Fluoride treatment in corticosteroid induced osteoporosis

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SUMMARY Severe osteoporosis with multiple vertebral fractures occurred in two girls receiving prolonged high dose corticosteroids for relapsing dermatomyositis. Sodium fluoride, supplemented with calcium and vitamin D, helped control secondary osteoporosis in one case and should be considered as part of the curative treatment of corticoid induced osteoporosis.

Sodium fluoride is now used in idiopathic osteoporosis of aging adults,1 2 as it should be able to increase bone mass. Prolonged high doses of treatment with corticosteroids may produce severe osteoporosis in children. The histomorphometric and histodynamic method3 represents a quantitative approach to the evaluation of bone disease under treatment with fluoride.

Case reports

Case 1. A 10 year old, prepubertal girl was treated for dermatomyositis. From August 1980 to December 1982 she received the following treatment and dosages: prednisone 0-6-2 mg/kg/day, with calcifiediol 100 µg/day up to November 1981 and then alfalcacidol 0-5-1 µg/day up to December 1982, and also hydrochlorothiazide 75 mg/day. No height gain was observed from January 1981 to December 1982. At this time her height was 128 cm and dermatomyositis was stable, but treatment with corticosteroids induced a severe osteoporosis and multiple vertebral fractures (D6, D7, D10, D12, and L5).

From December 1982 to April 1984 she received prednisone 0-6-1·1 mg/kg/day on alternate days with alfalcacidol (0-5 µg/day), calcium carbonate (1·5 g/day), and hydrochlorothiazide. Sodium fluoride was given at a dose of 1 mg/kg/day for 16 months.

The height gain during this treatment was 10 cm and the girl remained impubertal. No other vertebral fractures occurred, and bone x ray profile has improved.

Case 2. This 7 year old girl presented with dermatomyositis in March 1981. She received an average dose of prednisone 1·4 mg/kg/day with alfalcacidol 0·25-0·75 µg/day and hydrochlorothiazide 75 mg/day without calcium supplementation because of hypercalciuria. In October 1982 her height was 123 cm and the presence of multiple vertebral fractures (eight vertebrae) revealed a severe osteoporosis associated with renal lithiasis. From June 1983 to May 1985 the dermatomyositis relapsed and treatment included prednisone 1·1 mg/kg/day in conjunction with sodium fluoride 1 mg/kg/day, alfalcacidol 0·5 µg/day, and hydrochlorothiazide 75 mg/day. During this time, the x ray profile of the spine improved and no other vertebral fractures occurred. At the end of the study the girl remained prepubertal and her height was 135 cm.

In both cases, after tetracycline double labelling, a bone biopsy specimen was taken before and after treatment with fluoride. The histomorphometric and histodynamic variables were compared (Table).

Discussion

In both children the natural history and bone radiology during extended treatment with corticosteroids for dermatomyositis seemed typical of corticosteroid induced osteoporosis. We could not study bone photon absorptiometry, but bone biopsy specimens were contributive: appreciable decrease of trabecular bone volume with decrease of the calcification rates and increased trabecular resorption.
Glucocorticoid-induced osteoporosis is a condition that results from the prolonged use of corticosteroids, which can lead to reduced bone density and increased risk of fractures. This condition is characterized by alterations in bone turnover, including increased bone resorption and decreased bone formation. While corticosteroids are effective in treating various chronic conditions, their long-term use is associated with significant bone-related complications.

