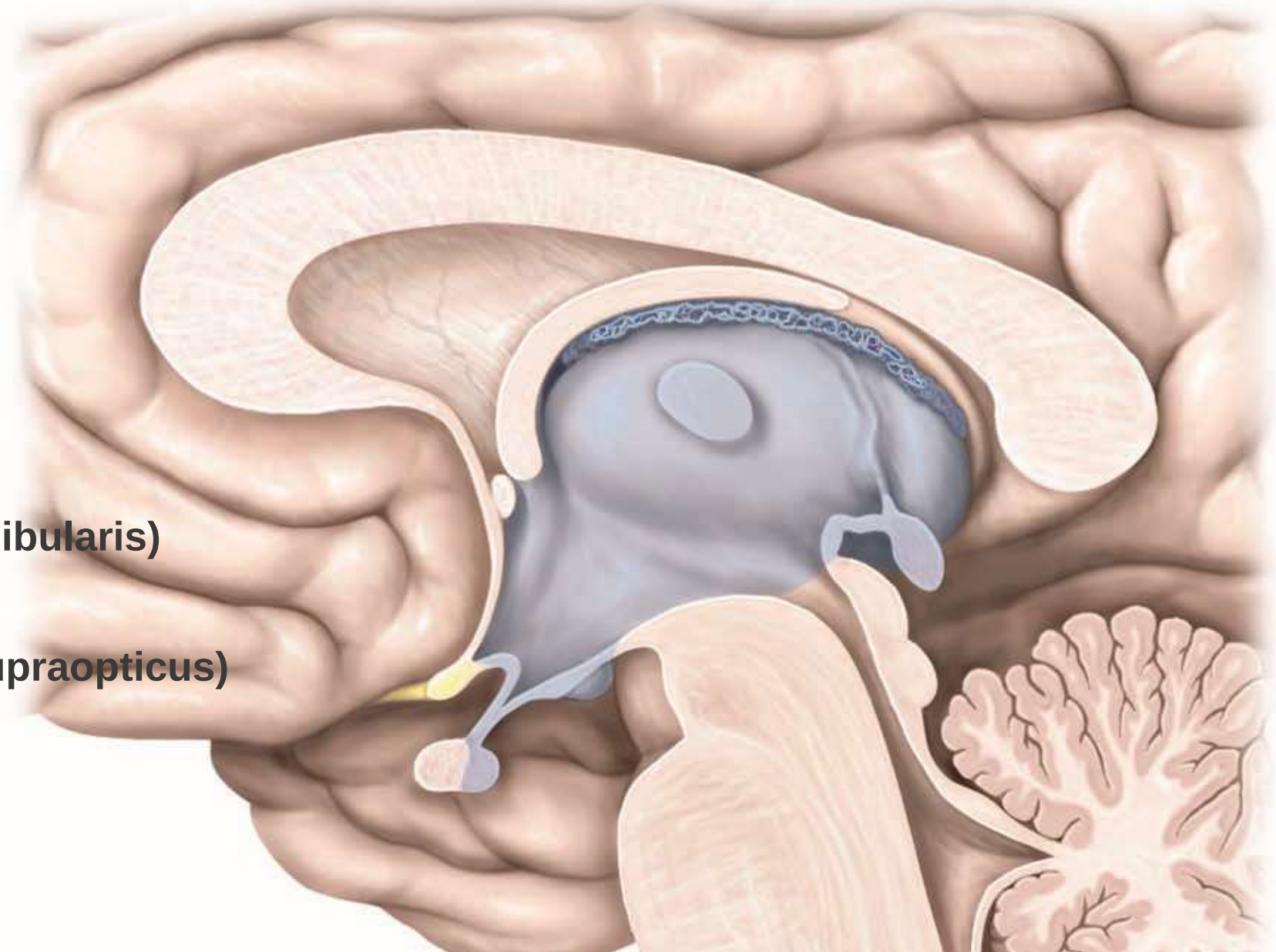
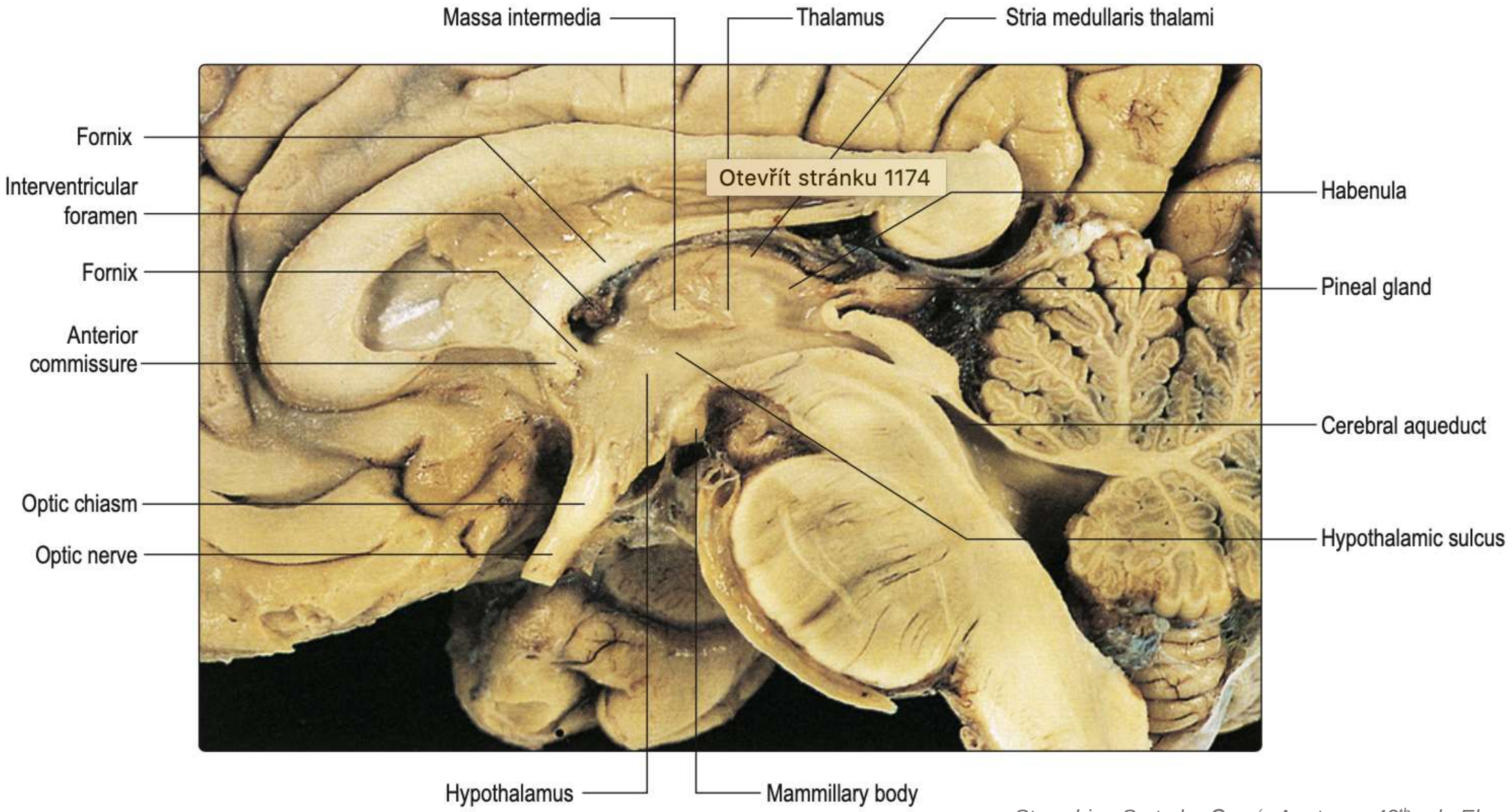
Neuroanatomy – diencephalon and basal ganglia

Diencephalon

- Plexus chorioideus
- Thalamus
- Adhaesio interthalamica
- Stria medullaris thalami
- Glandula pinealis
- Habenula
- Tuber cinereum
- Corpus mammilare
- Infundibulum (recessus infundibularis)
- Hypothalamus
- Chiasma opticum (recessus supraopticus)
- Area praeoptica
- Commisura anterior
- Fornix
- Lamina quadrigeminalis



Diencephalon



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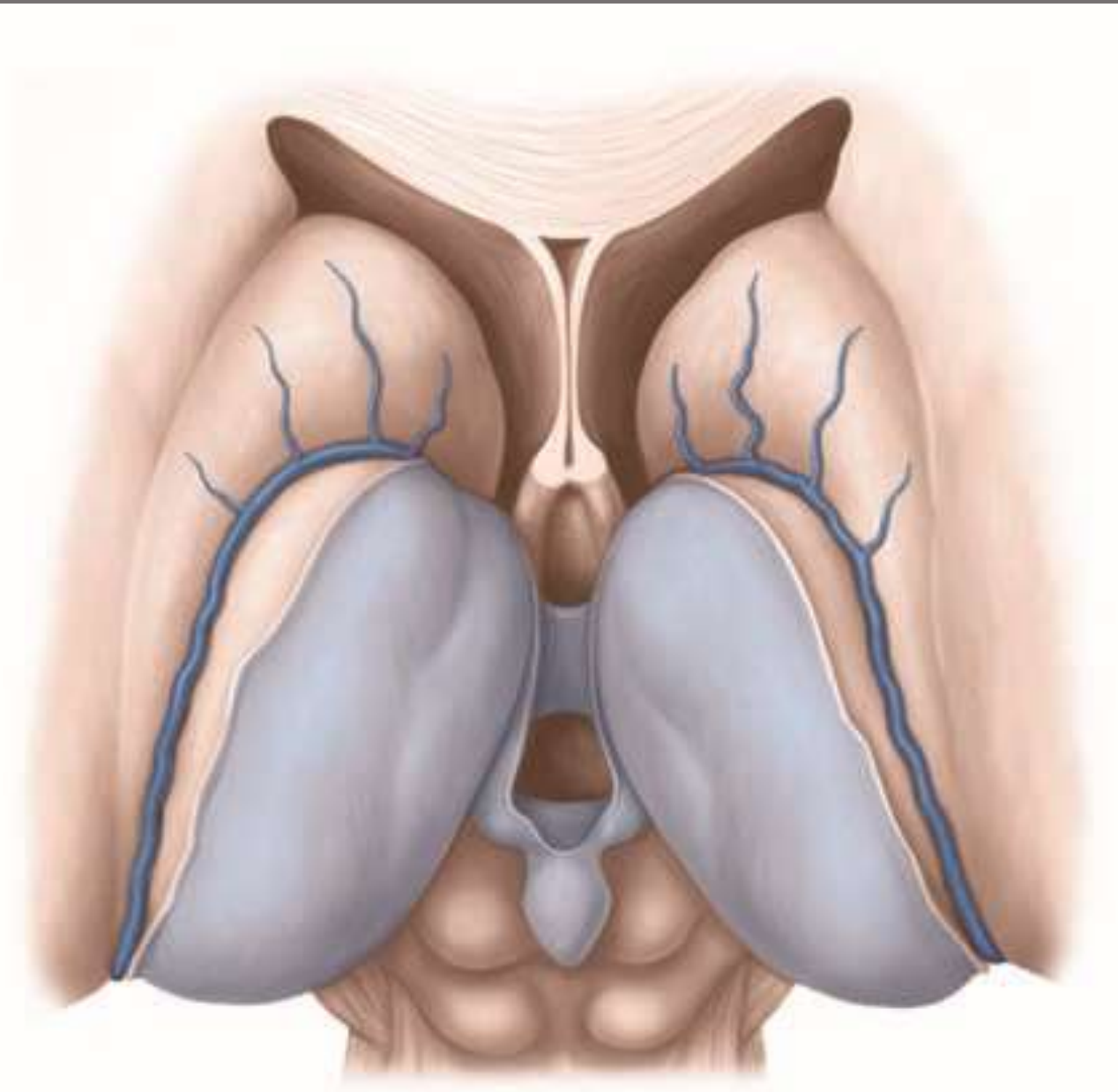
Diencephalon

- Thalamus
- Pulvinar thalami
- Glandula pinealis
- Brachium colliculi inferioris
- Corpus geniculatum laterale
- Tractus opticus
- Nervus opticus
- Infundibulum
- Corpus mammilare
- Lamina quadrigeminalis
- Pedunculus cerebri

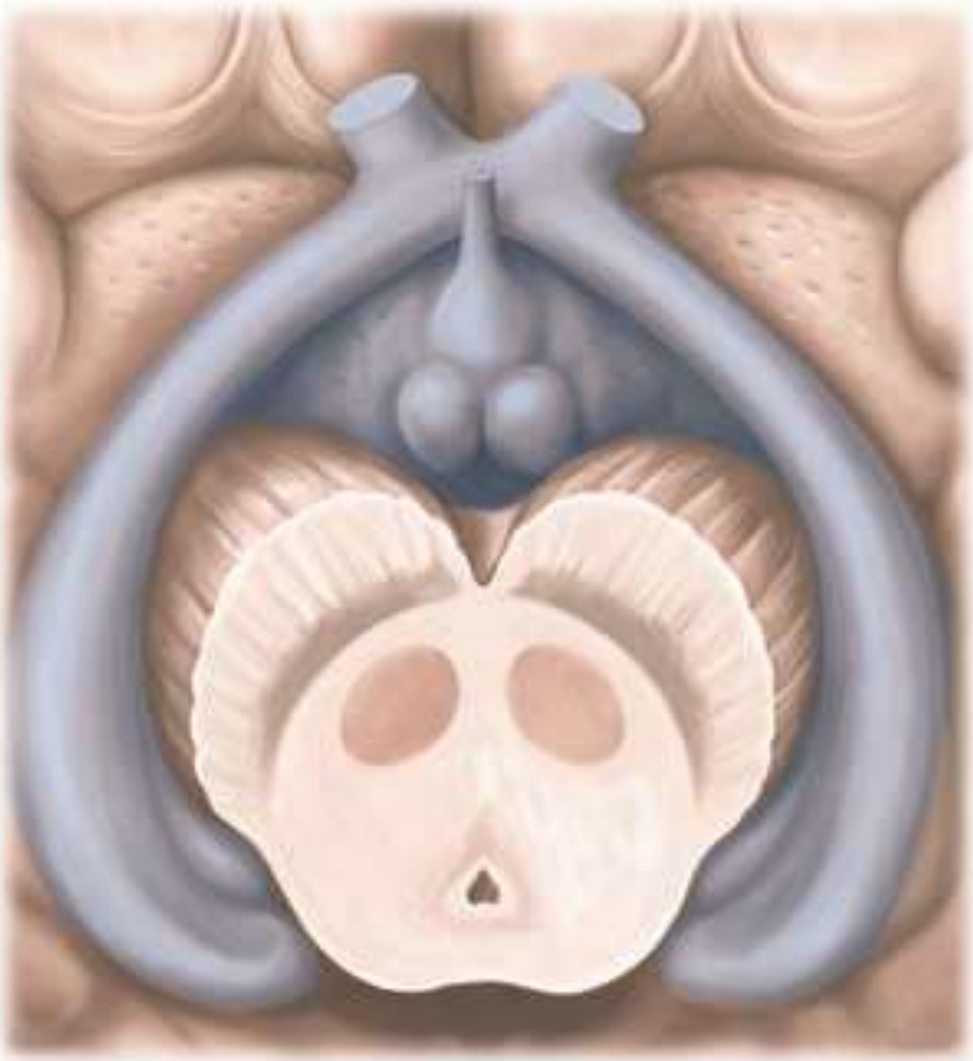
Diencephalon

- Thalamus
- Adhaesio interthalamica
- Pulvinar thalami
- Taenia choroidea
- Lamina affixa
- Habenula
- Glandula pinealis
- Lamina quadrigeminalis
- Vena thalamostirata
- Fornix
- Nucleus caudatus
- Septum pellucidum
- Corpus callosum



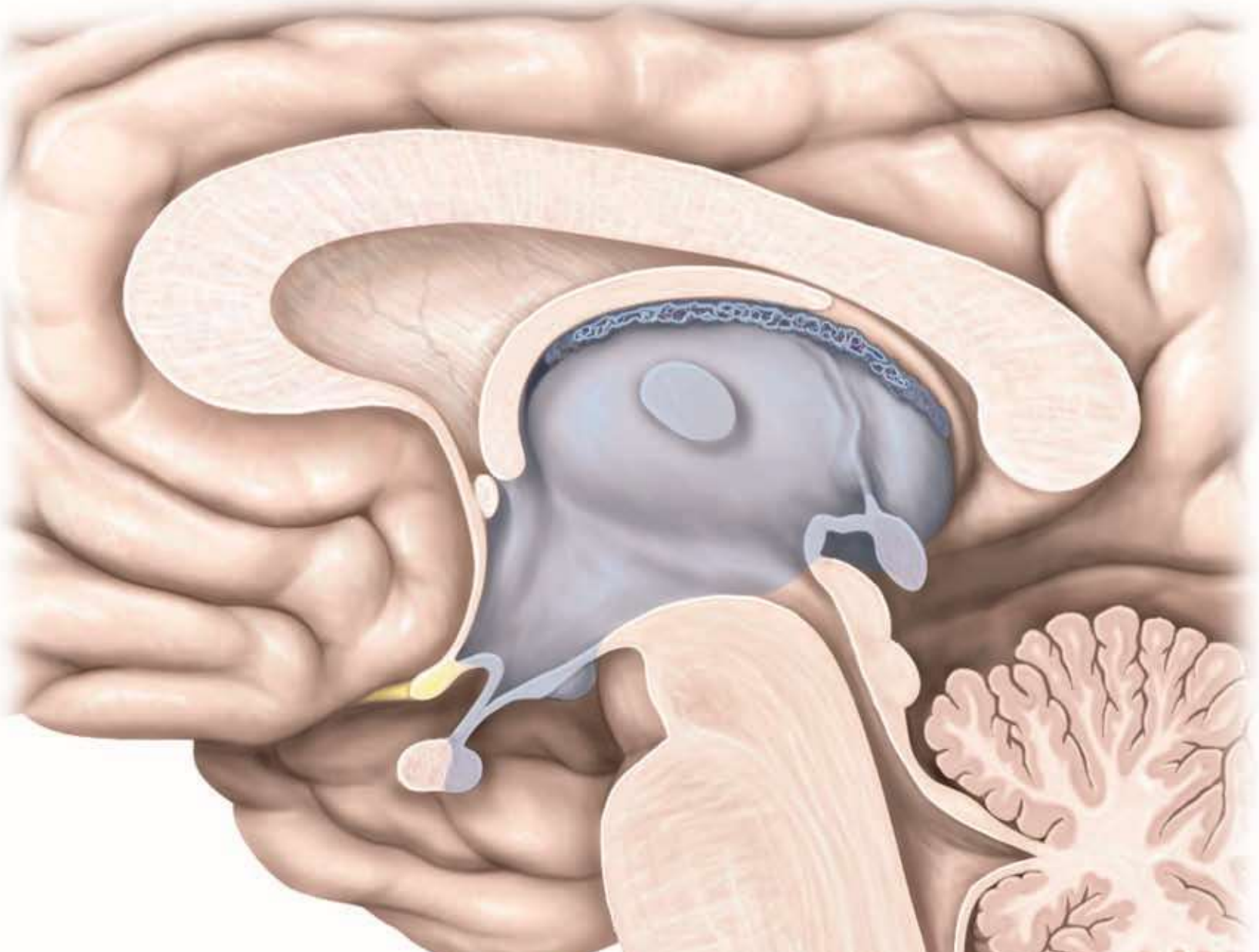
Diencephalon

- Nervus opticus
- Chiasma opticum
- Tractus opticus
- Corpus geniculatum laterale
- Infundibulum
- Tuber cinereum
- Corpora mammilaria
- Pedunculus cerebri
- Substantia nigra
- Nucleus ruber
- Tectum (lamina quadrigeminalisú
- Aquaeductus mesencephali



Diencephalon

- **Epithalamus**
  - Glandula pinealis
  - Habenulae
- **Thalamus**
- **Subthalamus**
  - Nucleus subthalamicus
  - Zona incerta
  - (globus pallidus)
- **Hypothalamus**
  - Chiasma opticum, tractus opticus
  - Tuber cinereum, neurohypofýza
  - Corpora mammilaria



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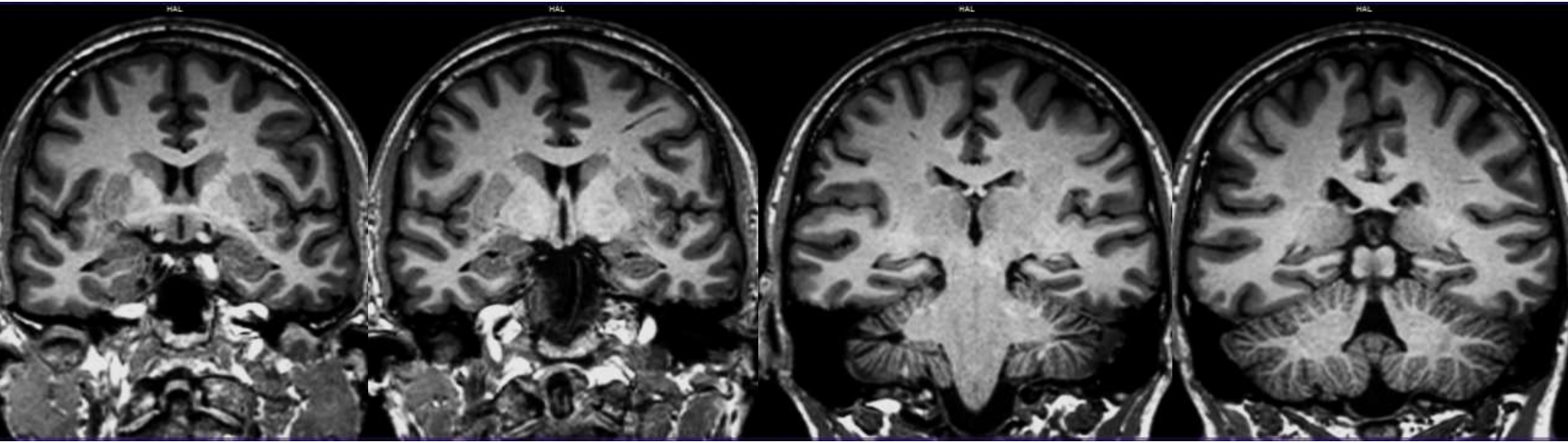

