ULTRASOUND DENSITOMETRY IN THE DIAGNOSTIC OF OSTEOPENIC SYNDROME IN CHILDREN WITH CHRONIC LUNG DISEASES

According to the modern imaginations chronic lung disease (CLD) in children is the significant risk factor of the development of bone formation disorders. 194 children at the age 10-16 years old with chronic pneumonia and chronic bronchitis were included to the investigation. The study examines the features of structural and functional condition of the bone tissue with taking into account the degree of duration severity of chronic lung diseases in children. It suggests that osteopenic syndrome in children with CLD is a constant companion of the duration of pathological process.

Keywords: Osteopenic syndrome, chronic lung diseases, children.

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Introduction

Osteopenic syndrome is one of the actual pediatric problems due to the high distribution and the influence on the manifestation of osteoporosis in adult patients (Belaeva, 2008; Pochkailo et al., 2007; Campos, 2004). The investigations which have been performed for the last decade have really proved that the problem of osteoporosis is associated with the period of childhood (Sheplagina et al., 2003). Children’s age attracts attention because in this period the bone mass is intensively increased. In this plan the significant importance it has the puberty period because to its end the level of bone mass in the most parts of skeleton is reached 86% of the adult’s bone mass (Rudenko, 2001; Tomashhevskaya et al.; 2005; Campos., 2004; Infante et al., 2000; Giampiero et al., 2005). Disorders of the bone formation process in child by the influence of as chronic diseases and as the other factors lead to the forming of osteopenic syndrome even in the children’s age and as a result to increasing development risk of osteoporosis and bone fractures in consequence (Sitiy, 2004).

For the last years there has been increased the list of clinical conditions accompanied by the loss of the bone tissue and stipulated by the different causes and pathogenic mechanisms. Meanwhile, not sufficient attention is given to the study of the osteopenic syndrome in children with CLD.

Chronic lungs’ diseases (CLD) in children is medical and social problem in pediatrics, they have risk of progressive course with the disability outcome (Astafeva, 2003; Kaganov et al., 2001; Sheplagina et al., 2005). During the development of the stable irreversible disorders of the bronchial patency the obligate complications develop; main forms of which include respiratory failure, hypoxia and induced by it pathobiochemical shifts. In addition, the clinical course of CLD is not limited to respiratory symptoms; it also has extrapulmonary manifestations, the least known of which is pulmonogenic osteopenia and osteoporosis. This state is not leading in the clinical picture but significantly reduces the quality of life of children, which in turn worsens the course of the basic disease. Therefore, studying changes in bone tissue in patients with chronic lung disease and finding active prevention ways are the urgent tasks in the modern pulmonology.

Quantitative ultrasound densitometry is perspective new method allowing to evaluate the condition of the bone tissue by passing speed of the ultrasound wave through the bone (SOS-speed of sound) and due to the size of its attenuation in the bone (BUA - broadband ultrasound attenuation), and due to Z-criteria (Z-score). The aim of our work
was to study the features of structural and functional condition of the bone tissue considering the degree of duration severity of chronic lungs’ diseases in children.

Materials and methods

There were 194 patients with CLD at the age from 10 to 16 years old under our observation. Depending on the clinical forms of CLD patients were divided into the following manner: patients with chronic pneumonia (CP) - 110 patients (with deformation of bronchus without its enlargement - 82, with bronchiectasis - 28); patients with chronic bronchitis (CB) - 84 (obstructive - 46 patients, without obstruction - 38 patients). Distribution of the investigated patients due to sex and age is presented in Table 1.

