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Cerebellum and diencephalon

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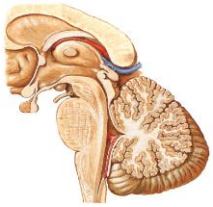
Department of Anatomy

Cerebellum



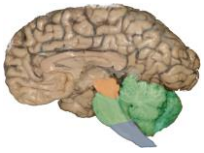
Inside the posterior cranial fossa

(fossae cerebellares)

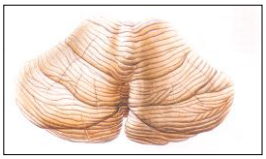
On the dorsal side of the brain stem

Together with the brains stem borders the 4th ventricle

fissura transversa cerebri (tentorium cerebelli) – divides from the occipital lobe



Cerebellum



130-150 g

Vermis cerebelli

Hemispheria cerebelli

Margo anterior
(incisura cerebelli ant.)

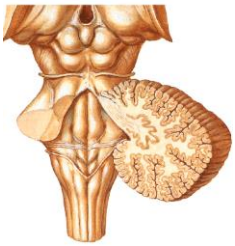
Margo posterior
(incisura cerebelli post.)

Pedunculus flocculi

Flocculus

Sulci cerebelli

Folia cerebelli



Connected with brain stem by three peduncles:

1. Pedunculi cerebellares sup. (mesencephalon)

   velum medullare sup.

2. Pedunculi cerebellares med. (pons Varoli)

3. Pedunculi cerebellares inf. (medulla oblongata)

   fastigium (vallecula cerebelli)

   velum medullare inf.

LOBUS ANTERIOR

Lingula (vinculum lingulae)

Lobulus centralis (ala lobuli centralis)

Culmen (lobulus quadrangularis sup.)

FISSURA PRIMA

LOBUS POSTERIOR

Declive (lobulus quadrangularis inf.)

Folium vermis (lobulus semilunaris sup.)

Tuber vermis (lobulus semilunaris inf.)

FISSURA HORIZONTALIS

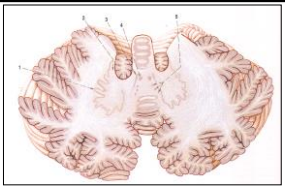
Pyramis (lobulus biventer)

Uvula (tonsilla cerebelli)

FISSURA UVULONODULARIS

PARS FLOCCULONODULARIS

Nodulus (flocculus)



Gray matter

cortex cerebelli

nuclei cerebelli (ncll. fastigii, ncl. globosi, ncl. emboliformis, ncl. dentatus)

White matter

arbor vitae

Functional division of the cerebellum:

1. **Vestibulocerebellum** (archicerebellum)

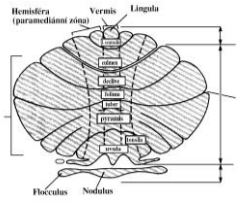
   lingula, pars nodulofloccularis

2. **Spinocerebellum** (palaeocerebellum)

   medial and paramedial zone of the lobus anterior and posterior

3. **Neocerebellum**

   lateral zone of the lobus anterior and posterior



Vestibulocerebellum (archicerebellum)

Control of balance, orientation in environment, coordination of eye movement

Direct afferentation from the vestibular apparatus,

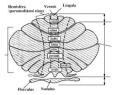
Bidirectional connection with the vestibular nuclei

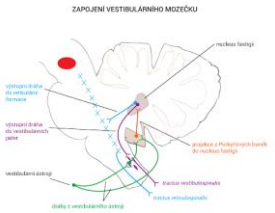
- tr. vestibulospinalis -> ncll. motorii (postural mm.)

