# Hypothalamus

**The hypothalamus** is a relatively small basal region (4 $cm^3$) of the diencephalon between the anterior commissure and the corpora mammillaria, forming the lower part of the walls and base of the **third cerebral ventricle.**

MRI of the brain. The arrow shows the position of the hypothalamus.

In front, it extends to the chiasma opticum, from which the lamina terminalis goes upwards.

A round white formation commissura anterior can be recognized at the lamina terminalis.

Under the anterior commissure, there is a small, richly blood-stained place - organum vasculosum laminae terminalis - periventricular organ.

From the bottom of the 3rd cerebral ventricle downwards goes the infundibulum, at its end the pituitary gland is attached.

The front part is an **endocrine gland**.

The posterior part of the infundibulum, which approaches the corpora mammillaria, contains another periventricular organ, the **eminentia mediana**, and immediately behind it is the **tuber cinereum**.

Viewed from the ventral surface, it is the area between (and above) the chiasma opticum and the corpora mammillaria, in the middle of this surface is a bump, the tuber cinereum, from which the infundibulum with a suspended pituitary gland extends.

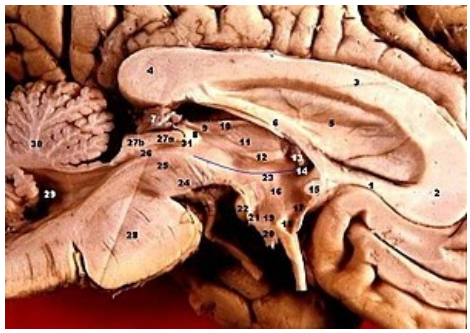
The hypothalamus contains several dozen nuclei, which are usually divided into:

- anterior (supraoptic) region
- middle (tuberal) region
- posterior (mammillary) region

or into:

- region of the chiasma opticum;
- middle region of the infundibulum
- posterior region with corpora mammillaria.

You can find more information about individual nuclei here (https://en.wikipedia.org/wiki/Hypothalamus#Nuclei), however, their detailed knowledge goes beyond the requirements of the exam.



1 – Corpus callosum (rostrum), 2 – Corpus callosum (genu), 3 – Corpus callosum (corpus), 4 – Corpus callosum (splenium), 5 – Septum pellucidum, 6 – Fornix (corpus), 7 – Glandula epiphysialis, 8 – Recessus pinealis, 9 – Habenula, 10 – Stria medullaris thalami, 11 – Thalamus (pars dorsalis), 12 – Adhaesio interthalamica, 13 – Plexus choroideus, 14 – Foramen interventriculare, 15 – Comissura anterior, 16 – Hypothalamus, 17 – Lamina terminalis, 18 – Recessus supraopticus, 19 – Recessus infundibuli, 20 – Infundibulum, 21 – Tuber cinerum, 22 – Corpora mamillaria, 23 – Sulcus hypothalamicus (modrá čára), 24 – Mesencephalon (crus cerebri), 25 – Tegmentum mesencephali, 26 – Aqaeductus mesencephali, 27 – Tectum mesencephali: a – Colliculus superior b – Colliculus inferior, 28 – Pons, 29 – Ventriculus quartus, 30 – Cerebellum, 31 – Comissura posterior.

## Nuclei of area hypothalamica rostralis

- **nucleus suprachiasmaticus** - above the chiasma at the bottom of the 3rd cerebral ventricle, internal biological clock

- **nucleus supraopticus** - from the lateral side on the chiasma opticum

- **nuclei preoptici** - three nuclei, signs of dimorphism

- **nucleus paraventricularis -** neurosecretory cells that produce oxytoxin and vasopressin

In case of damage to the n.ucleus paraventricularis and nucleus supraopticus there will be increased diuresis, vasopressin deficiency and feeling of thirst.