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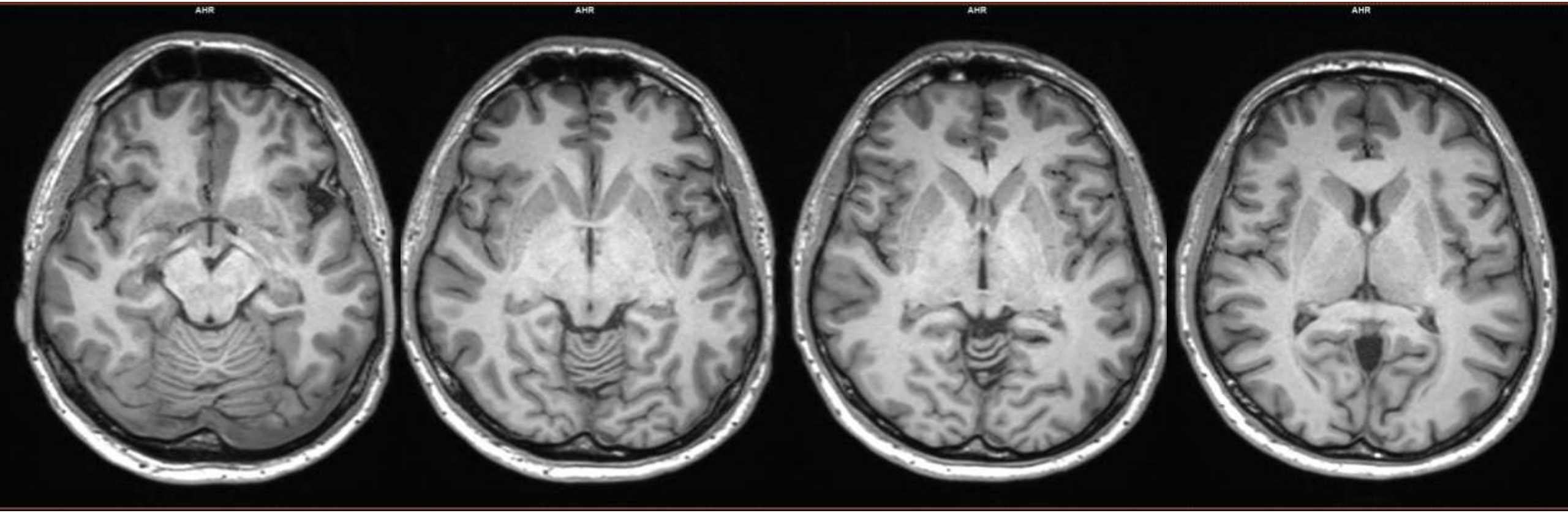

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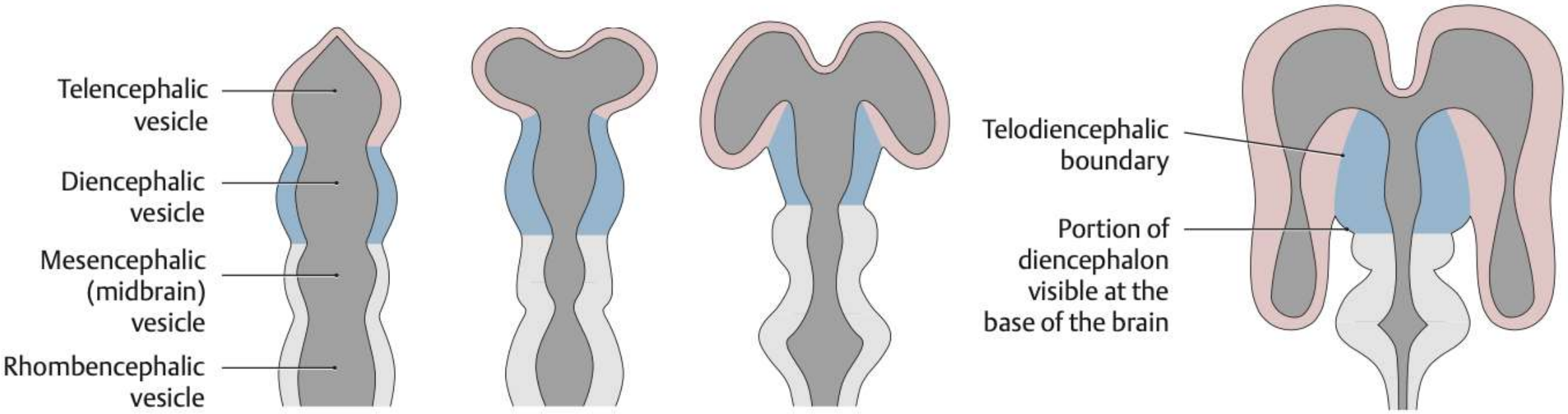
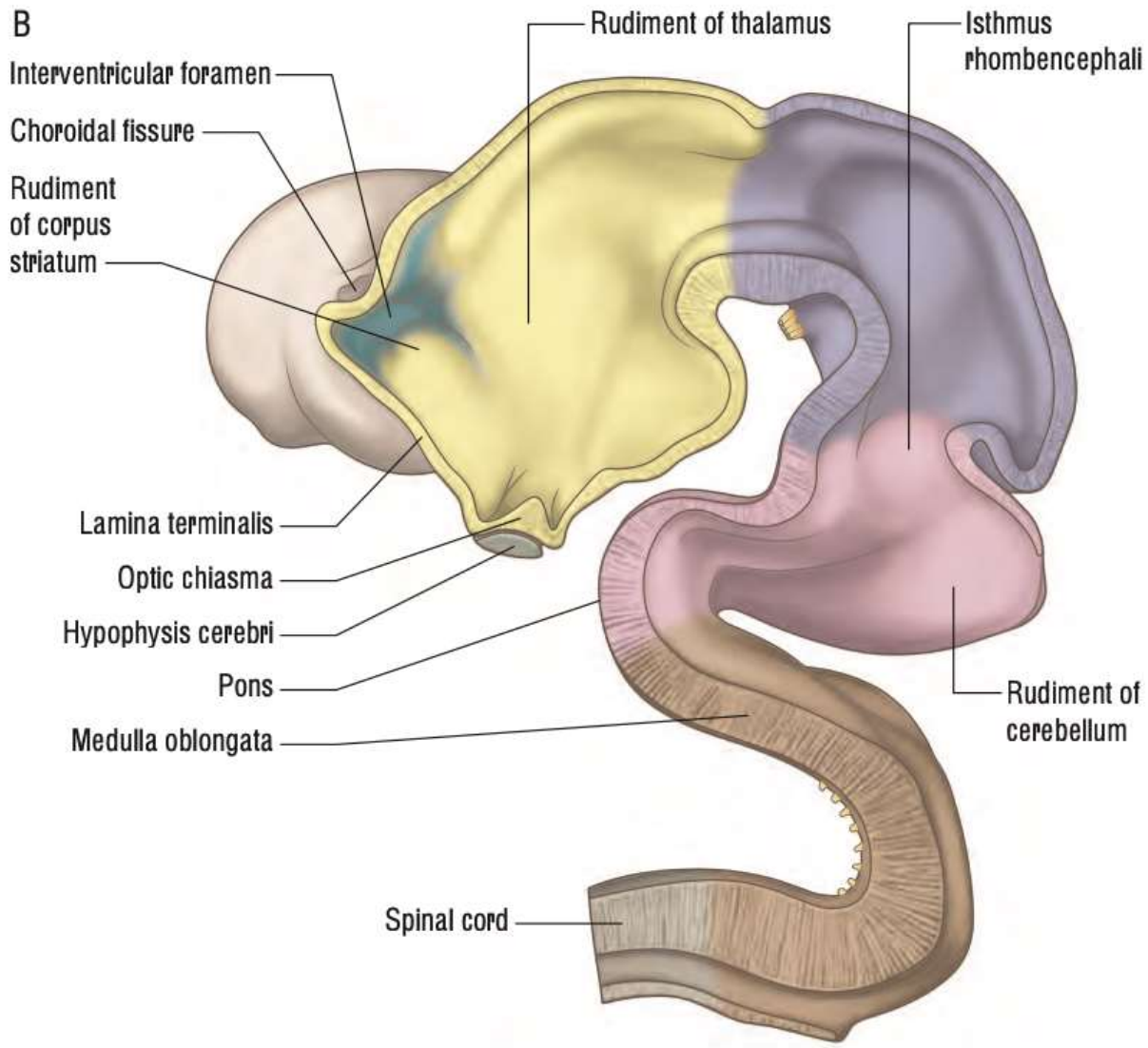


Diencephalon

- Developing from prosencephalon
- Originally tube-form
- Structures around III. ventricle
- Ventrally development of hypothalamus
- Dorsally development of thalamus thalamus
- Laterllaly eye forming sacs
- Neurons
  - Periventricular development
  - Peripheral migration to nuclei



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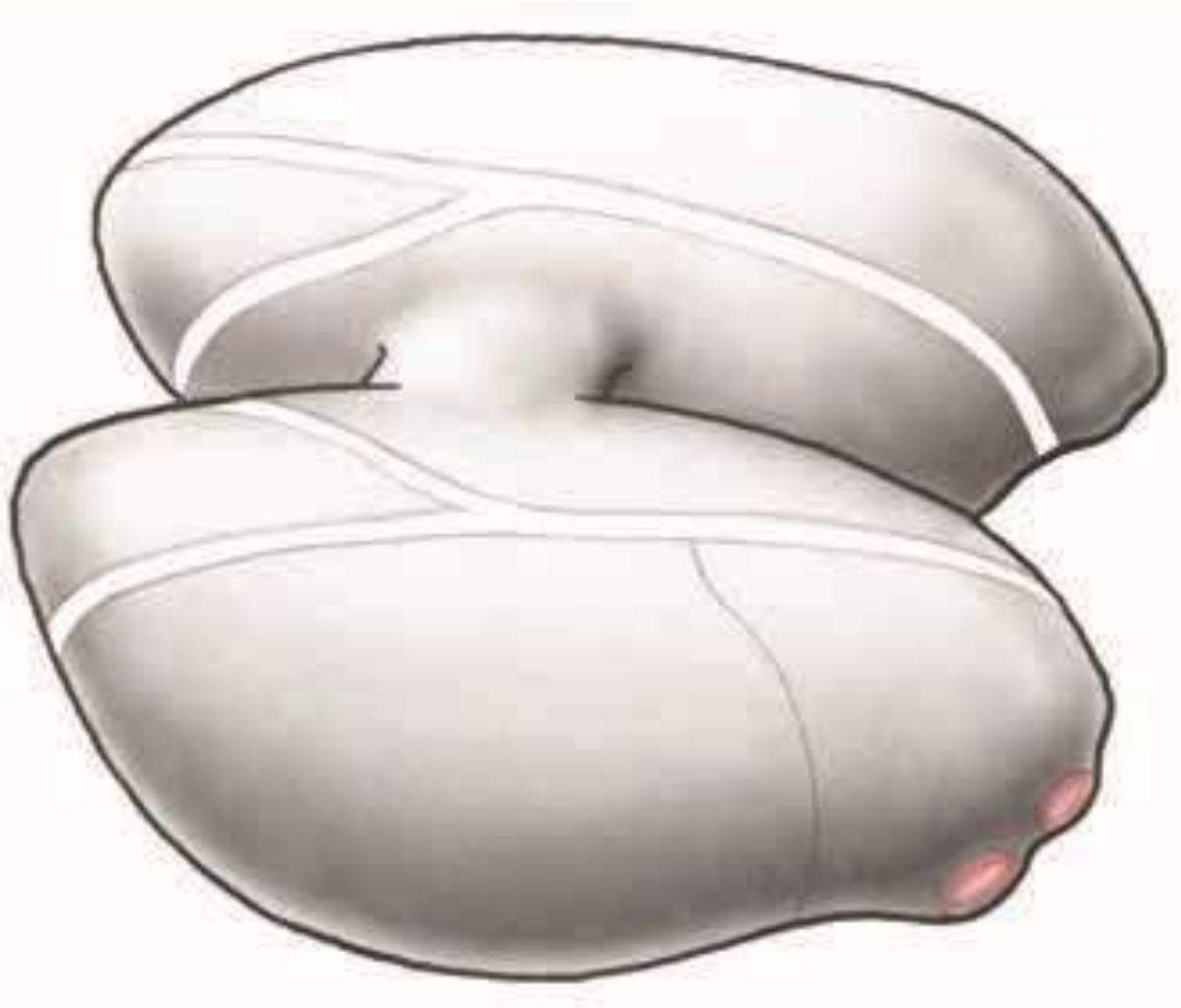
Thalamus

- **Tuberculum anterius thalami**
- **Lamina medullaris interna**
  - Y–like hhite matter bundle splitting the gray matter
- **Corpus geniculatum laterale**
- **Corpus geniculatum mediale**
- **Pulvinar thalami**
- **Adhesio interthalamica**

- ***function***
- *heterogenous*
  - *formerly „gate to mining “*
  - *Function based on the afferentation and projection*
- *Sensoric functions*
- *Motorics control*
- *Limbic system*



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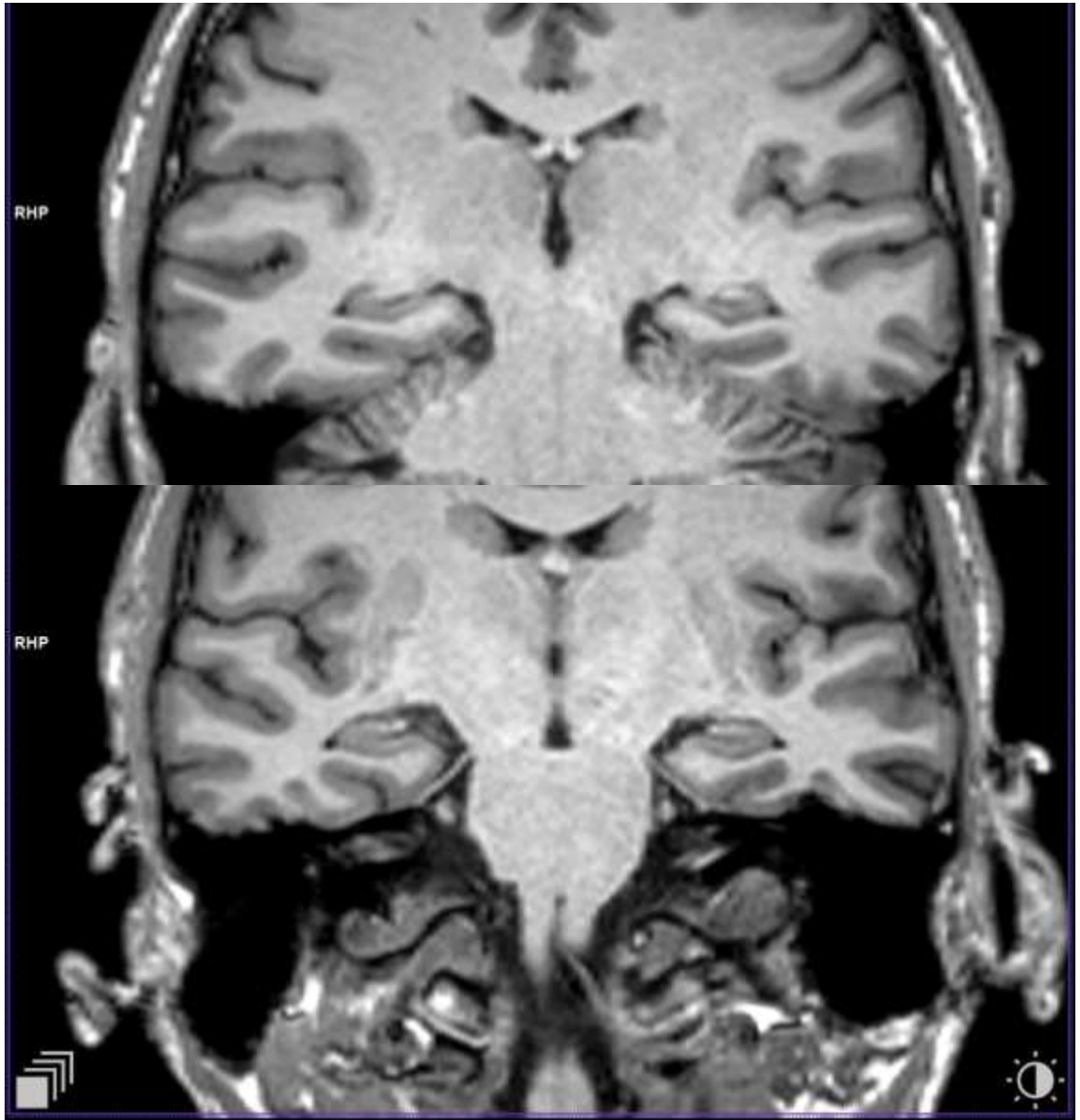
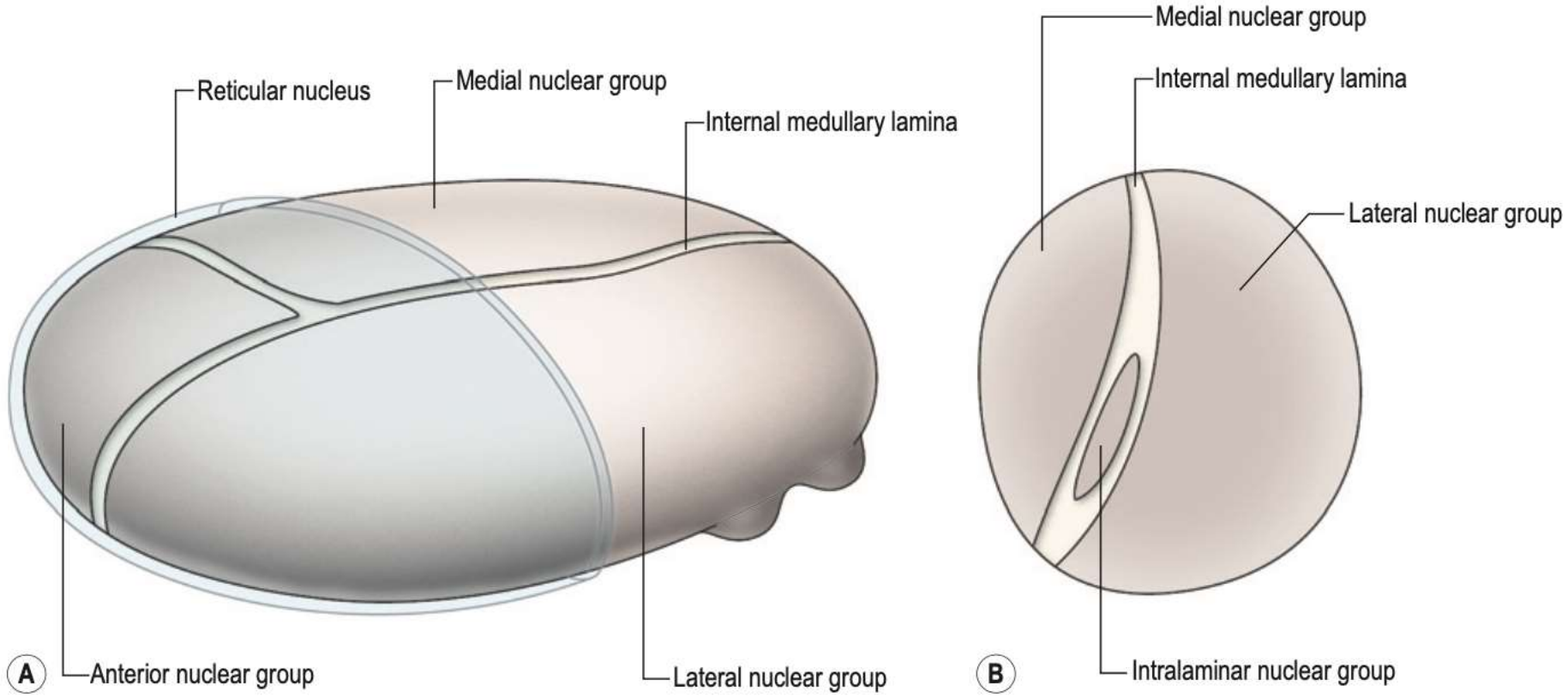
Thalamus

- Space relations
- Mdial surface
- III. ventricle
- Interthalamic adhesion – gray matter bridge
- Dorsolateral - nc. caudatus
- between thalamus and nc. caudatus
  - stria terminalis
- Dorsally on the surface of thalamus
- Epithalamus
  - Trigona habenularum
  - ncc. habenulares ending of stria terminalis
  - Trigona connected by commisura habenularium
  - on comissura habenularium hanged corpus pineale
  - Below comissura posterior epithalmica



Lamina medullaris interna

- White mater plate
- Inside nc. intralaminares
- Anteriorly, lamina medullaris interna is dividing and surrounding anterior thalamic nuclei



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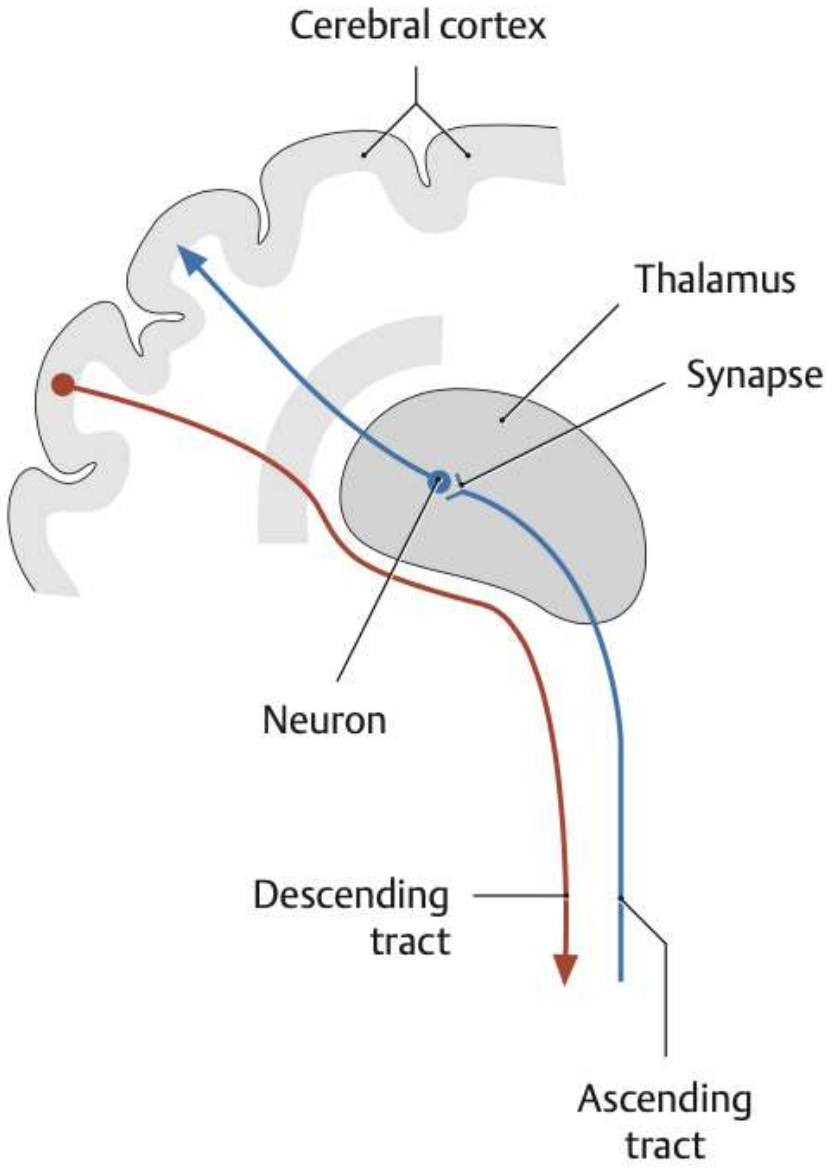
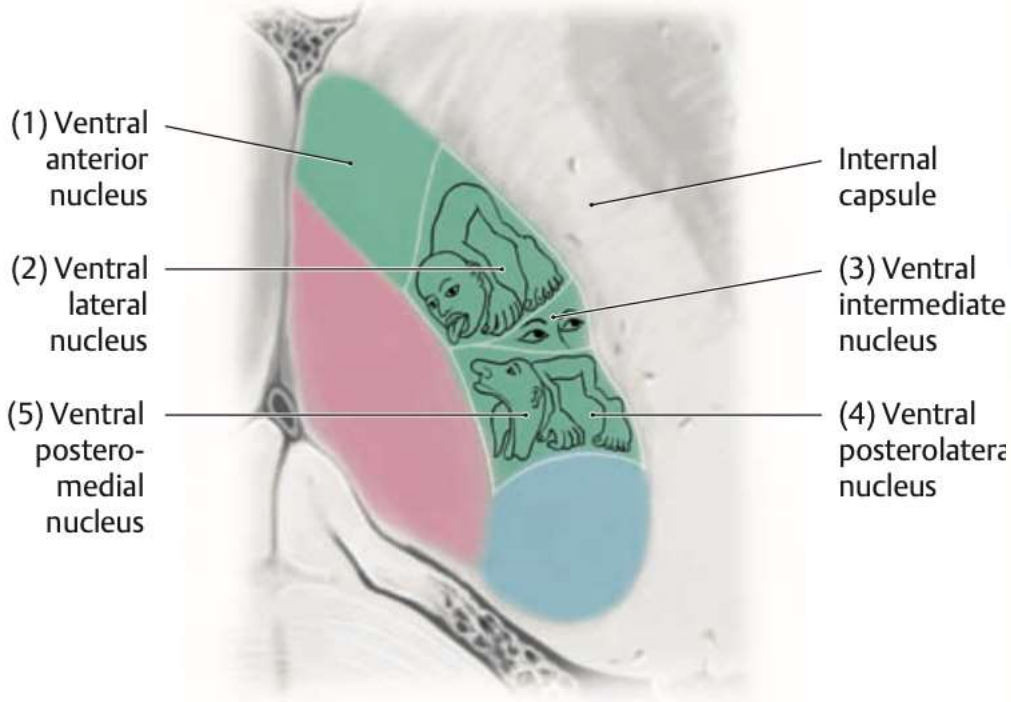
Thalamus