<table>
<thead>
<tr>
<th>Form of CLD</th>
<th>Patient's age</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>10 years old</td>
<td>11-12 years old</td>
<td>13-14 years old</td>
<td>15-16 years old</td>
</tr>
<tr>
<td>Chronic pneumonia</td>
<td>Boys</td>
<td>22 (20%)</td>
<td>14 (12.7%)</td>
<td>19 (17.3%)</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>10 (9%)</td>
<td>6 (5.5%)</td>
<td>6 (5.5%)</td>
</tr>
<tr>
<td>Chronic bronchitis</td>
<td>Boys</td>
<td>10 (11.9%)</td>
<td>11 (13%)</td>
<td>12 (14.3%)</td>
</tr>
<tr>
<td></td>
<td>Girls</td>
<td>8 (9.5%)</td>
<td>8 (9.5%)</td>
<td>10 (12%)</td>
</tr>
</tbody>
</table>

The distribution of the children due to sex showed us the predominance of boys over girls: in chronic pneumonia - 81 patients (73.6%), and in chronic bronchitis - 47 patients (55.9%). It should be noted that with the age the amount of sick children increases both in general level and in specific clinical forms.

Structural and functional condition of the bone tissue was studied using ultrasound densitometry of the heel bone on “DPX-MD+” equipment supplied with children’s program (South Korea). Bone strength STI (stiffness index) expressed in percents was determined. According to WHO criteria the normal mineral density was diagnosed on Z-score > - 1 SD, decreasing mineral density (osteopenia) on Z-score < - 1 SD, and osteoporosis - on Z-score < - 2.5 SD.

Results and discussion

According to ultrasound osteometry data the average index of STI in the investigated patients was 55.4%. The decreasing of bone mineral density (BMD) was diagnosed in 150 children with CLD. In patients with chronic pneumonia it was diagnosed in 80 patients (72.7%), and in patients with chronic bronchitis - in 70 patients (83.3%). The frequency of osteopenia was determined in 98 (50.5%) children with CLD, osteoporosis was found in 52 (26.8%) patients (Table 2).

<table>
<thead>
<tr>
<th>Clinic variants of CLD</th>
<th>Normal bone strength Z-score &gt; - 1 SD</th>
<th>Osteopenia Z-score &lt; - 1 SD</th>
<th>Osteoporosis Z-score &lt; - 2.5 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic pneumonia n=110</td>
<td>30 (27.3%)</td>
<td>58 (52.7%)</td>
<td>22 (20%)</td>
</tr>
<tr>
<td>Chronic bronchitis n=84</td>
<td>14 (16.7%)</td>
<td>40 (47.6%)</td>
<td>30 (35.7%)</td>
</tr>
</tbody>
</table>

Thus, the received data testify about the significant negative influence of CLD on the bone mineral density, the cause of which probably is related to the chronic hypoxia which is negatively affected on the harmonic development.

52 (26.8%) patients found with osteoporosis had severe duration of the basic disease, early beginning of the clinical manifestation, frequent exacerbations of the chronic bronchopulmonary process and stable hypoxemia and significant disorders of the bronchial patency. Clinical manifestations of the osteopenic syndrome in the investigated children were characterized by complaints to backaches and pain in the legs (32 patients - 16.5%).
Clinical variants and severity of the disease influenced on bone mineral density of the sick patients with CLD. The investigations showed that low and very low indexes of the bone strength were determined in patients with bronchiec tasis (p 0.001). Evaluation of bone mineral density in patients with allergic component of the chronic bronchitis showed that in patients with severe duration of the disease (they who got systemic steroids and permanently used inhaled steroids during more than 4-5 years) there were significant decrease of bone mineral density. Osteoporosis appeared reliably high (p<0.001) in those examined in patients who received systemic steroids.

Assuming the presence of the age and sexual specific features of the bone metabolism in children, we have examined age changes in densitometric indexes. We have noted the increase of the bone mineral density with a peak in girls at the age of 11-12 years old (p<0.001); the same increase we have noted in boys at the age of 13-15 years old with a peak at the age of 15 years old (p<0.001) in comparison with the other age groups.

In general, the determined features of the bone mineralization in children with CLD define the need of monitoring of skeleton mineralization as the base in primary prevention of osteoporosis in adult.

**Conclusion**

Osteopenic syndrome in children with CLD is a permanent companion of pathological process course. The index of the bone strength has significant relationship with severity of the disease. The use of the modern noninvasive technologies could allow us studying condition of the bone tissue with the high accuracy. The modern diagnostics of the osteopenic syndrome in CLD allow us carrying out timely prevention of the structural and functional disorders of the bone tissue.

**References**