## Nuclei of area hypothalamica intermedia

- **nucleus arcuatus** - just above the ependymal lining of the 3rd cerebral ventricle in the place where it narrows into the recessus infundibuli, it synthesizes release factors and release-inhibiting factors, from where they go through the blood to the adenohypophysis

**- nucleus ventromedialis a dorsomedialis** - connected to the amygdala by the stria terminalis

- they regulate the parasympathetic parts of the ANS (autonomic nervous system) - miosis, bradycardia, hypotension...

- in case of damage to the nucleus ventromedialis - insatiable hunger in animals

- **nucleus ventromedialis** - stimulation in animals induced aggressive behavior

### Nuclei of area hypothalamica posterior

- **nuclei mammillares** - within or around the corpora mammillaria

- **nucleus posterior**

- they regulate the sympathetic part - pupil dilation, tachycardia, tachypnea, dilatation - bronchodilation, hypertension and suppression of peristalsis
- vasoconstriction when the body temperature drops

## Function

The function of the hypothalamus is very complex, it can be said that there is no important activity in our body that is not regulated by the hypothalamus.

1. regulation of body temperature;
2. regulation of food and liquid intake (feelings of hunger/fullness, feeling of thirst);
3. regulation of sexual behavior and probably also sexual orientation;
4. regulation of emotions - involvement in the limbic system;
5. regulation of circadian (24-hour) rhythms, including sleep, and rhythms with a longer period (onset of puberty)
6. superior structure for the autonomic nervous system;
7. superior structure for hormonal regulation;

- production of releasing and inhibiting factors for the adenohypophysis;
- production of hormones of the neurohypophysis (ADH (vasopressin) + oxytocin): mainly ncl. supraopticus and ncl. paraventricularis.

The function of the hypothalamus (as well as other areas of the brain) is investigated by a series of experiments (for example on rats), in which individual areas are stimulated with an electrode or their function is eliminated by damage. The data obtained on experimental models are supported/compared with the description of individual clinical case studies, in which the patient's symptoms are known, as well as specific brain damage caused by disease.

For example, damage to the tuber cinereum causes atrophy of the gonads, damage between the tuber cinereum and chiasma opticum causes premature sexual development (hypogenitalism or, on the contrary, pubertas praecox − premature puberty, then they can be one of the symptoms of a tumor in this area in humans). Stimulation or damage to other areas lead for example to excessive or minimal intake of food or liquids, behavioral disorders (initiation of aggression, panic attacks, violent laughter), sleep disorders, body temperature regulation disorders, autonomic innervation disorders, which are manifested as fluctuations in blood pressure or slowing of heart action.

## Sexual dimorphism of the hypothalamus

Some nuclei of the hypothalamus are a typical (but not the only) example of morphological (and functional) differences between the male and female brain. There are several nuclei in the hypothalamus, which are 1.5–3× larger in men than in women (they also contain 1.5–3× more neurons). It seems that some of these nuclei are statistically significantly smaller in homosexual men than in heterosexual men. On the contrary, some of these nuclei are statistically significantly larger in homosexual women compared to heterosexual women.

Women, on the other hand, have a larger commissura anterior and a more often present and larger adhesio interthalamica, i.e. structures connecting the hemispheres, compared to men.

## Links

### Related articles

- Diencephalon
- **Hypothalamus hormones:** ADH

### External links

- Hypothalamus, Neuroanatomy (http://www.neuroanatomy.wisc.edu/coursebook/neuro2(2).pdf)
- What is hypothalamus, News Medical (https://www.news-medical.net/health/What-is-the-Hypothalamus.aspx)

### References


1. BAO, Ai-Min a Dick F SWAAB. Sexual differentiation of the human brain: Relation to gender identity, sexual orientation and neuropsychiatric disorders. *Front Neuroendocrinol* [online]. 2011, vol. 32, no. 2, s. 214-26, dostupné také z <https://www.ncbi.nlm.nih.gov/pubmed/21334362>. ISSN 0091-3022 (print), 1095-6808.
2. ↑ SWAAB, D F, W C CHUNG a F P KRUIJVER, et al. Structural and functional sex differences in the human

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