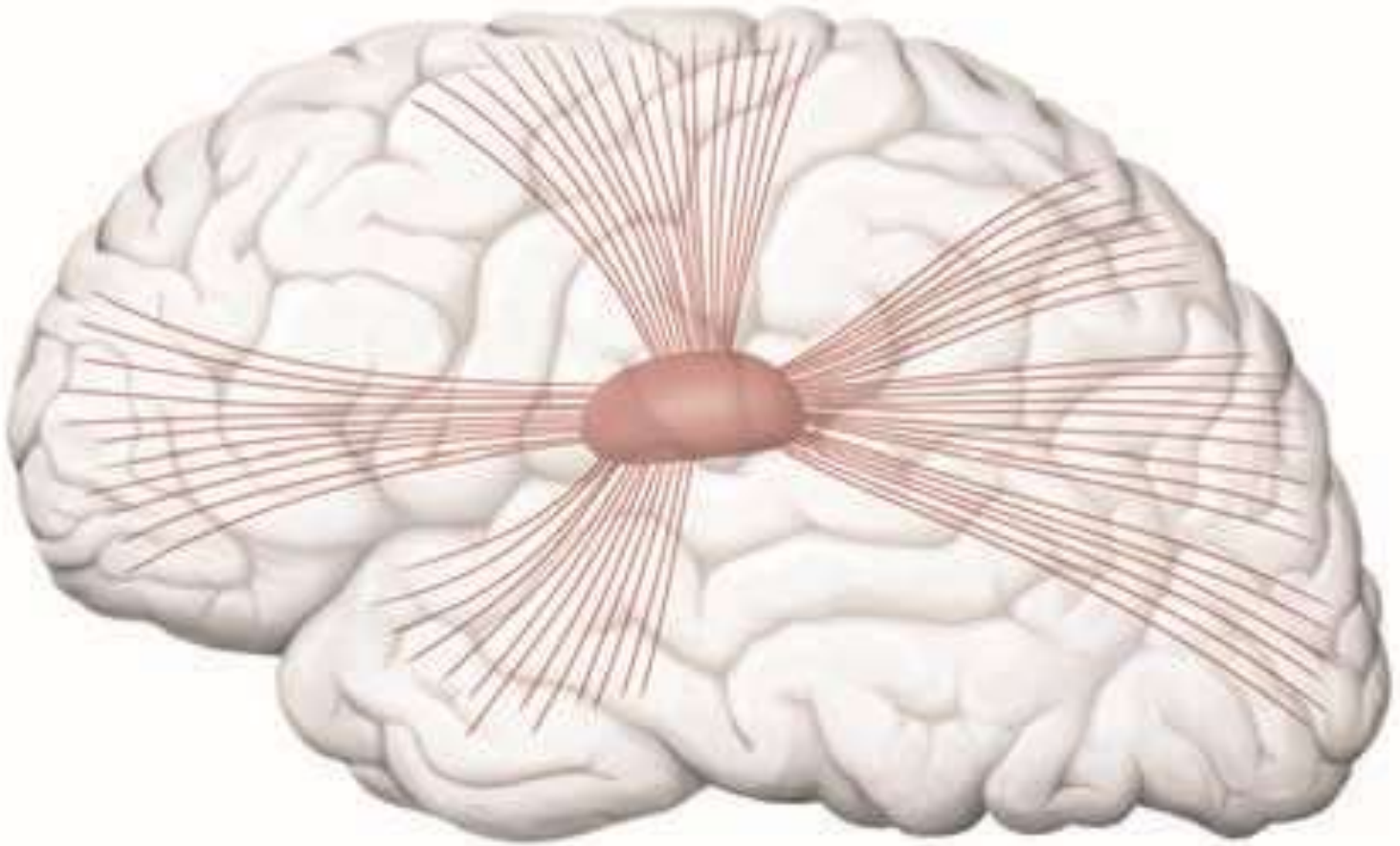
- **SPECIFIC NUCLEI**
  - *Projetion to cortex*
- **Nospecific nuclei**
  - *Projection to diencephalon, brain stem*
- **Integrating nuclei**
- **Intralaminar nuclei**
  - *lamina medullaris interna*

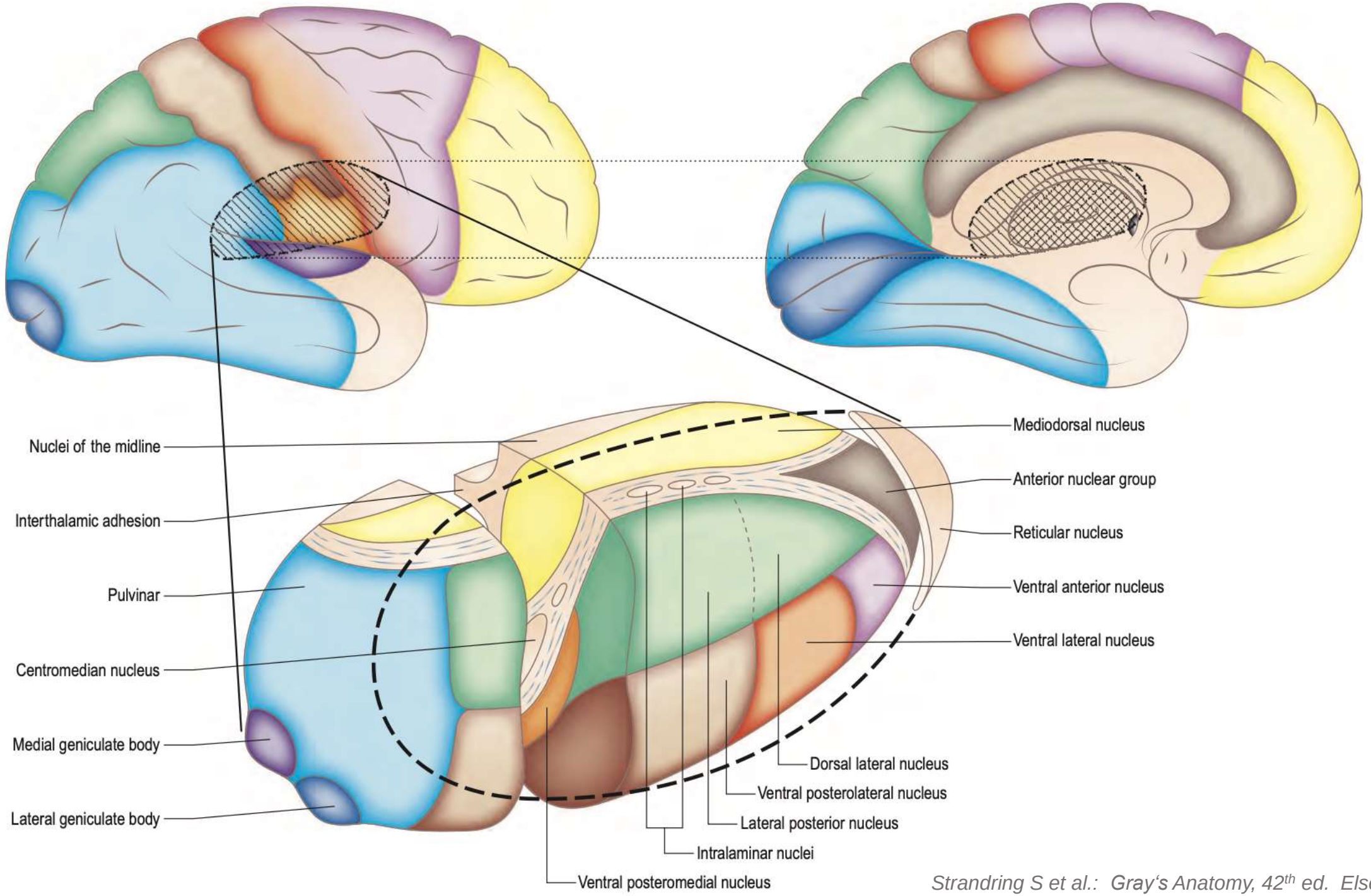


Thalamus

- **Specifická thalamická jádra**
  - *Projekce do cortexu telencefala (palia)*







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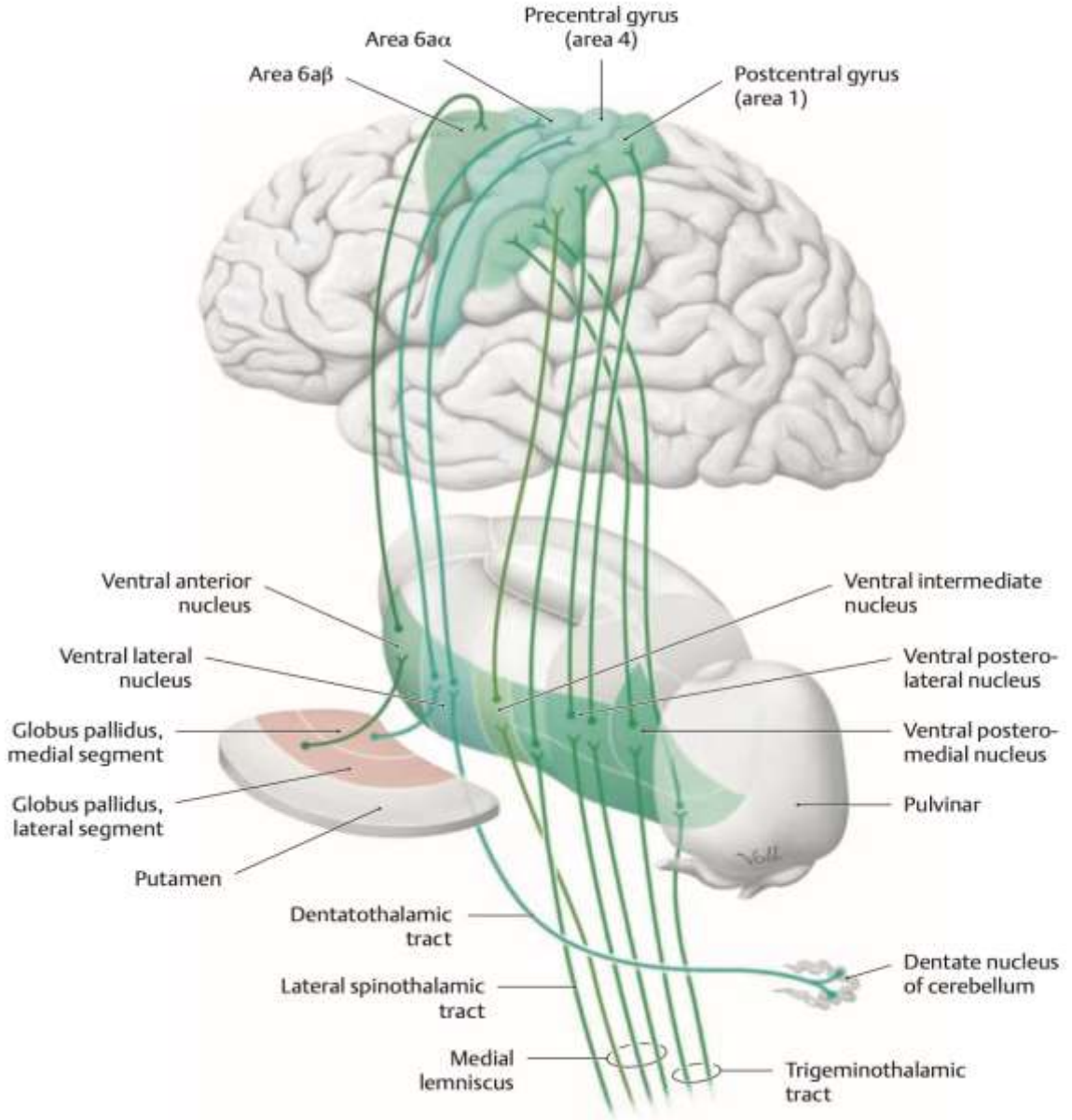
Thalamus

- **specific**
- **Sensoric relay**
- **Ventrolaterální jádra**
  - ***Nc. ventralis posterolateralis VPL***
  - *Lemniscus medialis*
  - *Tractus gracilis + cuneatus*
    - *Tactile and discrimination*
  - *Tractus spinothalamicus*
    - *Nociception and heat*
  - ***Nc. ventralis posteromedialis***
  - *Tractus strigeminothalamicus*
    - *Head pain and heat*

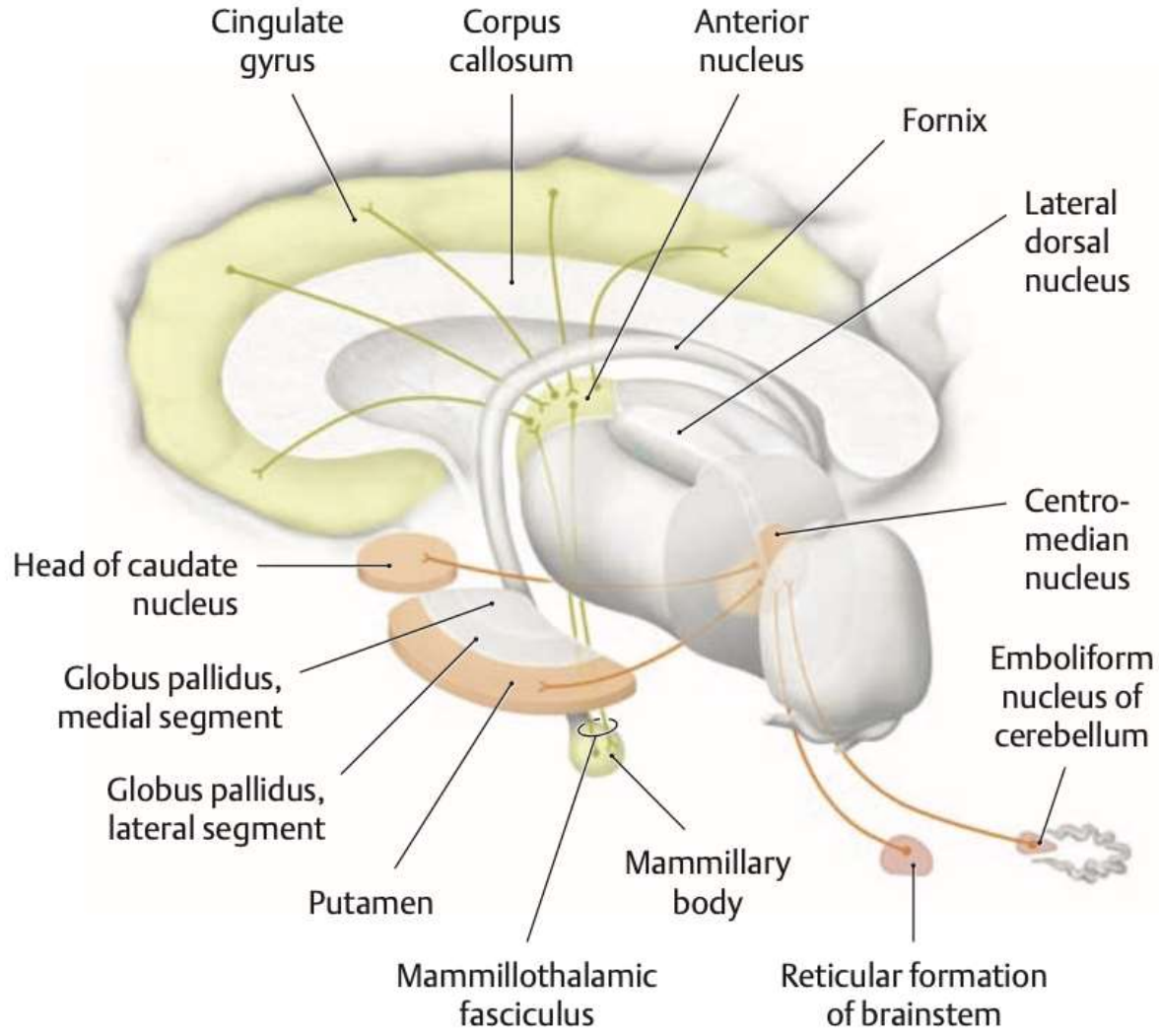


Thalamus

- **specific**
  -
- **Limbic**
- **Nc. anterior**
  - ***Gyrus cinguli***

- **nonspecific**

  - ***Nc. centromedianus***
  - *Ascending reticular activation system*
  - *(ARAS)*
  -

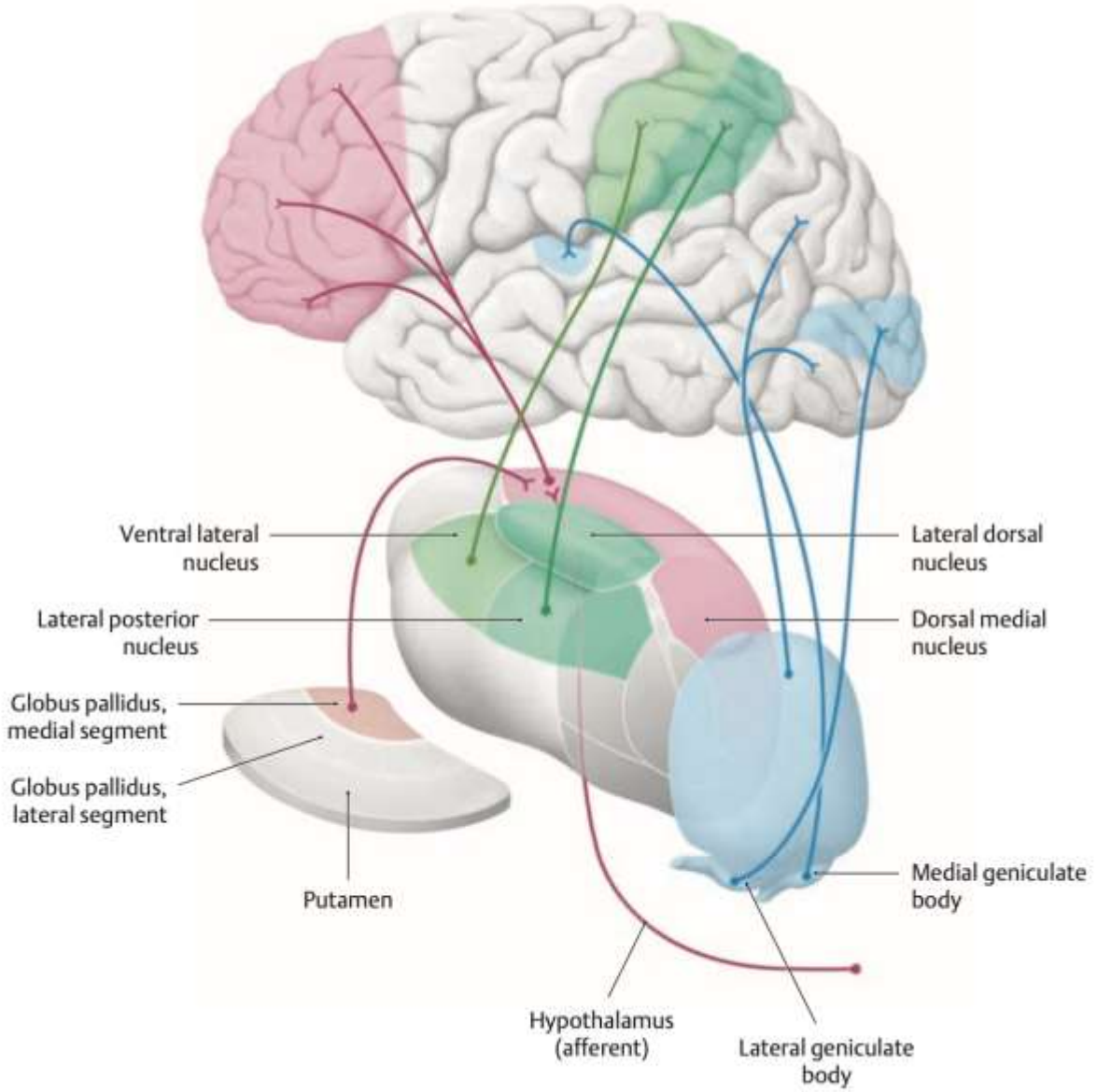


Thalamus

- **Medial nuclei**

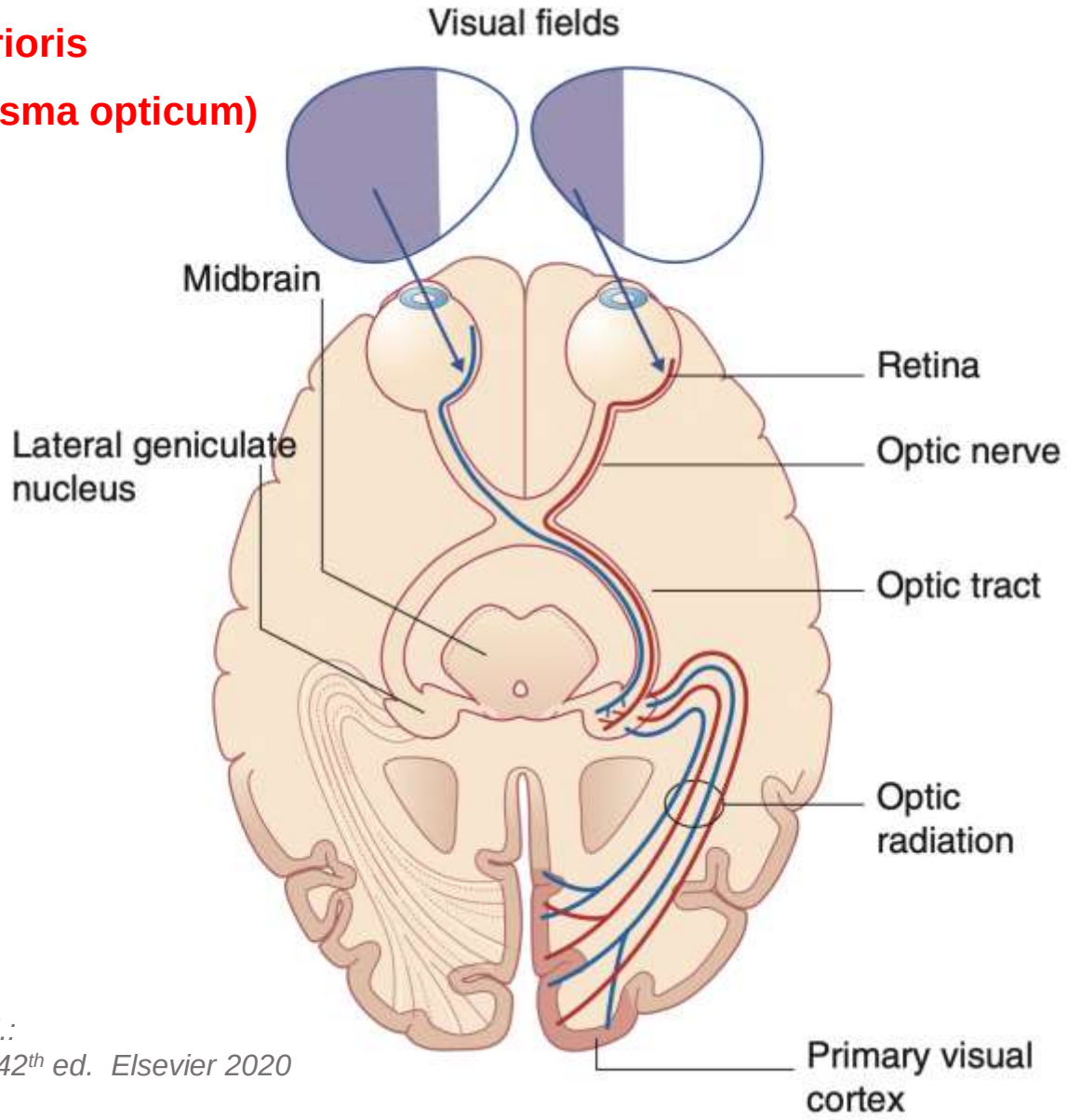
- **Laterla nuclei**
  - *Integrační funkce*

