CNS Module

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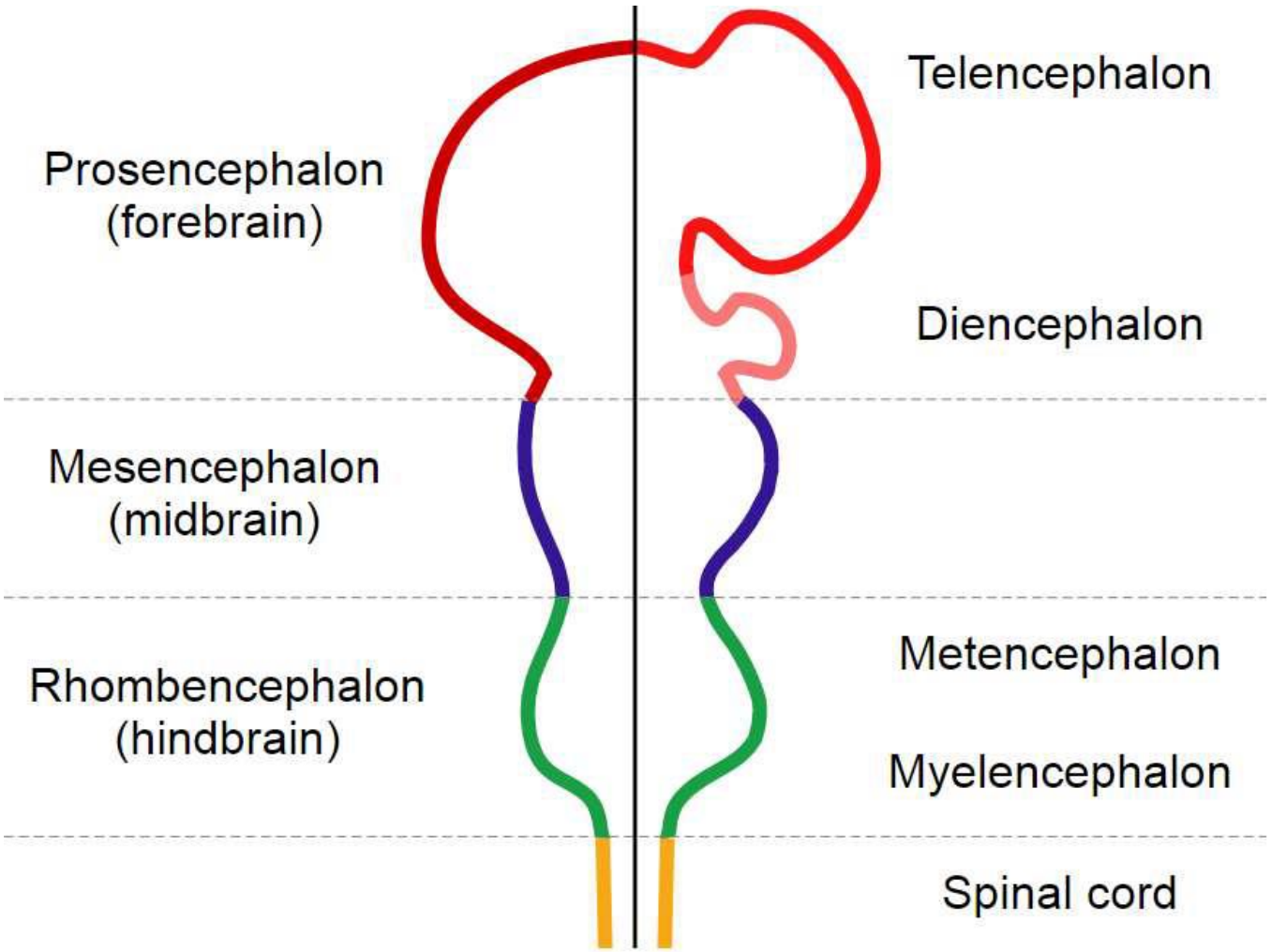
Diencephalon

Diencephalon

- **By the end of this session, you should be able to :**

1. Know the precise location of the diencephalon, its parts, relations to near by structures

2. Identify the most relevant connections with its parts


Telencephalon
Prosencephalon
(forebrain)
Diencephalon
Mesencephalon
(midbrain)
Metencephalon
Rhombencephalon
(hindbrain)
Myelencephalon
Spinal cord

Diencephalon

- Site: It is the part of the forebrain which lies above the midbrain, between the lower parts of the 2 cerebral hemispheres.

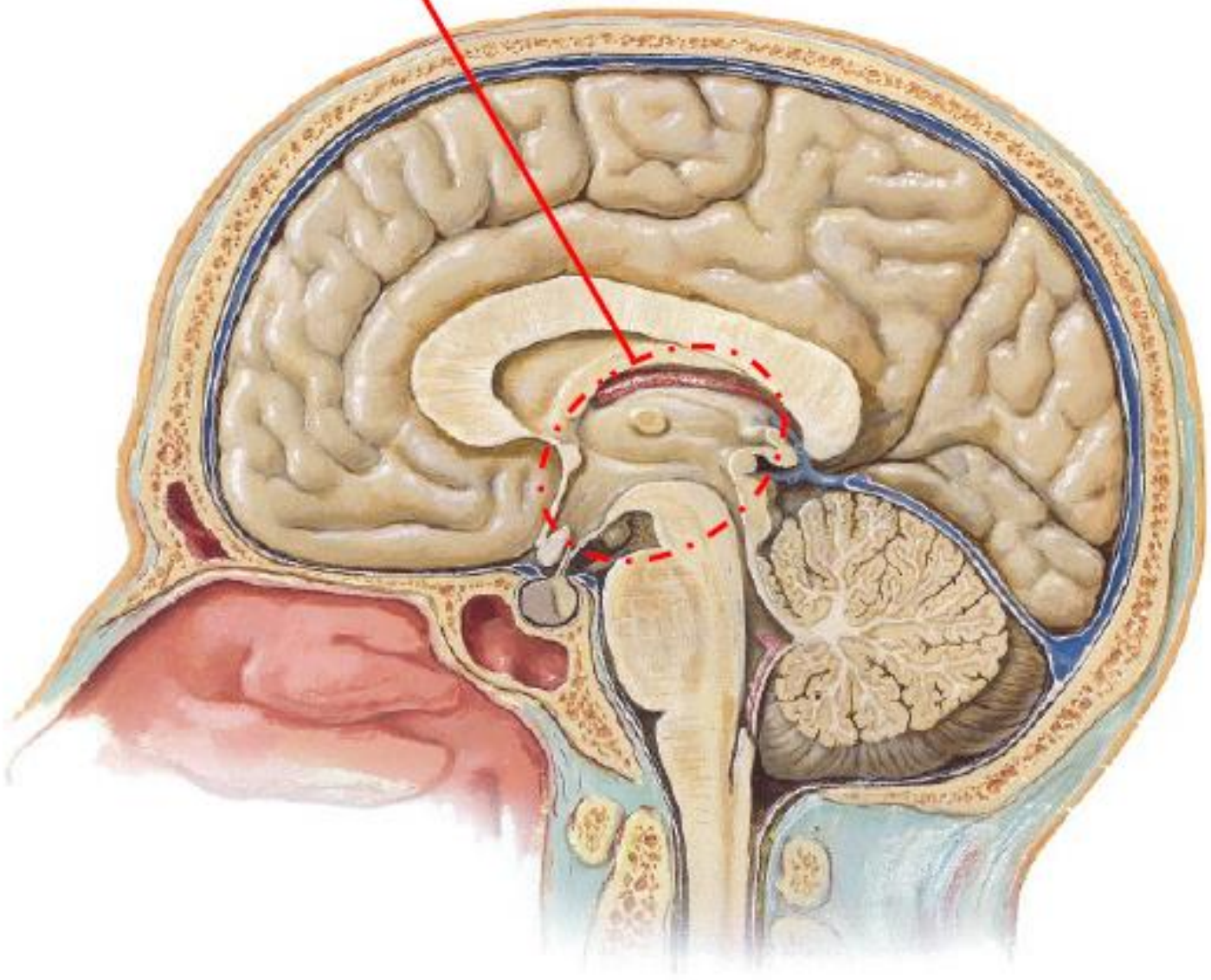
- Consists of
  - Thalamus
  - Subthalamus
  - Hypothalamus
  - Epithalamus

- The third ventricle lies between the 2 halves of the diencephalon.

Diencephalon

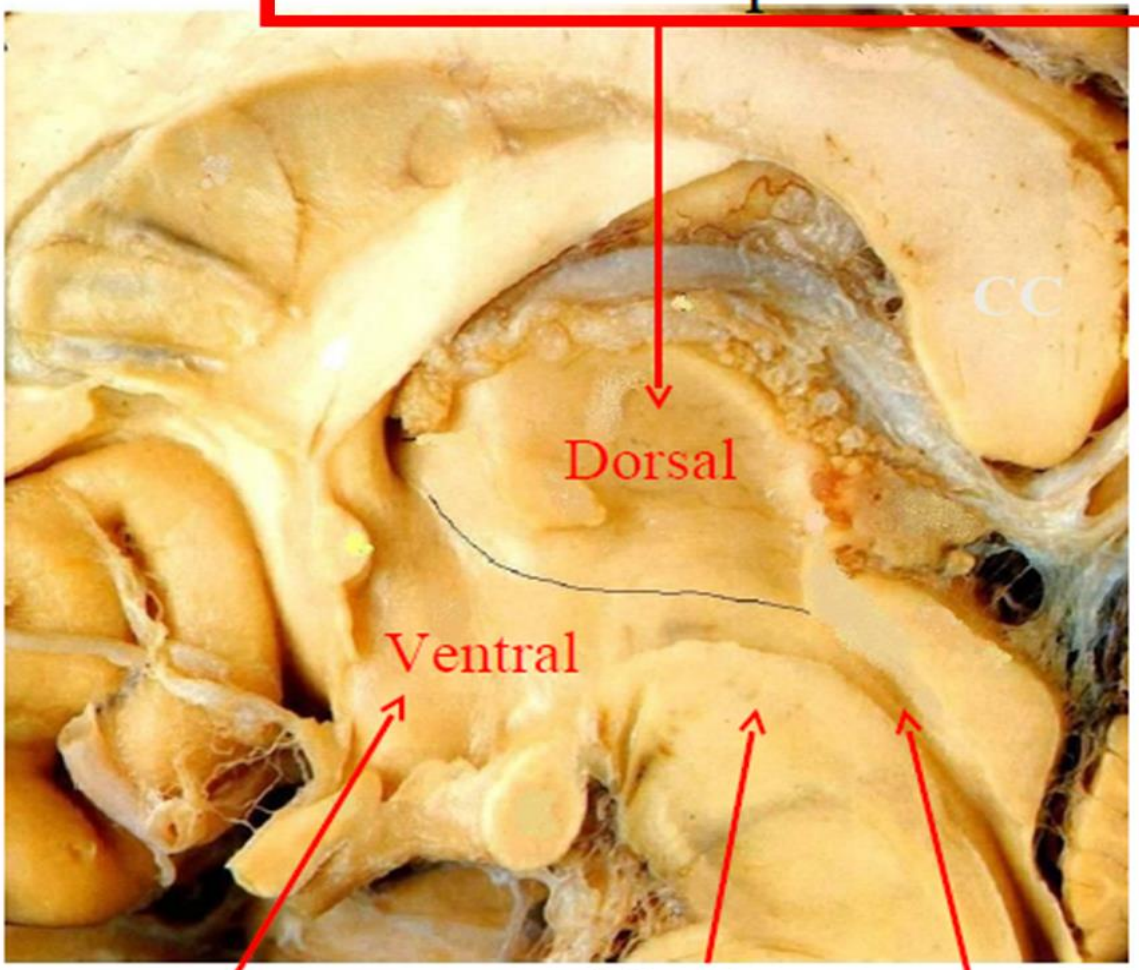
Divisions	Subdivisions
Pars dorsalis	
• Thalamus (dorsal thalamus)	
• Metathalamus	Medial and lateral geniculate bodies
• Epithalamus	Pineal gland (body), habenular nuclei and commissure, and posterior commissure
Pars ventralis	
• Subthalamus (ventral thalamus)	Subthalamic nucleus, and zona inserta
• Hypothalamus	

Diencephalon



- On the medial surface, the diencephalon is subdivided, by hypothalamic sulcus (indicated by black line) into:
  - Dorsal part:
  - Ventral part:

Dorsal part
Thalamus & Epithalamus



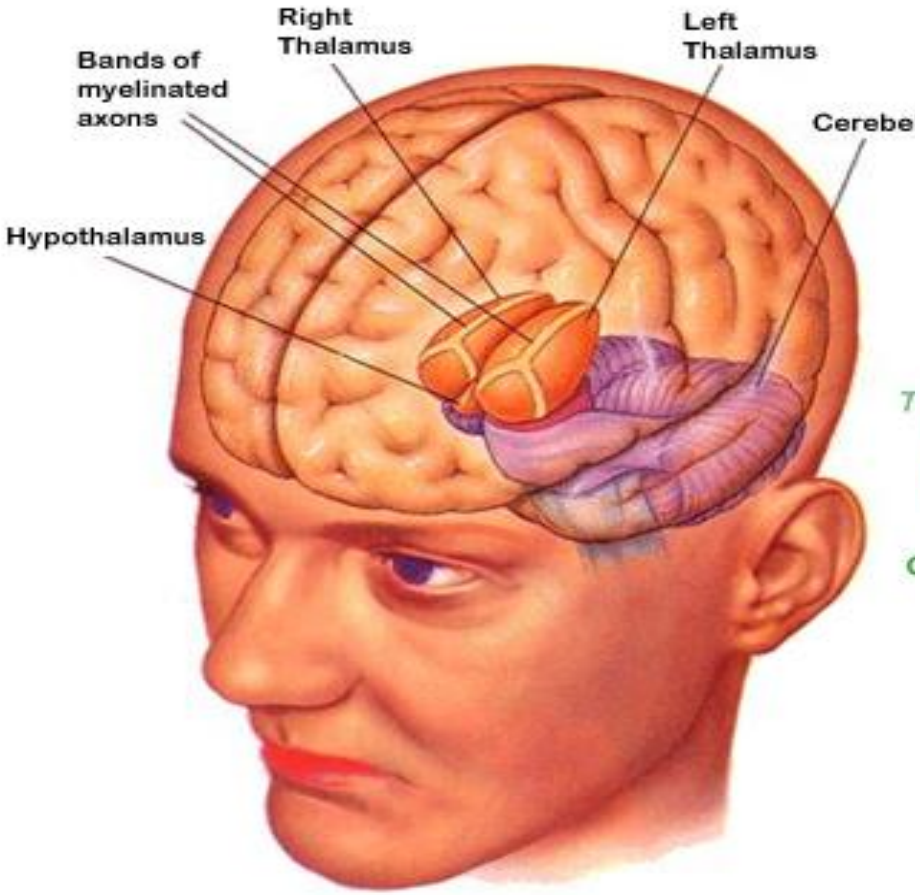
Ventral part
Subthalamus & Hypothalamus

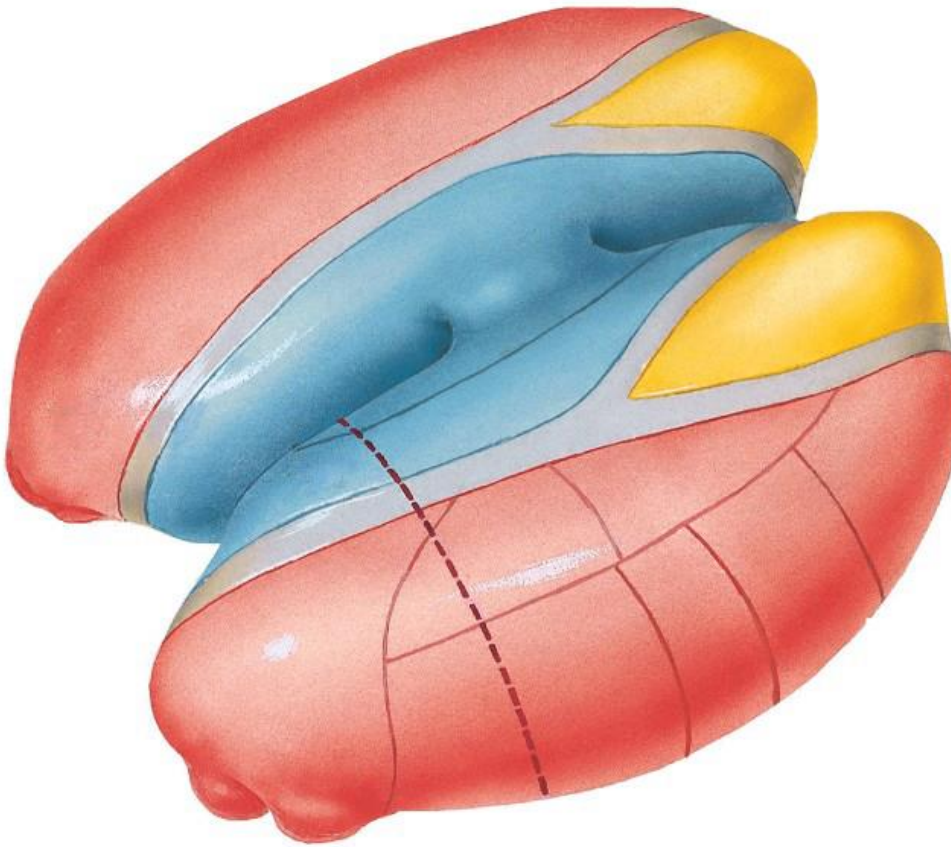
Thalamus

Definition: The thalamus is a large, paired, ovoid mass of gray matter, forms the upper 2/3 of the lateral wall of the third ventricle.

The two thalami are connected across the midline in about 70% of humans through the interthalamic adhesion (not an actual connection).

It ***relays all sensations*** **EXCEPT** ***Smell***. It also relays motor and limbic impulses going to the cerebral cortex.

