Streszczenie w języku angielskim

Obesity is the main factor predisposing to the development of many complications, including cardiovascular, respiratory, neurological, and endocrine. The risk of these complications is related to the amount of adipose tissue, its location, and the duration of the underlying disease. The structural changes in adipose tissue accompanying obesity lead to changes in the expression of fatty acid transport proteins, fatty acids transport, and lipids balance. The transmembrane transport of fatty acids in adipose tissue is promoted mainly by the fatty acid translocase (FAT/CD36), the plasma membrane fatty acid-binding protein (FABPpm), and the fatty acid transport proteins (FATP1 and FATP4). Excessive adipose tissue mass also leads to the development of insulin resistance through the overproduction of insulin antagonists and the direct secretion of increased levels of free fatty acids into the blood.

Matrix metalloproteinases are involved in adipogenesis and angiogenesis. These enzymes participate in the development of obesity complications through the degradation and remodeling of adipose tissue extracellular matrix molecules.

Long-term positive energy balance leads to the development of obesity and the formation of oxidative stress in cells, excessive production of reactive oxygen species, and intensification of inflammation. N-acetylcysteine and alpha-lipoic acid are antioxidants with well-documented beneficial effects on the metabolic complications of obesity. N-acetylcysteine is a cysteine derivative that serves as a precursor to reduced glutathione synthesis, whereas alpha-lipoic acid is an essential endogenous co-factor of an enzymatic complex involved in energy generation, as well as the inactivation of free radicals, and by its reduced form, also interacts with reactive oxygen species.

The aim of the study was to evaluate the effect of N-acetylcysteine or alpha-lipoic acid on a high-fat diet on selected plasma parameters (insulin, glucose, FFA, DAG, TAG); histology of visceral and subcutaneous adipose tissue; expression (at the mRNA and protein level) of fatty acid transporters (FAT/CD36, FABPpm, FATP1, FATP4) and the subsequent accumulation of fatty acids in selected lipid fractions (FFA, DAG, TAG) in visceral and subcutaneous adipose tissue; and expression (at the mRNA and protein level) of extracellular matrix metalloproteinases (MMP2 and MMP9) in visceral and subcutaneous adipose tissue.

Male Wistar rats were divided into four groups (10 rats per group): control group (CTRL), high-fat diet group (HFD), high-fat diet with N-acetylcysteine group (HFD + NAC), high-fat diet group with alpha-lipoic acid (HFD + ALA). Plasma insulin and glucose were determined by colorimetric and ELISA methods. The collected adipose tissue samples were subjected to immunohistological evaluation. MRNA and protein expression levels, FAT/CD36, FABPpm, FATP1, FATP4, MMP2, and MMP9, were assessed by real-time PCR and Western blot methods, respectively. The level of lipids (FFA, DAG, and TAG) in plasma and adipose tissue was estimated using the gas-liquid chromatography method.

The conducted research shows that the supply of antioxidants during the use of a high-fat diet leads to a reduction in body weight, glucose, insulin, and lipid levels in the plasma of the tested rats. The use of antioxidants also reduced the size of adipocytes and the number of macrophages, as well as increased the number of immunopositive CD68 cells in visceral and subcutaneous adipose tissue. Moreover, the use of antioxidants significantly influenced the occurrence of changes in the expression of mRNA and protein proteins of fatty acid transporters in both adipose tissue deposits. The four-weeks long use of antioxidants significantly lowered the lipid level in the adipose tissues. It was also shown that the use of antioxidants during the high-fat diet regimen significantly influenced the expression of mRNA and proteins of matrix metalloproteinases.

In summary, we can conclude that a high-fat diet leads to significant changes in the histological images of adipocytes, which is also reflected in changes in the expression of fatty acid transporter proteins, lipids and matrix metalloproteinases. N-acetylcysteine and alpha-lipoic acid have different effects on visceral and subcutaneous adipose tissue. Using antioxidants can help protect adipose tissue from the harmful effects of oxidative stress by regulating the expression of fatty acid transporter proteins and matrix metalloproteinases.