Thermal sensing

Temperature is perceived by two types of sensory organs, one reacts to temperatures slightly higher than body temperature (heat sensors), the other to temperatures slightly lower (cold sensors). However, only two different degrees of heat are adequate stimuli, since cold does not represent any form of energy. The thermal sensory organ consists of *free nerve endings* that respond to the absolute temperature and not to the temperature gradient of the skin.

There are separate places on the skin that are sensitive to cold and to heat. But there are 4-10x more sensitive places to the cold. Cold receptors respond to the temperature range between 10–38 °C and heat receptors to the range of 30–45 °C. Sensory organs are located subepithelially, and therefore their reaction is determined by the temperature of the subcutaneous tissues (we perceive metal objects subjectively cooler than wooden objects when touched, even though the absolute temperature of both is the same, because metal dissipates heat from the skin much faster). At a skin temperature below 20°C and above 40°C there is *no adaptation*, but in the range between 20–40°C skin temperature *adaptation is present*, i.e. that temperature-induced sensations gradually weaken until temperature neutrality. Above 45°C, *tissue damage* begins and thermal sensations become painful.

Thermal sensing receptors

Thermal stimuli are perceived by at least three types of sensory receptors: cold and heat receptors and pain receptors. The sensation of "**freezing cold**" and "**burning hot**" arises in pain receptors.

Although the existence of **thermal nerve endings** is almost certain, it has not yet been proven histologically[1]. They are probably free nerve endings (the thermal sensation is mainly carried out by slow C fibers).

The cold receptor is a small myelinated nerve ending of the Aδ type, branched several times, the ends of which penetrate the basal part of the epidermis. In addition to conduction by Aδ fibers, conduction by C fibers is also possible, suggesting that some free nerve endings could also function as cold receptors.

Thermal sensing pathways

The afferent fibers for conducting **cold sensations** are Aδ and C fibers, while the afferent fibers for conducting **heat sensations** are only C fibers. These fibers enter the posterior spinal roots and most of them terminate in Rexed laminae I, II and IV (1st neuron – pseudounipolar cells of the spinal ganglia). Neurons in these laminae cross in the same segment and enter the ipsilateral lateral and anterior spinal cords as the spinothalamic tract. This pathway enters the thalamus, where it ends in the nc. ventralis posterolateralis, in ncc. intralaminares and in nc. posterior thalami (2nd neuron – neurons located in lamina I, IV and V). From these nuclei, the thalamocortical tract leads to the postcentral gyrus (primary sensitive cortical area) and to the association areas of the occipital, parietal and temporal lobes (3rd neuron - neurons of the thalamic nuclei).

Links

Related articles

- Sensitive pathways of the CNS
- pain

References

1. E. HALL, John. *Textbook of Medical Physiology.* 12. edition. Saunders, 2010. 1120 pp. ISBN 978-1-4160-4574-8.

Použitá literatura

GANONG, William F. *Přehled lékařské fyziologie.* 20. edition. Praha : Galén, 2005. 890 pp. ISBN 80-7262-311-7.

DRUGA, Rastislav – GRIM, Miloš – DUBOVÝ, Petr. *Anatomie centrálního nervového systému.* 1. edition. Praha : Galén; Karolinum, 2011. 219 pp. ISBN 978-80-7262-706-6.

E. HALL, John. *Textbook of Medical Physiology.* 12. edition. Saunders, 2010. 1120 pp. ISBN 978-1-4160-4574-8.