- **Dorsal nuclei**
  - ***Pulvinar***
  - ***Corpora geniculata***
  - *Hearing – mediale*
  - *Vision - laterale*



Nucleus of lateral genniculate body

- **Connection with colliculus superior – brachium colliculi superioris**
- **Connection with tractus opticus (retina - nervus opticus - chiasma opticum)**
- **LEFT visual field**
  - temporal half of retina from left eyeball
  - nasal half of retina from right eyeball
- **RIGHT visual field**
  - temporal half of retina from right eyeball
  - nasal half of retina from left eyeball
- **Six layers**
  - Lamina 1 and 2 – magnocellular
  - Lamina 4 to 6 - parvocellular
- **Spatial organisation of hte endings**
  - Upper quadrants medially
  - Lowerquadrants laterally
  - Layers 1, 4, 6 from contralateral eyeball
  - Vrstvy 2, 3, 5 from ipsilateral eyeball
- **Afferent connection**
  - radiatio optica (fasc. Grattioleti)
  - area 17 – occipitla lobe
  - Cortical image of the outer world



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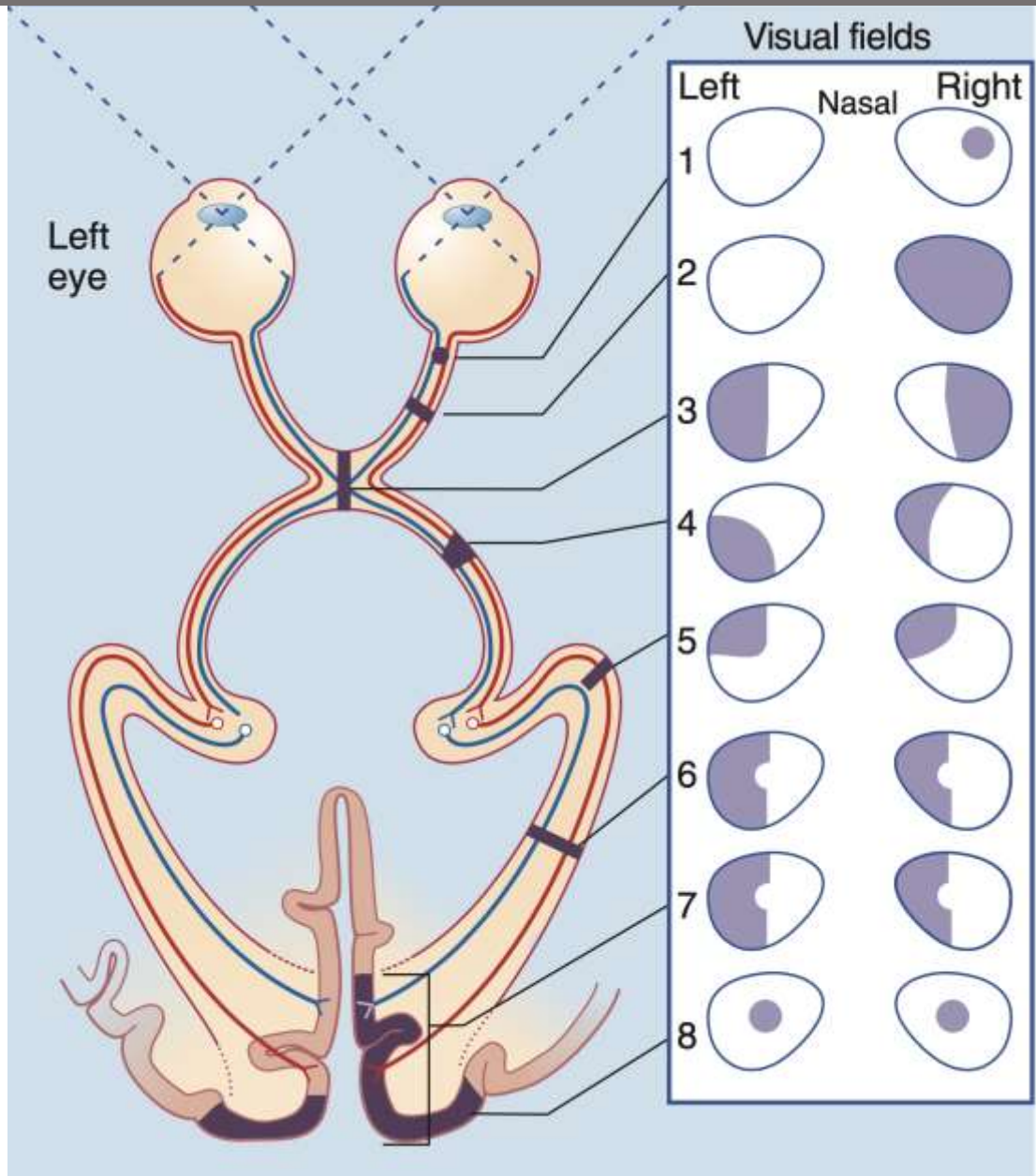
Hemianopsy

- **hemianopsy**
  - **Partial loss of viusal field vision**
- **Injury of nervus opticus – amaurosis**
  - **Loss of one eyeball vision**
- **Injury of chiasma – bitemporal hemianopsy**
  - **Loss of crossed visual information**
- **Injury of tractus opticus – hmonymous hemianopsy**
  - **Loss of a half part of the visual field**



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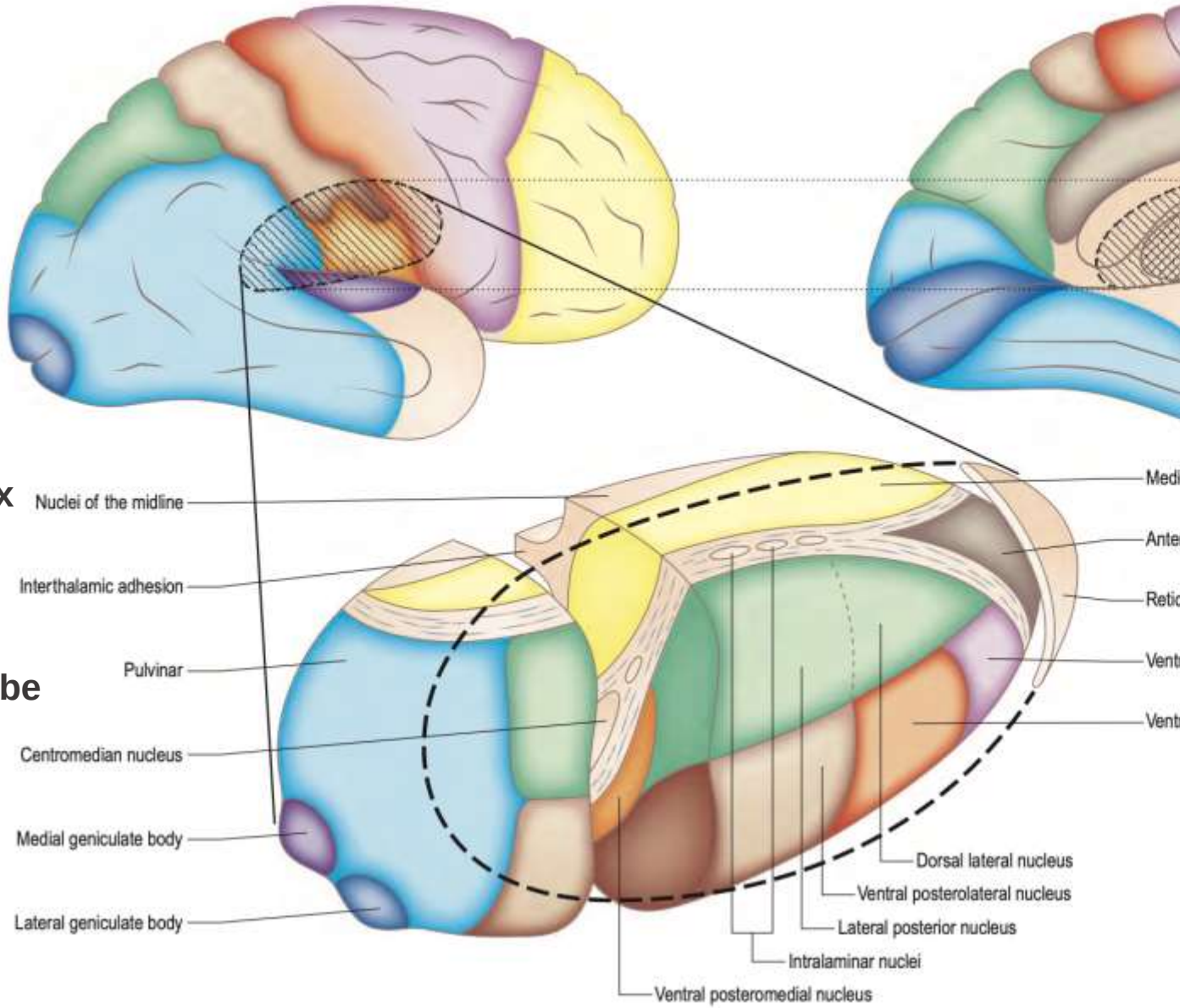
Nucleus of medial genniculate body

- **Afferent connection**
- **Brachium colliculi medialis**
- **Nucleus ventralis**
  - **Tonotopic organisation**
  - **To primary auditory cortex**
- *Nucleus dorsalis*
- *Nucleus medialis*
  - **Both projections to association auditory cortex**
- **Efferent connection**
- **Radiatio acustica**
  - **Posterior part of capsula interna to temporal lobe**



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Epithalamus

- **Brainstem circle fo the limbic system**
- Trigonum habenulare
- Nuclei habenulae medialis et lateralis
- **Afferent connections**
  - imput – stria medullaris thalami
  - septum verum
  - Olfactory areas of paleocortex, piriform area
  - archicortex (hippocampus)
  - hypothalamus
  - pallidum internum
- Comissura habenularia – vice-versa connection
- **Efferent connections**
  - Nc. interpeduncularis
  - Formatio reticularis

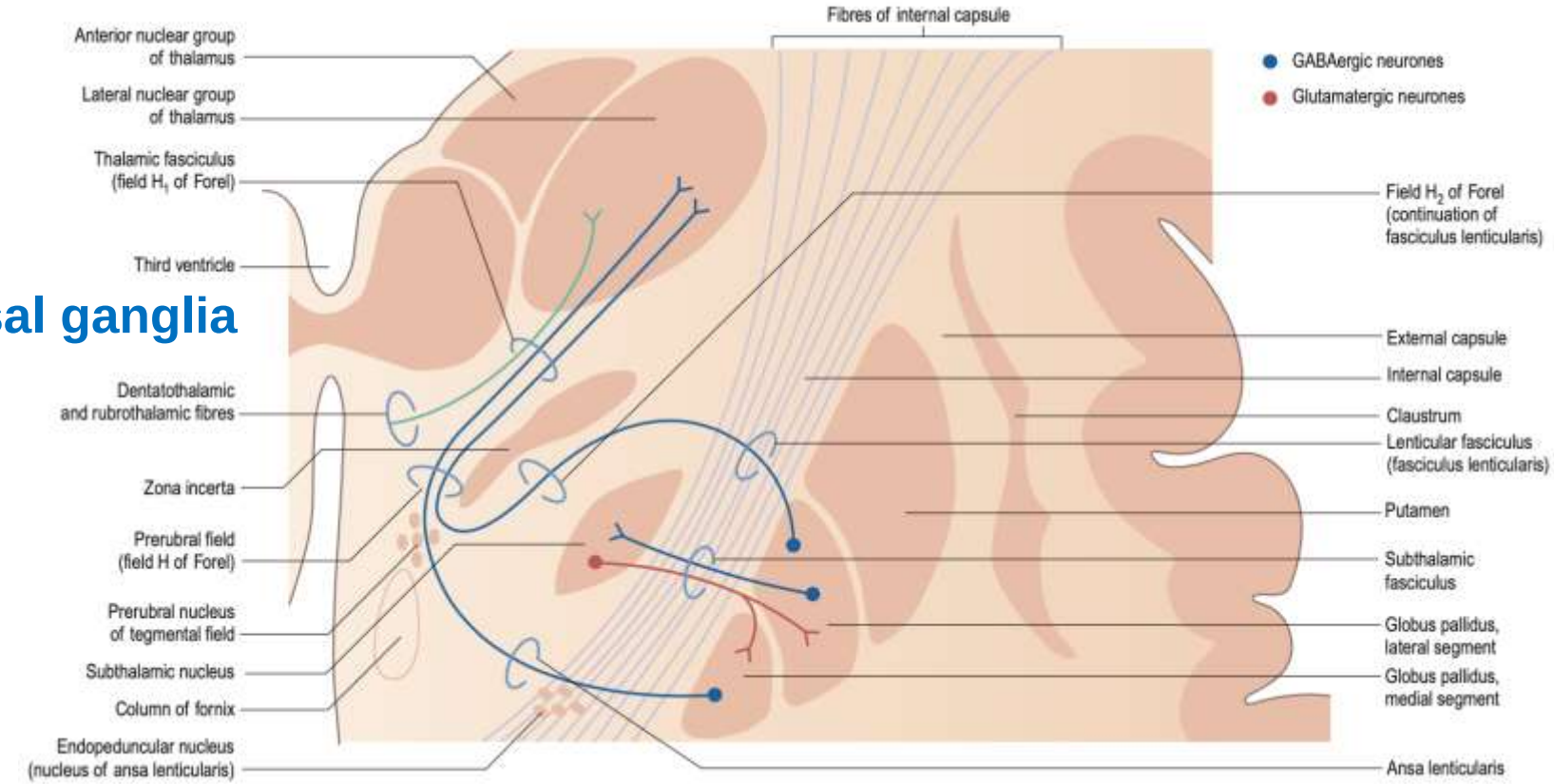
- Corpus pineale
- Commisura posterior

Corpus pineale –pineal gland

- Hanged on commisura habenularium
- Related to III. ventricle roof
- Epitheloid cells – pinealocytes – modified neurons
- Fibrilary astrocytes
- photoreceptors of primitive vertebrates up to – new-zealand hateria („the third eye“)
- Pineal gland
  - obtaining information form multineuronal system from retina
  - with interposition of hypothalamus and reticular formation
- Pinealocyty – serotonin – metabolizace na melatonin – biorytmy a sexuální chování
- Cirkadian rhytms – regulated from anterior lobe of pituitary gland
- Melatonine production increases during darkness, drops down during light
- Calcifications – acervulus cerebri – cerebral sand
- Inhibitory influence to pituitary and other endocrine glands

Subthalamus

- injury
  - Hemibalismus
    - Contralateral extremity
  - Chorea and athetosis
- A part f indirect pathway of basal ganglia
  - Ventral to thalamus
  - Lateral to hypothalamus
- Nucleus subthalamicus (Luysi)
  - splitted (fasciculus lenticularis)
  - From dorsal zona incerta
- Projection neurones
- Afferent connection
  - Pallidum externum – fasciculus subthalamicus – GABA
  - Motor, premotor, motor supplementary area – glutamate
  - Intralaminary thalamic ncc. - noradrenalin
  - Substantia nigra – pars compacta – dopamine
  - Raphela ncc. RF – serotonine
  - Nc. pedunculopontinus - acetylcholine



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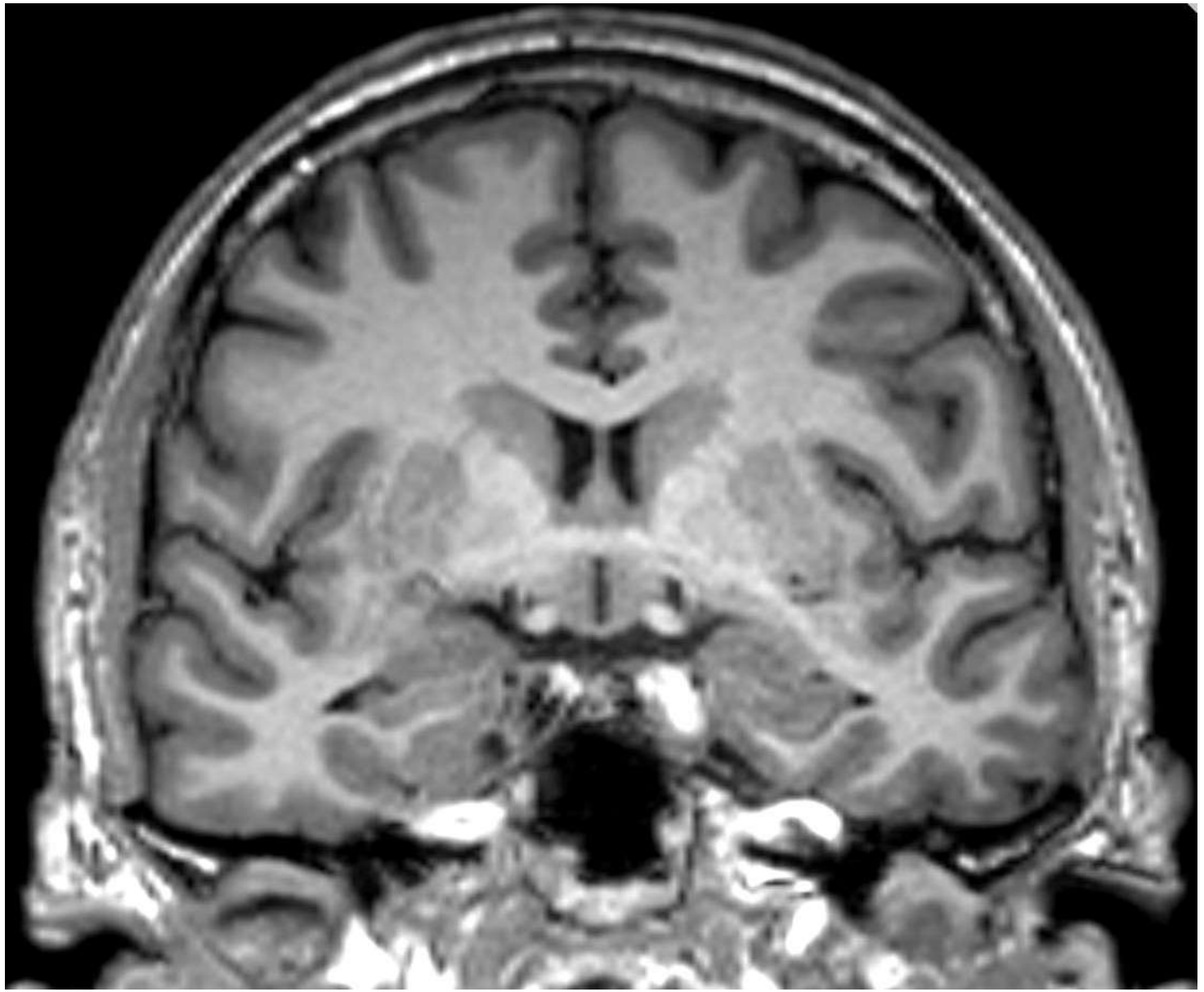
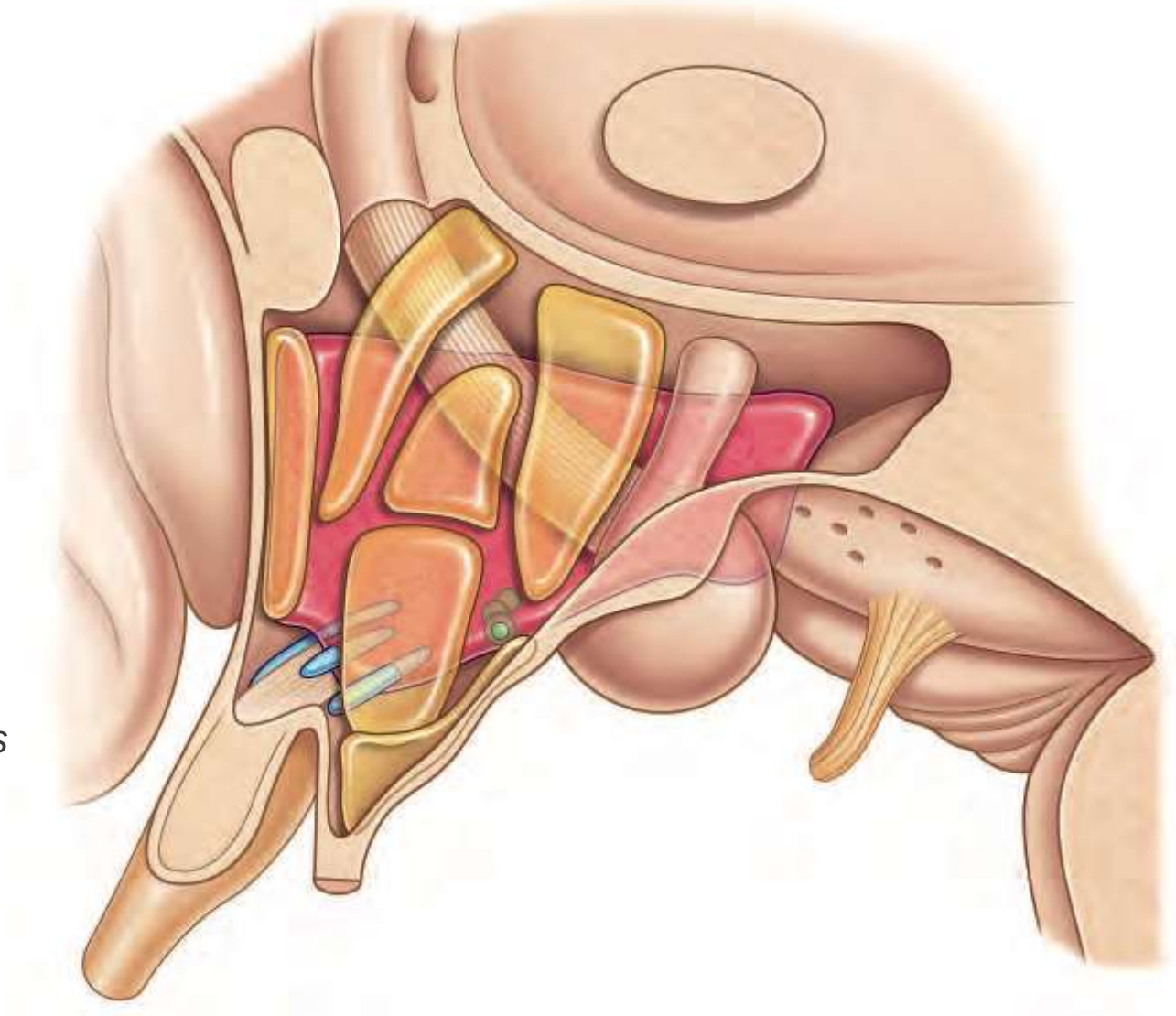
Hypothalamus

