Thalamus

The thalamus arises from thediencephalon, the secondary brain vesicle, which is created in the area of the prosencephalon (of the primary frontal lobe). For mammals, its considerable expansion related to the development of higher brain functions, which occurs in these animals, is characteristic. It consists of a large number of groups of neurons, nuclei (see below). In general, we can say that the function of the thalamic nuclei is the integration and conversion of signals from the lower divisions of the nervous system (spinal cord, brainstem and the cerebellum) and the basal ganglia into the cerebral cortex and the striatum. Some cores are also a part of the limbic system or motor control circuit. The transmission of signals does not take place only in one direction, but is reciprocal.

External description of the thalamus

Thalamus (MRI)

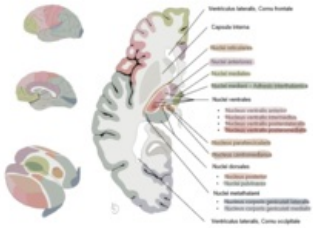
The thalamus is a paired ovoid structure, on the frontal section it has a rounded triangular shape. We can therefore distinguish a medial, dorsal and lateral surface on it. It extends anteriorly in the tuberculum anterius, posteriorly it expands into a cushion-like formation called the pulvinar thalami. On the dorsal surface of the lower part of the pulvinar we find two paired bumps – the *corpus geniculatum laterale* and the *corpus geniculatum mediale*.

The medial surface of the thalamus is turned to the thirdventricle of the brain. The thalamus of both sides are often connected by a bridge formed by the gray matter of the brain called adhesio interthalamica. In addition, on the medial surface we find the sulcus hypothalamicus, which separates the thalamus from the hypothalamus. A bundle of nerve fibers - stria medullaris - is visible at the junction of the medial and dorsal surfaces.

It attaches to the dorsal surface of the thalamus via the taenia choroidea telencephalon. In addition, on this surface we find the epithalamus, trigona habenularum and on the lower surface two paired bumps - corpus geniculatum mediale and laterale.

The lateral surface of the thalamus faces the capsula interna.

Nucleus caudatus adjoins the thalamus from the dorsolateral side .



Thalamic nuclei and tracts

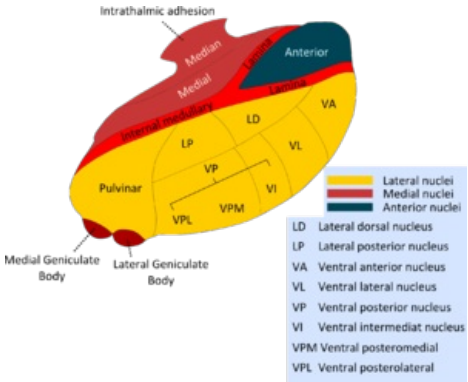
Types of neurons

In the thalamus, we encounter three types of neurons (projective, inhibitory and a specific type of neurons in the nucleus reticularis thalami), which we distinguish based on differences in morphology, mediators that are expressed in them and their projection to other areas of the nervous system.

- **Projective neurons** – they project to the cortex or striatum, these are excitatory neurons, and the glutamate is their mediator .
- **Inhibitory interneurons** – they inhibit projection neurons, their mediator is GABA.
- **Neurons nc. reticularis thalami** – they inhibit other thalamic nuclei, their mediator is also GABA.

Thalamic nuclei

As a thalamic nucleus we refer to a group of neurons that are under the influence of the same afferent and project to the same area of the cortex or telencephalon. The projections of the nuclei to the cerebral cortex are ALWAYS reciprocal, with the cortico-thalamic one being stronger (its job is to prevent the transmission of less important information to the cortex).



Nuclei of the thalamus

Basic groups of thalamic nuclei

1. **Ncc. anteriores** (nc. anterodorsalis, nc. anteroventralis, nc. anteromedialis) receive afferent connections from the corpora mammillaria, efferent connections to the gyrus cinguli, are part of the limbic system.
2. **Ncc. mediani** (ncc. paraventriculares anteriores et posteriores, nc. rhomboidalis, nc. Reuniens) are a part of the limbic system.
3. **Nc. medialis dorsalis** – it has both afferent and efferent connections with the prefrontal cortex.
4. **Nuclei intralaminares** (nc. paracentralis, nc. parafascicularis, nc. centralis lateralis, nc. centralis medialis, nc. centromedianus), receive afferent connections from the reticular formation, send efferent connections to the striatum and large areas of the cerebral cortex.

5. **Ncc. ventrolaterales** – are the largest group of thalamic nuclei, individual nuclei differ in afferent and efferent connections – nc. ventralis anterior (afferentation from nc. globosus, efferentation goes to the striatum), nc. ventralis medialis (afferentation from the cerebellum, efferentation to the motor areas of the cerebral cortex), nc. lateralis dorsalis et nc. lateralis posterior (both have efferents to the cortex of the occipital lobe and the cortex of the limbic system), nc. ventralis lateralis (efferentation to the motor areas of the cerebral cortex), ncc. ventrales posteriores (the so-called ventrobasal complex of the thalamus) including nc. ventralis posterolateralis (afferents from the lemniscus medialis and from the spinothalamic pathways) a nc. ventralis posteromedialis (afferent from the sensory components of the cranial nerves, efferent to the postcentral gyrus cortex).
6. **Ncc. posteriores** – pulvinar association nuclei (afferentation and efferentation to the cortex of the parietal and temporal lobes).
7. **Nc. corporis geniculati lateralis** – afferents receive through the tractus opticus and nervus opticus from the retina, efferents go to the visual cortex.
8. **Nc. corporis geniculati medialis** – afferent comes from inferior colliculus, efferent sends to acoustic cortical areas.
9. **Nc. reticularis** – afferents represent collaterals of thalamo-cortical and cortico-thalamic pathways, efferents to ncc. mediales and ncc. intralaminares, are part of the ascending activating system.

Other ways of dividing the thalamic nuclei

In addition to the anatomical division mentioned above, we can divide the nuclei of the thalamus in terms of their function and way of connection.

Division by function

- **Non-specific nuclei** – they are part of the ascending activation system(ncc. mediani, ncc. intralaminares).
- **Specific sensoric nuclei** – they ensure the transmission of signals from peripheral receptors to the corresponding cortical areas (nc. ventralis posterolateralis, nc. ventralisposteromedialis, nc. corporis geniculati lateralis, nc. corporis geniculati medialis).
- **Specific non-sensoric nuclei** – they are part of the limbic and motor control system (ncc. anteriores, nc. mediodorsalis, ncc. ventrales), they regulate emotional and memory functions (nc. mediodorsalis).
- **Associational nuclei** – they ensure the transfer of signals to association areas of the cerebral cortex (ncc. posteriores, ncc. laterales).

Division according to the method of connection

- **Nuclei relay** – they have one main subcortical entrance and project into a precisely defined cortical area.
- **Integrative nuclei** – they receive signals from multiple subcortical inputs, projecting into several cortical association areas.

Links

Connected pages

- Subthalamus
- Basal ganglia
- Hypothalamus
- Diencephalon

External links

- Diencephalon, About.com Biology (https://www.thoughtco.com/diencephalon-anatomy-373220)
- Diencephalon, Wikipedia (https://en.wikipedia.org/wiki/Diencephalon)

Literature

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- ČIHÁK, Radomír. *Anatomie 3.* 2. edition. Grada Publishing, 2004. pp. 692. ISBN 978-80-247-1132-4.