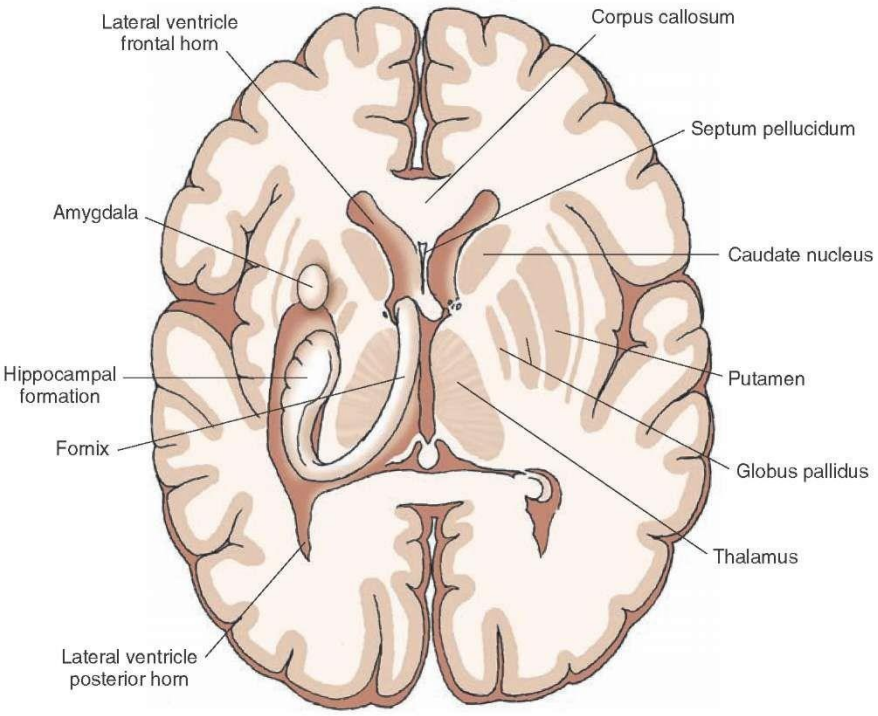

Right
Thalamus
Left
Thalamus
Bands of
myelinated
axons
Cerebe
Hypothalamus

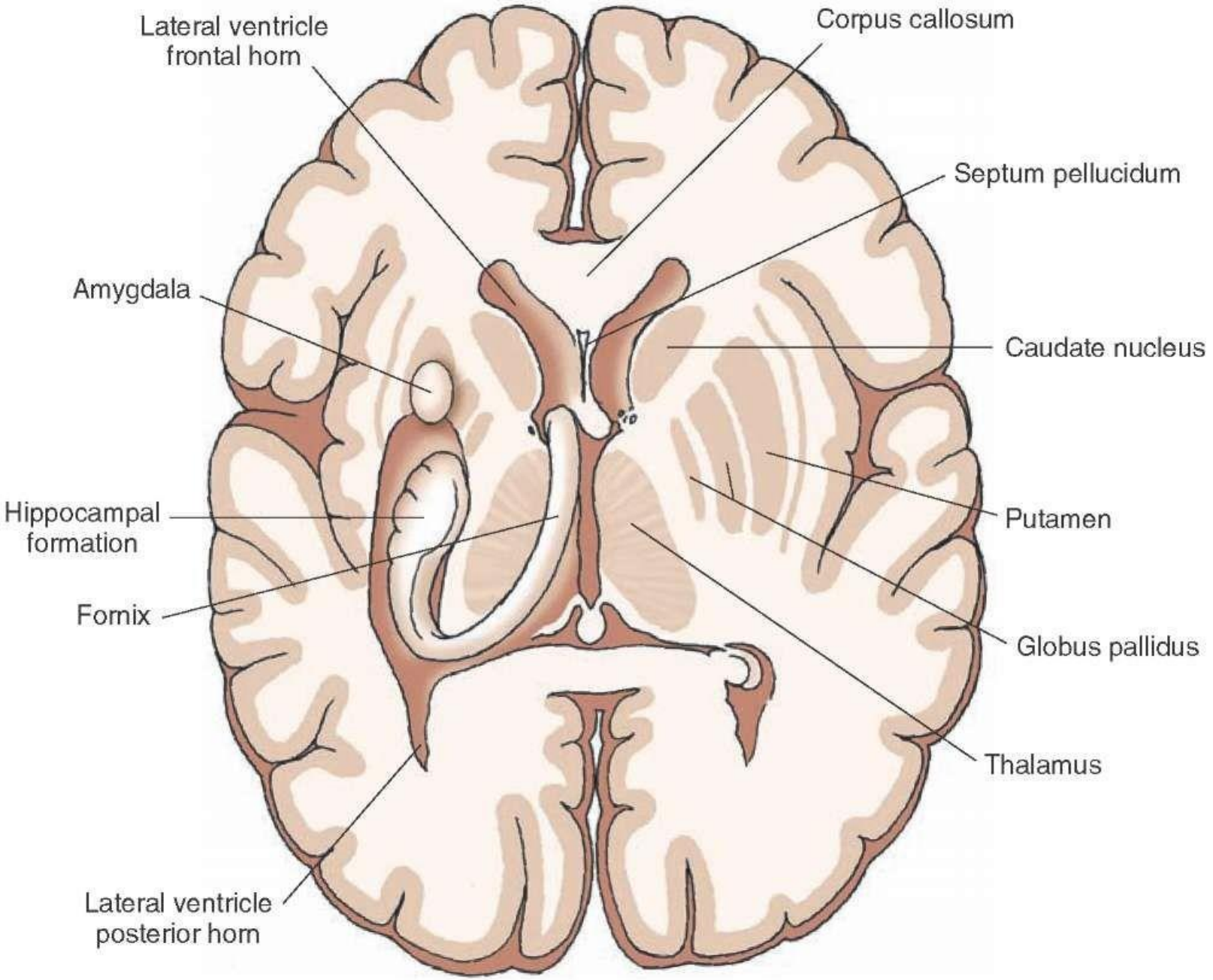


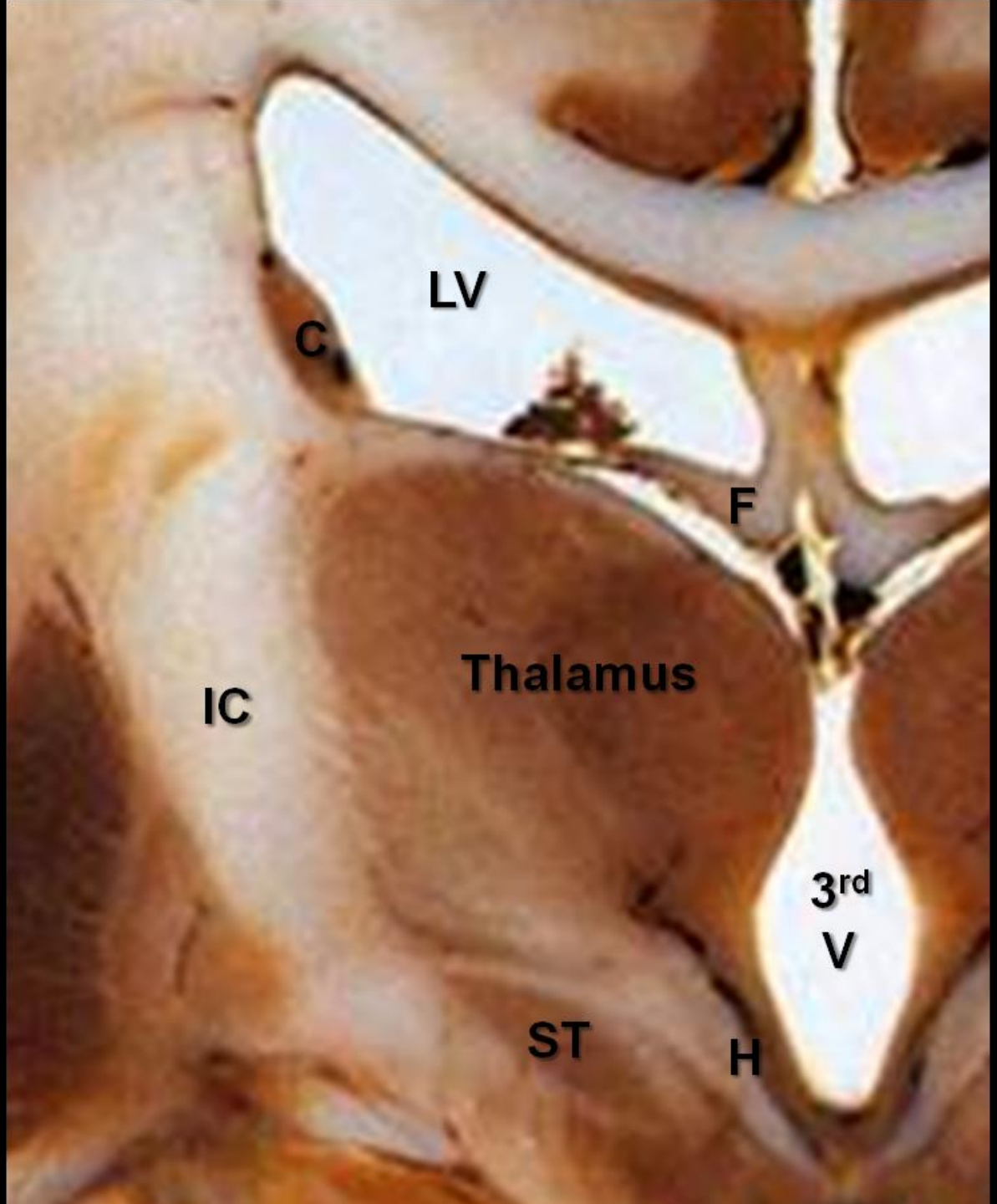
Relations

Lateral: Posterior limb of the internal capsule (IC)

Medial: Together with hypothalamus, forms the lateral wall of the 3rd ventricle



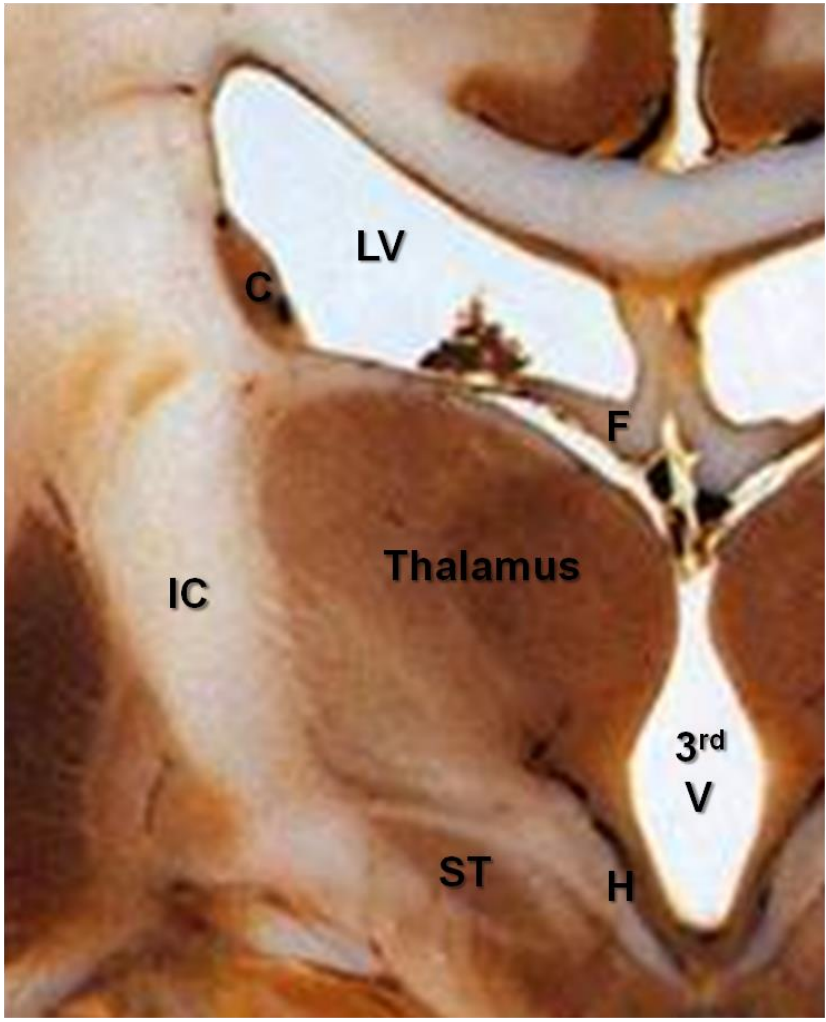

Lateral ventricle
frontal horn
Corpus callosum
Septum pellucidum
Amygdala
Caudate nucleus
Hippocampal
formation
Putamen
Fornix
Globus pallidus
Thalamus
Lateral ventricle
posterior horn