- nuclei
- White matter fibers
- Fornix
- Fasciculus mamillothalamicus
- Medial and lateral hypothalamus



Hypothalamus

- **Medial hypothalamus**
  - **anterior hypothalamus**
  - **Area preoptica medialis**
  - **Nucleus paraventricularis**
  - **Nucleus supraopticus**
  - *Production of oxytocine, vasopresien*
    - *Tractus hypothalamohypophysealis*
  - **middle hypothalamus**
  - **Nucleus suprachiasmaticus**
  - **Nc. hypothalamicus ventromedialis**
  - **Nc. hypothalamicus dorsomedialis**
    - *Cirkadian pacemaker*
    - *Input of visual fibers – tractus retinohypothalamicus*
    - *Controls*
      - *hormonal secretion*
      - *Heartbeat*
      - *Body temperature*
      - *Melatonine production*
      - *Motion activity*



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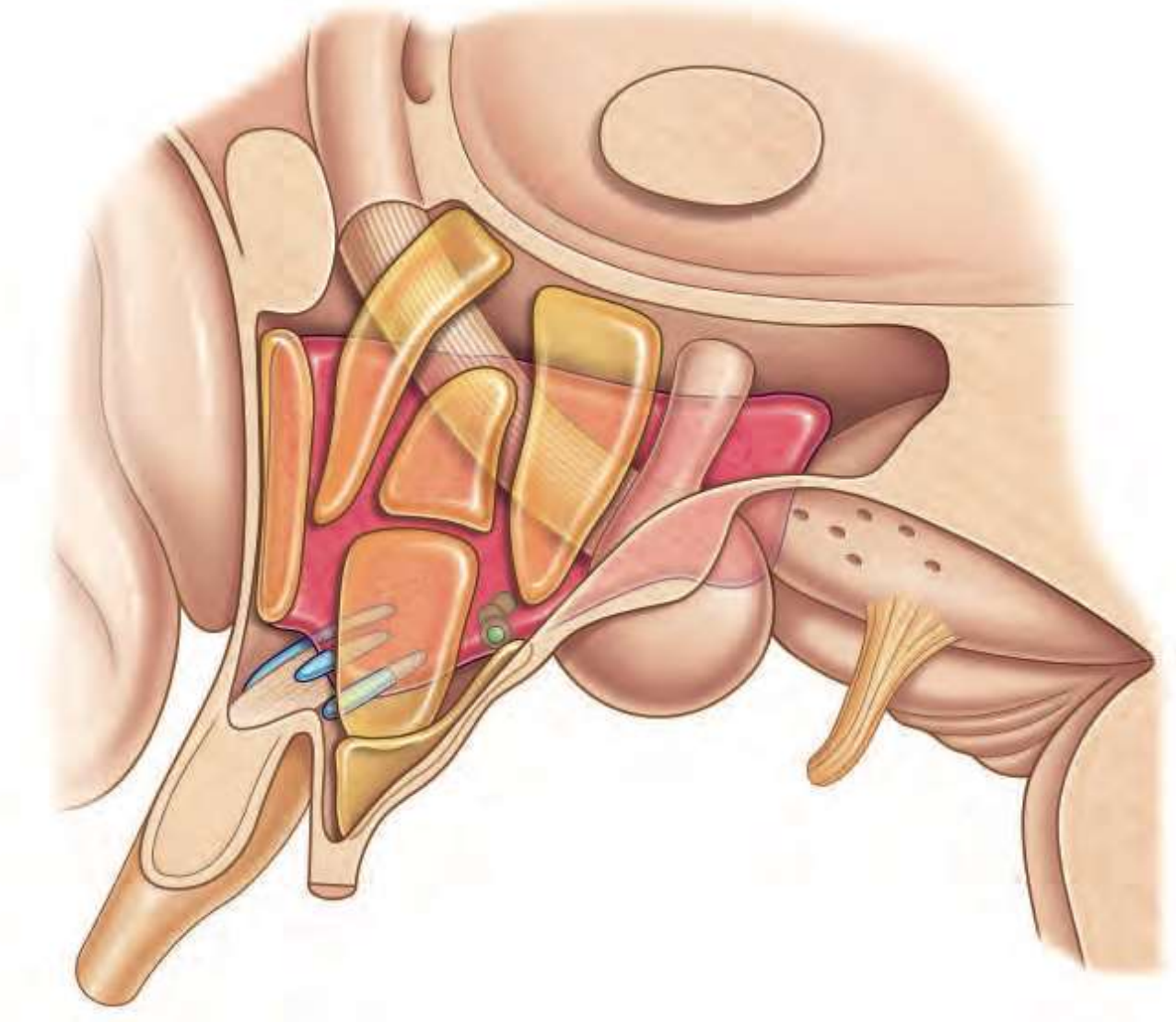
Hypothalamus

- middle hypothalamus
  - Nucleus suprachiasmaticus
    - *Nc. hypothalamicus ventromedialis*
    - *Nc. hypothalamicus dorsomedialis*
  - Tuber cinereum
  - Ncc. tuberales
  - Nc. infundibularis
- Controlling of
- Metabolical processes and sexual behaviour



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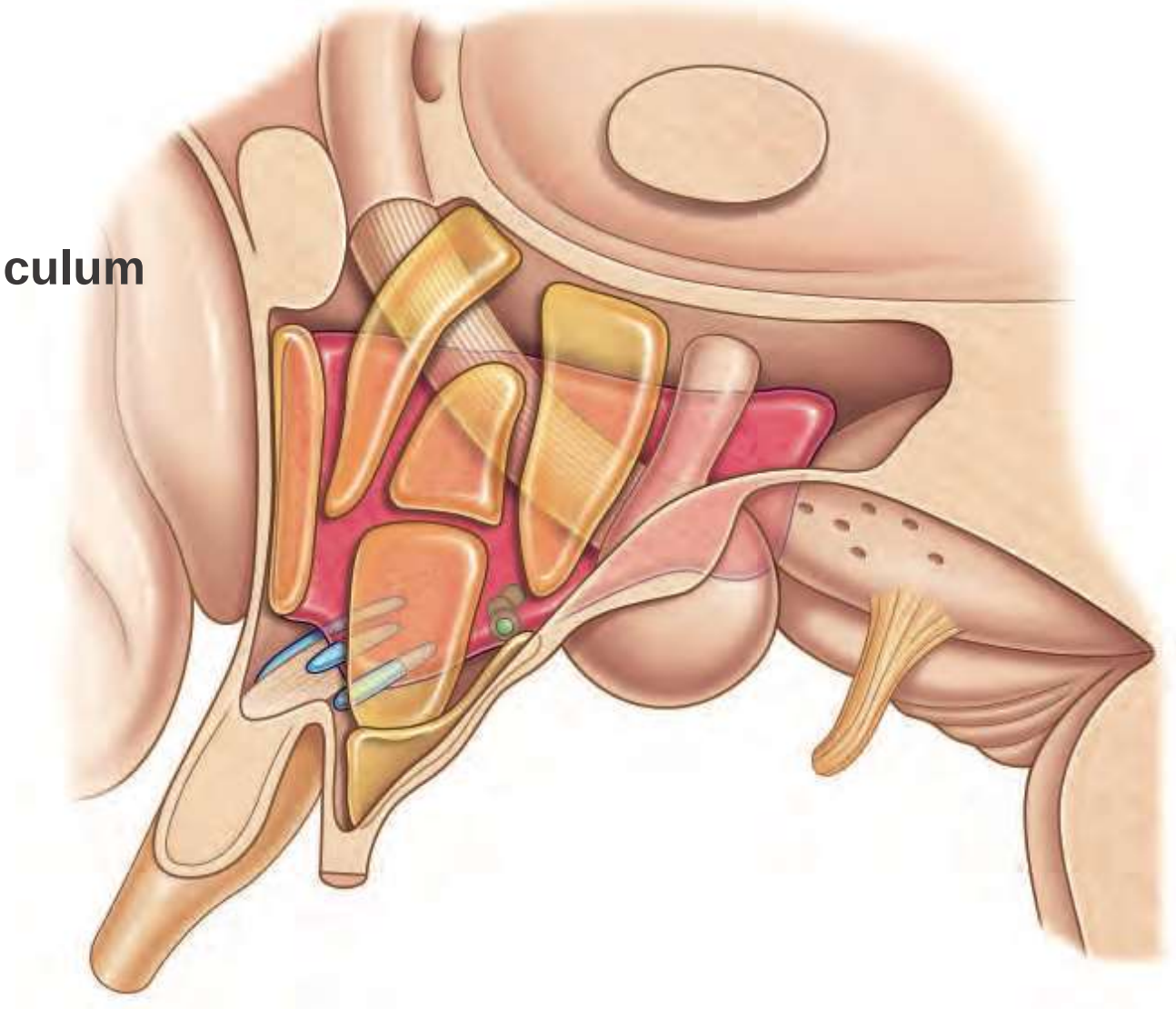
Hypothalamus

- **dorsal hypothalamus**
- **Corpora mammilaria**
  - *Nc. mamilaria medialis et lateralis*
  - *Nc. hypothalamicus posterior*
- **Connection to hippocampus formation – subiculum**
- **Corpora mamilaria**
  - **limbic system**



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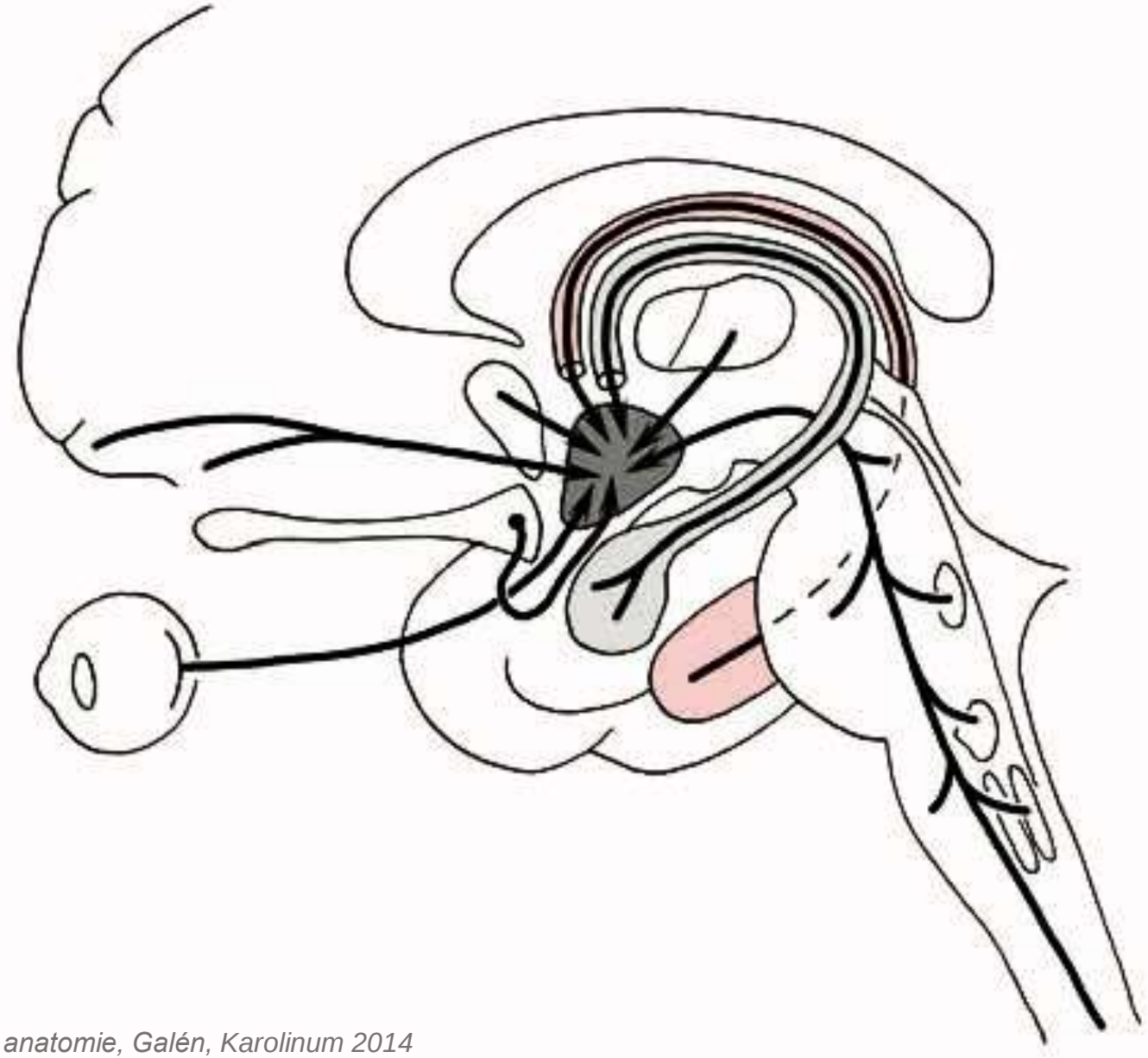
Hypothalamus

- **Afferent connections**
  - Truncus cortico-thalamicus
  - Tractus septo-hypothalamicus
  - Tactus amygdalo-hypothalamicus
  - Tractus retinothalamicus
  - Tractus reticulothalamicus
  - All kinds of informations
  - all reception modalities



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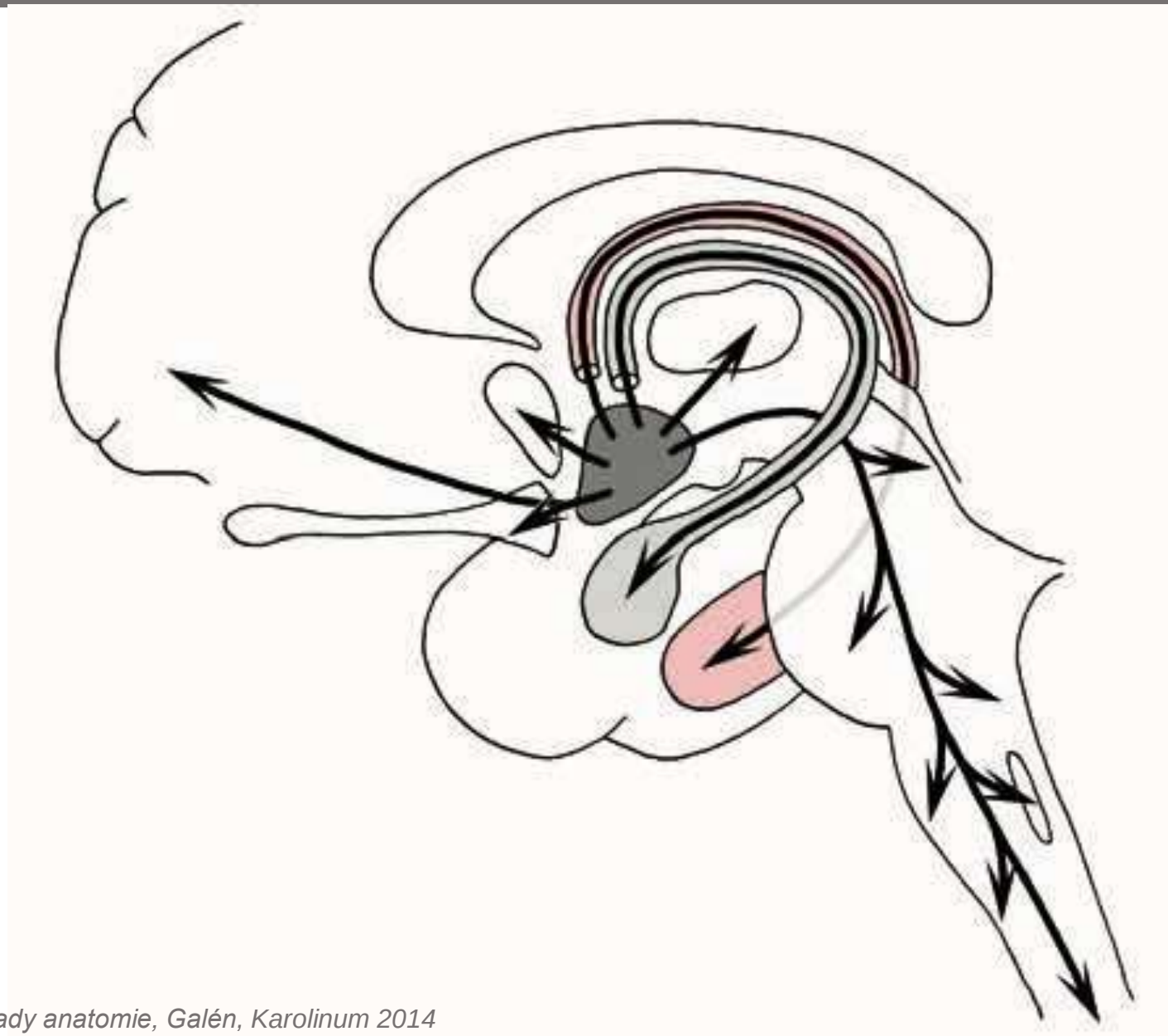
Hypothalamus

Efferent connections

- Tractus hypothalamocorticalis
- Tractus hypothalamoseptalis
- Tractus mammilothalamicus
- Tractus hypothalamothalamicus
- Tractus hypothalamoreticularis
- Tractus hypothalamospinalis
- Tractus hypothalamohypophysealis



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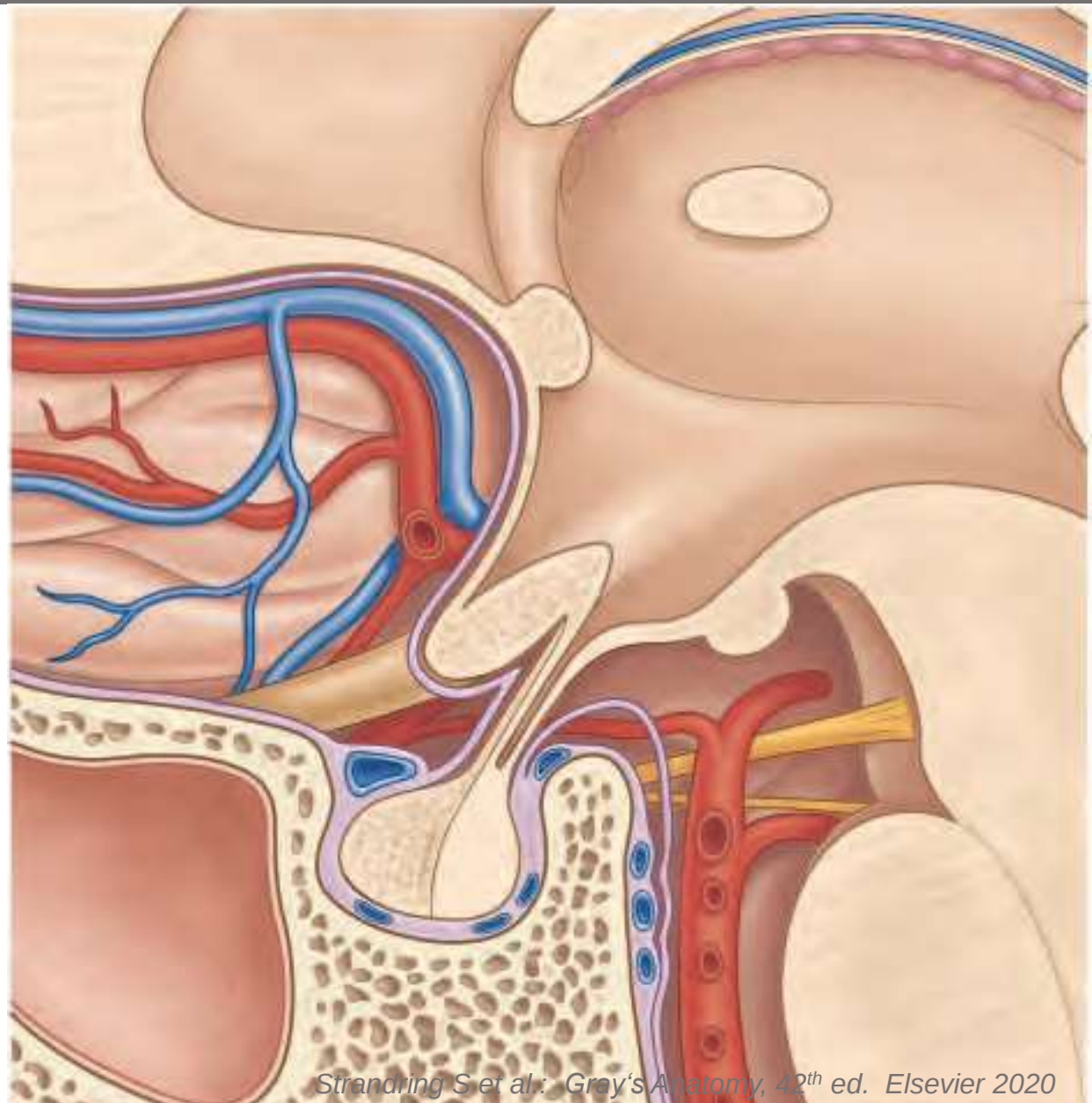
Hypothalamo-hypophyseal system

