Effects of extreme temperatures on living organisms

It is generally known that under normal conditions, the internal temperature of the human body is close to 37°C. But if the human body is exposed to extreme temperatures, both low and high, for a long time, a problem arises. **Hypothermia** (undercooling) occurs at low temperatures and **hyperthermia** (overheating) at high temperatures. Both of these conditions are very serious and life-threatening. They are associated with other complications such as frostbite, blisters, burns, and the like. However, if they are applied correctly, they can have a beneficial effect on the body.

Use of cold

Cryopreservation

In the case of tissues and cells, low temperatures are used to **preserve** them. Freezing organs is not yet possible, but reduced temperatures can at least be used to **reduce metabolic activity**, for example during transplantation. However, some tissues and individual cells can be completely frozen, a process called **cryopreservation**. Water turns into ice during freezing, which is very dangerous for the cell; can form both outside and inside the cell.

Extracellular ice is not so dangerous if it does not disrupt its membrane, however, its formation can be prevented by rapid freezing (ice is formed from water that escapes from the cell due to a change in osmotic pressure during slow cooling).

Intracellular ice is much more dangerous and its formation means almost certain death for the cell. Its formation can be prevented by adding cryostabilizers, i.e. substances that prevent water from turning into ice form, lowering the freezing point and increasing the viscosity of the substance. Unfortunately, most of these substances are toxic in higher concentrations, and therefore they can only be used on thin tissue preparations and cells. This is also a major obstacle in organ cryopreservation.

Cryosurgery

Cryosurgery is a method of treatment that uses **cryodestruction** - the freezing of tissue at an extremely low temperature with a device called a **cryocauter**. It is mainly used to remove tumors.

Cryotherapy

The healing effects of a cold environment have been known since the time of ancient Egypt and later Greece when even the heroic Hippocrates devoted himself to cold treatment. Cryotherapy saw great flourishing during the Napoleonic Wars when a large number of severe injuries were solved by amputations and compresses made of snow and ice used to numb limbs. The beginning of modern cryotherapy goes back roughly to the beginning of the 20th century when the first cryo-chamber was constructed by the Japanese Toshiro Yamauchi in 1978. The development is also related to technical progress, which enabled the liquefaction and long-term storage of gases. The improvement of cryotherapy was mainly done by Polish and German experts.

Use of heat

Thermotherapy

Thermotherapy is a method using heat to reduce acute or chronic pain or to strengthen the overall health of the organism. It is the most commonly used method of rehabilitation, especially effective in reducing pain related to muscle tension or spasms. Heat can be supplied to the body (positive thermotherapy) or removed from the body (negative thermotherapy).

Microwave thermotherapy

This is an oncological treatment method using microwave tissue heating. It is based on the fact that some tumor cells are sensitive to temperatures higher than 42 °C, while healthy cells generally survive an increase in temperature up to 45 °C. It follows that heating the tissue to a temperature between 42° and 45° selectively destroys tumor cells. Hyperthermia is particularly effective in treating large tumors.

Because blood circulation is impaired in the tumor tissue, its ability to thermoregulate is also reduced. The bigger the tumor, the stronger the effect. In normal tissue, blood circulation increases by heating, and thus the temperature stabilizes, in tumor tissue, on the contrary, circulation decreases with increasing temperature, therefore it is possible to eliminate it very advantageously at a higher temperature.

Hyperthermia is used complementary to radiotherapy. While radiotherapy is effective for small tumors and works mainly on their surface, hyperthermia is most effective for tumors larger than 2 cm and works most strongly in their center.

Links

Related articles

- Cryopreservation
- Cryosurgery
- Cryotherapy
- Thermotherapy
- Microwave thermotherapy

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