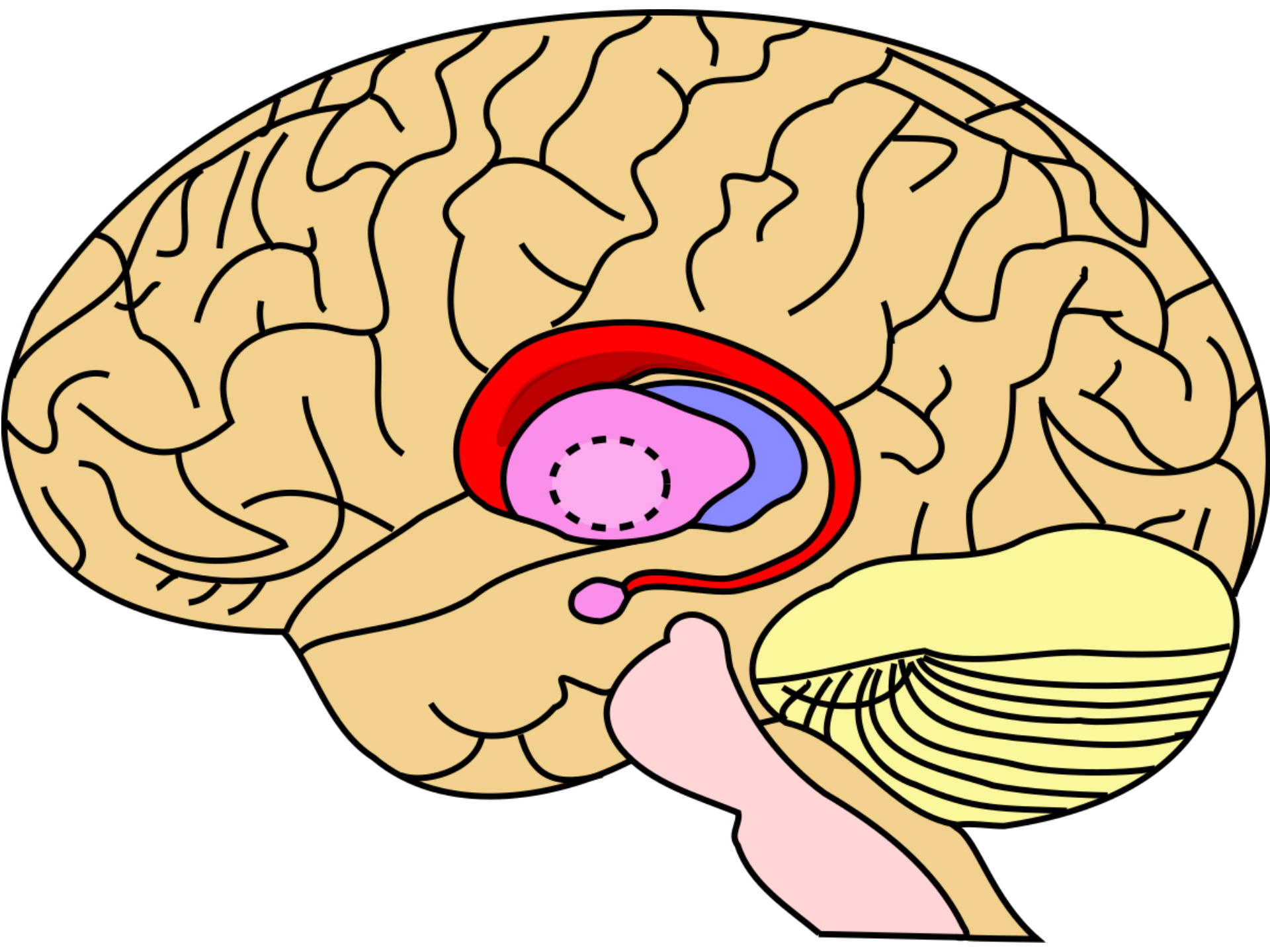

LV
C
F
Thalamus
IC
3rd
V
ST
H

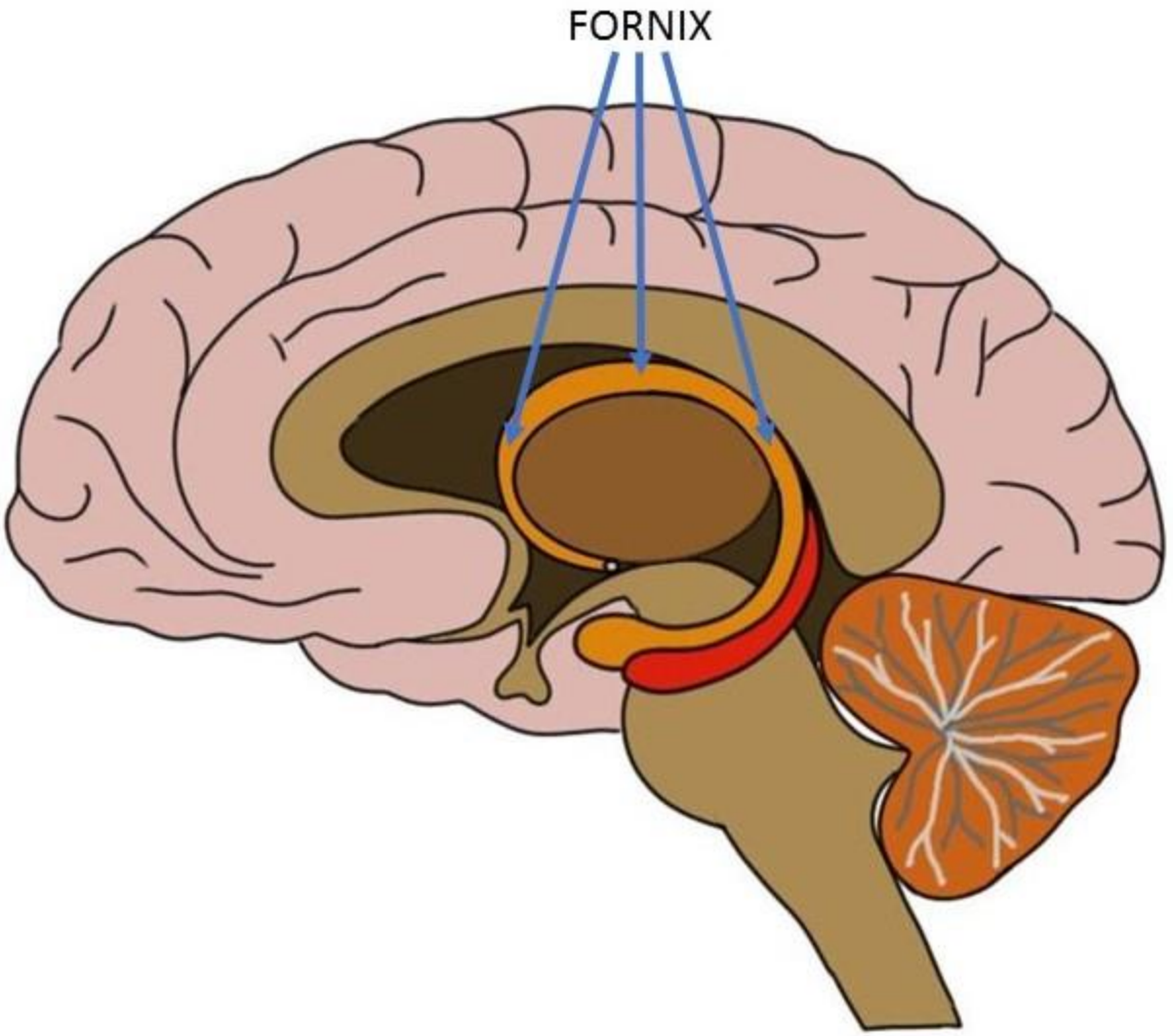
Relations

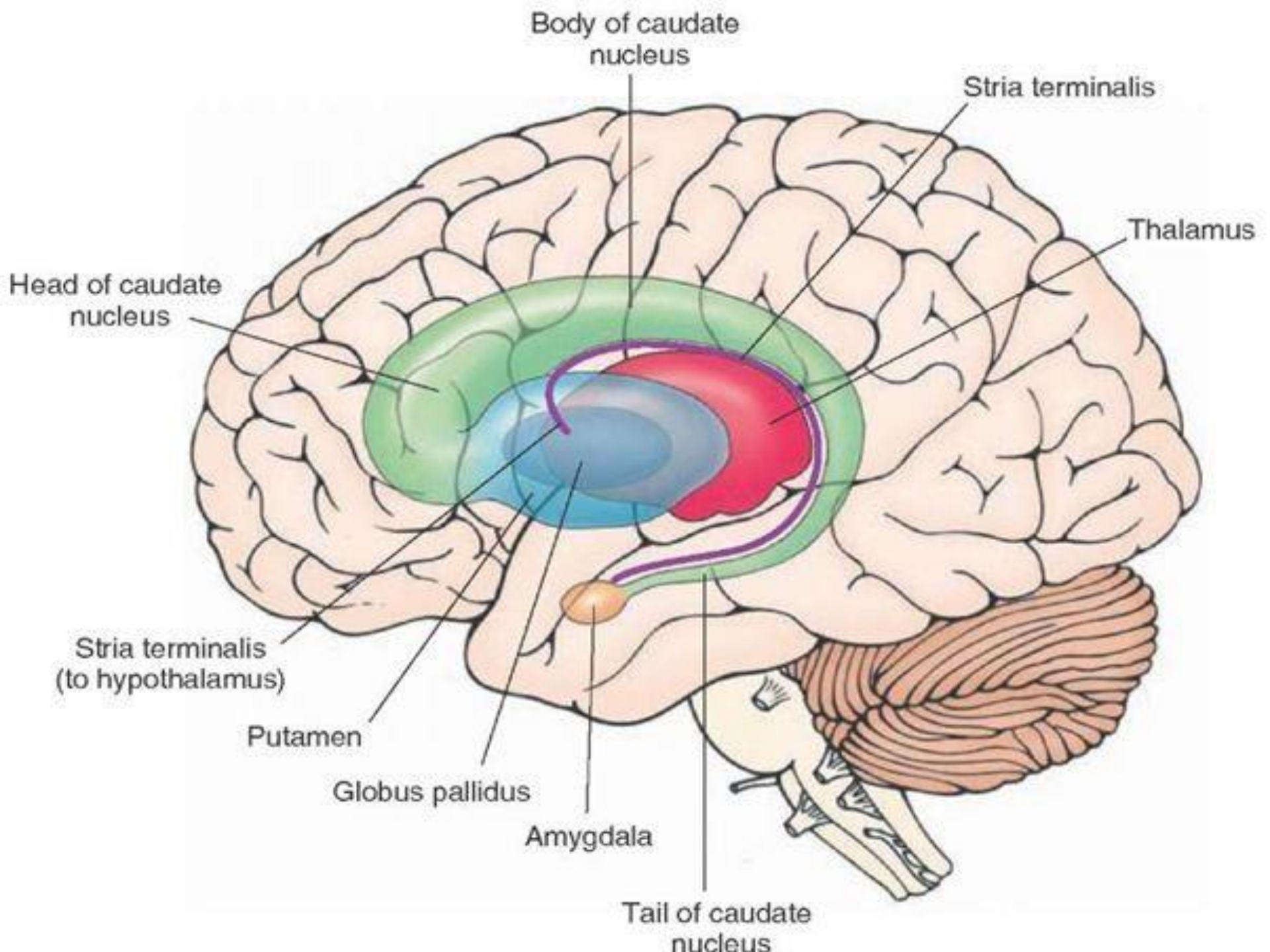
Superior: Caudate nucleus (C) fornix (F) & lateral ventricle (LV)

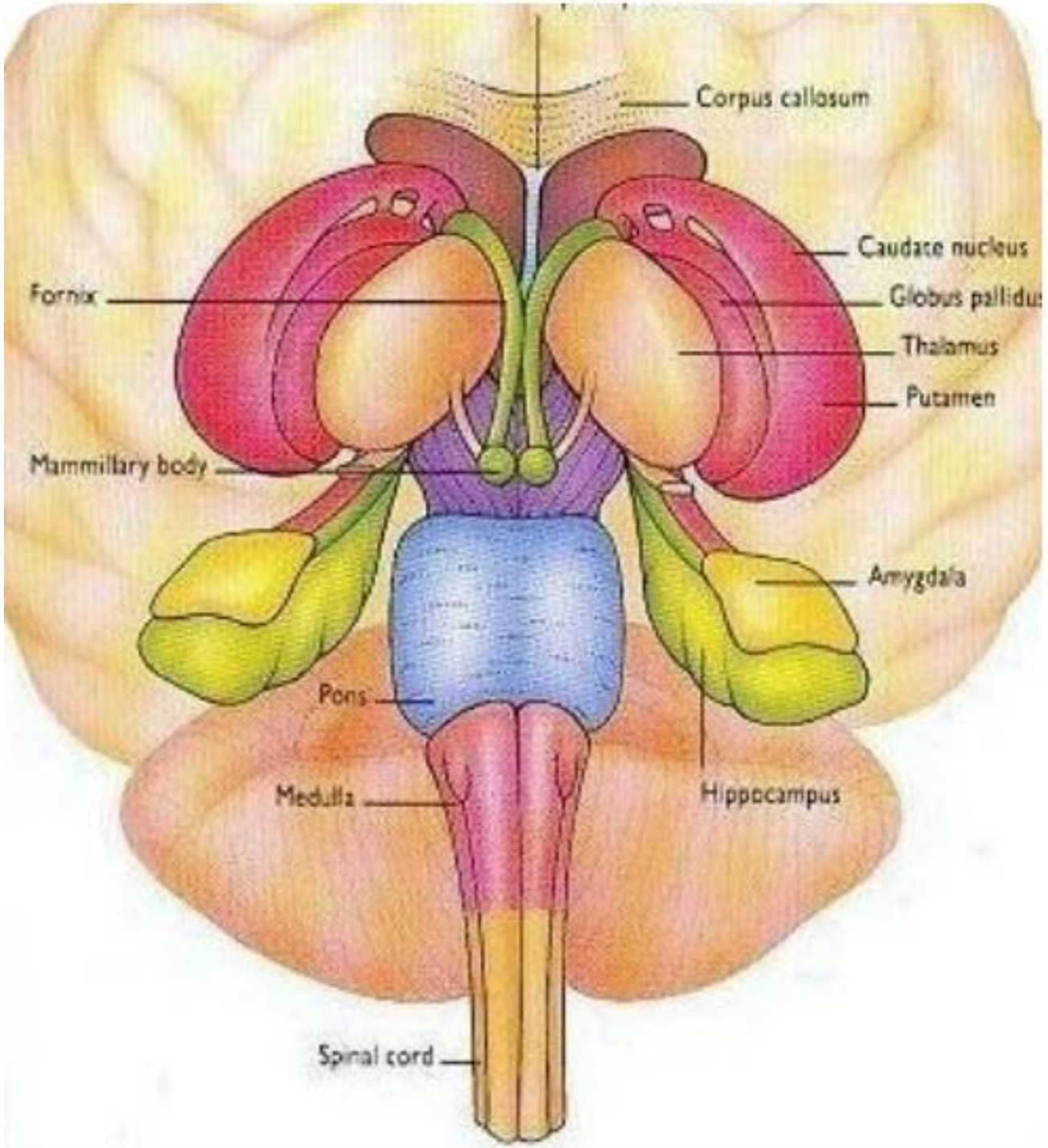
Inferior:
Hypothalamus (H) anteromedially & Subthalamus (ST) posterolaterally.






FORNIX


Body of caudate nucleus
Stria terminalis
Thalamus
Head of caudate nucleus
Stria terminalis (to hypothalamus)
Putamen
Globus pallidus
Amygdala
Tail of caudate nucleus


Corpus callosum
Caudate nucleus
Fornix
Globus pallidus
Thalamus
Putamen
Mammillary body
Amygdala
Pons
Medulla
Hippocampus
Spinal cord

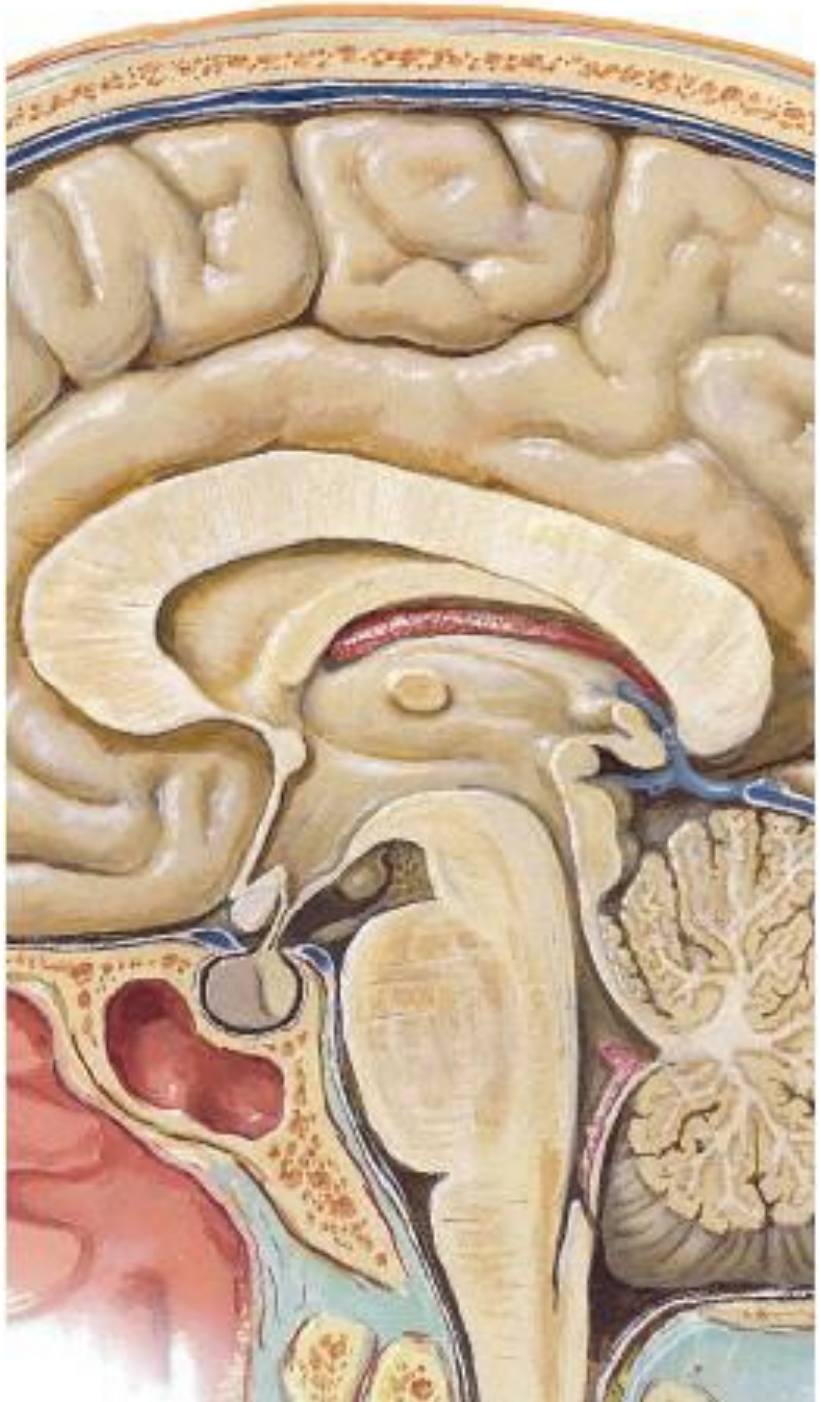
External Features of Thalamus

Thalamus has 2 ends:

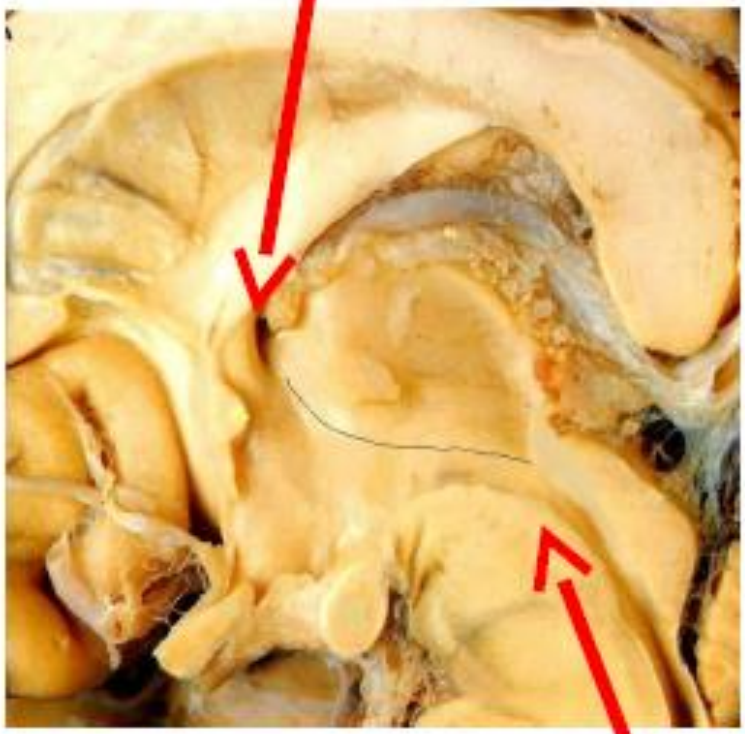
Anterior end of the thalamus is narrow and rounded, which lies just behind the interventricular foramen

Posterior end is expanded to form the pulvinar, which lies above the superior colliculus of midbrain

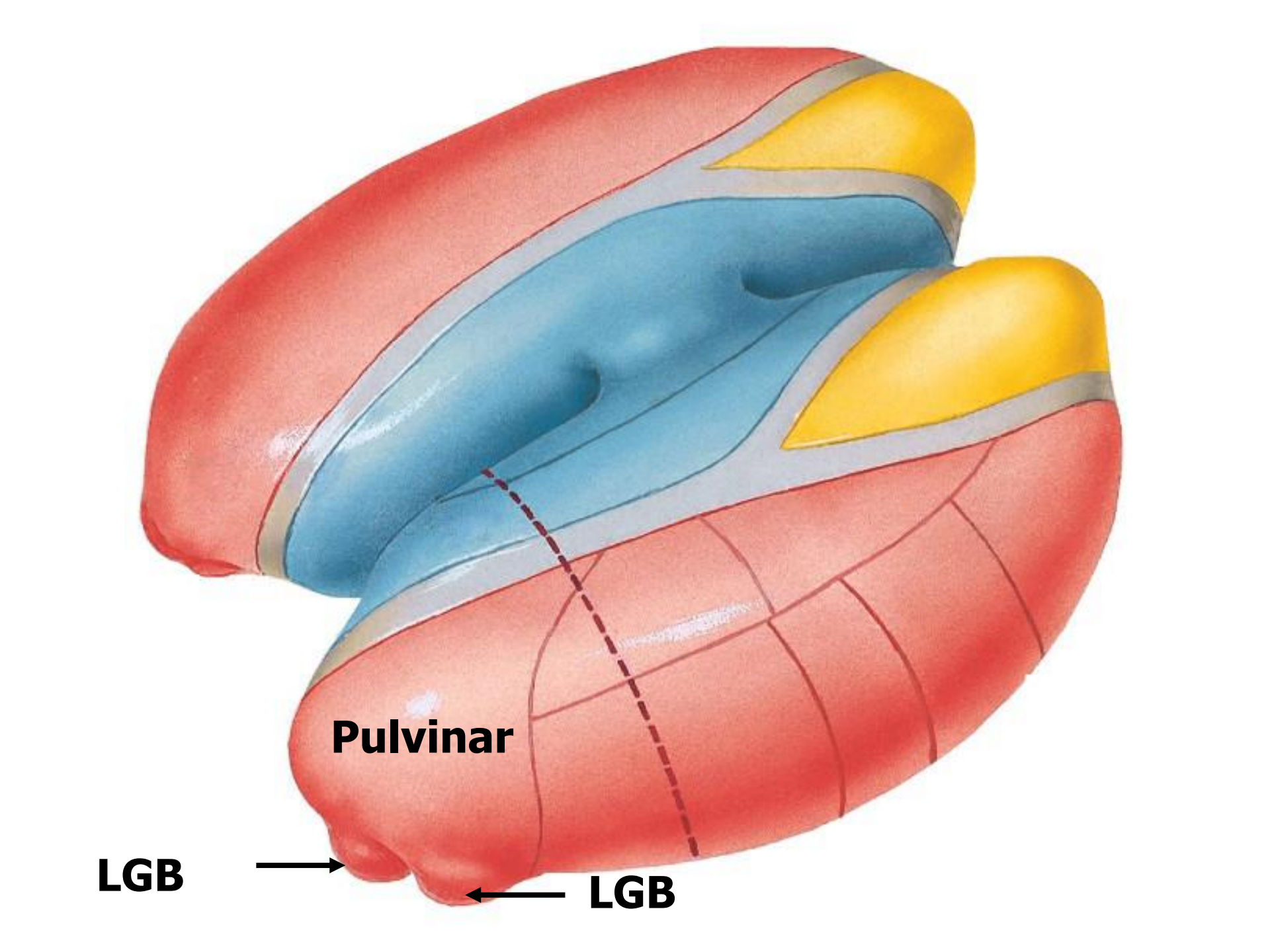
Lateral & medial geniculate bodies bulge out from pulvinar

