Background: Recent studies have shown a new link between skeleton, fat tissue, and insulin action. However, clinical data are still limited, especially in children.

Objective: The aim of the presented study was to investigate the relationship between bone and fat hormones and glucose metabolism in children with type 1 diabetes mellitus (T1DM) and obesity.

Methods: Forty-six T1DM children, mean age 12.2±4.6 yrs, mean BMI 20.0±4.7 kg/m², 16 obese children, (age 11.3±3.8 yrs, BMI 27.2±7.3 kg/m²), and 11 control, healthy children, (age 11.5±5.0 years), BMI 19.0±2.8 kg/m² were included into the study. Fasting blood samples were obtained for analysis of bone derived osteocalcin (OC) and Receptor Activator of Nuclear Factor κB ligand (RANKL), and adiponectin and leptin, as well as vitamin D, lipid profile, glucose, HbA1c concentrations were measured at 8.00 AM. Hormones were measured by immunochromy, vitamin D by HPLC and other parameters by routine chemistry methods. Statistical analysis was performed in all groups using ANOVA with post-hoc Tukey test and multiple regression analysis.

Results: There were significant differences regarding leptin, HbA1c, LDL-cholesterol, HDL-cholesterol/Total Cholesterol levels among groups p<0.001 (Table 1). In T1DM, multiple regression analysis adjusted for age and BMI showed negative correlation between OC and leptin (r=-0.37, p=0.02) and positively correlation between leptin and vitamin D (r=0.4, p=0.01). In contrary, serum RANKL correlated positively with adiponectin (r=0.3, p=0.04). Moreover vitamin D correlated negatively with HbA1c (r=-0.3, p=0.03). In obese patients strong correlation between adiponectin and HbA1c (r=-0.8, p=0.00) has been found. In control group only positive correlation between OC and vitamin D (r=0.7, p=0.03) was noted.

Conclusion: It is suggested that crosstalk between bone and fat tissue in pediatric patients depends on insulin action.

The role of bone and fat tissue in glucose metabolism in two different metabolic conditions: obesity and diabetes mellitus type 1 – a pilot study

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Table 2. Differences in lipid profile (mean±SD data are presented) among the groups of patients with T1DM, obese patients and controls.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>T1 DM</td>
<td>4.4±0.7</td>
<td>1.01±0.7</td>
<td>1.57±0.3</td>
<td>2.36±0.7</td>
<td>35.07±7.8</td>
</tr>
<tr>
<td>obese</td>
<td>4.07±1.1</td>
<td>1.5±1.0</td>
<td>1.18±0.3</td>
<td>3.04±0.8</td>
<td>20.6±7.2</td>
</tr>
<tr>
<td>control</td>
<td>3.94±0.8</td>
<td>1.02±0.5</td>
<td>1.42±0.3</td>
<td>2.04±0.5</td>
<td>37.3±10.1</td>
</tr>
</tbody>
</table>

p 0.07 0.07 <0.0001 <0.001 <0.001

Type 1 DM patients

Multiple regression analysis adjusted for age and BMI showed that serum OC negatively related to as well leptin as HbA1c levels (p<0.02 and p=0.01) and positively related to HDL Cholesterol /Total Cholesterol index, HbA1c (p=0.02) in patients with T1 DM.

In contrary, serum RANKL, positively related to adiponectin (p=0.04). Moreover vitamin D negatively related to HbA1c (p=0.03).

Anthropometrical measurements

Height was measured to the nearest centimeter using a rigid stadiometer. Weight was measured unclothed to the nearest 0.1 kg using a stadiometer. Weight was measured unclothed to the nearest 0.1 kg using a digital scale.

Material

Blood samples were drawn once from the antecubital vein in the fasting state, at 08.00 hours.

Statistical analysis

Statistical analysis was performed using the Statistica software package. In statistical analysis ANOVA with post-hoc Tukey test, and multiple regression analysis were used.

Discussion

Fasting plasma glucose levels are is elevated in osteoporotic women treated with drugs inhibiting bone resorption and serum undercarboxylated osteocalcin levels are positively correlated with bone resorption in healthy women.

In adults serum osteocalcin was associated with measures of insulin resistance, adipokine levels, and the presence of metabolic syndrome. It has been shown that serum leptin is negatively correlated to insulin resistance and obesity. Serum osteocalcin is positively associated with bone mineral density at the distal radius in patients with type 2 diabetes mellitus, so leptin and adiponectin may have a protective effect on bone metabolism.

In children there found some relationshios between osteocalcin, adiponectin and insulin secretion in a weight-dependent manner.

Vitamin D depletion induces RANKL-mediated osteoclastogenesis and bone loss. In obese children vitamin D is related to hyperinsulinaemia. It was reported that hypovitaminosis D is a risk factor for developing insulin resistance independent of adiposity.

Conclusions

Our preliminary data suggest that cross-talk between bone and fat tissue exists in pediatric patients and it could be associated with insulin action. Further studies on larger groups regarding this problem are needed.

Acknowledgements

This study was supported by a grant nr K/ZDS/001812, from Medical College, Jagiellonian University in Cracow.