### Histomorphometric Variables in Bone Biopsy Specimens Taken from the Two Cases

<table>
<thead>
<tr>
<th></th>
<th>Trabecular Bone Volume (%)</th>
<th>Resorption Surfaces (%)</th>
<th>Osteoid Volume (%)</th>
<th>Osteoid Surfaces (%)</th>
<th>Thickness Index of the Osteoid Seams</th>
<th>Calcification Rate (μg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Case 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before treatment</td>
<td>9.8</td>
<td>6.3</td>
<td>7.6</td>
<td>34.6</td>
<td>21.9</td>
<td>0.84</td>
</tr>
<tr>
<td>During treatment</td>
<td>10.0</td>
<td>15.3</td>
<td>10.5</td>
<td>48.2</td>
<td>21.7</td>
<td>1.76</td>
</tr>
<tr>
<td><strong>Case 2</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before treatment</td>
<td>8.9</td>
<td>7.3</td>
<td>1.5</td>
<td>10.1</td>
<td>14.8</td>
<td>0.45</td>
</tr>
<tr>
<td>During treatment</td>
<td>11.5</td>
<td>6.8</td>
<td>1.7</td>
<td>15.3</td>
<td>11.0</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Controls</strong> (mean SD)</td>
<td>22.9(4.5)</td>
<td>3.6(1.1)</td>
<td>2.1(1.4)</td>
<td>11(6.8)</td>
<td>19.3(3.6)</td>
<td>1.31(0.33)</td>
</tr>
</tbody>
</table>

Trabecular bone volume is the percentage of trabecular bone tissue in total spongy space. Resorption surfaces are the percentage of total trabecular resorption surface area. Osteoid volume is trabecular osteoid volume expressed as a percentage of total bone volume. Osteoid surfaces are the percentage of trabecular surface area covered with osteoid. The thickness index of the osteoid seams is the ratio of osteoid volume to osteoid surface area multiplied by 100. Calcification rate is calculated by double labeling of the calcification front with tetracycline.

### Discussion

Glucocorticoids, which are synthetic derivatives of cortisone, are commonly used to treat inflammatory and autoimmune conditions. While effective, their long-term use can lead to glucocorticoid-induced osteoporosis (GIO), characterized by increased bone resorption and decreased bone formation. This condition is particularly prevalent in long-term corticosteroid users, such as patients with chronic obstructive pulmonary disease or those undergoing corticosteroid therapy for autoimmune diseases.

**Bone Biopsy Findings**

- **Case 1**: Before treatment, the trabecular bone volume was 9.8%, with a resorption surface of 6.3% and an osteoid volume of 7.6%. The osteoid surfaces were 34.6%, with a thickness index of 21.9 and a calcification rate of 0.84 μg/day. During treatment, the trabecular bone volume increased to 10.0%, with a resorption surface of 15.3% and an osteoid volume of 10.5%. The osteoid surfaces were 48.2%, with a thickness index of 21.7 and a calcification rate of 1.76 μg/day.

- **Case 2**: Before treatment, the trabecular bone volume was 8.9%, with a resorption surface of 7.3% and an osteoid volume of 1.5%. The osteoid surfaces were 10.1%, with a thickness index of 14.8 and a calcification rate of 0.45 μg/day. During treatment, the trabecular bone volume increased to 11.5%, with a resorption surface of 6.8% and an osteoid volume of 1.7. The osteoid surfaces were 15.3%, with a thickness index of 11.0 and a calcification rate of 0.35 μg/day.

- **Controls**: The mean trabecular bone volume was 22.9%, with a resorption surface of 3.6%, an osteoid volume of 2.1%, and a thickness index of 19.3. The calcification rate was 1.31 μg/day.

**Clinical Implications**

- **Bone Turnover**: The histomorphometric data indicate increased bone resorption and decreased bone formation during corticosteroid treatment. The increased osteoid seams suggest that bone remodeling is taking place, which may contribute to bone loss.

- **Vertebral Pain Relief**: While fluoride treatment was found to improve vertebral pain relief, it is important to note that the mechanism of action and long-term effects of fluoride therapy require further investigation.

- **Mineral Metabolism**: The improved mineral metabolism observed in patients with corticosteroid-induced osteoporosis after fluoride treatment suggests that fluoride therapy may be beneficial in managing bone loss.

**Conclusion**

Curative treatment for glucocorticoid-induced osteoporosis remains a significant challenge. While fluoride is effective in improving vertebral pain relief and vertebral strength, additional studies are needed to fully understand its long-term effects on bone health and overall quality of life. Further research is essential to identify safe and effective therapeutic strategies for patients with glucocorticoid-induced osteoporosis.
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