Hyperinsulinemia and Hypovitaminosis D Among Overweight Adolescents

Ge B, Long K, Pancoast T, Tosh A
Department of Child Health, University of Missouri School of Medicine

Background
In the past two decades, the prevalence of childhood obesity has doubled. Obesity, insulin resistance, and type 2 diabetes mellitus have been shown to be interrelated. Hypovitaminosis D has also been shown to be more prevalent in overweight patients. Because current studies regarding insulin resistance and hypovitaminosis D have focused on the adult population, we have chosen to examine the adolescent population in this study.

Purpose
To evaluate associations between hyperinsulinemia, vitamin D levels, and obesity in an adolescent cohort, as well as ensure the safety and efficacy vitamin D2, 50,000 IU weekly therapy.

Methods
Subjects aged 10-18 years old attending the Adolescent Obesity and Diabetes Clinic were recruited to participate in a cross-sectional study. Body Mass Index (BMI), fasting serum insulin, pre- and post-therapy 25-hydroxyvitamin D and calcium levels were examined. Low serum 25-hydroxyvitamin D (hypovitaminosis D) was categorized as normal (≥30 ng/mL), insufficient (20-29 ng/mL), and deficient (<20 ng/mL). BMI percentiles were classified as overweight (≥85%) and obese (≥95%). Patients with a fasting serum insulin level >20 mc unit/mL were considered to have hyperinsulinemia. Spearman’s rank correlation coefficients were computed and statistical significance was established (p < 0.05).

Results
The study included 297 adolescents, with mean age at first visit of 13.6 years. Among 195 subjects for whom initial fasting insulin levels were obtained, 50% had hyperinsulinemia. Mean 25-hydroxyvitamin D among 168 subjects was 23.0 ng/mL (SD 9.2). 70 (42%) were vitamin D insufficient, and 68 (40%) were vitamin D deficient (Table 1). Prior to treatment, mean serum 25OH vitamin D level was 14.52 ng/mL (SD 2.73) and calcium level was 9.58 mg/dL (SD 0.45). After 8 weeks of high dose therapy, mean 25OH vitamin D level was 25.74 ng/mL (SD 8.56) and calcium level was 9.44 mg/dL (SD 0.49) (Figure 1). Increased BMI was associated with increased fasting insulin (r=.38, p=0.0035) and age (r=.39, p<0.0001). Of the 227 subjects with multiple BMIs reported over time, 92 (41%) demonstrated BMI reduction.

Table 1. Comparison of Mean 25-Hydroxyvitamin D Levels

<table>
<thead>
<tr>
<th>25OH Vitamin D classification</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (&gt;30 ng/mL)</td>
<td>30</td>
<td>18%</td>
</tr>
<tr>
<td>Insufficient (20-30 ng/mL)</td>
<td>70</td>
<td>42%</td>
</tr>
<tr>
<td>Deficient (&lt;20 ng/mL)</td>
<td>68</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>168</td>
<td>100%</td>
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</tbody>
</table>

Figure 1: Effect of High Dose Therapy on Serum 25-Hydroxyvitamin D and Calcium Levels

Interpretation and Future Plans
For patients who received high dose therapy, the improvement in the 25OH vitamin D level was significant (p<0.001). There was no observed increase in calcium levels, so the high dose vitamin D2 therapy was considered safe. A statistically significant association was found between BMI and hyperinsulinemia. These findings suggest that obesity may be a risk factor for hyperinsulinemia and hypovitaminosis D. Data suggests that weight stabilization and weight loss are reasonable and realistic goals in the context of a medical weight disorders clinic. A limitation of this study is the small sample size. Further investigation should be performed, including determining the effect of high dose vitamin D2 therapy on BMI in adolescents.

References