Evaluation of levels of selected markers of carbohydrate and lipid metabolism and their association with the occurrence of overweight and obesity in children and adolescents after cancer treatment.

In recent years, there has been significant improvement in the diagnosis and treatment of childhood cancers, increasing 5-year survival rates to around 80% in developed countries. However, the side effects of intensive therapies, including chemotherapy, radiotherapy, and surgical interventions, have resulted in numerous health complications. About 60% of survivors experience at least one chronic condition, and 27.5% face life-threatening complications. Early detection of disturbances, particularly metabolic disorders, is crucial for improving survivors' quality of life. Increasing attention is being given to identifying early biomarkers for lipid and carbohydrate metabolism disorders, which could enable the diagnosis of cardiovascular diseases and reduce mortality in this patient group.

The aim of this study was to analyze the relationship between selected markers of lipid and carbohydrate metabolism with the occurrence of overweight, obesity, and metabolic syndrome factors in patients who have completed childhood cancer treatment. The first publication evaluated the concentrations of adipocyte and epidermal fatty acid binding proteins (A-FABP, E-FABP) after the completion of treatment for acute lymphoblastic leukemia (ALL) in childhood. The second publication investigated the relationship between selected carbohydrate metabolism markers (C-peptide, ghrelin, GIP, glucagon, insulin, PAI-1, resistin, leptin, and visfatin) and the presence of insulin resistance and metabolic syndrome factors in ALL survivors.

The study was conducted in two groups of patients: Group 1 consisted of 62 patients (mean age at the time of study: 12.41 ± 4.98 years), and Group 2 included 56 patients (mean age at the time of study: 12.36 ± 5.15 years) who had been treated for ALL in childhood. Overweight and obesity in the study group were determined based on BMI values according to the OLA/OLAF percentile charts for age and sex. HOMA-IR was calculated using the formula: insulin concentration (uIU/mL) × glucose concentration (mmol/L) / 22.5. Metabolic syndrome factors for children under 16 years old were defined according to the IDF guidelines: waist circumference (WC) ≥ 90th percentile, triglycerides (TG) ≥ 150 mg/dL, HDL-cholesterol < 40 mg/dL, blood pressure ≥ 130/85 mmHg, fasting glucose concentration ≥ 100 mg/dL. Patients aged 16 years or older were assessed according to the IDF guidelines for adults: WC ≥ 94 cm for men and WC ≥ 80 cm for women, TG ≥ 150 mg/dL, HDL-cholesterol < 40 mg/dL for men and < 50 mg/dL for women, blood pressure ≥ 130/85 mmHg, fasting glucose concentration ≥ 100 mg/dL. Serum concentrations of A-FABP and E-FABP were assessed using an ELISA kit (BioVendor Laboratorni Medicina a.s., Brno, Czech Republic). In contrast, concentrations of selected carbohydrate metabolism markers were evaluated using the Bio-Plex Pro

Human Diabetes 10-Plex Panel (Bio-Rad Laboratories, Hercules, CA, USA). Ethical approval for both studies was obtained from the Bioethics Committee of the Medical University of Białystok.

The study group showed higher concentrations of A-FABP ($p < 0.001$) compared to the control group, while the concentration of E-FABP ($p = 0.325$) did not differ between the two groups. Overweight and obese patients had higher A-FABP concentrations ($p = 0.006$) compared to those with normal BMI. In the study group, 53.23% of patients met at least one criterion for metabolic syndrome. Children with at least two metabolic syndrome factors presented higher concentrations of A-FABP ($p = 0.018$) and E-FABP ($p = 0.026$) compared to those without metabolic syndrome criteria, as well as compared to the control group (A-FABP: $p = 0.001$; E-FABP: $p = 0.021$). In the second study, the study group exhibited higher concentrations of GIP ($p = 0.026$), glucagon ($p = 0.001$), leptin ($p = 0.022$), and PAI-1 ($p = 0.047$), and lower concentrations of ghrelin ($p < 0.001$) compared to the control group. Overweight and obese children treated for ALL showed higher concentrations of glucagon ($p = 0.006$) and leptin ($p = 0.034$) than patients with normal BMI. Patients more than five years after anticancer treatment exhibited higher concentrations of PAI-1 ($p < 0.001$) and resistin ($p = 0.002$) compared to those with shorter follow-up times. In the comparison of patients with at least one metabolic syndrome criterion to those without, higher concentrations of C-peptide ($p = 0.028$), leptin ($p = 0.003$), and PAI-1 ($p = 0.034$) were observed in the group with metabolic syndrome factors. Abnormal HOMA-IR was observed in 10.7% of patients, who showed higher concentrations of C-peptide ($p = 0.005$), glucagon ($p = 0.042$), and leptin ($p = 0.016$) compared to the subgroup with normal HOMA-IR. Glucagon (AUC 0.71; $p = 0.003$) and leptin (AUC 0.67; $p = 0.026$) were identified as the best predictors of overweight and obesity in the study group.

Patients who have completed treatment for ALL in childhood exhibit disturbances in lipid and carbohydrate metabolism, which increases the risk of developing metabolic syndrome and cardiovascular diseases later in life. Overweight and obesity contribute to an increased risk of metabolic disorders in this patient group. Therefore, regularly monitoring patients after childhood anticancer treatment for metabolic disorders is essential to enable early intervention and prevent long-term health complications.

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