Efferent connection with RF

- tr. reticulospinalis -> ncll. motorii (muscular tonus)

Connections with FLM (eye movement coordination and head





Spinocerebellum (palaeocerebellum)

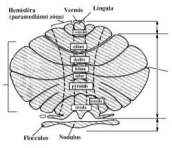
Processing of infromation from the locomotor system, control of muscular tone, coordination of movements

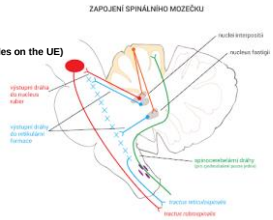
Proprioception: tr. spinocerebellaris ant. et post., tr. cuneocerebellaris, tr. trigeminocerebellaris

Efferent pathways:

to RF – tr. reticulospinalis (muscular tone)

to ncl. ruber – tr. rubrospinalis (coordination of muscles on the UE)





Neocerebellum (neocerebellum)

Coordnination of movements, muscular tone

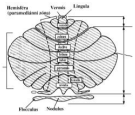
Afferentation from the cortex:

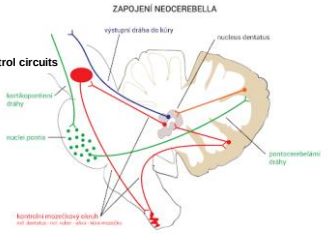
tr. cortico – ponto - cerebellaris)

efferentation:

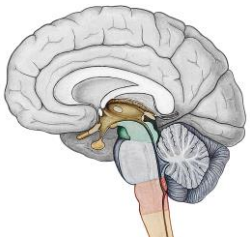
ncl. ruber – ncl. olivares – cerebellum– control circuits

thalamus – to the motor cortex





Diencephalon (hindbrain)



Thalamencephalon

(alar plate - sensory)

- Thalamus
- Epithalamus
- Metathalamus

sulcus hypothalamicus („sulcus limitans")

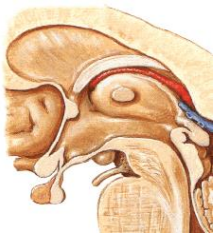
Hypothalamus and subthalamus

(basal plate - motor)

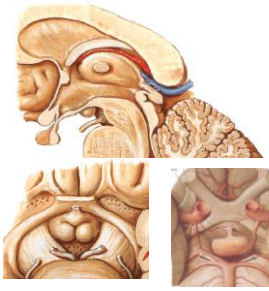
Rostral side of the diencephalon

Lamina terminalis

(between commisura anterior and chiasma opticum)



Basal side of the diencephalon



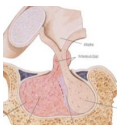
Chiasma opticum

Infundibulum

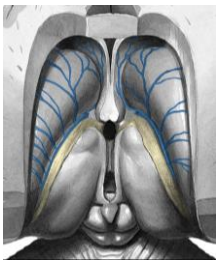
Hypophysis cerebri

Tuber cinereum

Corpora mamillaria



Dorsal side of diencephalon



Thalamus

Tuberculum thalami anterius

Pulvinar thalami

Stria terminalis
(vena thalamostriata)

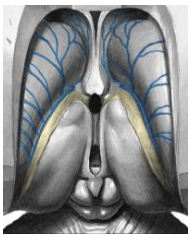
Lamina affixa thalami

Taenia choroidea
(tela choroidea ventriculi lateralis)

Stria medullaris thalami
(tela choroidea ventriculi tertii)

Epithalamus

Dorsal side of diencephalon



Epithalamus

Stria medullaris thalami

Trigonum habenulae

Commissura habenularum

Commissura posterior

Corpus pineale (epiphysis)

Posterolateral side of the diencephalon

Metathalamus

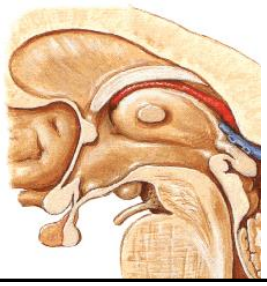
corpus geniculatum mediale

(auditory pathway)

corpus geniculatum laterale

(visual pathway)

