 0.14 \text{ mmol/L} [2.21 \pm 0.33 \text{ mg/dL}]) \) vs \( 0.94 \pm 0.14 \text{ mmol/L} [2.28 \pm 0.33 \text{ mg/dL}] \), \( P = .03 \). Among the group of children with acute asthma exacerbation, 75 had mild attacks, 67 had moderate attacks, and 32 had severe attacks.

A comparison of the mean magnesium levels in each respective group revealed no significant correlation between magnesium levels and pulmonary function test results.

Because the 3 study groups of children were significantly different only in regard to sex and magnesium levels (which were significantly lower among male patients), we adjusted serum magnesium levels for sex using multivariate linear regression.

The observed differences in serum magnesium levels among the 3 study groups lost their statistical significance after removing the confounding effect of sex.

COMMENT

It is not clear whether magnesium deficiency plays a role in the development of asthma, but magnesium salts have a therapeutic role as an adjunct to traditional therapy of asthma.11 One previous study reported concomitant hypomagnesemia in adults with bronchial asthma. Findings from our study demonstrated that serum magnesium levels in asthmatic children during and between exacerbations are not significantly different from those of a control group. This is consistent with findings from studies conducted on adults with asthma.2,4,6 Our study found no observed correlation between serum magnesium levels and the severity of asthma attack, consistent with results from a published study conducted in adults.4 Since all 3 study groups had serum magnesium levels generally within the normal range, serum magnesium levels are not useful for characterizing the severity of the disease or the disease exacerbation. Serum magnesium levels are also not predictive of the need for or response to magnesium infusion as an adjunct to treatment in the emergency department.
Although intravenous administration of magnesium sulfate to outpatients with asthma led to improvement in pulmonary function tests, the results of our study suggest that factors other than serum magnesium level could play a role in determining the severity of an attack, the degree of response to standard therapy, and, finally, the need for and benefit of magnesium sulfate.

No relation was found between the regular use of inhaled corticosteroids and serum magnesium level, contrary to the findings from a published study that demonstrated a small, but statistically significant, decrease in serum magnesium levels. This could be partially explained by the lower dose of corticosteroids given to children compared with adults. The relation we found between sex and serum magnesium levels has not been described previously. To my knowledge, there is no physiologic basis to suspect a sex difference in magnesium levels, since laboratory standards for magnesium have not been demonstrated to be sex specific.

In conclusion, we found no evidence for the existence of decreased magnesium level in children with asthma. These data suggest that serum magnesium level determination plays no useful role in the evaluation and management of asthmatic children during and between exacerbations.

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REFERENCES