- **Hypothalamus**
  - **Nuclei and their responses**
  - **Emotional and exteroreceptive stimmuli**
- **Sekretion of releasing factors/hormones**
  - **CRH – corticotropine releasing hormone - ACTH**
  - **TRH – thyreotropine releasing hormone - TSH**
  - **ĢnRH – gonadotropine releasing hormone – FSH, LH**
- *Inhibitory factors - somatostatine*
- **Hypophysis – pituitary gland**
- **Lobus anterior – adenohypophysis**
  - *Rathke pouch – stomodeum – accesor. nasopharynx*
  - *Pars principalis, intermedia, tuberalis*
- **Lobus posterior – neurohypophysis**
  - **Processus of hypothalamus**
  - **Modified glial cells - pituicytes**
  - **Neural fibers**
  - **Transportation of peptidic hormones**



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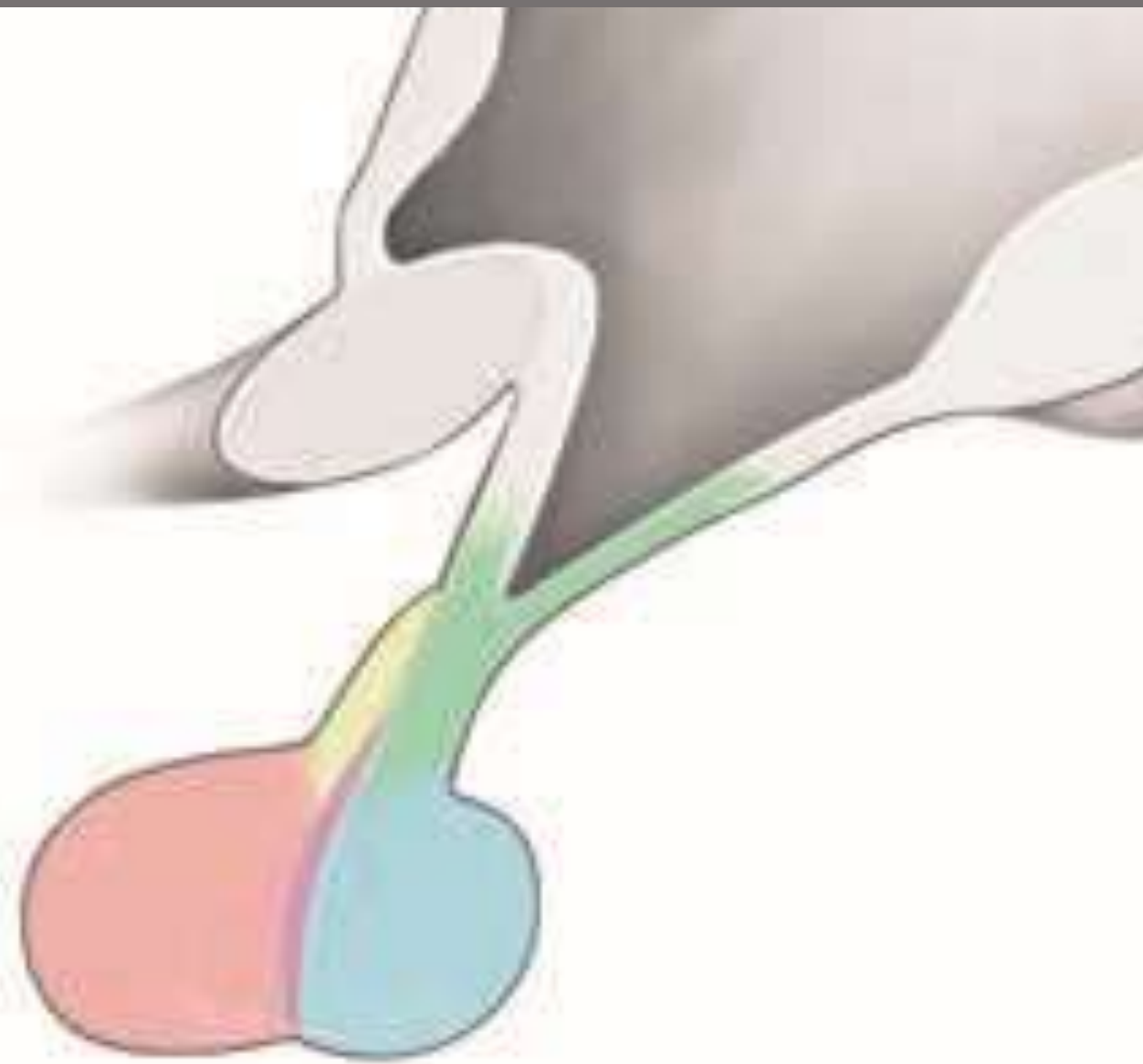
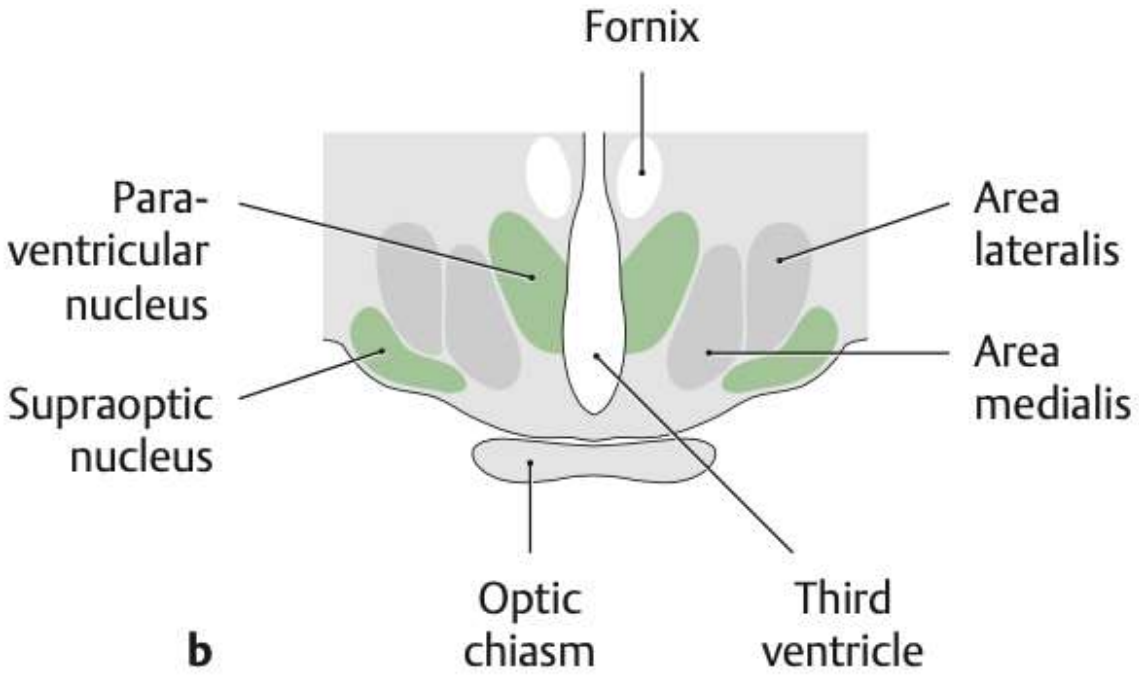
Hypophysis

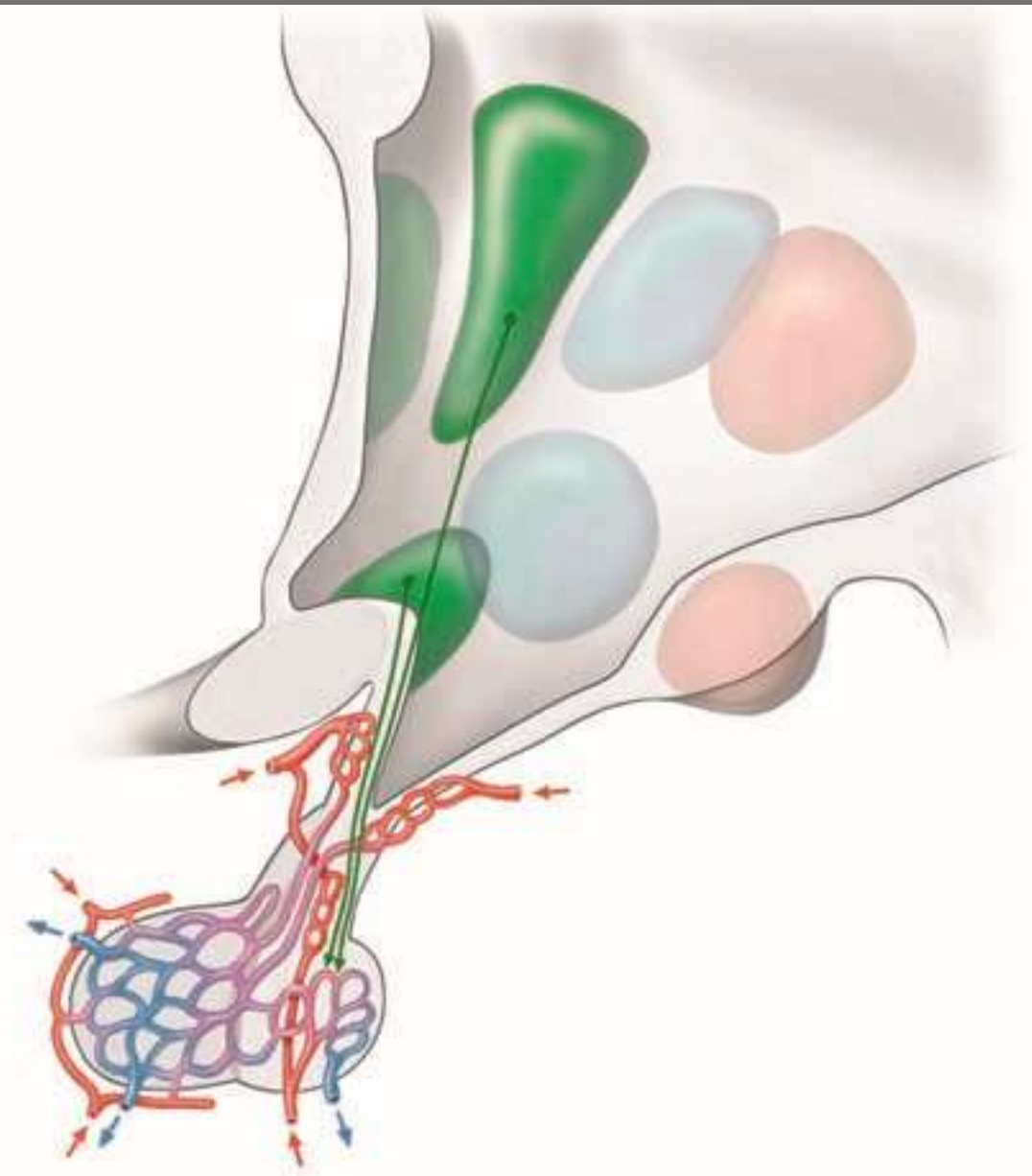
- *Infundibulum*
- **Neurohypophysis – lobus posterior**
- **Adenohypophysis – lobus anterior**
- ***Pars tuberalis***
- ***Pars intermedia***
- **Pars distalis**



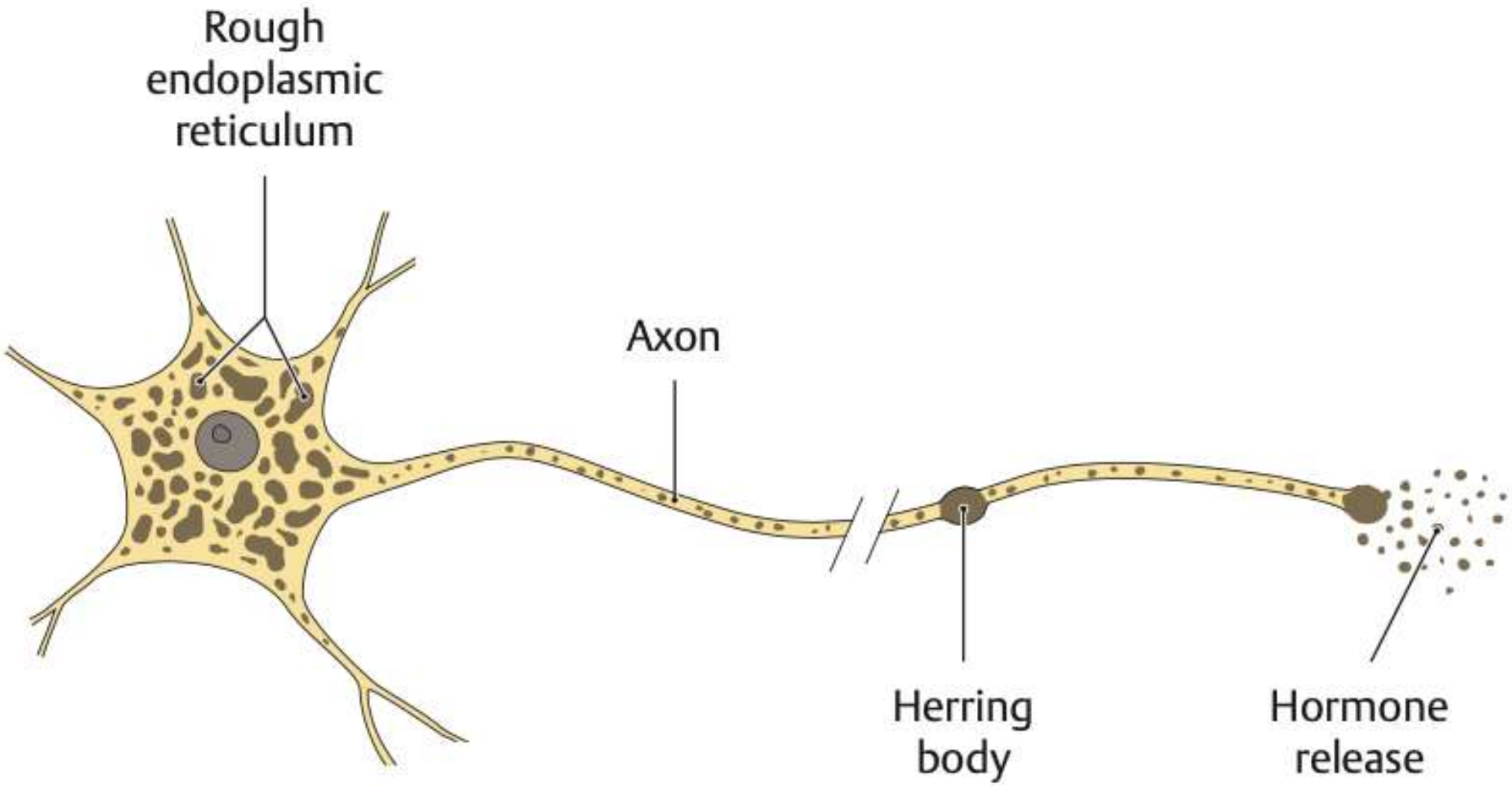
Hypophysis

- ***Nucleus paravetricularis***
- ***Nc. supraopticus***
- ***Antidiuretický hormon***
- ***Oxytocin***





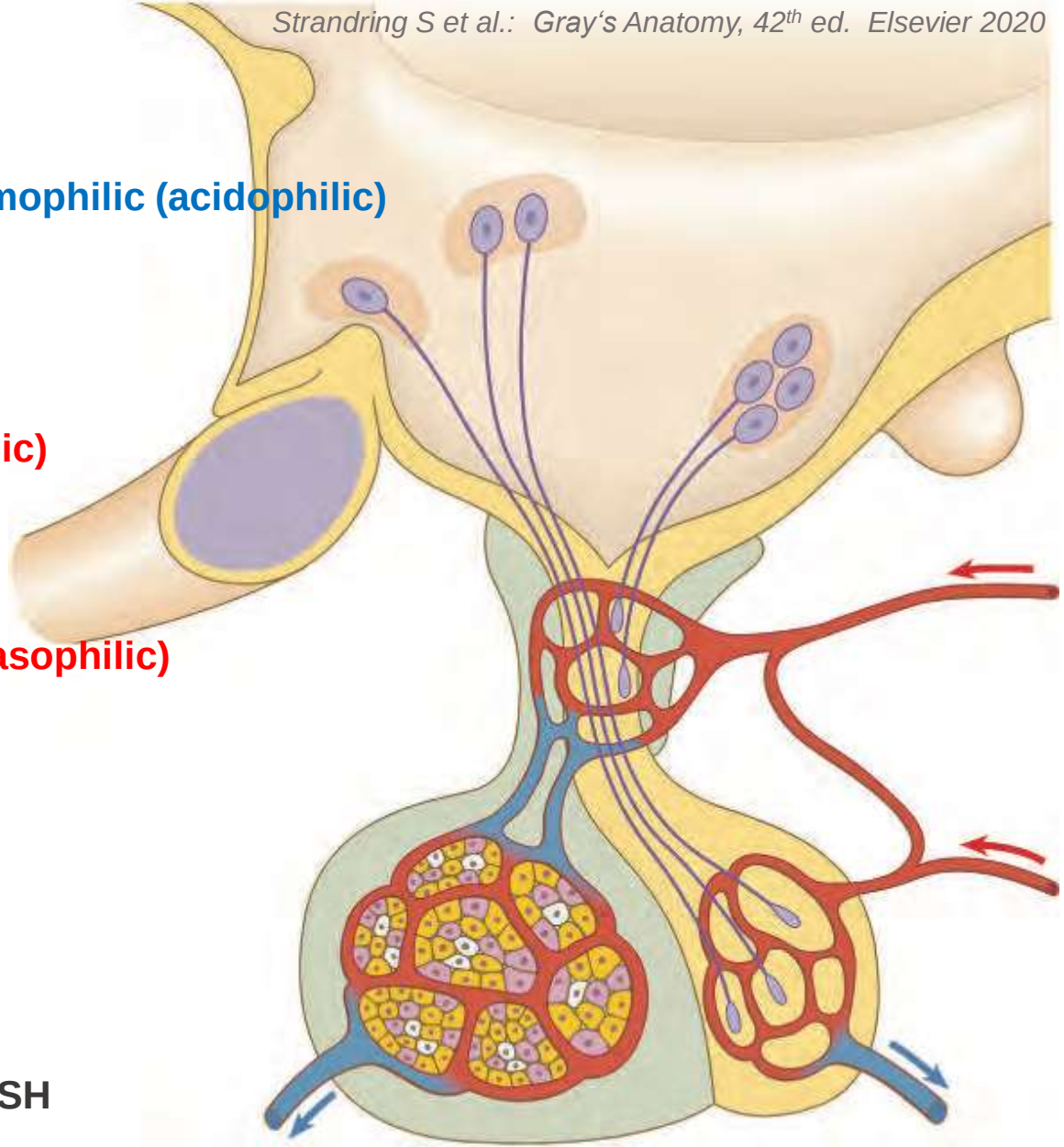
Hypophysis


Rough endoplasmic reticulum
Axon
Herring body
Hormone release

Adenohypophysis – anterior lobe

- Adenohypophysis
  - Neuropeptides
  - Somatotropine (STH) = growing hormone (GH) – chromophilic (acidophilic)
    - Tissue and organs growing
  - Prolaktine (PRL) – chromophilic (acidophilic)
    - Milk secretion
  - Glycoproteins
  - Adrenocortikotropine (ACTH) – chromophili (acidophilic)
    - Adrenal cortex
  - Thyreotropine (TSH) - chromophili (basophilic)
    - Thyroid gland
  - Folikulostimmulating hormone (FSH) - chromophili (basophilic)
    - Ovarial folicles – stimmulated production of hormones
    - Sertoli bb - spermatogenesis
  - Luteinizating hormone (LH) - chromophili (basophilic)
    - Secrerion of progesterone from corpus luteum
    - Leydig cells – secretion of testosterone

- Pars intermedia, chromophobic cells – lost granula
- Pars tuberalis – cslusters and funicles – basophilic LH a FSH