Medial side of the diencephalon



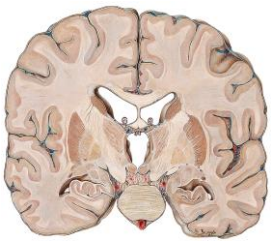
Lateral wall of the third ventricle

sulcus hypothalamicus

(foramen interventriculare - aquaductus cerebri)

adhesio interthalamica

Lateral side of the diencephalon

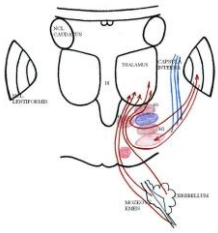


Connected with telencephalon

(capsula interna, nucleus caudatus)

Subthalamus

ventrocaudally from thalamus and lateral from hypothalamus



Field of Forel H_1

(fasciculus thalamicus)

Zona incerta
(gray matter)

Field of Forel H_2

(fasciculus lenticularis)

ncl. subthalamicus (Luysi)

ncl. reticularis

substantia nigra and globus pallidus derived from subthalamus

Structure of the diencephalon

Alar plate (sensory)

epithalamus

thalamus + metathalamus

< sulcus hypothalamicus

Basal plate (motor)

hypothalamus

subthalamus

Thalamus

Paired gray matter structure of ovoid shape (tuberculum ant.; pulvinar thalami), afferentation to the cortex

lamina medullaris interna – divides the groups of nuclei

GROUPS OF NUCLEI

anterior – ncll. anteriores

medial – ventral (ventromediales)

dorsal (dorsomediales)

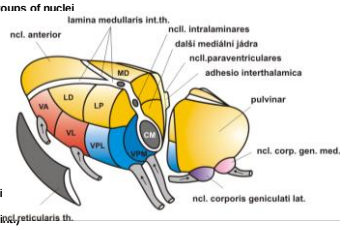
lateral – ventral (ventrolaterales!!!)

dorsal (dorsolaterales)

posterior – ncll. thalamici post. (ncll. pulvi

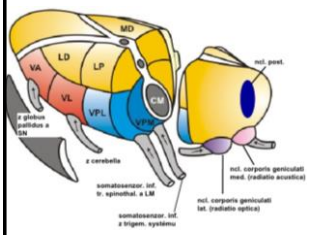
ncll. intralaminares (in lamina medullaris int.)

ncll. paraventriculares



SPECIFIC NUCLEI OF THE THALAMUS

Information about specific modality, precise somatotopic (retinotopic, tonotopic) formation



SOMATOSENSORY NUCLEI

VPL – ncl. ventralis posterolateralis

(LM: tr. bulbo-thalam.; tr. spinothalam.; tr. trigemino-thal.)

VPM – ncl. ventralis posteromedialis

(lemniscus trigeminalis)

SPECIAL SENSORY NUCLEI

ncl. corporis geniculati medialis (auditory p. – lemniscus lat.)

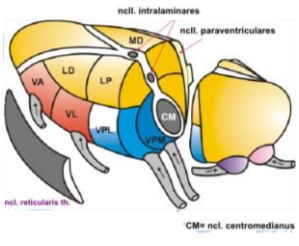
ncl. corporis geniculati lat. (visual pathway)

MOTOR FEEDBACK CIRCUITS

(VA) ncl. ventr. ant. (from BG, s. nigra to praemot.+ motor. cortex)

(VL) ncl. ventralis lateralis (from the cerebellum)

NONSPECIFIC NUCLEI OF THALAMUS



CM= ncl. centromedianus

interneurons

Similar as RF (ARAS, connection)

ncll. Intralaminares (ncl. centromedianus CM)

