Relationship Among Serum Selenium Levels, Lipid Peroxidation, and Acute Bronchitis in Infancy

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ABSTRACT

Thirty-four infants with acute bronchitis and 25 age-matched healthy controls were enrolled to investigate the relationship between serum retinol-deficiency (MDA) and selenium (Se) levels and the occurrence and severity of acute bronchitis in children. Serum samples were taken for serum Se and MDA measurements, and the clinical score was assessed at admission. Blood was taken again from the children with bronchitis at 2 mo after discharge from the hospital. Mean serum MDA levels were significantly higher in patients with acute bronchitis than at the postbronchitis stage and the controls (2.42±2.5 nmol/mL, 1.65±0.8 nmol/mL, and 2.70±2.0 nmol/mL, respectively; p<0.001). Infants with bronchitis had lower mean serum Se levels at the acute stage than after 2 mo (51.7±23.9 μg/dL, versus 68.4±26.4 μg/dL, p<0.005, respectively). Both of which were significantly lower than in the control group measurements (45.0±21.9 μg/dL; p<0.05). A negative correlation was indicated between serum MDA and Se levels in the patient group (r=−0.65, p<0.001). The age of the patient, child's immunological status, parental smoking habit, and family crowding index were not correlated with serum Se, MDA levels, or clinical score at admission.

In conclusion, increased MDA levels and impaired Se status demonstrate the presence of possible relationship between these parameters with the occurrence and severity of acute bronchitis in children.

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INTRODUCTION

Bronchiolitis is mainly a viral infant disease with no adequate and definitive drug treatment for symptom control except for routine supportive management (oxygen, intravenous fluid, etc.). Inhaled albuterol is advised if improvement is documented after a trial; aerosolized epinephrine has supplied some benefit in very limited studies. Ribavirin, as an antiviral agent, has been considered for some high-risk infants and corticosteroids are not claimed to be beneficial. Thus, investigations should focus on obtaining more definitive results for the treatment of the disease. Antioxidants may be beneficial for the immune system, low levels of selenium (Se) might be associated with the development of symptoms in patients with bronchiolitis, because animal studies have shown that the host content of antioxidant trace elements, including Se, influences responses to inflammatory stimuli. According to recent work on this trace element, it has been suggested that selenium status could also affect the viral pathogen itself, as well as the host’s immune response (1).

In addition to this antioxidant defense status of the host, including trace elements, the severity of infectious disease is also affected by the excessive or inappropriate production of the oxidant molecules, particularly the lipid peroxides, which destroy the invading microorganisms and the damaged tissue. A Se-dependent enzyme glutathione peroxidase (GSH-Px) is one of the primary antioxidants that is present in tissues and that limits the amount of lipid peroxides and is estimated by malondialdehyde (MDA) levels (2).

We have evaluated the serum Se and MDA levels of infants with acute bronchiolitis at their emergency admission to assess the possible role and interrelationship of Se deficiency and lipid peroxidation (LPO) in contributing to the emergence of bronchiolitis. There are no current data on whether selenium-deficient infants are at increased risk of hospitalization of bronchiolitis in children. We have tried to evaluate if an important role for Se can be proposed for the treatment of bronchiolitis.

MATERIALS AND METHODS

This case-control study was carried out between September 2002 and May 2003 in Dicle University Hospital, Diyarbakir, including 34 infants with acute bronchiolitis admitted to the emergency room and 25 age-matched healthy infants in the control group.

RESULTS

The study group consisted of 12 females and 22 males with a mean age of 9.62±8.8 months. There were 25 age-matched (mean: 11.5±8.9 months) healthy...
children (9 females, 16 males) in the control group. The patient and the control groups had similar nutritional status (body weight, triceps skinfold thickness, duration of breast-feeding) and housing conditions (family crowding index and socioeconomic status) (data not shown). Serum total protein and albumin levels were similar between the study and control groups (6.2±0.9 g/dL and 3.4±1.1 g/dL vs. 6.5±0.8 g/dL and 3.5±0.8 g/dL, respectively).

Infants with bronchiolitis had lower levels of serum Se at the acute stage than at the postbronchiolitis stage (31.7±28.9 μg/L vs. 65.4±26.4 μg/L, respectively), both of which were significantly lower than the control group measurements (145±21.9 μg/L) (p<0.001). There was a significant increase in serum MDA levels at the bronchiolitis stage at the acute stage than at the postbronchiolitis stage and the controls, 4.2±2.5 nmol/mL, 1.4±0.8 nmol/mL, and 0.7±0.2 nmol/mL, respectively (p<0.001) (see Table 1).