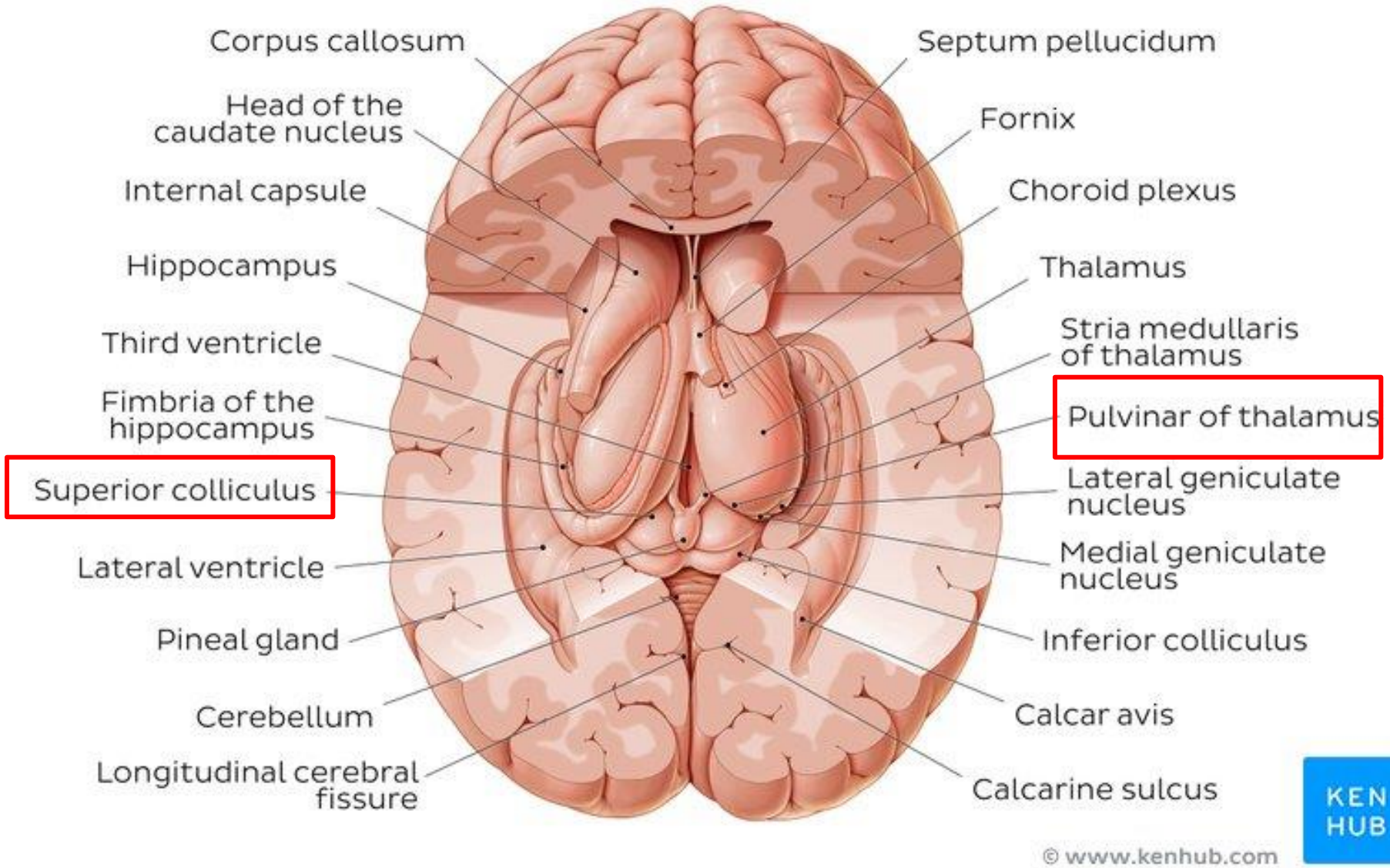


Rostrally interventricular foramen



Caudal: midbrain


Pulvinar
LGB
LGB


Corpus callosum
Head of the caudate nucleus
Internal capsule
Hippocampus
Third ventricle
Fimbria of the hippocampus
Superior colliculus
Lateral ventricle
Pineal gland
Cerebellum
Longitudinal cerebral fissure
Septum pellucidum
Fornix
Choroid plexus
Thalamus
Stria medullaris of thalamus
Pulvinar of thalamus
Lateral geniculate nucleus
Medial geniculate nucleus
Inferior colliculus
Calcar avis
Calcarine sulcus
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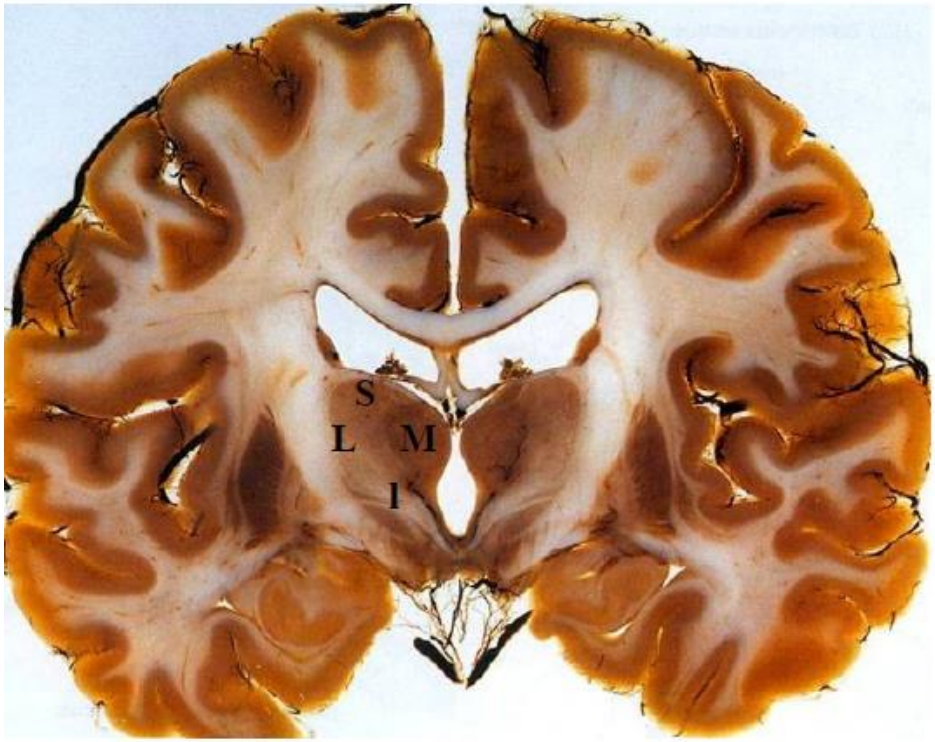
Relations

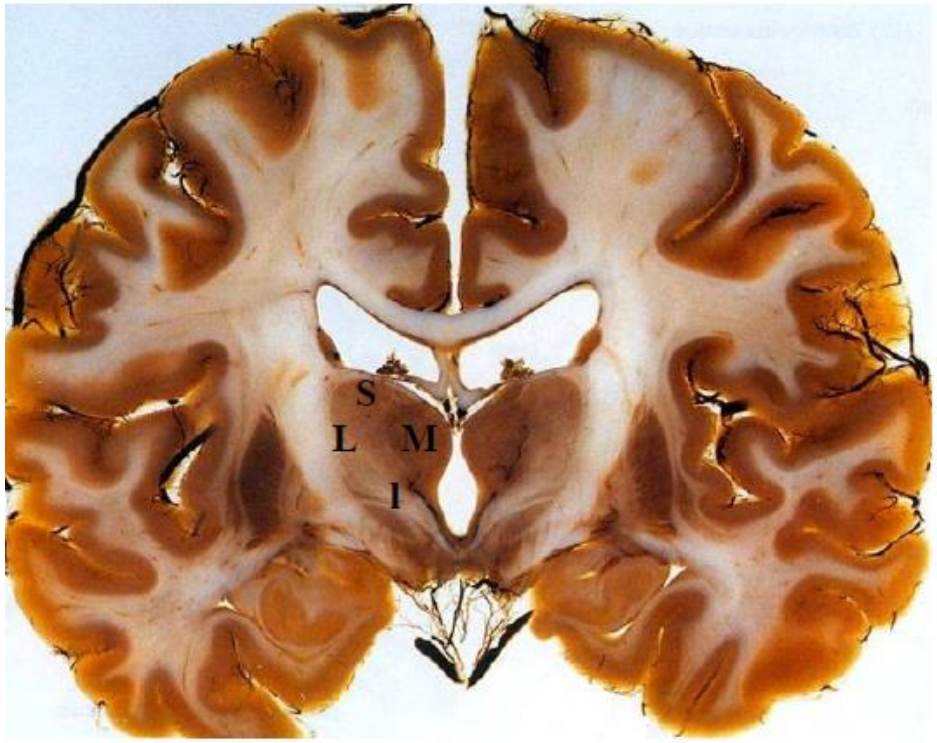
Thalamus has 4 surfaces:

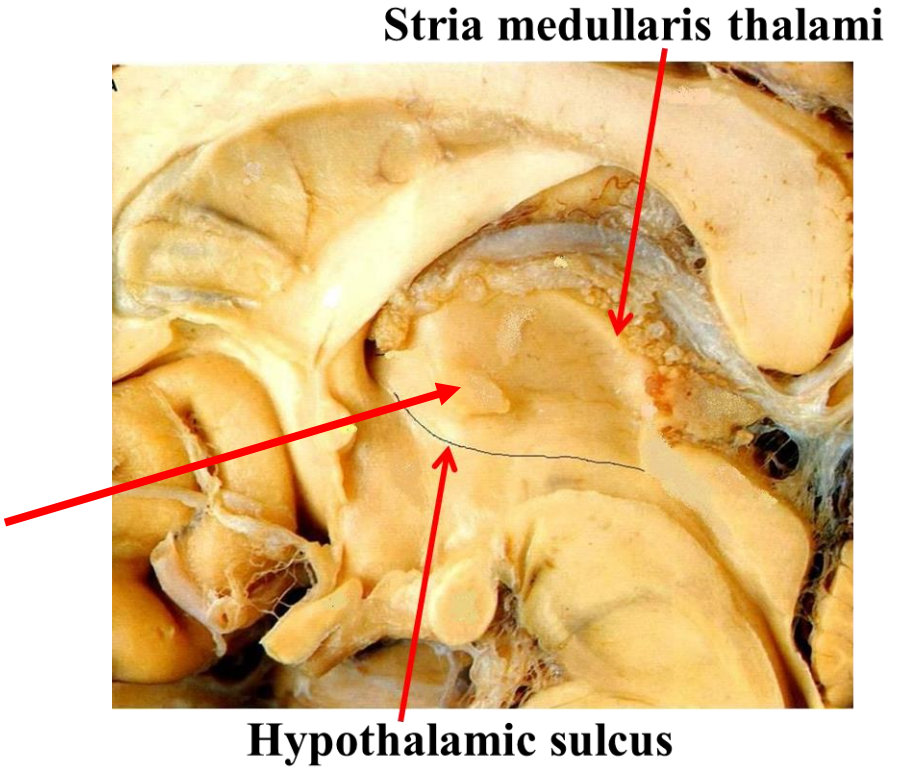
1. Lateral
2. Medial
3. Superior
4. Inferior

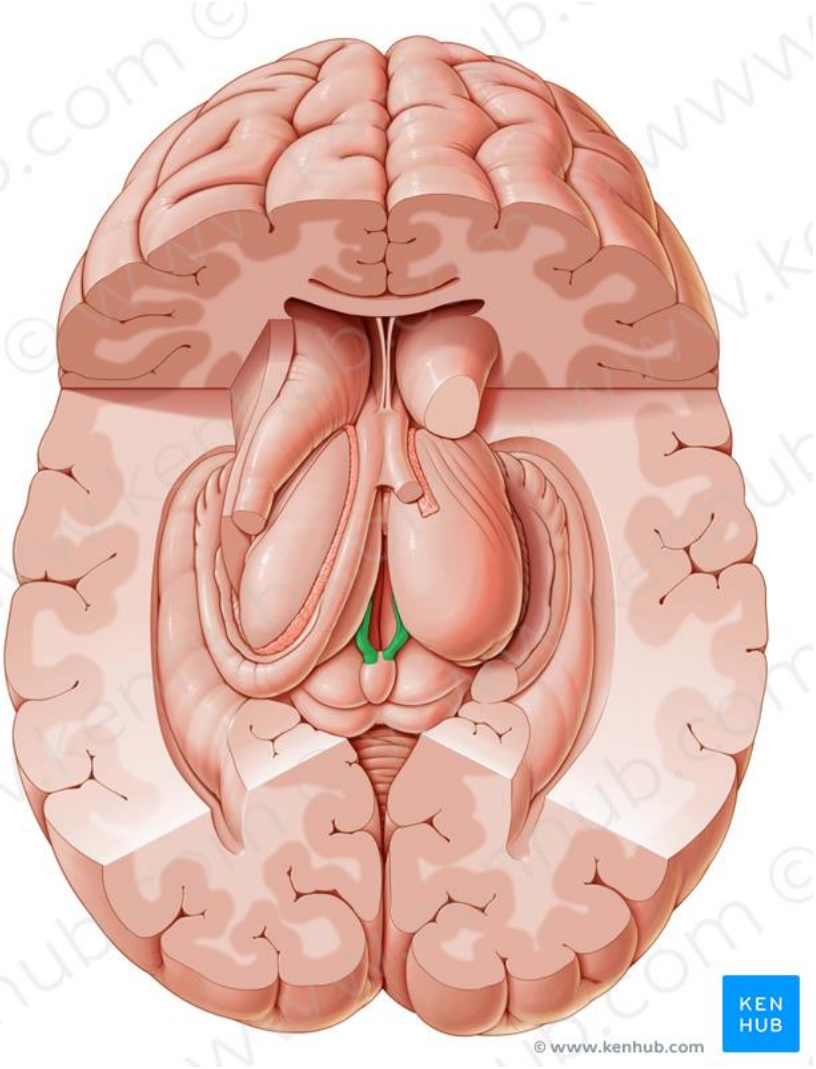


Medial Surface

- Forms the ***upper 2/3 of the lateral wall of the third ventricle***.
- It is lined by **ependyma (*neuroepithelial lining of the ventricular system)***
- ***Stria medullaris thalami*** (bundle of nerve fibers) courses along its dorsomedial margin.
- The two thalami are connected across the midline through the ***interthalamic adhesion***.
- Inferiorly is limited by ***hypothalamic sulcus***


S
L
M
I


Stria medullaris thalami
Hypothalamic sulcus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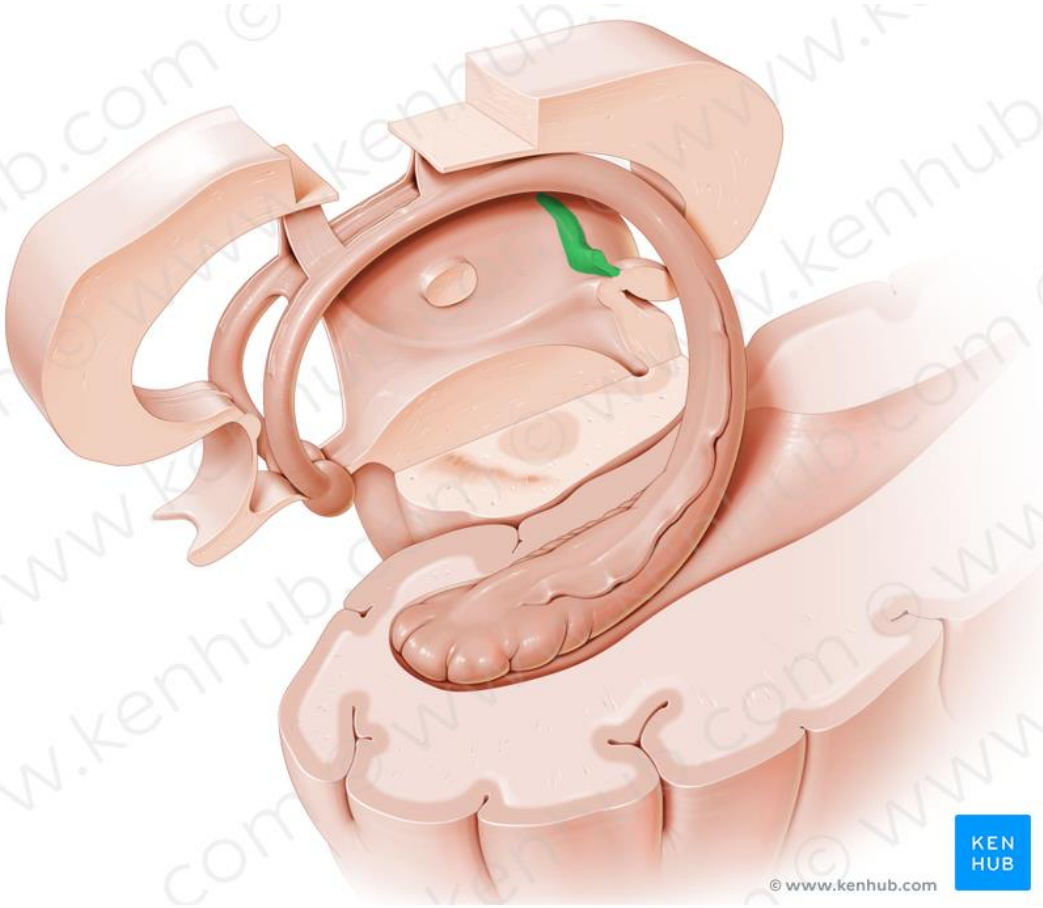
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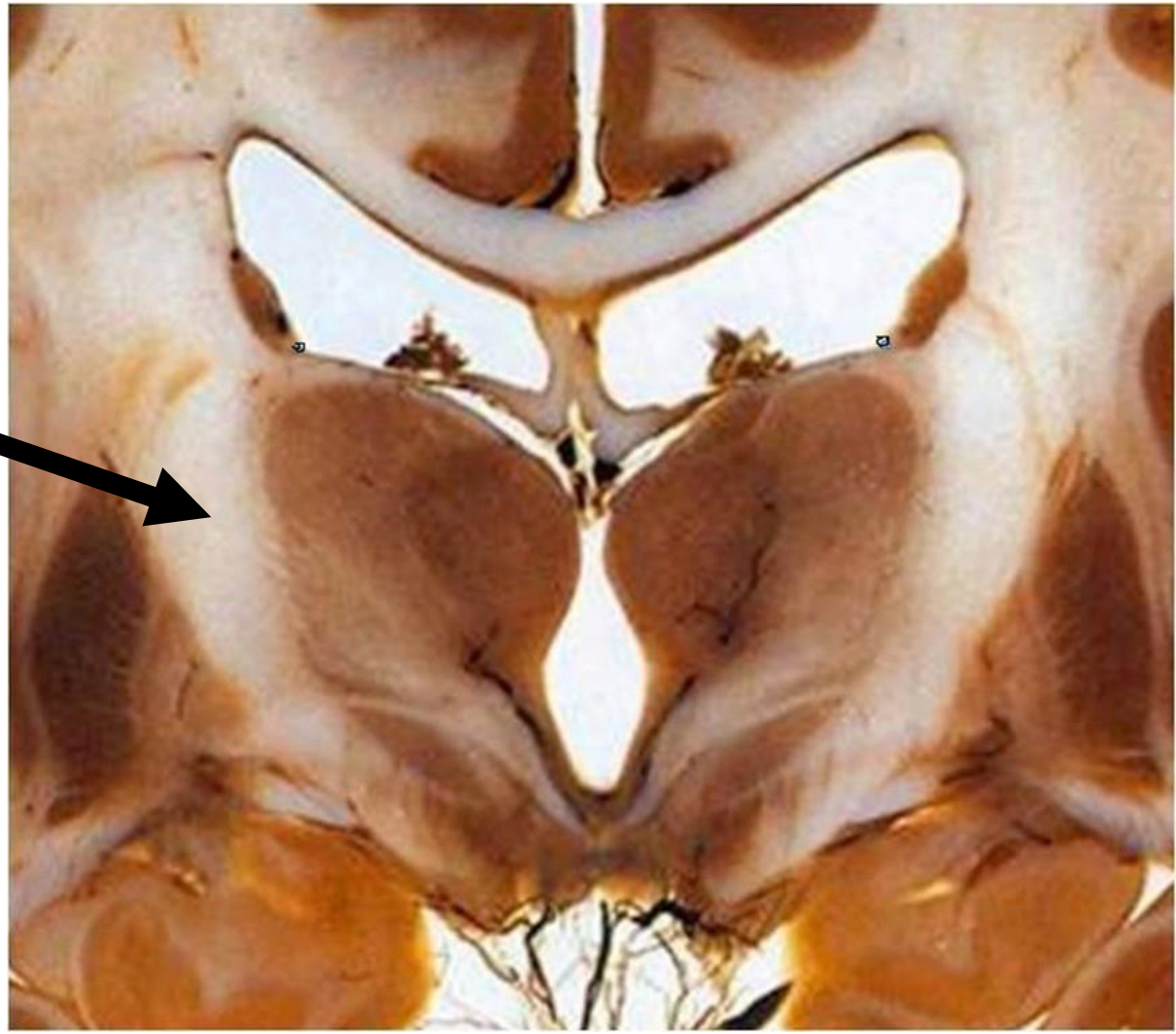
Lateral Surface of Thalamus

The lateral surface of the thalamus is coated by a layer of myelinated fibers named **external medullary lamina** that divides lateral surface with the reticular nuclei.