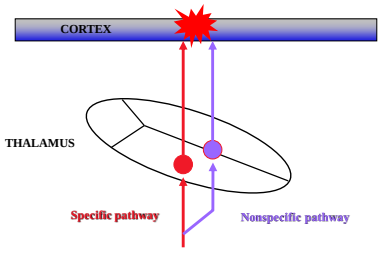
ncl. paravetriculares (mediani)

ncl. reticularis

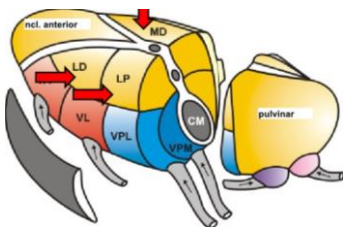
Integration of nuclear activity in thalamus

(strong afferentation from cortex)

AFFERENTATION TO THE CORTEX



ASSOCIATION AND INTEGRATION NUCLEI OF THALAMUS



ncll. anteriores (connection with limbic system)

from tr. mamillothal., hypothal. to gyrus cinguli

ncl. dorsomediales

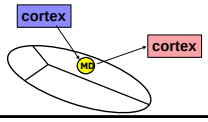
from limbic syst., from olfactory syst to praefront. c.

ncl. dorsolateralis (LD)

ncl. lateralis post.

ncl. pulvinares

Connection with all lobes of telencephalon



STRUCTURE OF HYPOTHALAMUS

Developed from the viseromotor zone of basal plate

Control of visceral reactions together with limbic system (rich connections) = „visceral brain"

(integrates afferent visceral information – received via interneurons)

contains nuclei controlling the sympaticus and parasympaticus

Towards the lower parts of CNS visceromotor information run via interneurons

(exception – fasciculus longitudinalis dorsalis and tr. tegmentalis centralis)

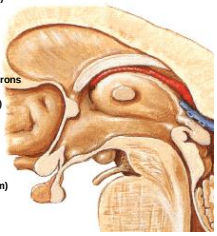
Hypothalamic function affected by chemical composition, pressure and temperature of blood

(control of homeostasis, body temperature, blood pressure and biorhytm)

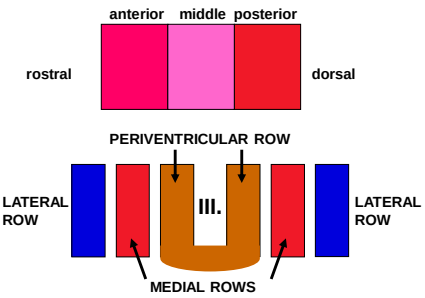
Coordination of neurohumoral controlling (hypothalamo-hypopysial system)

(hypophysis – neurosecretion, controls othe endocrine organs)

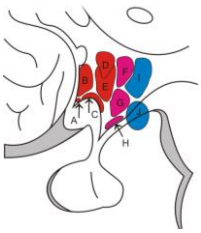
Nuclei around the 3rd ventricle



HYPOTHALAMIC NUCLEI



HYPOTHALAMIC NUCLEI



Ventral group

A – ncl. praechiasmaticus (cirkadian rhythm; tr. retino-hypothal.; pineal gl.)

B – ncl. praeopticus (sexual and maternity behav., homeostasis)

C – ncl. supraopticus (ADH)

D – ncl. paraventricularis (magnocel.- oxytocin; parvocel. - statins, liberiny)

E – ncll. anteriores (control of parasympaticus + similar f. as praeopticus)

Middle group

F – ncl. dorsomedialis

G – ncl. ventromedialis

} Food intake, control of sympathicus

H – ncl. arcuatus (seu infundibularis, statins + liberins)

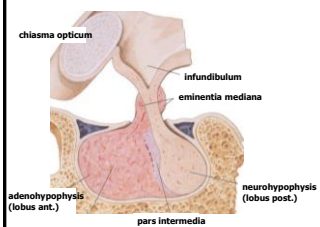
(ncll. tuberales – statins, liberins)

Posterior group

I – ncl. posterior (connection with RF)

J – ncl. mamillaris (limbic system)

HYPOPHYSIS CEREBRI



Hypophysis

Inside the sella turcica

DIVISION

lobus anterior (adenohypophysis)

glandular cells (STH, TSH, ACTH, LH, FSH, PRL)

stimulation of hypothalamo-hypophyseal portal syst.

