Rokhibjonov Adkhamjon Rakhmatjonovich
Andijan State Medical Institute, Assistant of the Department of Internal Diseases
Adhamjonrohibjonov013@gmail.com

HEAT EXCHANGE DISORDERS

Abstract: The ability to have a body temperature that is independent of environmental temperature is evolutionary acquisition. Thanks to him, organisms can control the intensity of metabolism to increase body temperature. Homoiothermic animals can maintain an optimum body temperature via the heat transfer into the environment.

Key words: Temperature homeostasis; fever; cytokines; febrile convulsions.

Резюме: Гомойотермность - эволюционное приобретение. Благодаря ему организмы могут управлять интенсивностью метаболизма для увеличения температуры тела и отдавать тепло в окружающую среду. Определенный уровень температуры необходим для функционирования ферментов, реализации химических реакций обмена веществ в клетках.

Ключевые слова: Температурный гомеостаз; лихорадка; цитокины, фебрильные судороги.

A living organism of any complexity requires the supply of nutrient substrates, from which, in the presence of oxygen, cells extract energy of various types - chemical, electrical, mechanical, thermal. Thanks to various types of energy, cells are able to maintain their structure and functions, including specific ones (contraction, secretion, generation of action potentials). The body, thanks to the production of energy, is able to respond to irritation, implement life-saving reflexes and instinctive programs for obtaining food, reproduction, avoiding life-threatening situations, aggression, and also adapt with not only a variety of species. The activity of existence and to a certain extent, the life expectancy of an organism depends on the energy of the processes of transformation of substances in its cells.

The implementation of any instinctive programs is possible provided that a large amount of energy is generated from substrates in the presence of oxygen. In winter, the animal's activity is reduced to a minimum and consists of experiencing an unfavorable time in a state of hibernation. There is a well-known pattern identified during chemical reactions, which consists in the fact that when the temperature of the reaction medium increases by 10 °C, its speed increases by 2-3 times.

An organism that heats up in the external environment due to an increase in its temperature produces more energy, including heat. Not only the heat balance, but also the amount of ATP energy produced in such animals depends on external heat. An increase in the production of thermal energy, which heats the cells and the body, accelerates metabolic reactions and therefore provides other types of energy for various types of activities . Moreover, even at negative environmental temperatures, there are mechanisms that allow the animal to have a temperature above 0 °C.

As a result of further evolutionary development, organisms appeared that were capable of not only actively producing heat in cells, but also being able to actively preserve it or get rid of its excess, forming a set of strictly homeothermic, or warm-blooded organisms. Vigorous metabolism in cells is characteristic of representatives of these species. Thanks to this, animals acquired the ability to actively exist regardless of the temperature of the external space.

Thus, homeothermy is an evolutionary acquisition consisting not only of the ability to regulate metabolism to increase/decrease the production of thermal energy, but also the ability to maintain body temperature fluctuations within certain limits by effectively transferring heat to the habitat.

A certain level of temperature is necessary for the functioning of most enzymes and the occurrence of chemical metabolic reactions in cells.

The processes of cell excitation, muscle contraction, secretion, absorption, and protective reactions of cells and tissues depend on the temperature of tissues and organs.

The components of the body's thermal balance are heat production and heat transfer.

Acceleration of biochemical reactions in the cytosol of target cells occurs under the influence of nerve impulses and hormonal regulators, as well as molecules secreted by bacteria, toxins, and products of immune system cells, cytokines, such as interleukin-1yu.

Agents that act as uncouplers of oxidative phosphorylation, under the influence of which cells in all heat-producing tissues switch to increased production of thermal energy, are adrenaline, norepinephrine and triiodothyronine. promotes the release of thermal energy into the external environment. Tachypnea, increased secretion of urine and feces increases heat transfer.

The main heat-generating organ for humans is the skin due to changes in skin circulation.

The greater the humidity of the surrounding air, the greater the conduction and radiation of heat by the skin, increasing its thermal conductivity and warm convection of heat from a heated body into the environment with the movement of air masses directly depends on the speed of air movement.

Evaporation from the skin (sweating) is an effective way of heat transfer, however, it is limited by both external factors (high air humidity or high temperature of the aquatic environment) and internal ones.

Reactions that retain heat in the body are varied. Integumentary formations in animals (fur), feathers in birds, subcutaneous fat in marine mammals create barriers to heat loss to the body. The phenomenon of pilot erection (“goose bumps” that appears in humans in the cold or during fever occurs due to contraction of the muscles that raise hair on the skin, leading to the creation of an air layer that helps retain heat in the body.

Behavioral thermoregulation of poikilothermic organisms is expressed in the fact that lizards “bask” in the sun, fish swim into warmer waters.

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