It is related to the **posterior limb of the internal capsule**

Posterior limb of the internal capsule



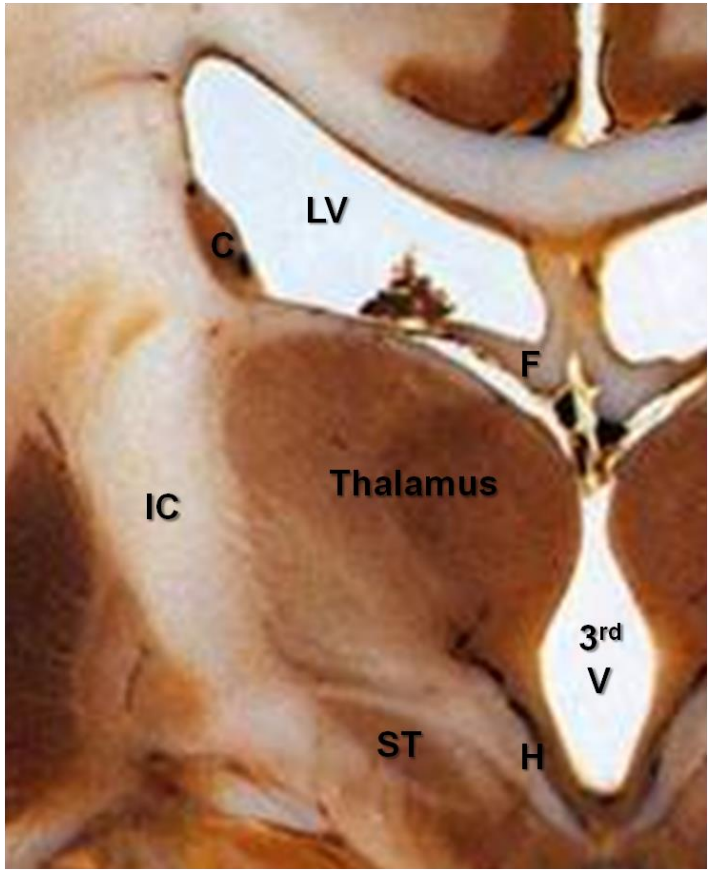
Superior Surface of Thalamus

It is covered by thin layer of white matter called **stratum zonale.**

Lateral part lies in the floor of the lateral ventricle and covered by **ependyma.**

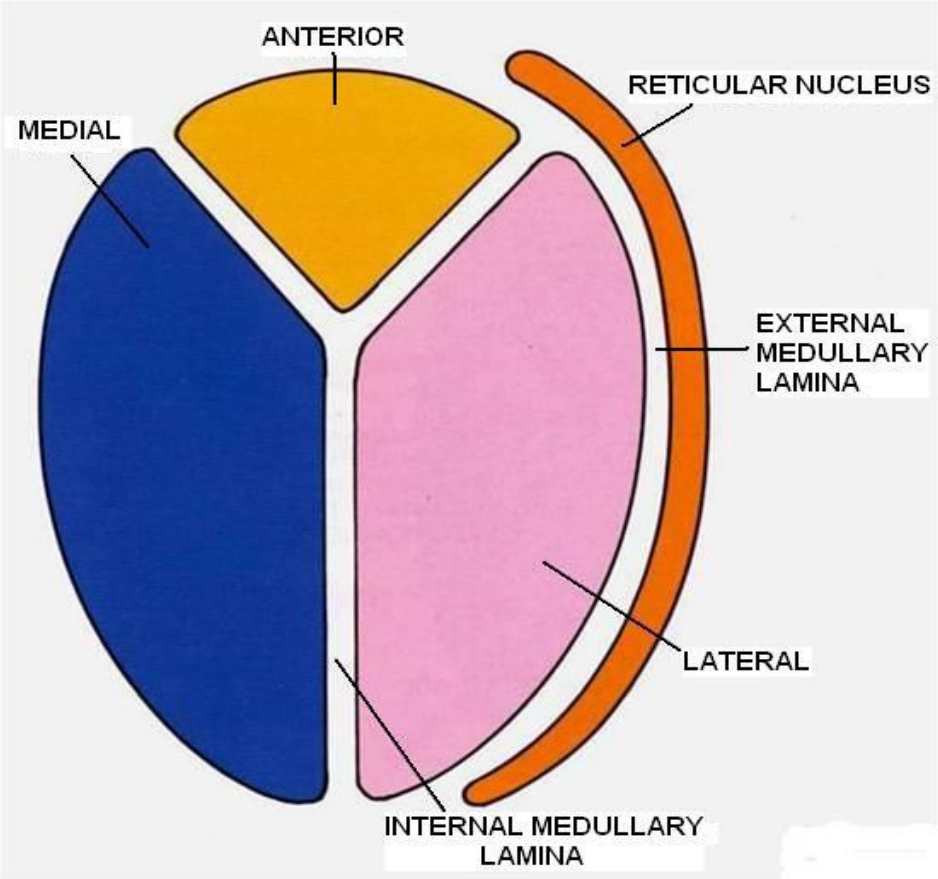
Inferior Surface of Thalamus

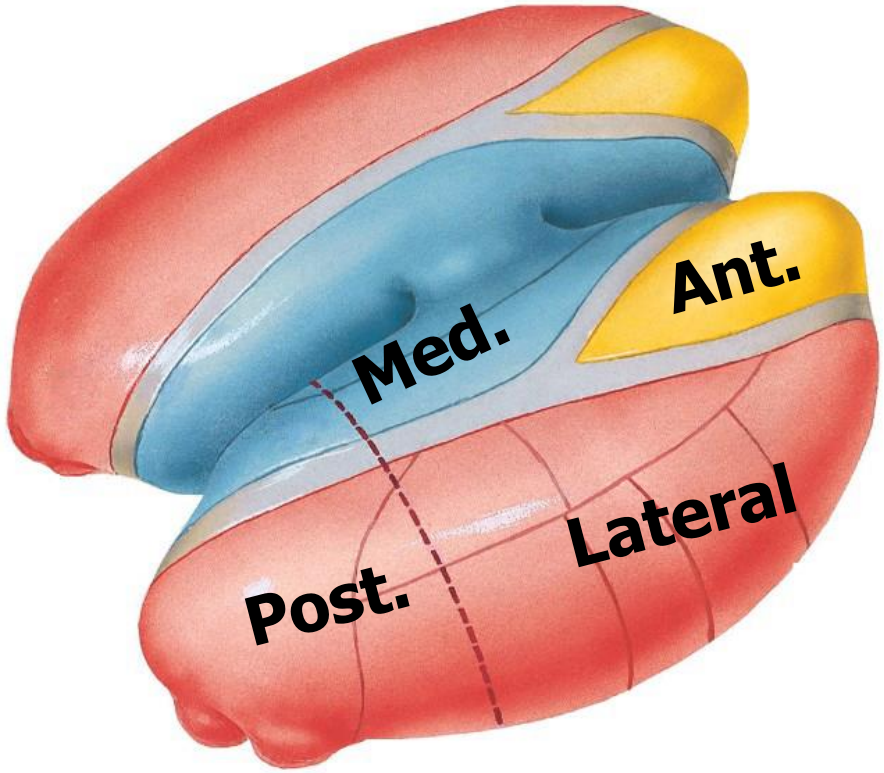
The inferior surface rest on hypothalamus (H) and subthalamus (ST).



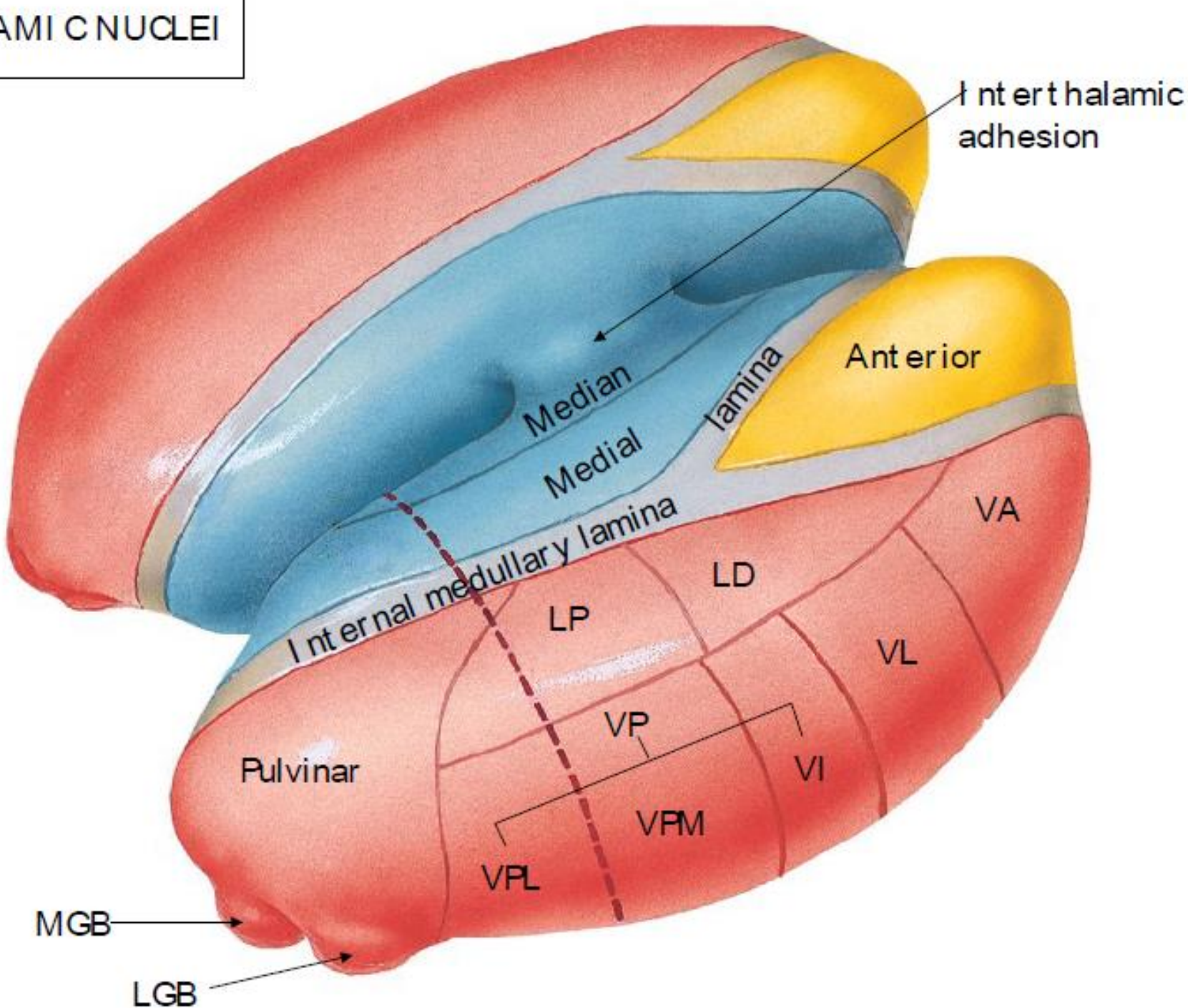
Thalamic Nuclei

- Thalamus is composed of ***grey matter***, **interrupted** by **2 sheaths** of **white matter** called ***medullary laminae***
- External medullary lamina located laterally, separates reticular nucleus (**on the lateral wall**) from the rest of the thalamic mass.
- Y shaped internal medullary lamina divides the thalamus into three parts:
  - Anterior
  - Medial
  - Lateral
- Each part contains several more nuclei


ANTERIOR
RETICULAR NUCLEUS
MEDIAL
EXTERNAL
MEDULLARY
LAMINA
LATERAL
INTERNAL MEDULLARY
LAMINA


Med.
Ant.
Post.
Lateral

THALAMI C NUCLEI



Thalamic Funtions

1. **Sensory fonctions.**
2. **Motor fonctions.**
3. **Integration fonctions.**
4. **Arousal fonction.**

Sensory Functions

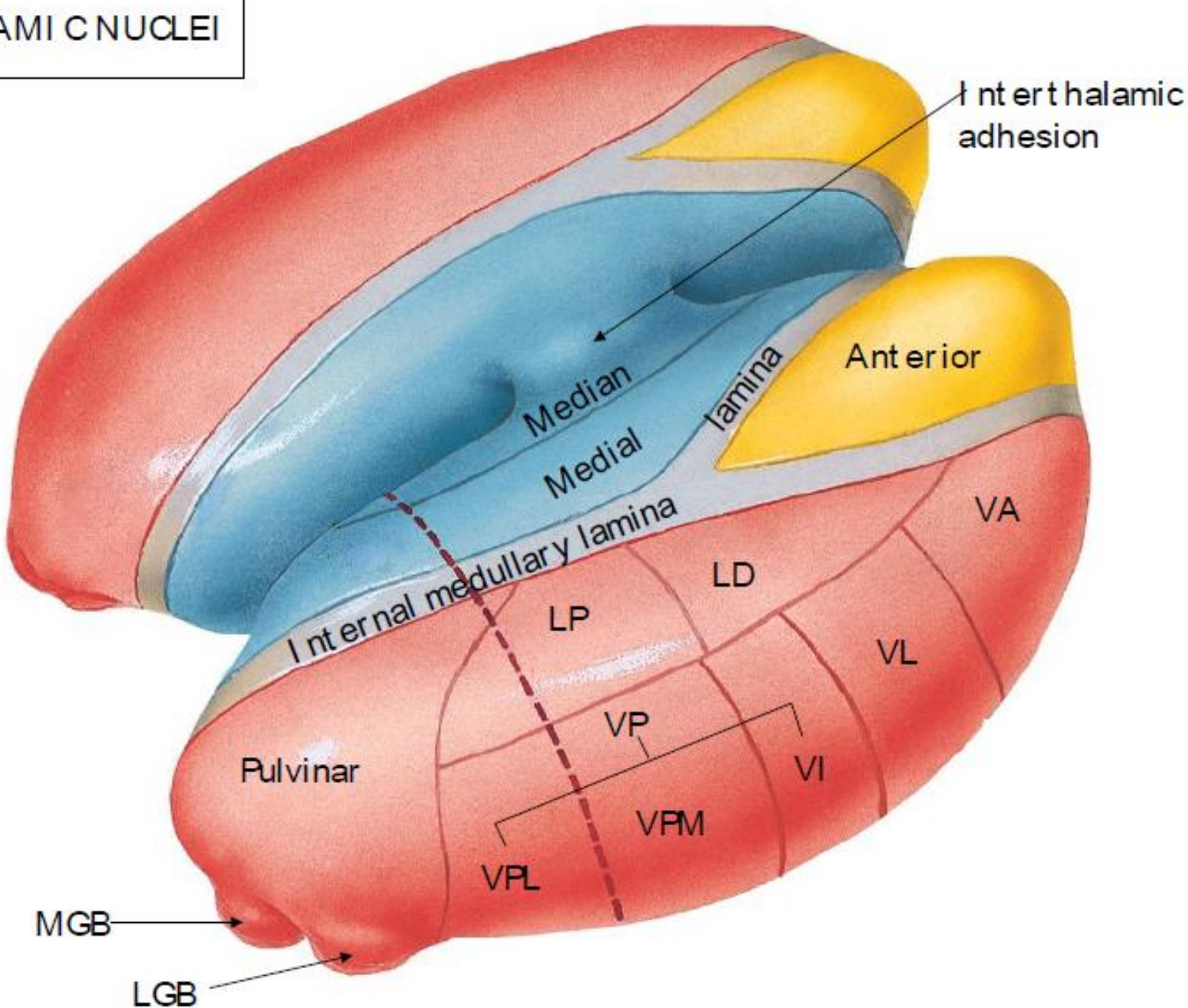
It is a sensory relay station:

All ascending sensory pathways before reaching, the cerebral cortex relay in the thalamus specially those carrying fine epicritic sensations ***(fine touch and temperature sensation)*** *from opposite side of the body*

1. ***Somatic sensory:***

Pathways relay in VPL and VPM nuclei of the opposite side, where those from the body relay in V.P.L and those from the head and the face plus taste relay in VPM

THALAMI C NUCLEI



Sensory Function

2. Special sensations:

Vision: the optic fibers from both retina reach LGB and projected to the visual cortex.

Hearing: auditory fibers from both ears relay in MGB before reaching the auditory cortex.

Olfaction: **recently**, olfactory pathway has found to pass through the dorsomedial nucleus to the orbitofrontal cortex.

Sensory Function

3. ***Gating of the ascending sensory information:***

Nerve fiber impulses are transmitted back from the cerebral cortical sensory areas to the thalamic relay nuclei which already project to these areas.

This ***cortical-feedback is inhibitory***, and it decreases transmission through these nuclei particularly ***when*** the ***sensory input is very high***, and the sensory system is overloaded with sensory input

Sensory Function

Thalamus as a sensory center:

The discrimination of many sensory impulses occurs in the thalamus, but the ***sensations felt are crude in nature*** eg: diffuse pain, crude touch & extremes of temperature change.

Motor Functions

- The ***VA and VL nuclei*** relay ***motor signals*** from the ***BG*** and ***cerebellum to*** the ***motor*** and ***premotor*** areas of the ***frontal lobe*** to control their functions.

- The ***VPL nucleus*** relays ***tactile*** and ***proprioceptive*** signals to the ***motor cortex***. This *provides sensory information* ***about position*** and movements of the different parts of the body.

- The ***non-specific nuclei adjust*** the general ***level*** of ***excitability*** of the ***motor cortex***.

Association and Integration Functions

- The ***anterior*** and ***medial nuclei*** together with **hypothalamus** and **limbic system** play a ***role*** in ***integrating*** the ***visceral*** and ***somatic*** motor ***responses evoked*** during ***emotional reactions*** with incoming sensory signals.

- The ***reciprocal connection*** between the ***DM nucleus*** of the thalamus and ***prefrontal areas*** may play a role in the ***coding***, ***storing*** and recalling of ***memory***.

Arousal Function

- The ***non-specific thalamic nuclei receive excitatory signals from the RAS*** of the brain stem, and ***project*** it ***to*** almost ***all areas*** of the cerebral ***cortex***, ***producing arousal*** and ***wakefulness***

Thalamic Nuclei

- Nuclei of the ***anterior group***: they form ***part*** of the ***limbic system*** (a system concerning with ***emotion*** and ***motivation***).

- Nuclei of the ***lateral group***: they form ***feedback loops*** with the ***limbic system*** and the ***parietal lobes*** of the cerebral hemispheres. They are concerned with ***integration*** of ***sensory information*** and influencing ***emotional states***.

Thalamic Nuclei

- Nuclei of the ***medial group***: they ***receive*** and relay ***sensory information*** from ***other parts*** of ***thalamus***.

- They also ***provide awareness*** of ***emotional states*** by making ***connections*** between ***emotional centers*** of the ***hypothalamus*** and ***frontal lobes*** of the cerebral hemispheres.

Thalamic Nuclei

- Nuclei of the ***ventral group***: they ***relay information*** from ***basal nuclei*** and ***cerebellum*** to ***somatic motor*** areas of the cerebral ***cortex***, and also relay sensory information about (touch, pressure, pain, temperature, and sense of position) to the sensory areas of the cerebral cortex.