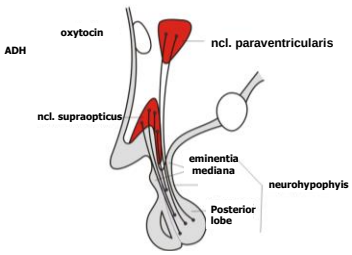
pars intermedia

lobus posterior (neurohypophysis)

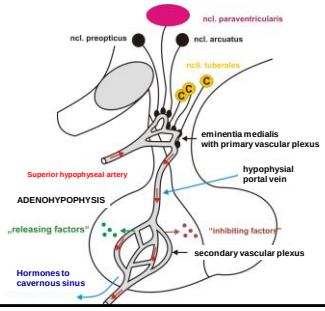
No glands, storage of hormones

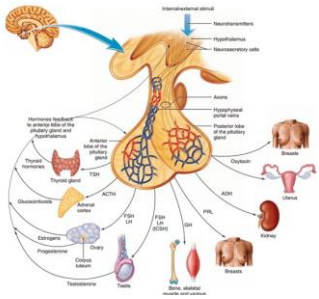
Hypothalamo-hypophyseal tract

HYPOTHALAMO-HYPOPHYSEAL TRACT



Hypothalamo-hypophysial portal pathway





https://me-pedia.org/wiki/Pituitary_gland

Subthalamus

Field of Forel H_1 (fasciculus thalamicus)

from the globus pallidus to thalamu between zona incerta and thal.

Zona incerta (regulation of water intake, motor f.)

Field of Forel H_2 (fasciculus lenticularis)

from globus pallidus to thalamu between zona incerta and ncl. subthalamicus

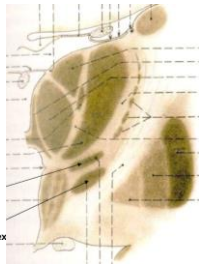
Ncl. subthalamicus (Luysi)

Processing of motor function

Connection with BG, sustantia nigra, ncl. ruber

Ncl. reticularis (only because of its position included to the subth.)

Integration of thalamic nuclei activity (strong afferentatioin from cortex



Epithalamus

Corpus pineale (epiphysis)

Phylonegenetically oldest – photosensitivity

Acumulation of calcium and phosphate (**acervulus cerebri**)

Melatonin prodction – decreased by light

melatonin - cirkadian rhytm, effect on hypopheseal function, genital glads, pigmentation (affect secretion of dopamine and serotonin, increases STH, cancer – pubertas praecox)

Stria medullaris thalami – connects hypothalamus with ncll. habenulares

Trigonum habenulae – ncll. habenulares

(tr. habenulointerpeduncularis – connection of the limbic systém with mesencephalon)

Commissura habenularum – connection of the habenular ncll.

Commissura posterior – connection with praetectal a. (synchron. pupilar. reflex)

References

Dubový, P., Jančálek, R.: Základy neuroanatomie a nervových drah I. Masarykova univerzita Brno, 2013

Dokládal, M., Páč, L.: Anatomie člověka III. Masarykova univerzita v Brně, 1995.

Čihák, R.: Anatomie 3. Praha, Grada, 2001, 2004

Sobotta, J.: Atlas of Human Anatomy Vol1 –2 Munich, Urban und Schwarzenberg, 1993

Páč, L., Vargová, L., Čuta, M. : Anatomie pro antropology III. Nadace universitas, Akademické nakladatelství CERM. Masarykova univerzita 2013.

Wiliams, P. & Warvick, R.: Gray´s Anatomy, 37 ed, Churhill Livingstone, 1996

Netter, F.: Atlas of Human Anatomy, 4th ed., Elseviesr, USA, 2006