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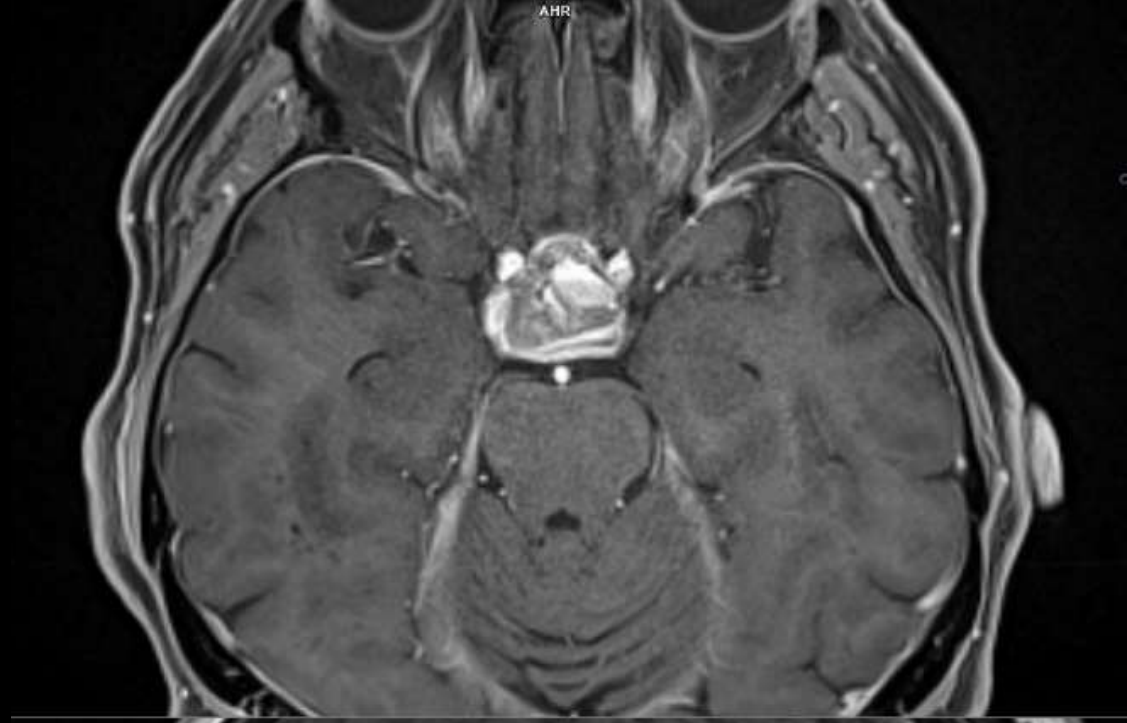
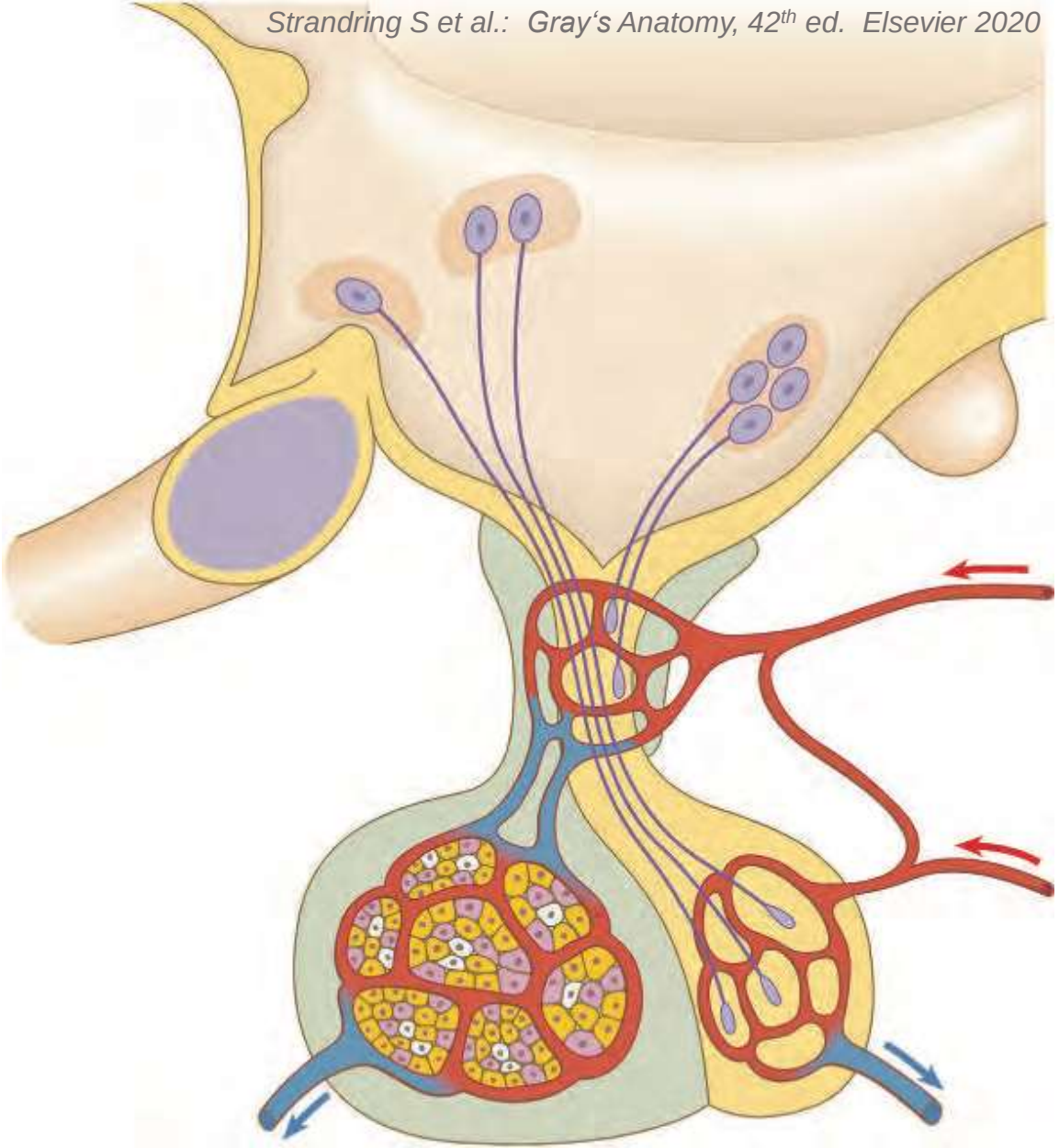

AHR


HLA

Neurohypophysis

- Processus of hypothalamus
- Lobus posterior – neurohypophysis
  - Processus of hypothalamus
  - Modified glial cells - pituicytes
  - Neural fibers
  - Transportation of peptidic hormones
  - Nc. supraopticus
  - Nc. paraventricularis
  - Vasopresine = antidiuretic hormone (ADH)
    - Water resorption in distal renal tubule
  - Oxytocine
    - Uteral contractions during deliverance
    - Milk ejection during breastfeeding



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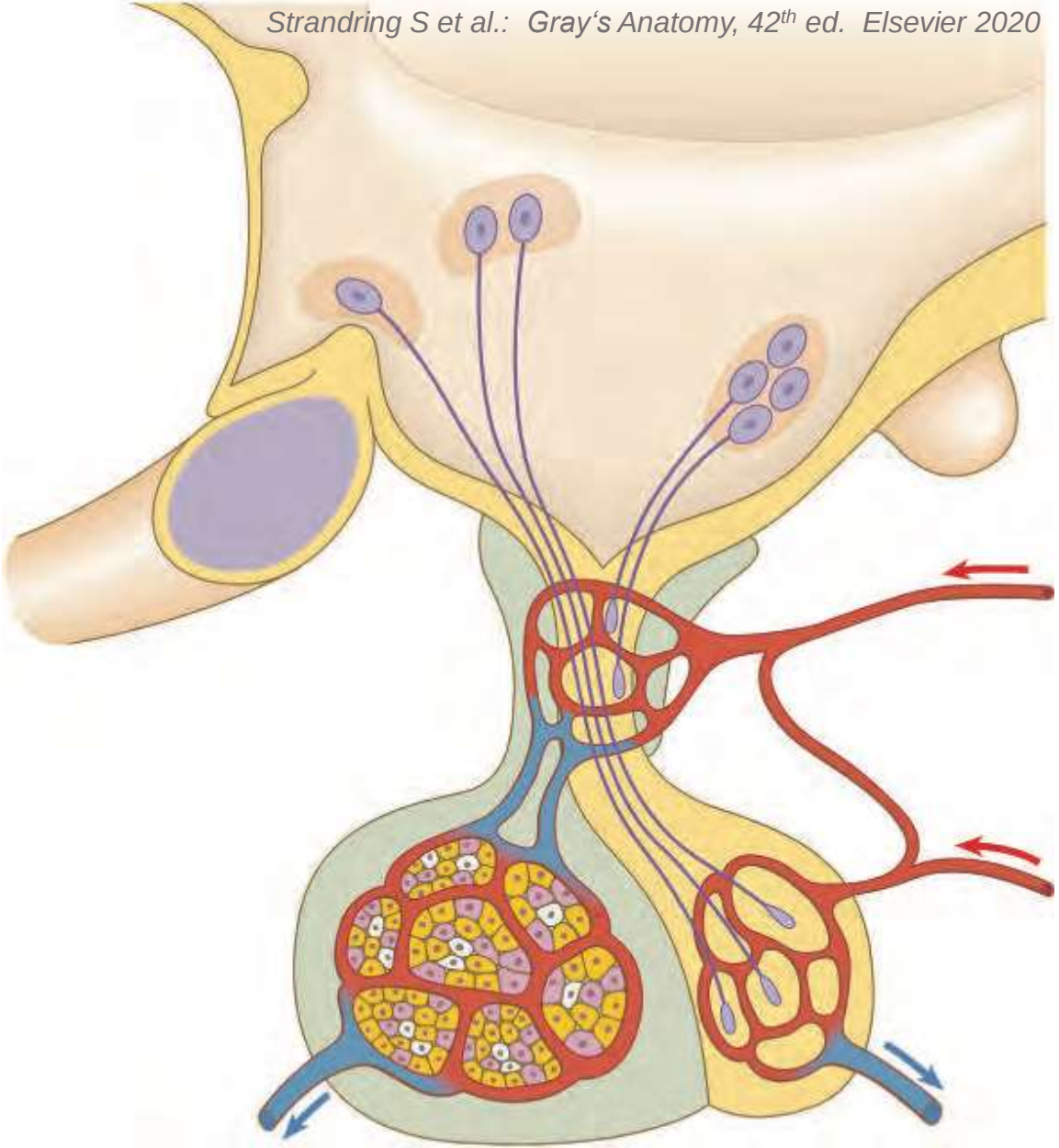
Vascular supply of the pituitary gland

- *A. carotis interna*
- **A. hypophysealis superior**
  - **trabecula**
- **A. hypophysealis inferior**

- **Plexus hypophysealis superior**
- ***Porta hypophysealis***
- **Plexus hypophysealis inferior**

- **Plexus hypophysealis lobi posterioris**

- **Hypophysela veins**
- **Dural sinuses**



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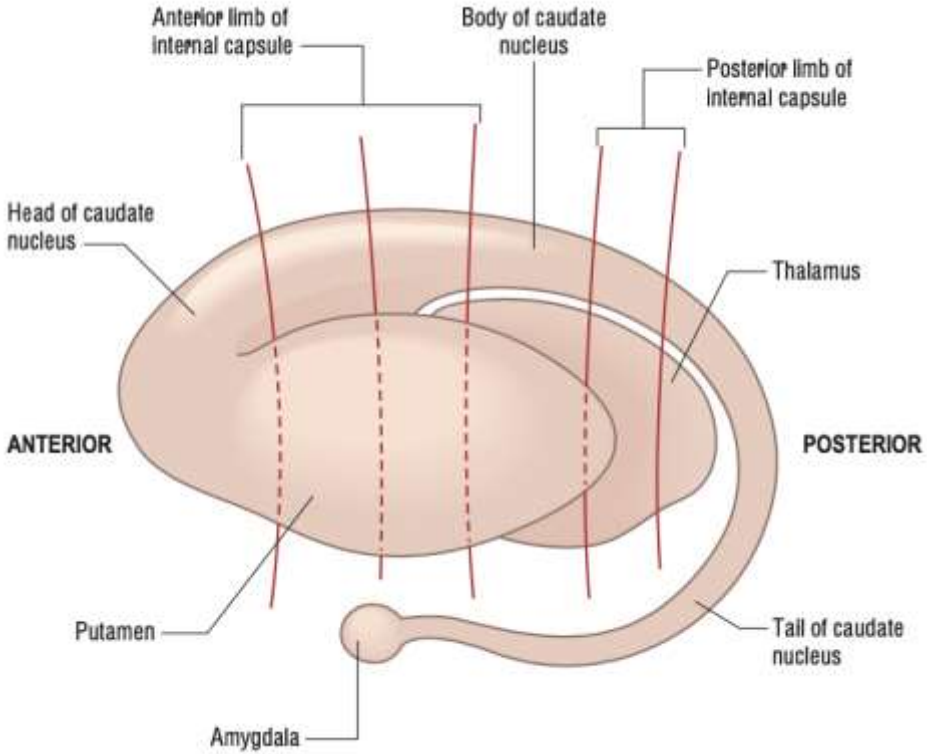
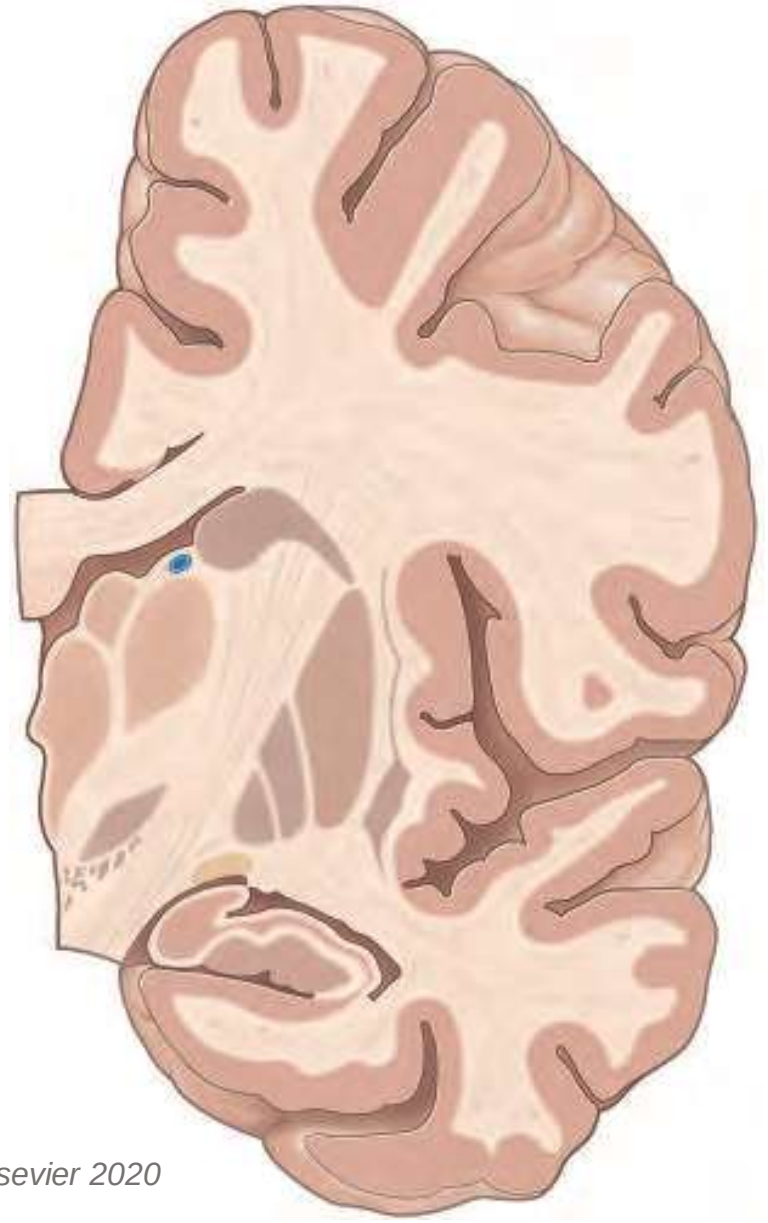
Basal ganglia

- Sucortical nuclei
- Corpus striatum
  - Nucleus caudatus
  - Putamen
  - Globus pallidus
- Claustrum
- Amygdaloid complex
- Associated centres
  - Diencephalon
  - Mezencephalon





- Neostriatum = striatum = nucleus caudatus + putamen
- Paleostriatum = globus pallidus = pallidum

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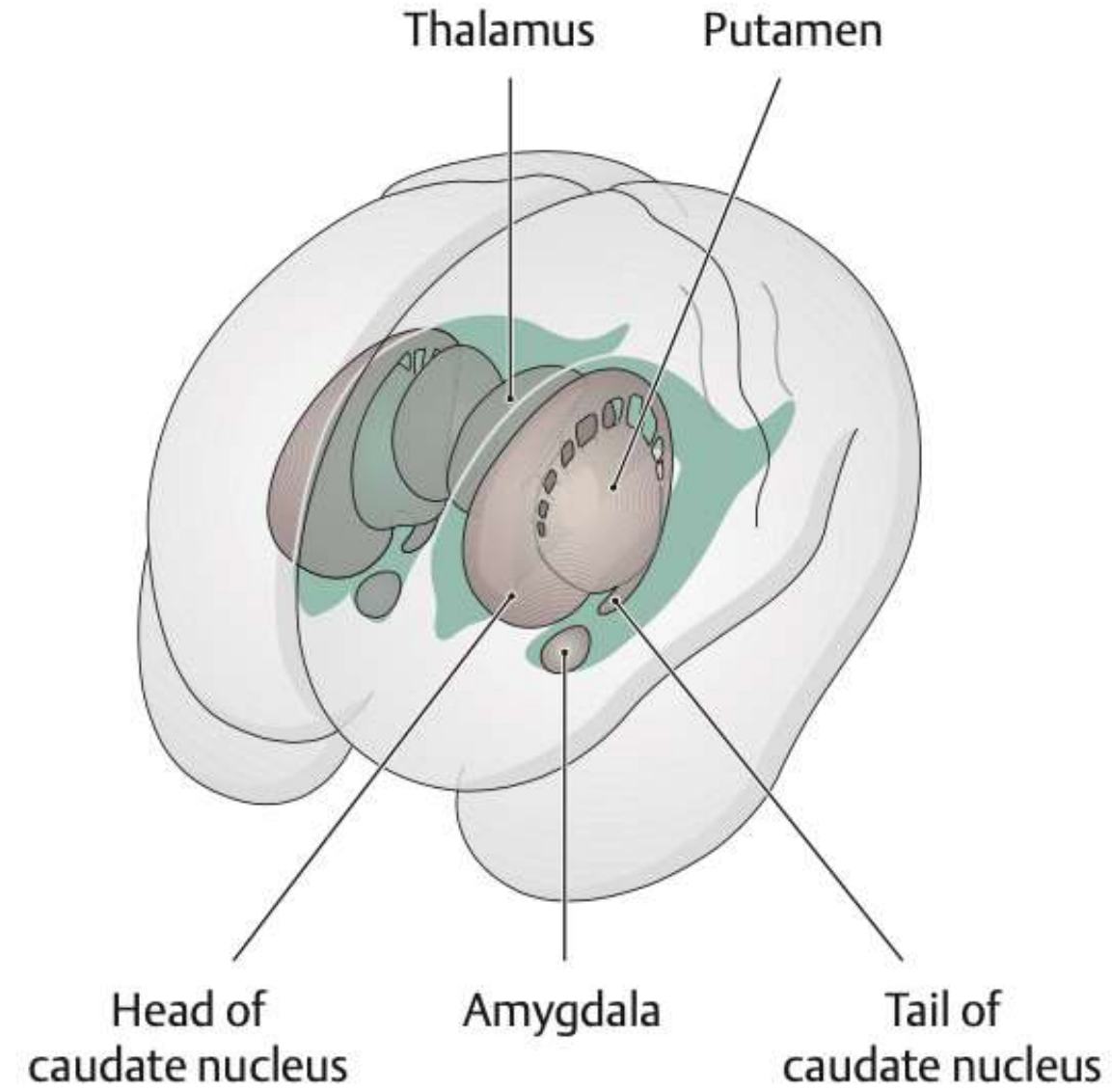
Basal ganglia

- **Corpus striatum**
  - **Nucleus caudatus**
  - **Putamen**
  - **Globus pallidus**
- **Claustrum**
- **Amygdaloid complex**
- **Associated to**
  - **Diencefalon**
  - **Mezencefalon**

- **Neostriatum = striatum = nucleus caudatus + puta**
- **Paleostriatum = globus pallidus**

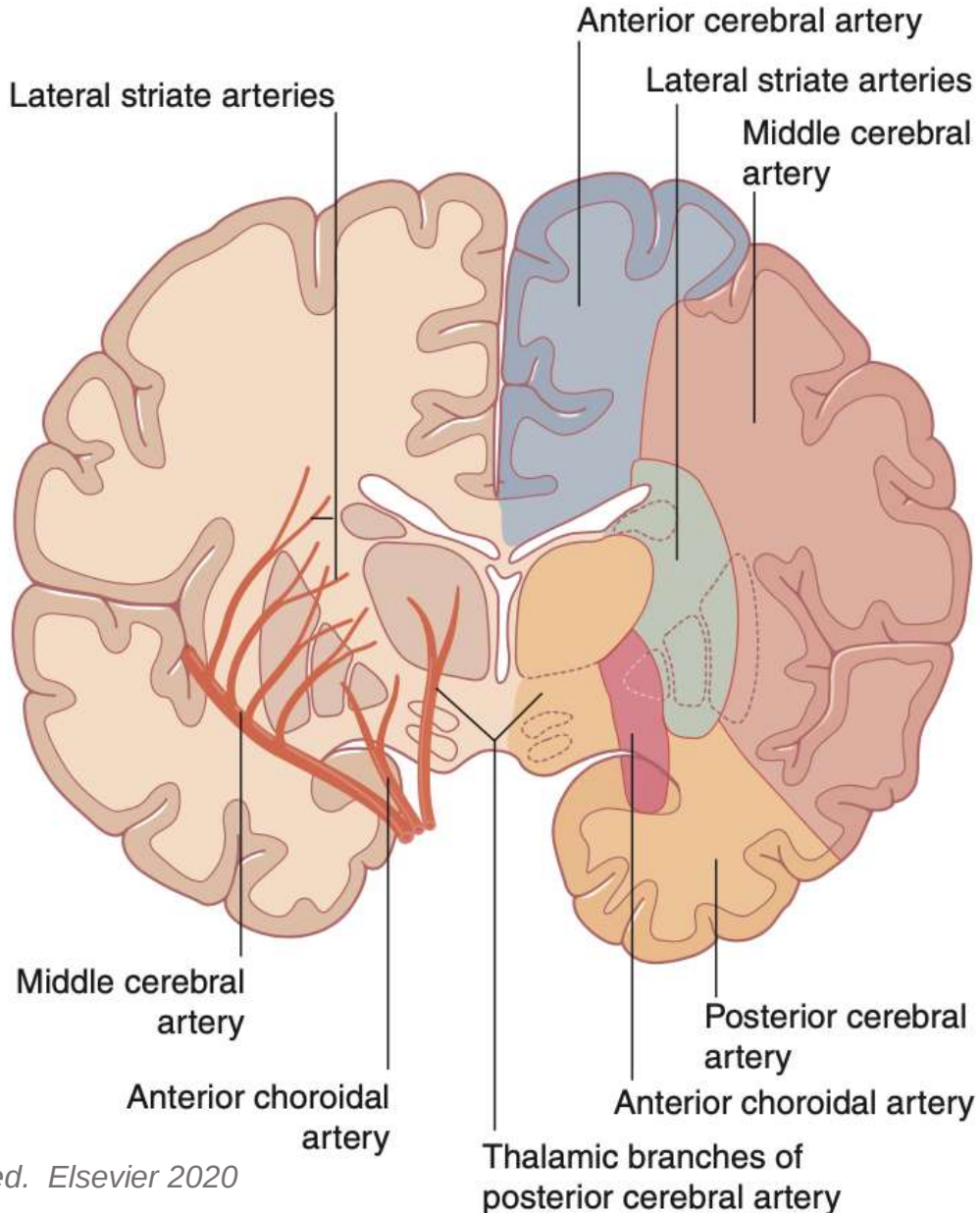


Basal ganglia and thalamus - arterial supply

- A. cerebri media
- Aa. centrales anteriores

- A. chorioidea anterior

- A. cerebri posterior
- Aa. centrales posteriores



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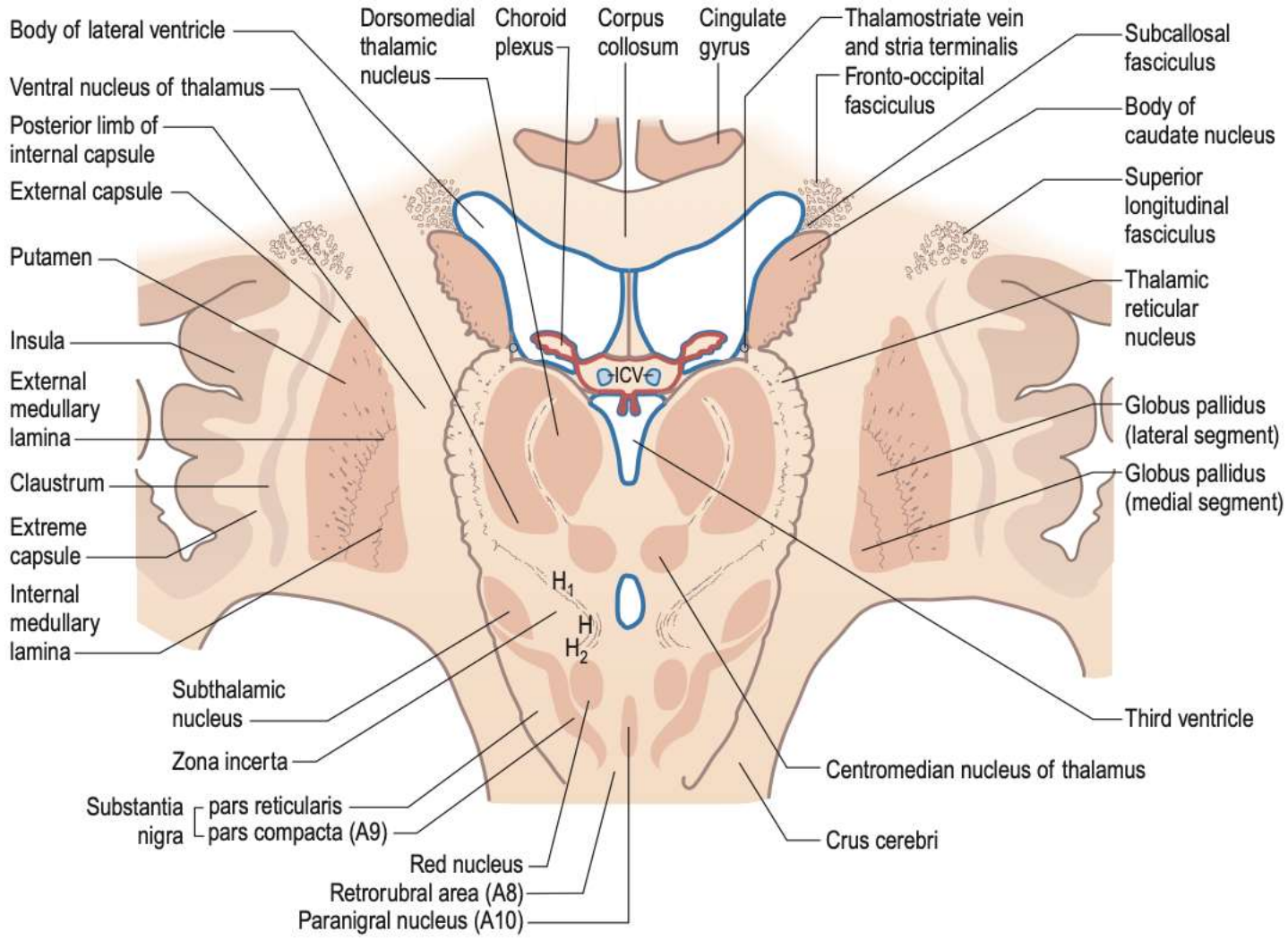
Basal ganglia