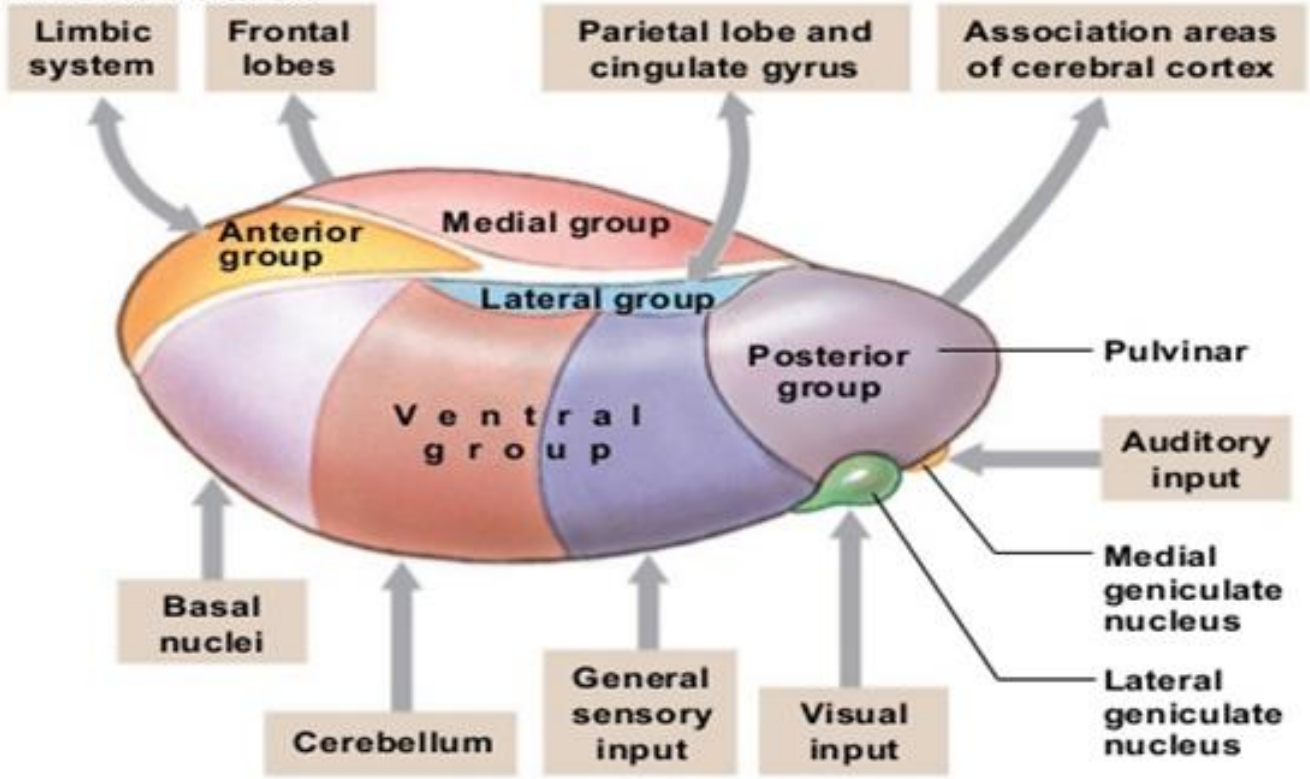
- The **posterior group**: includes **pulvinar** and **geniculate nuclei (MGB-LGB)**

- ***Pulvinar nuclei:*** integrate sensory information for projection to association areas of the cerebral cortex.

TABLE 14–5 The Thalamus

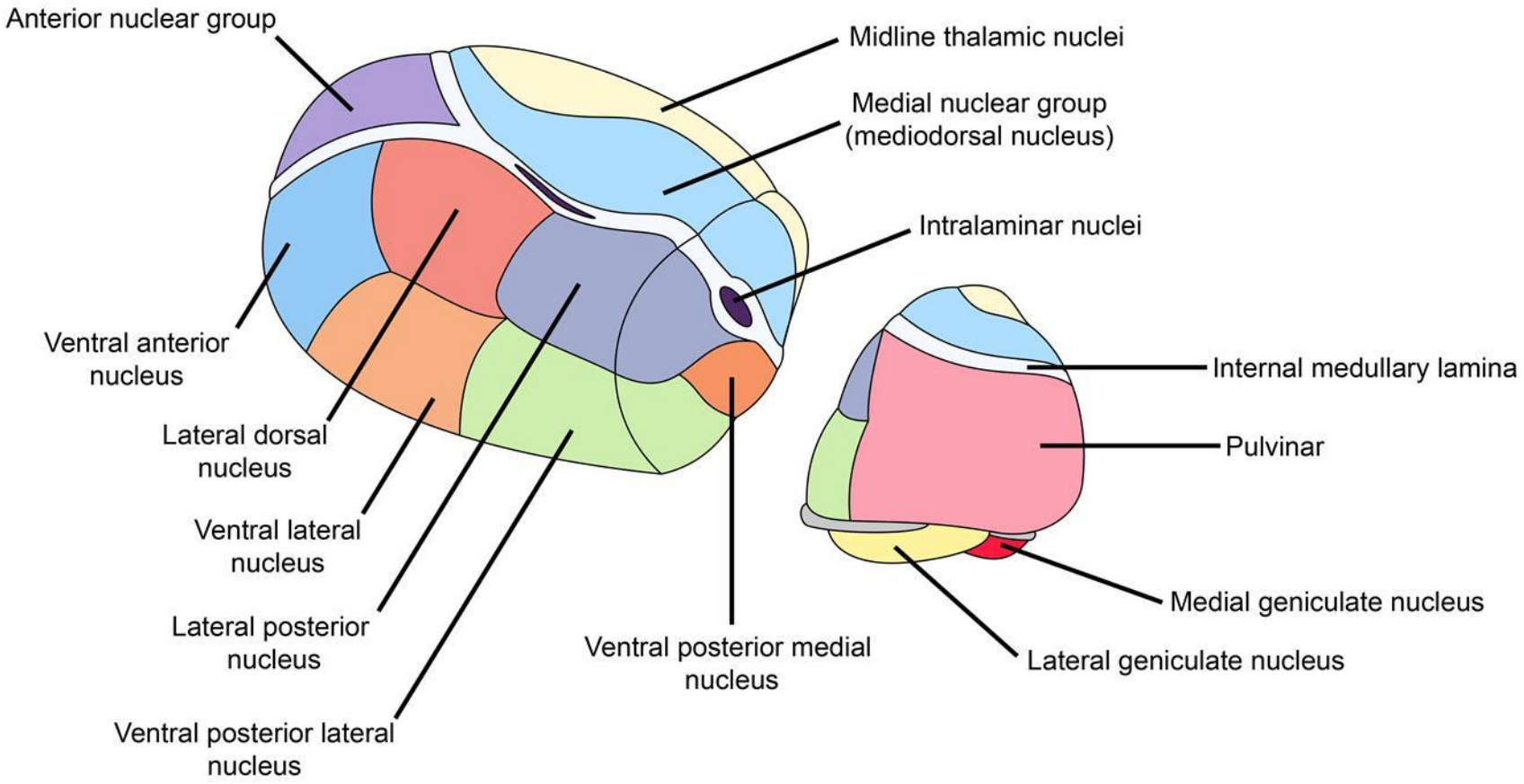
Group/Nuclei	Function(s)
ANTERIOR GROUP	Part of the limbic system
MEDIAL GROUP	Integrates sensory information for projection to the frontal lobes
VENTRAL GROUP	Projects sensory information to the primary sensory cortex; relays information from cerebellum and basal nuclei to motor area of cerebral cortex
POSTERIOR GROUP	
Pulvinar	Integrates sensory information for projection to association areas of cerebral cortex
Lateral geniculate nuclei	Project visual information to the visual cortex
Medial geniculate nuclei	Project auditory information to the auditory cortex
LATERAL GROUP	Integrates sensory information and influences emotional states

Figure 16.11b The Thalamus



b Enlarged view of the thalamic nuclei of the left side. The color of each nucleus or group of nuclei matches the color of the associated cortical region. The boxes either provide examples of the types of sensory input relayed to the basal nuclei and cerebral cortex or indicate the existence of important feedback loops involved with emotional states, learning, and memory.

Thalamus



Moises Dominguez

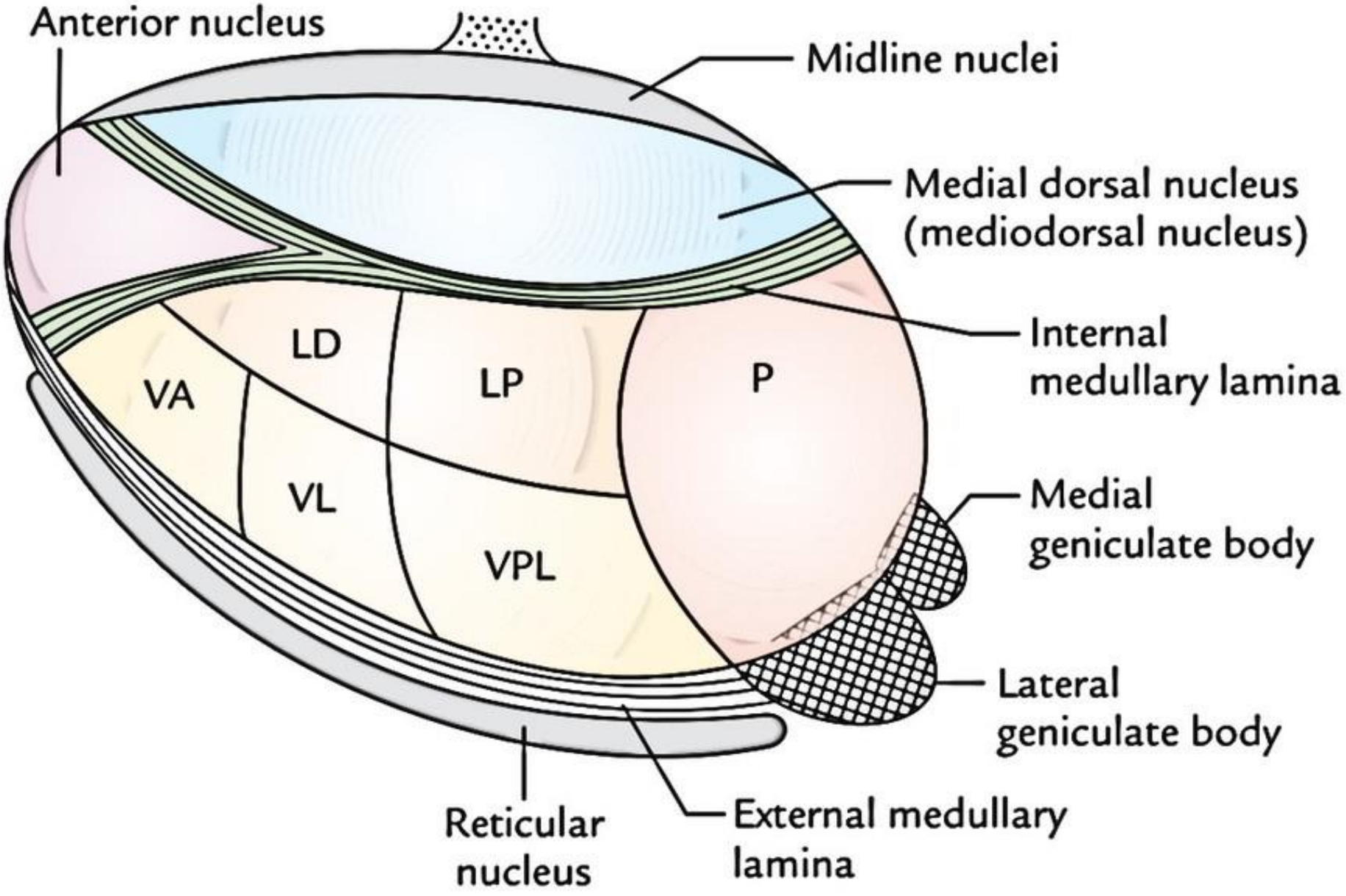
Reticular Nucleus

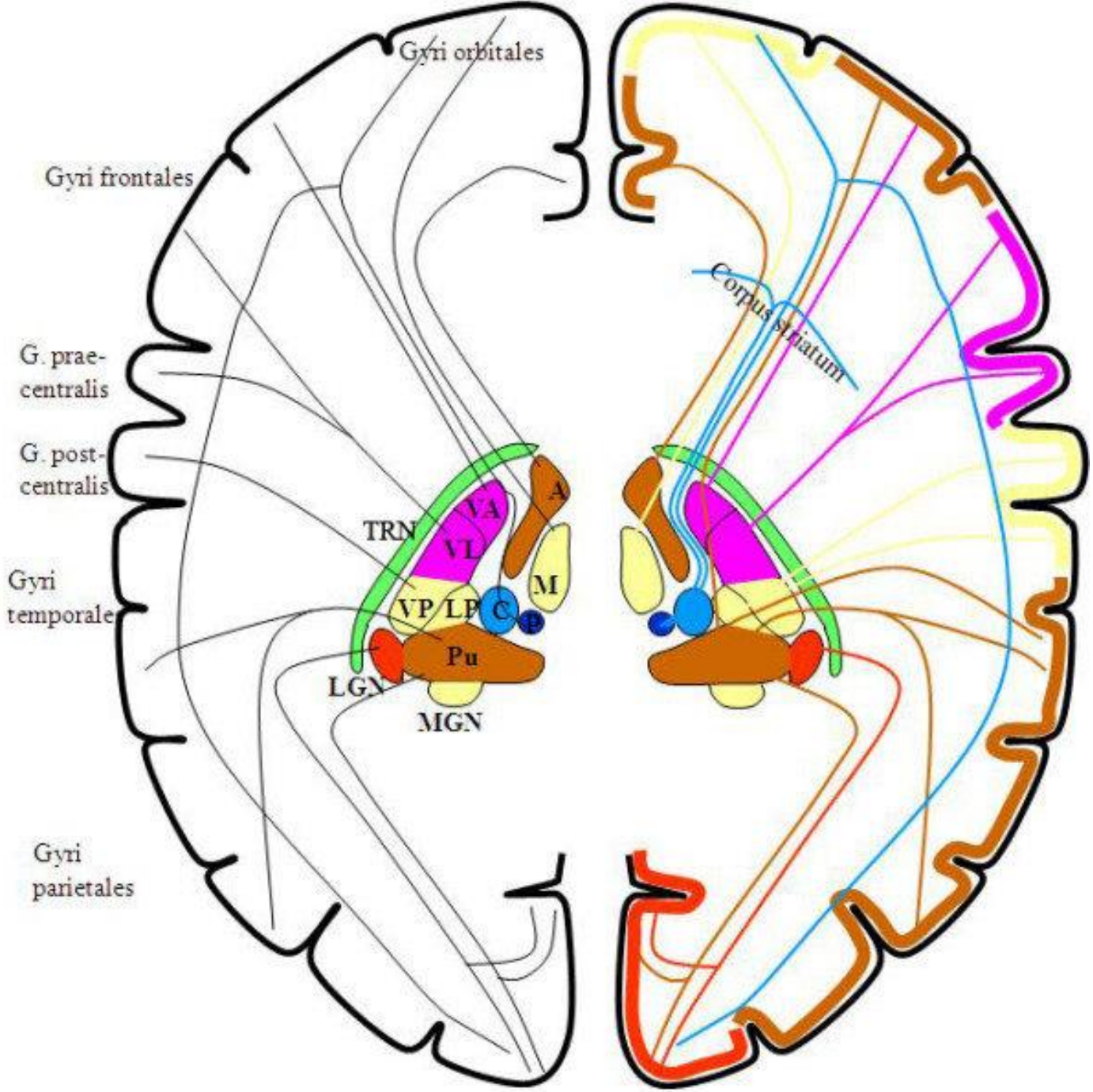
Thin layer of nerve cells between the external medullary lamina and the posterior limb of the internal capsule.

Afferent from the ***cerebral cortex and the reticular formation***, and its ***efferent*** is mainly to ***other thalamic nuclei.***

This is the only thalamic nucleus that does not project to the cerebral cortex.

Function: Modulates the activity of other thalamic nuclei.


Anterior nucleus
Midline nuclei
Medial dorsal nucleus
(mediodorsal nucleus)
Internal
medullary lamina
LD
VA
LP
P
VL
VPL
Medial
geniculate body
Lateral
geniculate body
Reticular
nucleus
External medullary
lamina


Gyri orbitales
Gyri frontales
G. prae-
centralis
G. post-
centralis
Gyri
temporale
Gyri
parietales
Corpus striatum
TRN
VA
VL
A
M
VP
LP
C
P
Pu
LGN
MGN

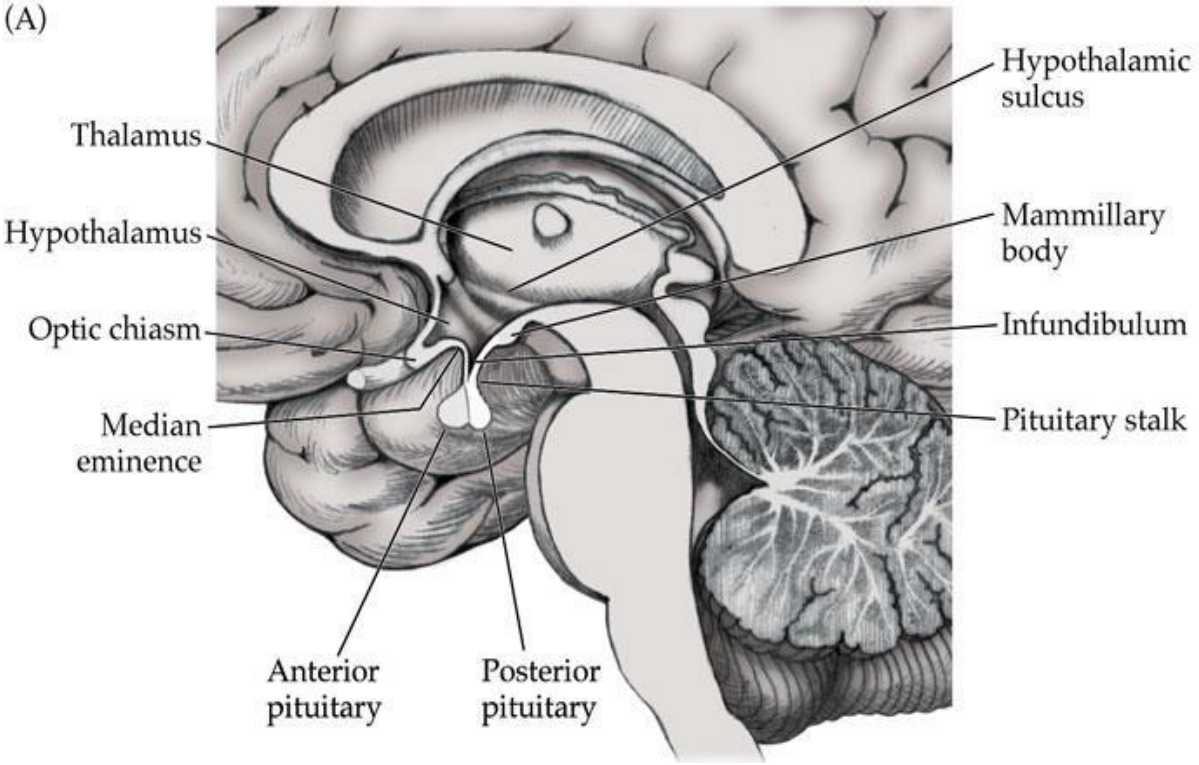
Hypothalamus

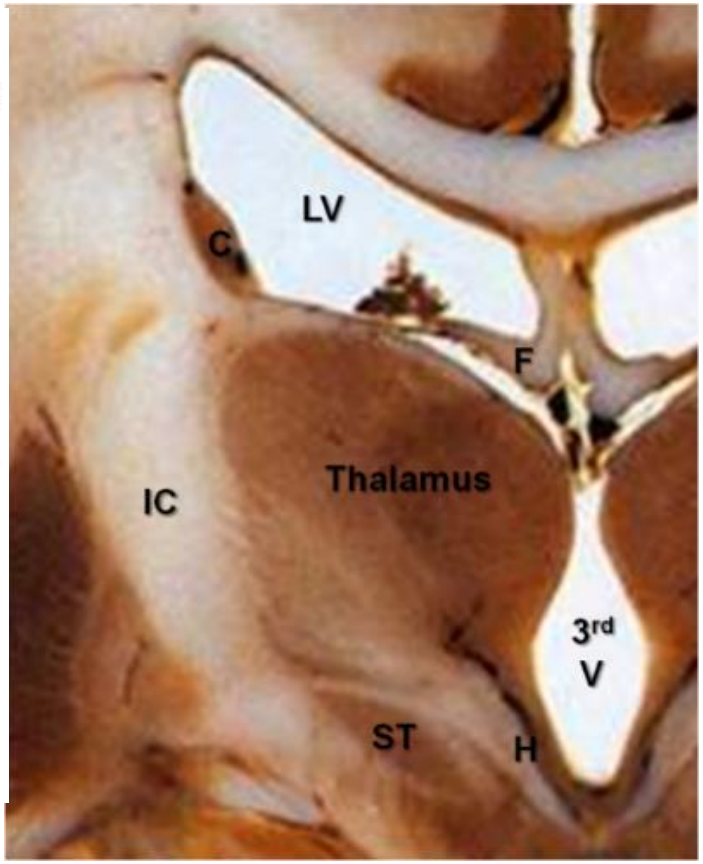
The hypothalamus is the part of the diencephalon lies ***below the thalamus***, and ventromedial to subthalamus.