Decreases in blood Se levels were correlated with MDA increases at admission in the patient group (r=0.85, p<0.001) (see Fig. 1). There was no significant relationship between the patient's clinical score at admission and serum MDA or Se levels (p>0.05). The mean duration of oxygen administration (2-3 L/min) was 5.6±3.8 h. There was no statistically significant correlation between the MDA levels and duration of oxygen administration (r=0.15, p>0.05). The age of the patient, child's immaturity status, parental smoking habit, and family crowding index were not correlated with serum Se levels, MDA levels, or clinical score at admission (p>0.05). The day of hospitalization was not correlated with serum Se and MDA levels, but positively correlated with the baseline clinical score (r=0.39, p<0.05).

Table 1: Comparison of Data in the Patient and Control Groups

<table>
<thead>
<tr>
<th></th>
<th>Acute Bronchiolitis (n=24)</th>
<th>Postbronchiolitis Stage (n=24)</th>
<th>Control (n=25)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Se (μg/L)</td>
<td>31.7±28.9</td>
<td>65.4±26.4</td>
<td>145±21.9</td>
<td>&lt;0.001*&lt;0.001*</td>
</tr>
<tr>
<td>MDA (nmol/mL)</td>
<td>4.2±2.5</td>
<td>1.4±0.8</td>
<td>0.7±0.2</td>
<td>&lt;0.001&lt;0.001*</td>
</tr>
<tr>
<td>Clinical score</td>
<td>6±1.3</td>
<td>0</td>
<td>0</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

Note: Age, Se, MDA, and score values are expressed as mean±SD. NS = not significant.

* Between acute and postbronchiolitis stages.

b Between acute bronchiolitis and controls.

DISCUSSION

The nutritional status and the plasma levels of trace elements of the host have long been proposed to be associated with both severity and susceptibility to infectious diseases (6,7). More striking results have been reported in adults and animal models, but there is no adequate evidence that levels of antioxidant nutrients, like Se, can modify the occurrence and severity of infectious diseases in children.

In animal models, Se has been associated with an improvement of T-cell function and reduced apoptosis as an essential micronutrient (8). Adequate Se might enhance resistance to infections through modulation of Interleukin (IL) production and, subsequently, the Th1/Th2 response. Selenium supplementation upregulates IL-2, which increases activation, proliferation, and differentiation of T-helper cells and downregulates the abnormally high levels of IL-8 and tumor necrosis factor-α (TNF-α) observed in infections, which has been associated with increased viral replication. Moreover, deficiency of Se also affects the cellular integrity, which is very important for receiving and responding to the mesothelial needed to coordinate an immune response.

Increased susceptibility to viral infection might have occurred in our patients related to the inhibition of Se-dependent functions of the immune system and the impaired antioxidant defense. Low Se plasma levels were often measured in most severe diseases (9). Although Se deficiency might impair the host's response to bronchiolitis, decreased levels might also be induced by the infection. Children with acute forms of the diseases are likely to become catabolic, resulting in a lowering of the serum Se levels.
Se and LPO in Bronchiolitis

Se and LPO in Bronchiolitis

Selenium deficiency has not been a predictor of symptom severity. We found no study in the literature that investigated the serum Se and MDA levels according to symptom severity in children with bronchiolitis. In a group of patients with bronchiolitis complicated by pneumonia, the acute period of the disease was characterized by a sharp rise in MDA, especially in more severe patients (13). In another study of acute infections, Se concentrations showed significant depressions compared with the values after the recovery, but the reduction of serum Se at the acute stage also did not correlate with the severity of infection (14).

In a study of mice, retinol induced oxidation and inflammation as shown by lipid peroxidation were diminished by a Se supplement, leading to the survival of mice during viral infection (15). Therapeutic effects of Se have also been shown on Mycoplasma pneumoniae infection and in a group of critically ill patients with sepsis (16).

REFERENCES

Distribution of Selenium-Containing Proteins in Human Serum

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ABSTRACT

Selenium-containing proteins in human serum of four volunteers in Beijing were separated and purified by preparative sodium dodecyl sulfate-polyacrylamide gel electrophoresis (SDS-PAGE). Selenium contents in the proteins were quantified by high-performance liquid chromatography (HPLC) coupled with a fluorescence detector (PLD) after pretreatment with a microwave digestion system and derivatization with 2,3-diaminonaphthalene (DAN). Five selenium-containing proteins with apparent molecular weights (MWs) of 68 kDa, 37.5 kDa, 49.2 kDa, 41.2 kDa, and 21.2 kDa respectively, were detected. By comparison with known data on serum selenium-containing proteins, the 68 kDa protein should belong to albumin, which took 63.9-9.8% of the total serum Se. The 37.5 kDa protein should be a selenium-containing protein (Se-CPP) and the 49.2 kDa protein was believed to be an isomer of selenium protein. The sum of Ser in selenoprotein P and its isomer took about 41.1-69.3% and was the major form of human serum selenium. The 41.2 kDa protein should be a selenium-containing protein that, to our best knowledge, was reported for the first time. The Se percentage in this protein corresponded to 12.6-20.6% of total human serum Se.

Index Entries: Selenium; selenoprotein; human serum.

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