Serum Magnesium Levels in Protein-energy Malnutrition

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Summary

Serum magnesium levels were measured by atomic absorption spectrophotometry in 46 malnourished and 12 healthy children, aged 3 months to 5 years. The nutritional status of children was classified in relation to weight for age and height for age using the Indian Academy of Pediatrics and the Waterlow classifications, respectively. NCHS data were used for the purposes of comparison. Serum magnesium levels were significantly low in children with moderate (weight for age 61-70 per cent) and severe (weight ≤60 per cent) malnutrition, and in children with marked linear growth retardation (height for age <85 per cent). Nearly half of the marasmic children had serum magnesium levels in the hypomagnesemic range (below 1.56 mg/dl). Serum magnesium levels had significant correlations with height for age and serum albumin.

Introduction

Magnesium is the second most common intracellular cation in the body and plays an essential role in numerous cellular reactions. It is involved in many enzymatic steps including the synthesis of fatty acids and proteins, the glycolytic pathway, and the formation of cyclic adenosine monophosphate (cAMP). Magnesium depletion in malnourished children may remain asymptomatic or may produce symptoms such as tremors, athetoid movements, seizures, and psychomotor changes. Deficiency of magnesium is known to compromise primary and secondary immune responses. Recently it has been demonstrated that hypomagnesemia may increase tissue susceptibility to lipid peroxidation, a process known to cause cellular injury. These observations assume considerable significance in malnourished children whose magnesium nutriture is frequently poor. Although magnesium status can be reliably assessed by balance studies, load tests, and muscle biopsy, these tests are difficult to perform and are time consuming. Because of its simplicity, the measurement of serum magnesium is a useful test to detect magnesium deficiency in routine clinical practice. The data on serum magnesium levels in malnourished children, particularly in marasmus, are conflicting. This prompted us to undertake the present study.

Materials and Methods

Forty-six malnourished children, aged 3 months to 5 years, were selected randomly from the out-patient and in-patient sections of the Department of Pediatrics, Institute of Medical Sciences, Banaras Hindu University, Varanasi, India. The nutritional status of the children was assessed in relation to weight for age and height for age using the Indian Academy of Pediatrics and Waterlow classifications, respectively. Weight was recorded to the nearest 50 g and stature to the nearest 0.1 cm. NCHS
TABLE 1
Serum levels of magnesium (mean ± SD) in relation to weight for age

<table>
<thead>
<tr>
<th>Weight for age</th>
<th>Number of children</th>
<th>Serum magnesium (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;80% (normal)</td>
<td>12</td>
<td>2.13 ± 0.14</td>
</tr>
<tr>
<td>71–80% (grade I PEM)</td>
<td>11</td>
<td>2.30 ± 0.18</td>
</tr>
<tr>
<td>61–70% (grade II PEM)</td>
<td>15</td>
<td>1.86 ± 0.22*</td>
</tr>
<tr>
<td>≤60% (grade III and IV PEM)</td>
<td>20</td>
<td>1.39 ± 0.18b</td>
</tr>
</tbody>
</table>

Relative to normal children, *p < 0.01; b p < 0.001.

TABLE 2
Serum levels of magnesium (mean ± SD) in relation to height for age

<table>
<thead>
<tr>
<th>Height for age</th>
<th>Number of children</th>
<th>Serum magnesium (mg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;95% (normal)</td>
<td>14</td>
<td>1.96 ± 0.25</td>
</tr>
<tr>
<td>95–90% (grade I)</td>
<td>14</td>
<td>1.83 ± 0.30</td>
</tr>
<tr>
<td>89–85% (grade II)</td>
<td>14</td>
<td>1.88 ± 0.35</td>
</tr>
<tr>
<td>&lt;85% (grade III)</td>
<td>16</td>
<td>1.45 ± 0.24*</td>
</tr>
</tbody>
</table>

Relative to normal children, *p < 0.001.

Reference data were used for the purposes of comparison. Children with infections of the liver, kidney, or other systemic disorders were excluded from the study. Twelve healthy children were selected as controls (weight for age >80 per cent of the expected) from the Immunization Centre of the department. Venous blood was collected in deionized vials using deionized syringes and needles. Serum was stored at −20°C until analysis. Magnesium was measured by atomic absorption spectrophotometry. The data were analysed using Student's t-test and correlation coefficient.

Results

Of the 20 children with weight below 60 per cent of the expected, 19 children had marasmus (oedema absent) and one child had marasmic kwashiorkor (oedema present). There was no case of pure kwashiorkor (weight between 60 and 80 per cent of the expected, plus oedema) in this study. Table 1 shows that serum magnesium levels were significantly low in children with moderate (grade II) (p < 0.01) and severe (grades III and IV) protein-energy malnutrition (PEM) compared to the control group (p < 0.001). Thirteen children (four with grade II and nine with grade III and IV PEM) were found to have serum magnesium levels below 1.56 mg/dl, the accepted lower limit of normal. Children with marked retardation in linear growth (height <85 per cent of the expected) had significantly lower serum magnesium levels (Table 2). There were significant correlations between serum magnesium levels and height for age (r = +0.4698; p < 0.001) and serum albumin (r = +0.36; p < 0.01).

Discussion

Previous studies gave contradictory results on serum magnesium levels in malnourished children, particularly in marasmus. The results of this study indicated that serum magnesium levels were significantly low in children with moderate and severe malnutrition. Nearly half of the marasmic children in this study had serum magnesium levels in the hypomagnesemic range (below 1.56 mg/dl). Hypomagnesemia in malnourished children may be due to inadequate intake, malabsorption, diarrhoea, and infection. The significant correlation between serum magnesium and serum albumin suggests that hypoaalbuminaemia may be another factor contributing to low serum magnesium levels in these children.

Serum magnesium levels were found to be significantly low in children with marked linear growth retardation (height for age <85 per cent of the expected). Furthermore, there was a highly significant correlation between serum magnesium levels and height for age. Magnesium is essential for many metabolic functions, including nucleic acid and protein synthesis. This may partly explain growth retardation in malnourished children. The results of the present study indicate that magnesium deficiency is common in malnourished children including those with marasmus, as indicated by significantly lower serum magnesium levels in these children.

References