Forms the ***floor*** and the ***lower part of*** the ***lateral wall*** of the ***third ventricle***.

Extends from the region of the optic chiasma to the caudal border of the mammillary bodies

(A)


Thalamus
Hypothalamus
Optic chiasm
Median eminence
Anterior pituitary
Posterior pituitary
Hypothalamic sulcus
Mammillary body
Infundibulum
Pituitary stalk


LV
C
F
Thalamus
IC
3rd V
ST
H

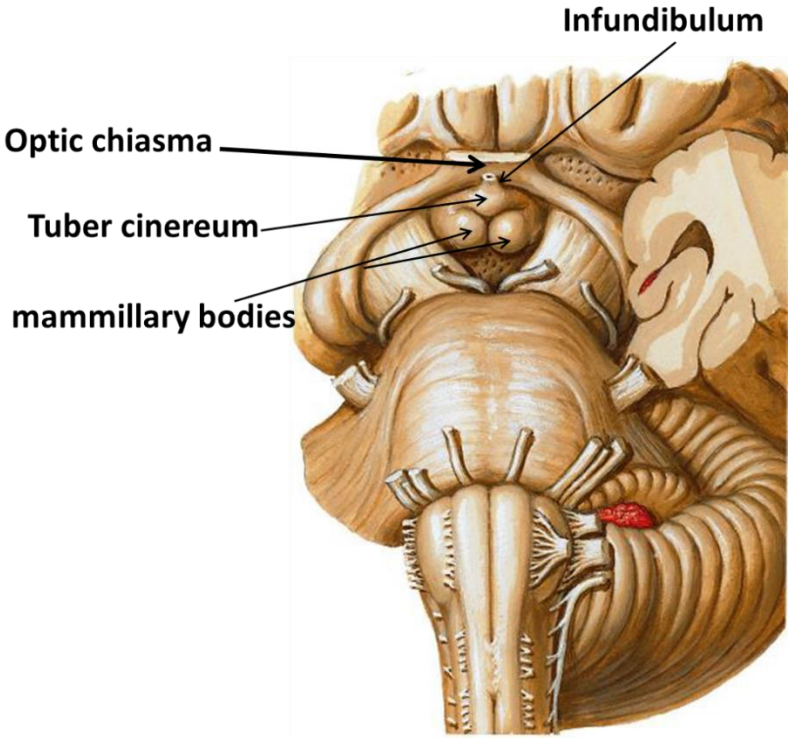
Hypothalamus

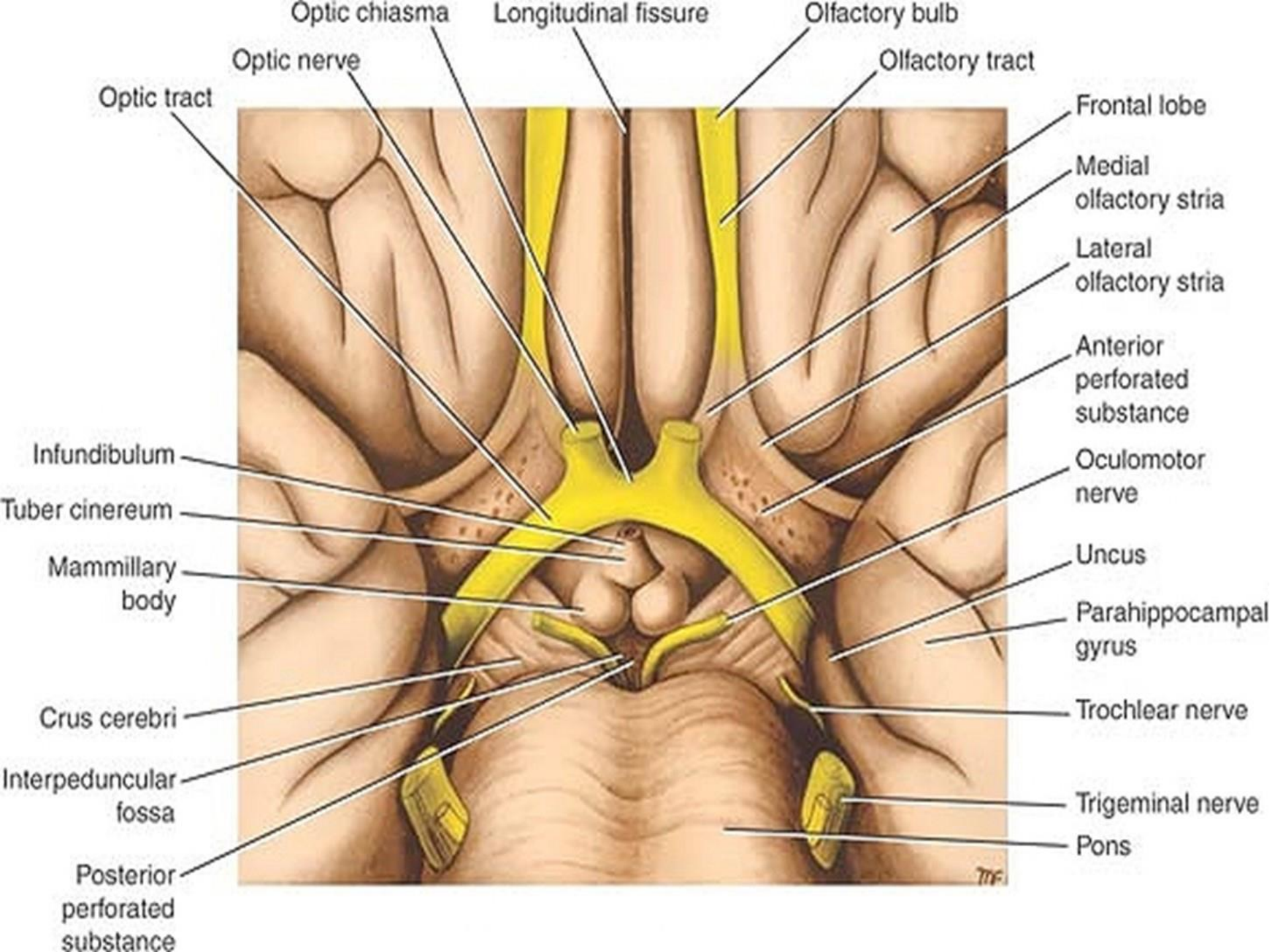
The floor of hypothalamus is formed by:

1. The **optic chiasm** anteriorly.
2. The **mammillary bodies** posteriorly.
3. The **tuber cinereum** in between.

i.e: Interpedunctular fossa

The **infundibulum** (or pituitary stalk) extends from the apex of tuber cinereum.




Optic chiasma
Longitudinal fissure
Olfactory bulb
Optic nerve
Olfactory tract
Optic tract
Frontal lobe
Medial olfactory stria
Lateral olfactory stria
Anterior perforated substance
Infundibulum
Oculomotor nerve
Tuber cinereum
Uncus
Mammillary body
Parahippocampal gyrus
Crus cerebri
Trochlear nerve
Interpeduncular fossa
Trigeminal nerve
Pons
Posterior perforated substance

Hypothalamic Nuclei

- The hypothalamic nuclei are divided by an imaginary parasagittal plane into medial and lateral zones. Lying within the plane are the **fornix** and the **mammillothalamic tract (part of the limbic system)**, which serve as markers:

- **Lateral Zone**

1. **Part of the preoptic nucleus**
2. **Part of the suprachiasmatic nucleus**
3. **Supraoptic nucleus**
4. **Lateral nucleus**
5. **Tuberomammillary nucleus**
6. **Lateral tuberal nuclei**

- **Medial Zone**

1. **Preoptic nucleus**
2. **Anterior nucleus**
3. **Suprachiasmatic nucleus**
4. **Paraventricular nucleus**
5. **Dorsomedial nucleus**
6. **Ventromedial nucleus**
7. **Infundibular (arcuate) nucleus**

Hypothalamic Nuclei

- ***It is typically divided into 4 regions from rostral to caudal***

1. ***Pre optic area***
2. ***Supra optic area (anterior)***
3. ***Tuberal area (middle)***
4. ***Mamillary area (posterior)***

Hypothalamic Nuclei

Preoptic area:

Medial preoptic nucleus, Lateral preoptic nucleus

Anterior (supraoptic) region:

Anterior hypothalamic nucleus, Supraoptic nucleus, Paraventricular nucleus, Suprachiasmatic nucleus

Middle (tuberal) region:

Arcuate nucleus, Ventromedial nucleus,

Dorsomedial nucleus

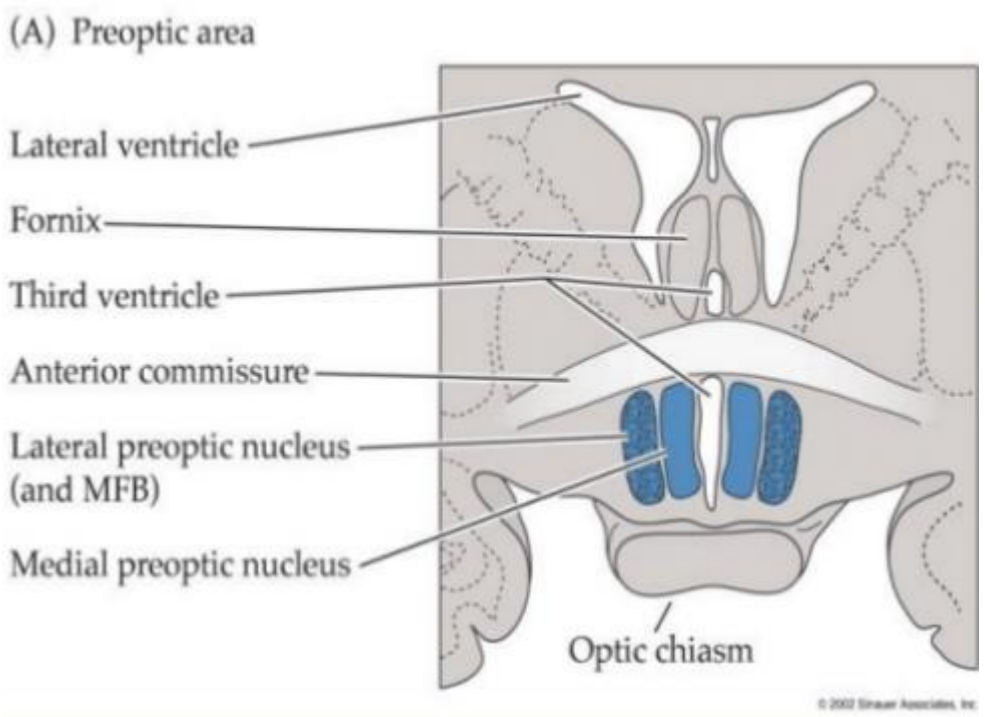
Posterior (mammillary) region:

Mammillary nuclei, Posterior hypothalamic nucleus

Hypothalamic Nuclei

Preoptic area:

Medial preoptic nucleus, Lateral preoptic nucleus



Bladder control, decrease blood pressure and heart rate

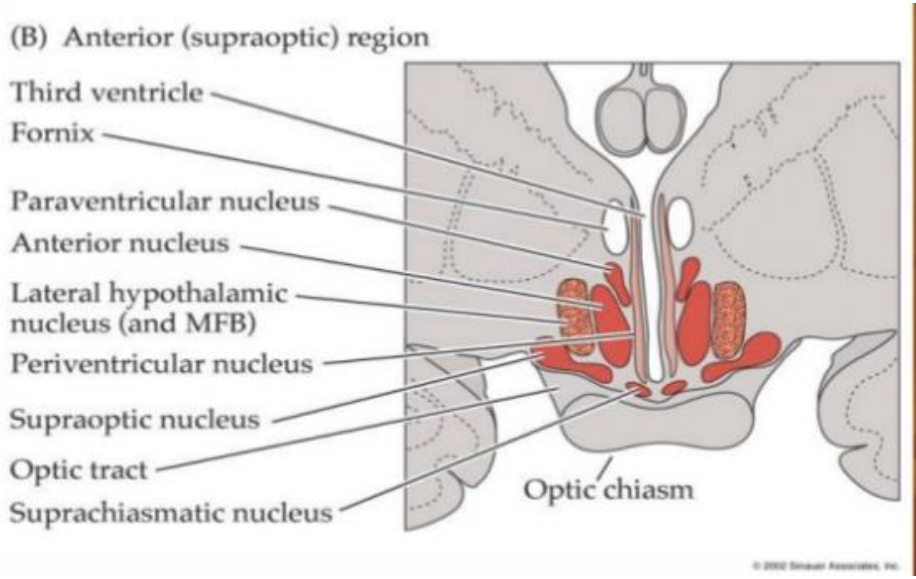
Hypothalamic Nuclei

Anterior region: ***Supraoptic***

Supra optic(vasopressin release)

Paraventricular (oxytocin release, water conservation)

Anterior (Body Temperature, punting, sweating)



Hypothalamic Nuclei

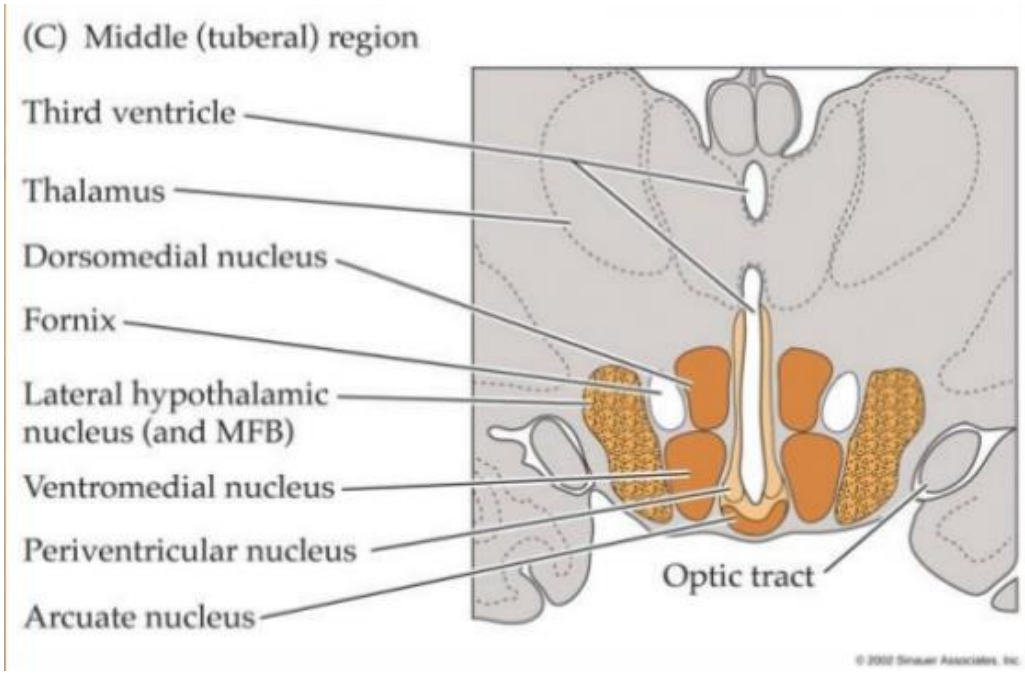
Middle (tuberal) region:

Ventromedial (satiety, neuroendocrine)

Dorso medial (GI stimulation)

Arcuate (neuroendocrine)

Lateral (hunger & thirst)

