

White, Brown, Beige Adipocytes: Modern Concepts of Function and Biological Role

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Aim of the study: In recent studies, some new properties of adipocytes brown (BAT) and white (WAT) adipose tissue have been discovered. The presence of three functionally different types of adipose tissue requires a detailed study of the complex regulation of adipose tissue development. The discovery of a functionally active BAT in an adult raises the need for studying the specific features of the metabolism of adipocytes and expanding the understanding of its biological role. In this regard, the main purpose of the study was to study the function of BAT and WAT under the influence of physical stress and stress, as well as the mechanisms of differentiation of adipocyte precursors into white, brown and beige adipocytes.

Material and Methods: The studies were carried out on male Wistar rats weighing 200-240 g. The dosed physical exercise was modeled by running animals in a treadmill for 10 minutes daily. Psychoemotional stress - placing animals in cages-pencil boxes in a dark room, with brief light and sound effects (20 minutes daily). From the BAT of rats, mitochondria were isolated by ultracentrifugation. They studied their respiration, measured the membrane potential, the activity of tricarboxylic acid cycle enzymes. The protein profile of white and brown adipose tissue was evaluated. The level of free amino acids and biogenic amines in BAT was measured by HPLC. The source of preadipocytes was mesenchymal stem cells isolated from brown adipose tissue of newborn rats. The effect of unsaturated fatty acids on the differentiation of adipocytes was studied.

Results: Activation of CTA enzymes in mitochondria of BAT at 90-minute cold stress (increase in activity of 2-OGDG by 96.1%, SDH by 65.2%, MDG by 35.8%), which is consistent with the role of BAT in the regulation of thermogenesis. Activation of BAT with chronic stress (psycho-emotional, physical exertion) was first discovered. In BAT, dopamine and serotonin have been detected; reactions of decarboxylation of aromatic amino acids and oxidative deamination of amines have been revealed. It has been established that asparagine and glutamine levels can be assessed as stress markers. In BAT, a high concentration of ornithine (209.75 ± 51.33 nmol / g tissue) was found, which increases by 25% in stress. This may be due to its effect on fat metabolism. Ornithine is synthesized from arginine and, in turn, serves as a precursor for citrulline, proline, glutamic acid. In case of chronic stress, the increase in the activity of the enzymes CTA (55.08% ITS, 2% OGDG by 36.4%, SDG by 30.9%, MDG by 43.9%) indicates activation of the mitochondrial function and involves the participation of BAT in the mechanisms of adaptation organism to stress. With chronic psychoemotional stress, the size of brown adipocytes decreases, the number of mitochondria increases in them. It was found that linoleic, eicosapentaenoic and arachidonic acids induced the proliferation of preadipocytes in a monolayer culture of brown adipose tissue.

Keywords: brown adipocytes, white adipocytes, mitochondria, stress, exercise, differentiation.