- principal input function
- Whole neocortex
- STRIATUM
- Efferent connections
  - globus pallidus
  - Substantia nigra
- principal output function
- GLOBUS PALLIDUM
- SUBSTANTIA NIGRA pars reticulata
- Efferent connection
  - Thalamus
- Bsal gagnlia disordes
- Abnormal motions
- Hypertonia (Parkinson disease)
- Abnormal involuntary motions (chorea, Huntington disease)



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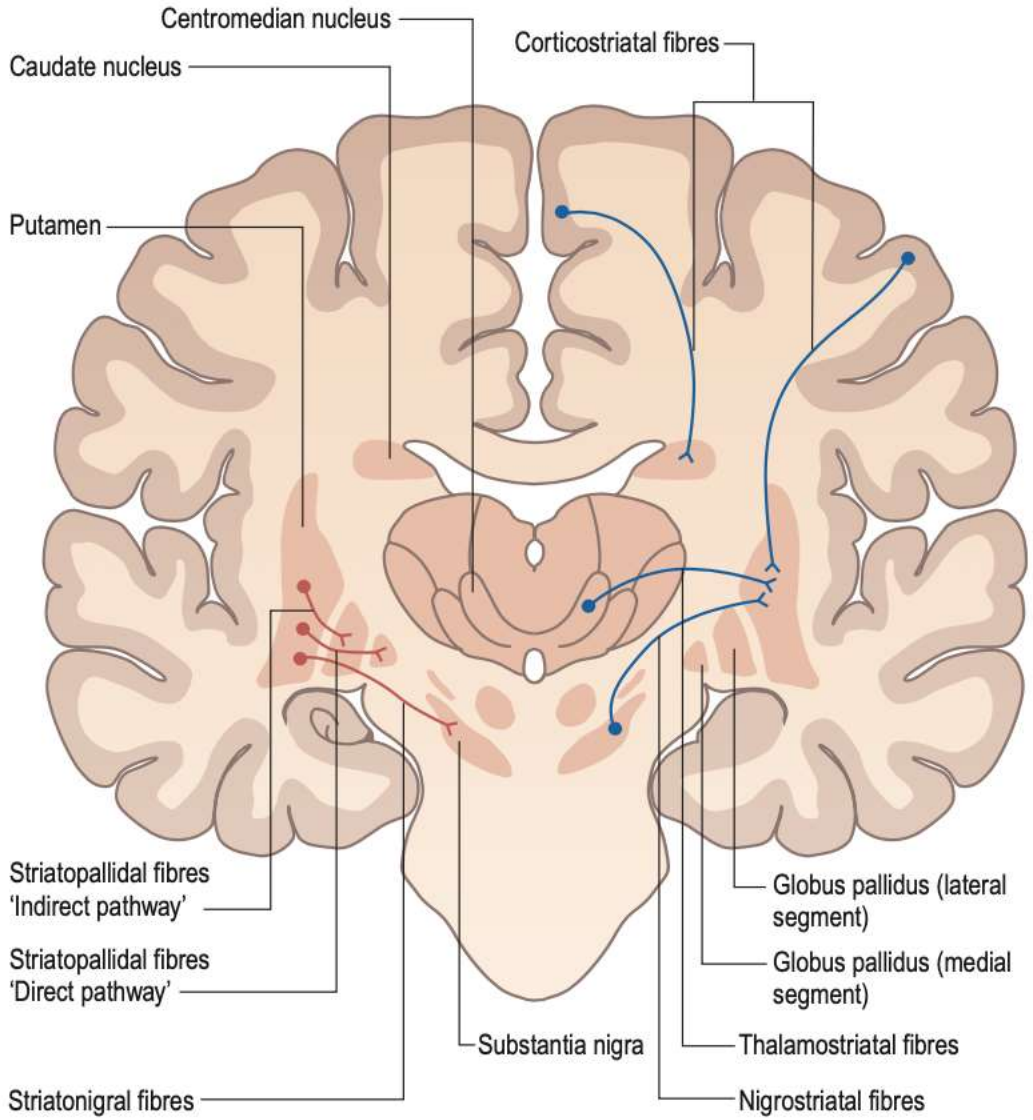
Striatum

- High cellular density
- Bugh vascular density
- GABA
- Enkefalines
  - D2 receptors of dopamine
- Substance P (dynorphin)
  - D1 receptors of dopamine
- Somatostatine
- Acetylcholine
- **Afferent connections**
  - Cortex
  - Thalamus
  - Substantia nigra
- **Efferent connections**
  - Globus pallidus – medial – „direct pathway“
  - Globus pallidus – lateral - “indirect pathway“
  - Nc. subthalamicus



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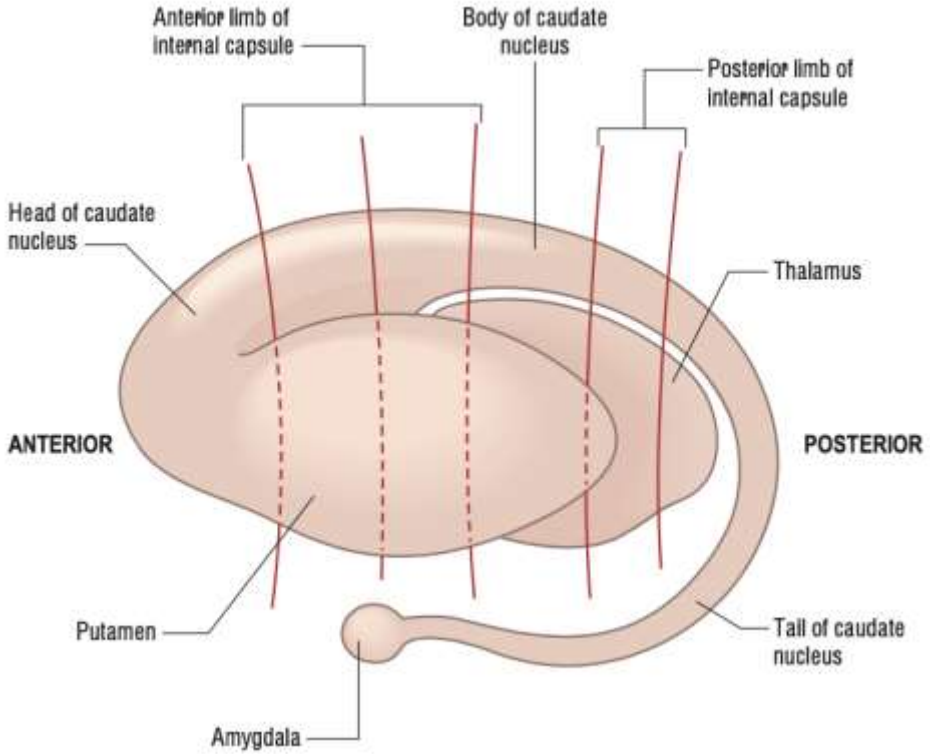
Striatum

- Corticistriatal connection
- Ipsilateral neocortex
- Orbitofrontal – caput nc. caudati pars inferior
- Dorsolateral frontal – caput nc. caudati
- Parietal – corpus nc. caudati
- Temporal and okcipital – cauda nc. caudati
- Somatosenzoric and motoric – putamen
  - Lower part – lateral
  - Upper part – medial
- Contralateral projection – cauda nc. caudati + inferior putamen



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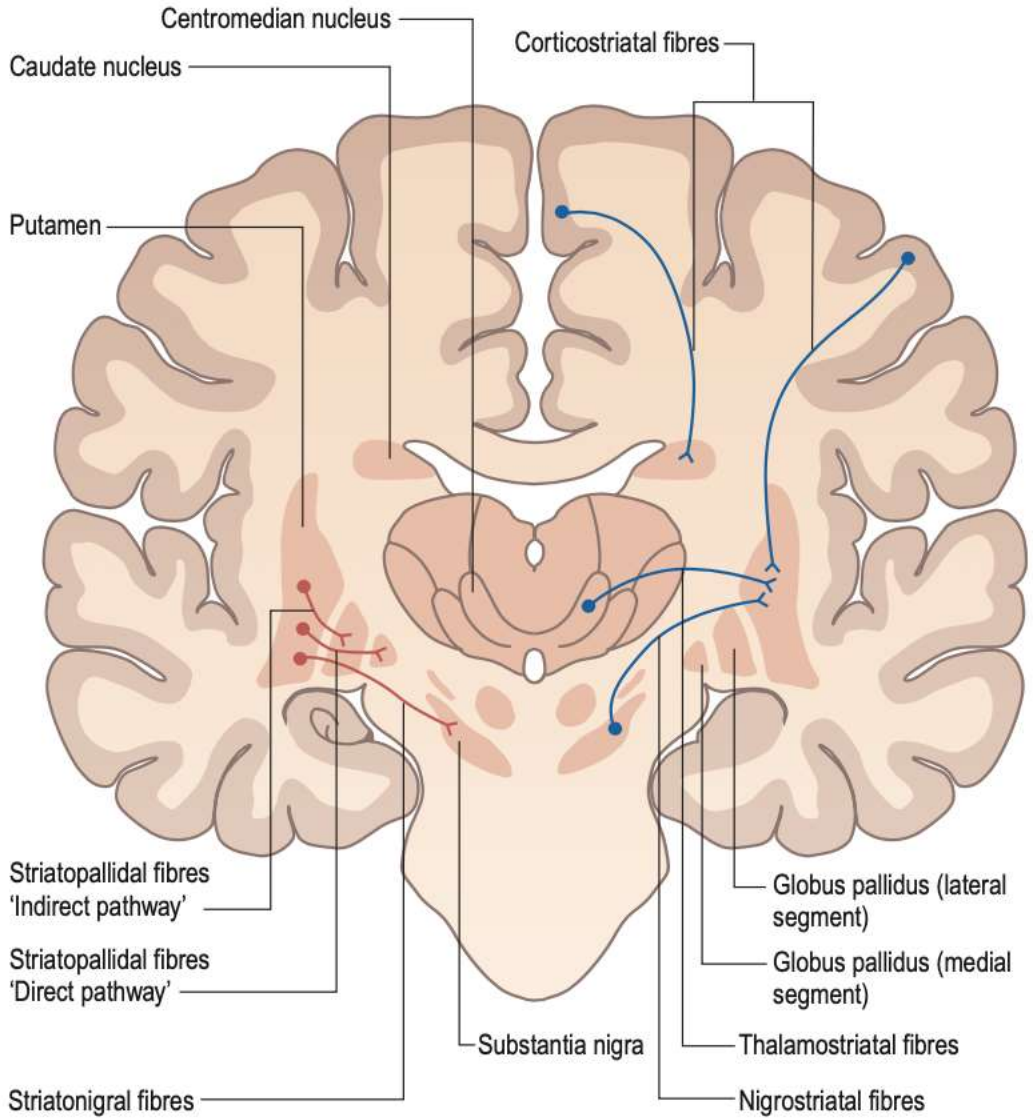
Striatum

- **Anibergic connections**
- **Dopamine**
  - *Substantia nigra pars compacta*
  - *Rubrostriatal connection*
- **Serotonine**
  - *Reticular formation, nuclei of raphe*
- **Noradrenaline-norepinephrine**
  - *Locus coeruleus*
- ***Connections of striatum***
- *Ventral striatum*
  - *Limbic cortex including allocortex*
  - *Nc. accumbens + tuber olfactorium*
  - *In the front of commisura anterior – addiction to cocaine, amphetamine*
  - *Decreases re-uptake of dopamine*
- *dorsal striatum*
  - *Motor cortex, prefrontal cortex kortex, gyrus cinguli*
  - *Intralaminar thalamic nuclei*



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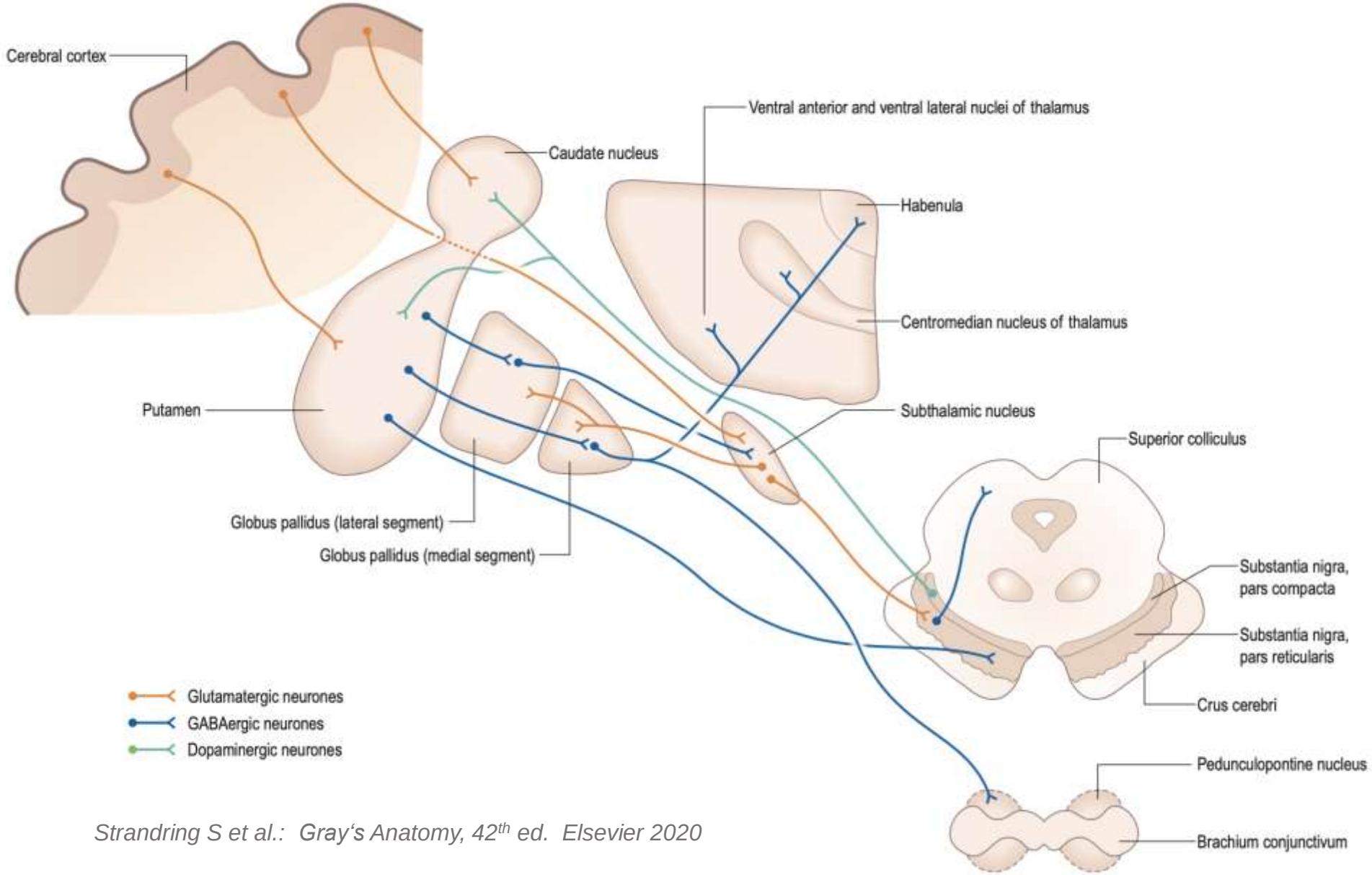
Connections of striatum



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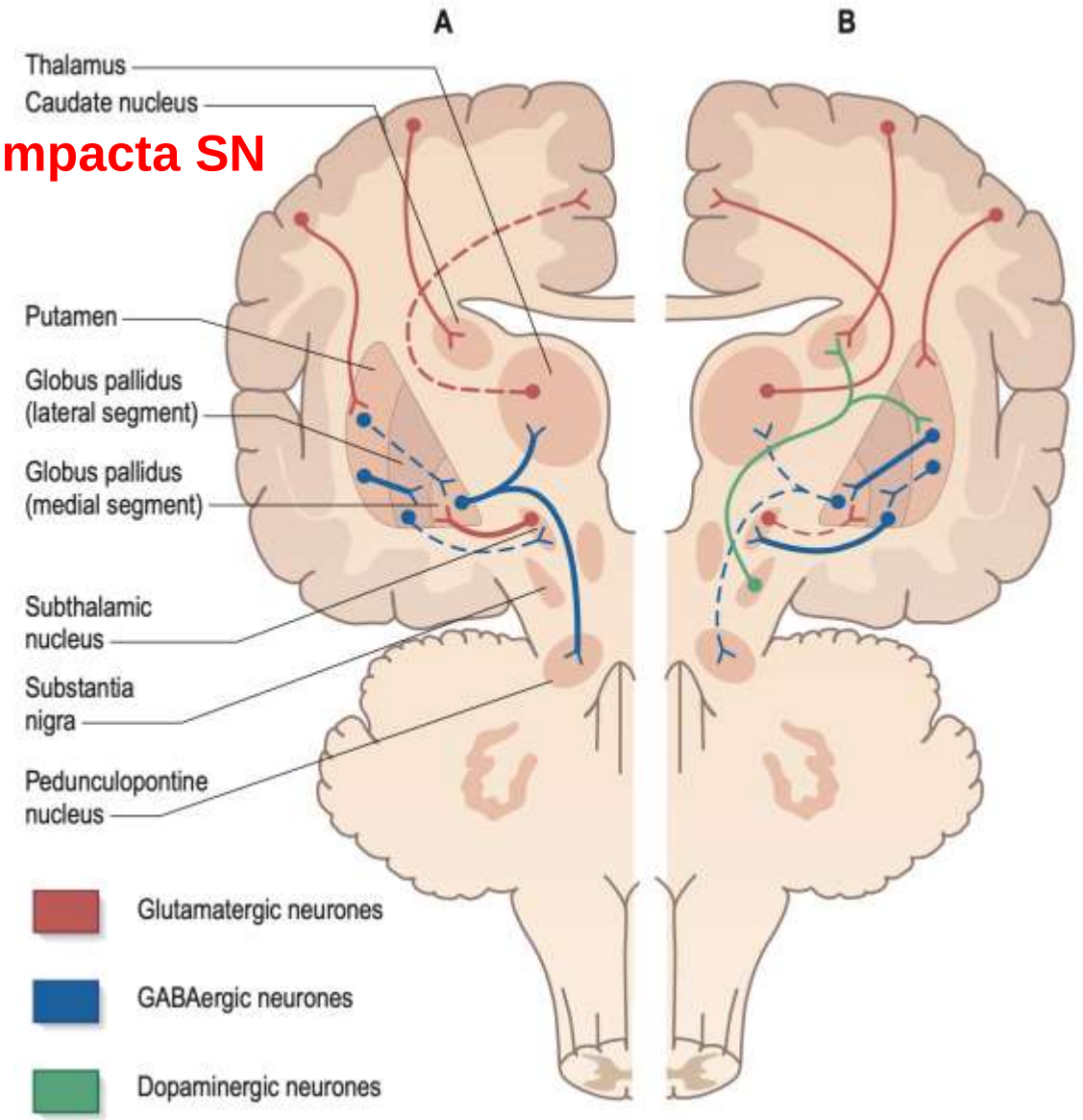
Bazal ganglia

- **Parkinson disease**
- **Degeneration of dopaminergic neurons in pars compacta SN**
- **Decreased concetration of dopamine in striatum**
- **Receptors preserved**
- *Decreased density of receptors*
  - *striatonigral degeneration*
- **Increased aktivity of the indirect pathway**
- **Decreased aktivity of the direct pathway**
- **Decreased inhibition of nc. subthalamicus**
- **Increased aktivity of thalamic motor nuclei**
- **Increased cortical activity**
- **Hypertonus**
- **Dyskinesia**



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Neuroanatomy – diencephalon and basal ganglia