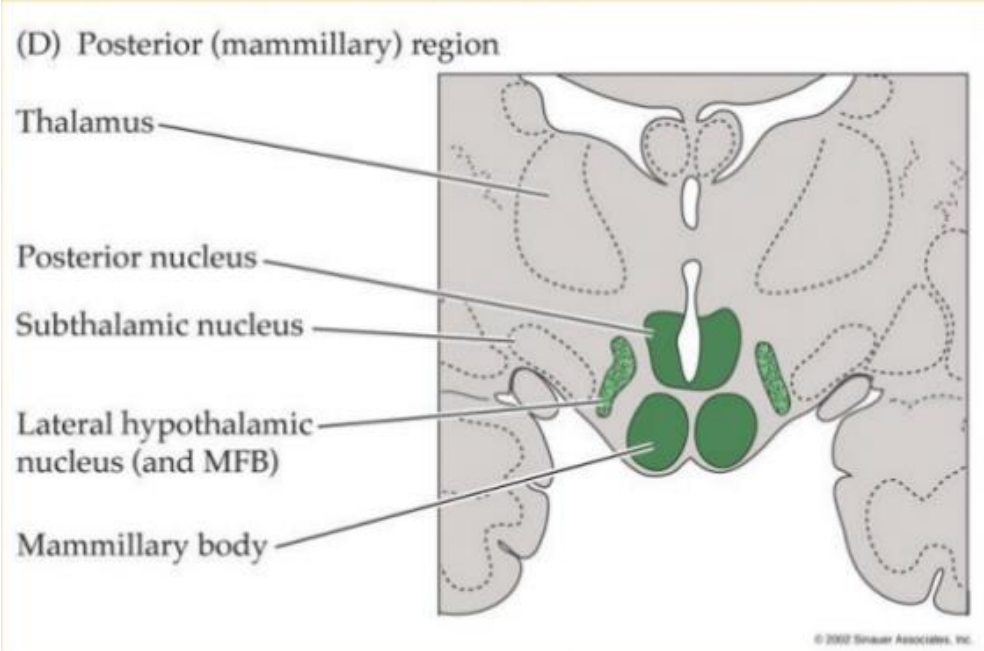


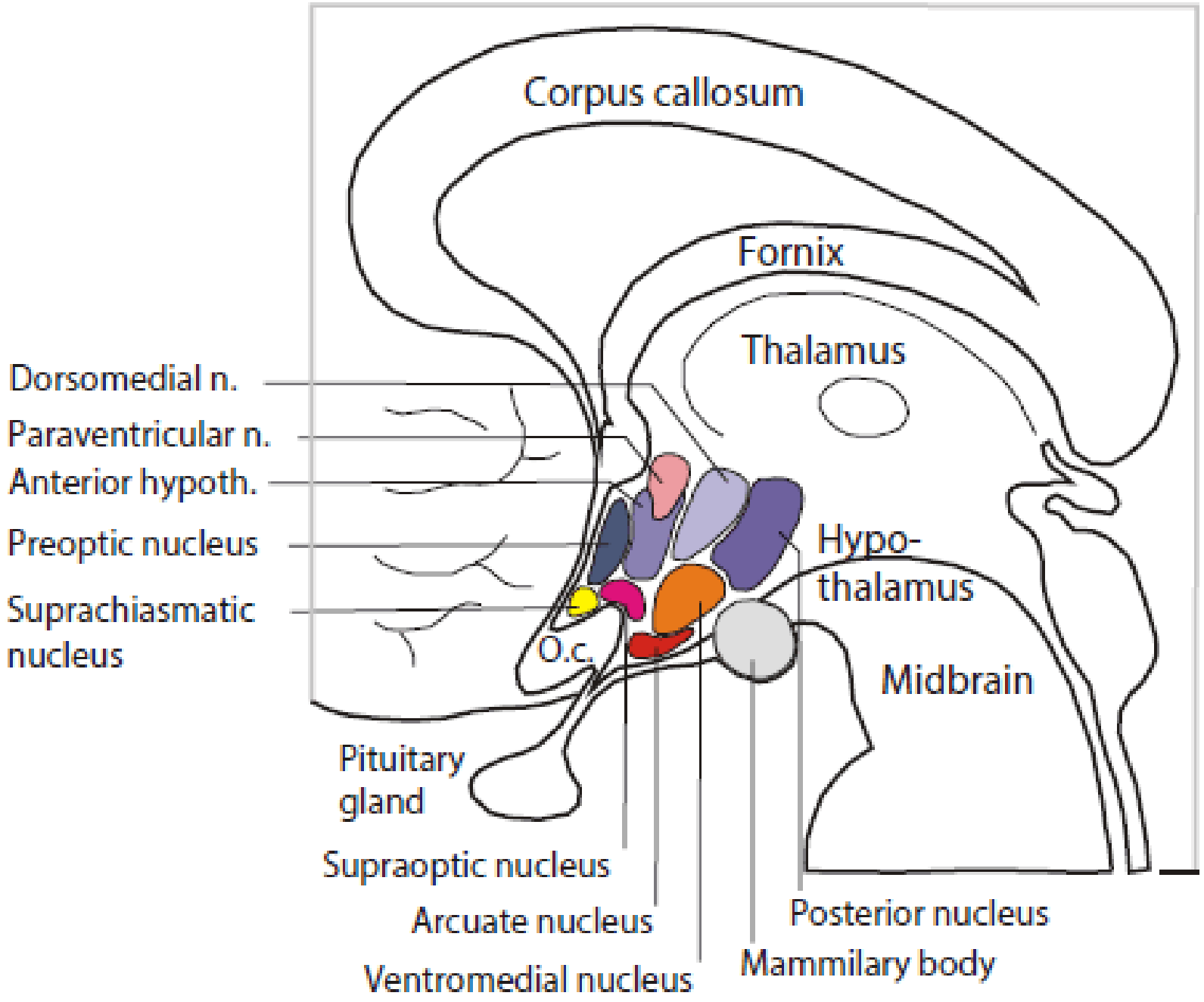
Hypothalamic Nuclei

Posterior (mammillary) region:

Mammilary body (feeding reflexes)

Posterior Hypothalamic N (increases BP, Pupillary dilation, Shivering)

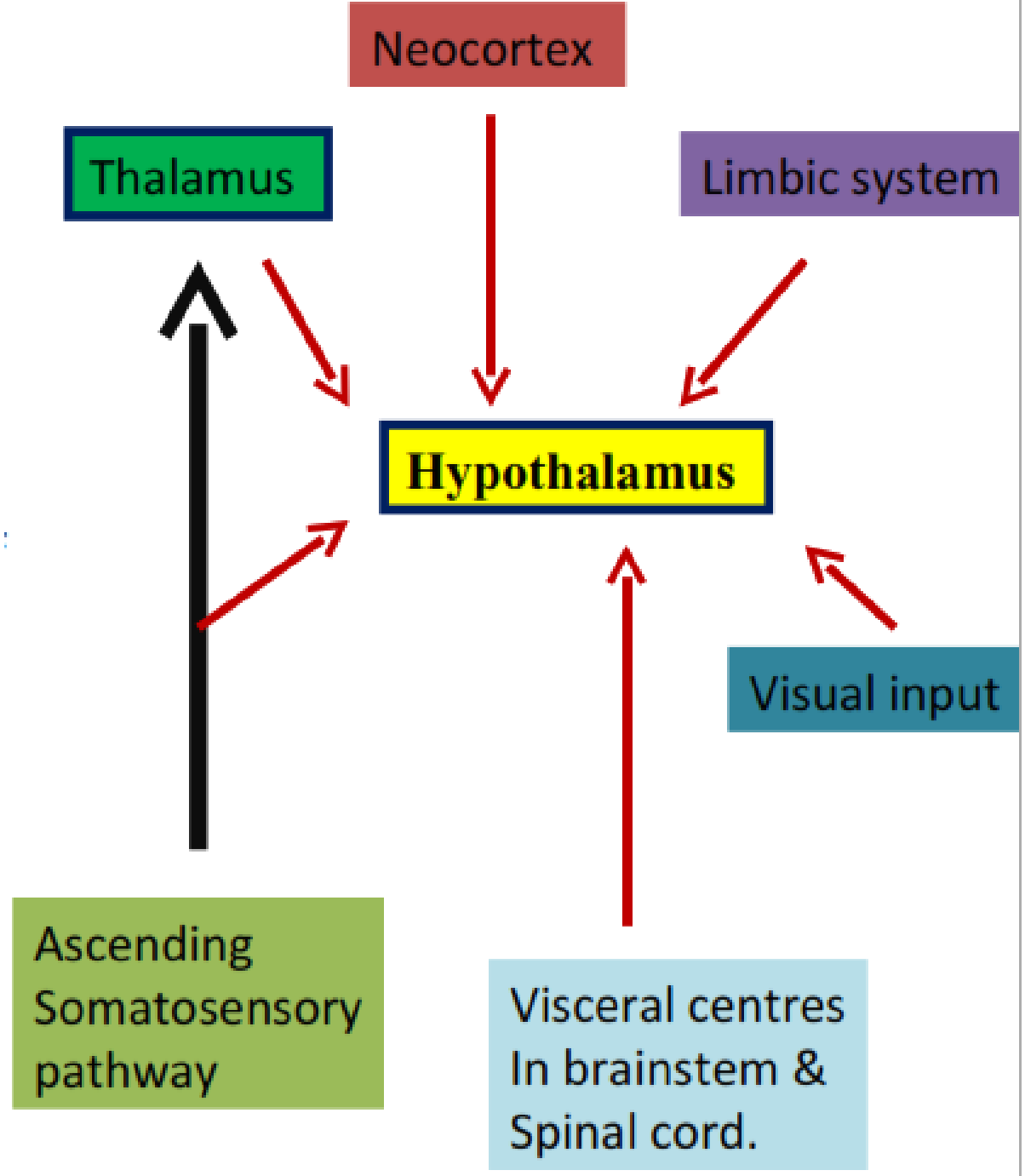




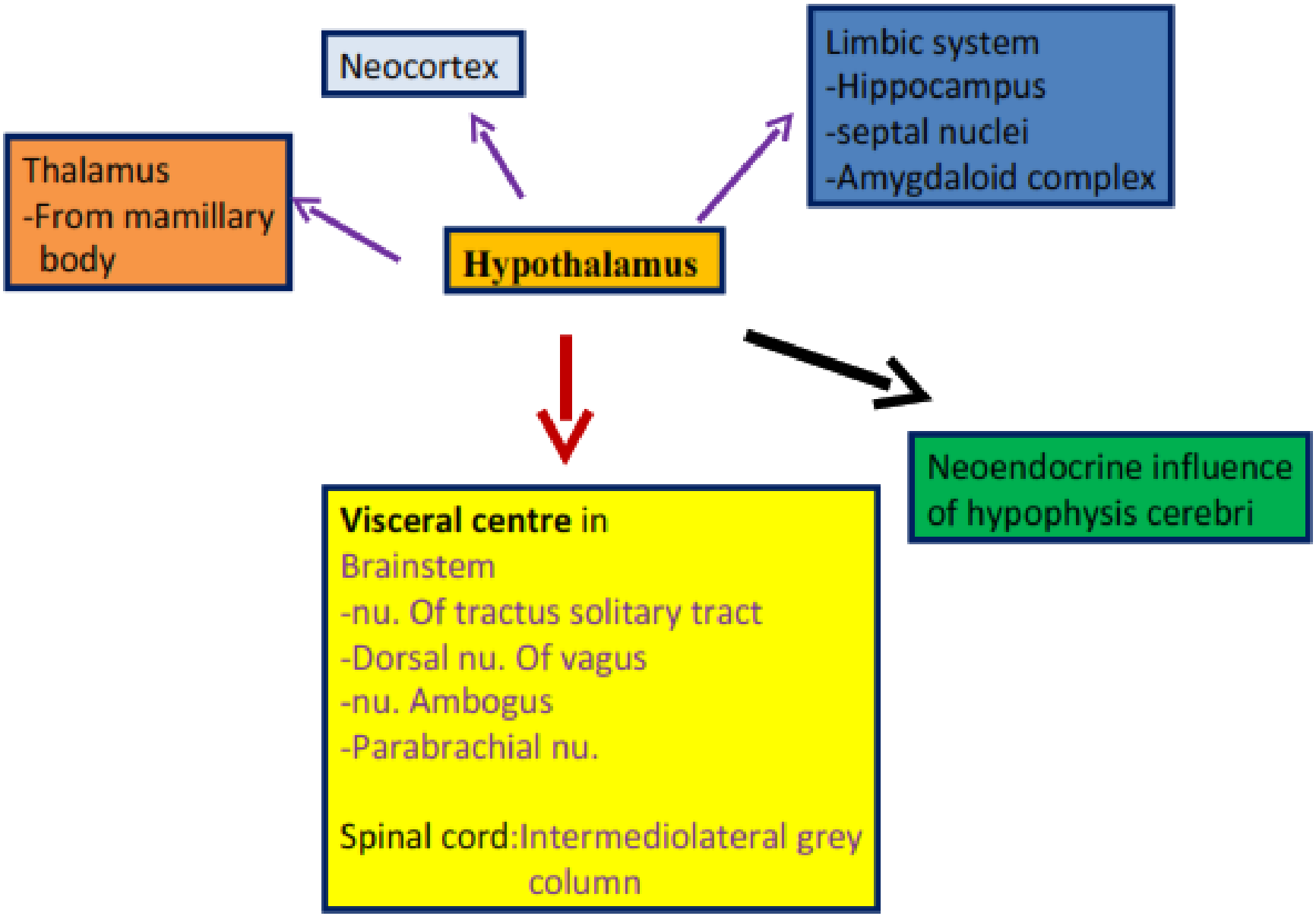
O.c: Optic Chiasm

Afferent Connections

1. From Olfactory area
2. Frontal lobe cortex
3. Hippocampus
4. Thalamus
5. Amygdala
6. Lemniscal system
7. Reticular Activating system
8. Raphe nucleus
9. Locus ceruleus


Neocortex
Thalamus
Limbic system
Hypothalamus
Visual input
Ascending
Somatosensory
pathway
Visceral centres
In brainstem &
Spinal cord.

Efferent connections of Hypothalamus



Hypothalamic Connections and Functions

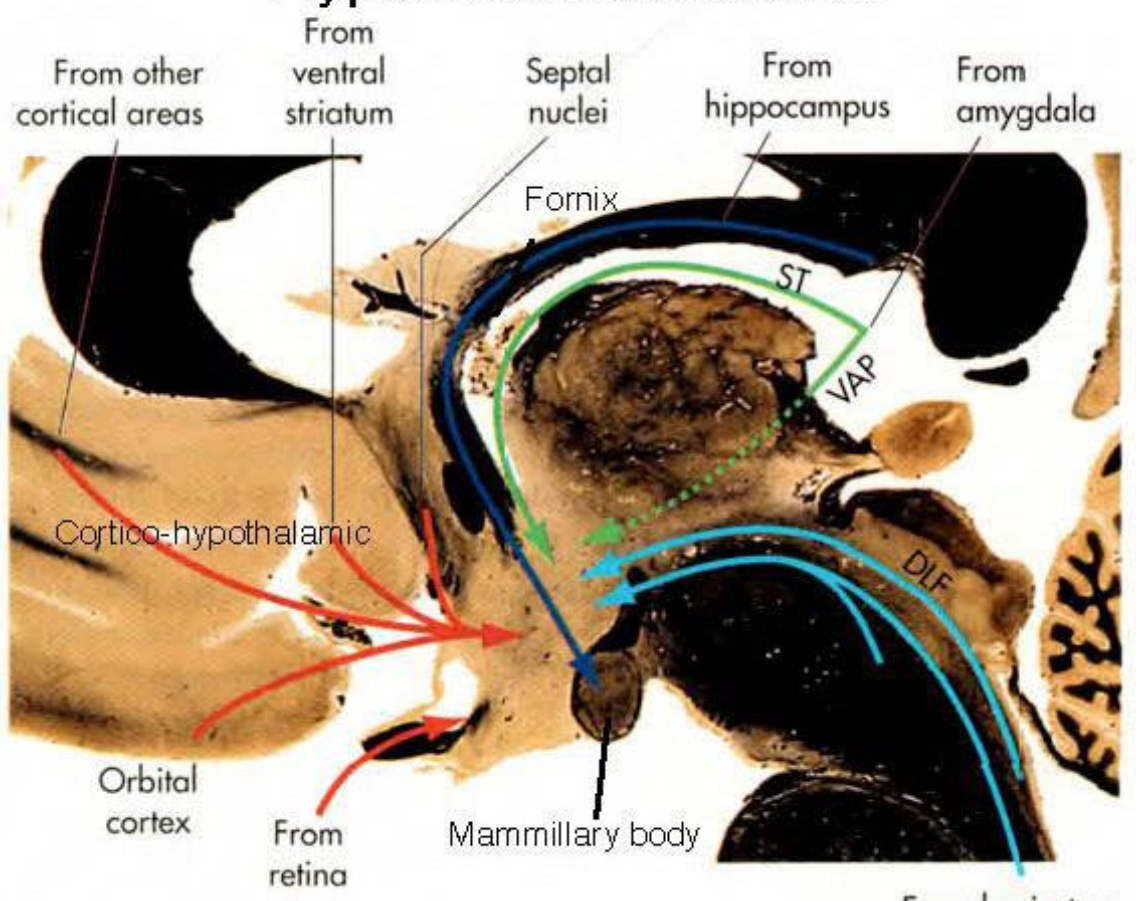


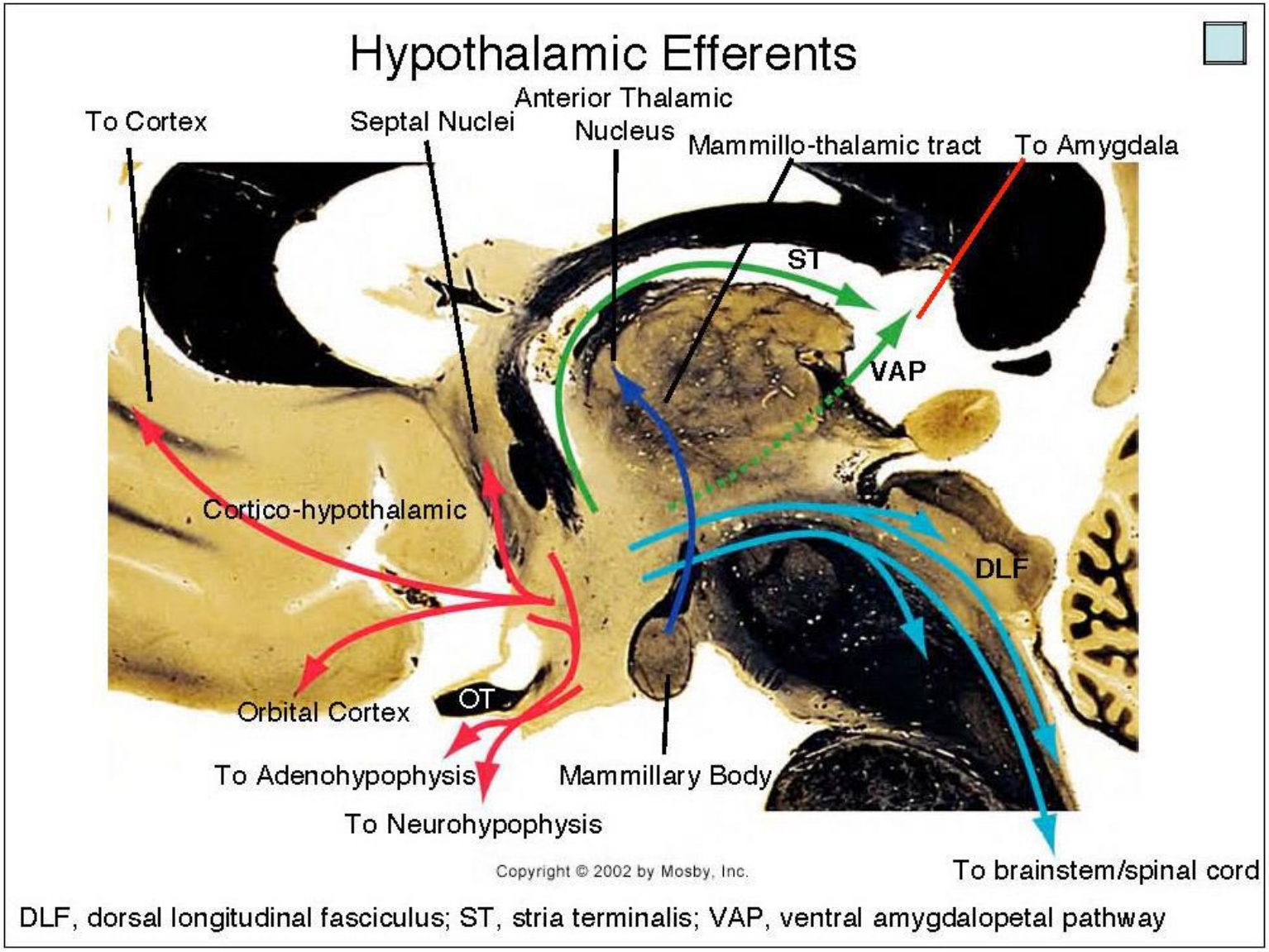
Figure 23-6

DLF, dorsal longitudinal fasciculus; ST, stria terminalis; VAP, ventral amygdalofugal pathway

Efferent Connections

1. Adenohypophysis
2. Neurohypophysis
3. Orbital cortex
4. Cerebral cortex
5. Septal nuclei
6. Thalamus
7. Mamillo thalamic-tract
8. Amygdala
9. Brain stem
10. Spinal cord

Hypothalamic Connections and Functions



Hypothalamic Connections and Functions

The hypothalamus contain neurons that are sensitive to several parameters in the blood such as hormones, glucose, temperature, and osmolarity.

It interacts with **endocrine glands**, **reticular formation**, **autonomic nervous system**, and **limbic system**.

Therefore, it participate in several important functions

Control the Pituitary Gland

The axons of hypothalamic neurons are connected to the hypophysis (pituitary gland) by two pathways:

A- Hypothalamo-hypophyseal tracts: the nerve fibers that travel from the **supraoptic** and **paraventricular nuclei** to the **posterior lobe of the pituitary gland**.

Supraoptic N. secretes **vasopressin (ADH)**
Paraventricular N. secretes **oxytocin**

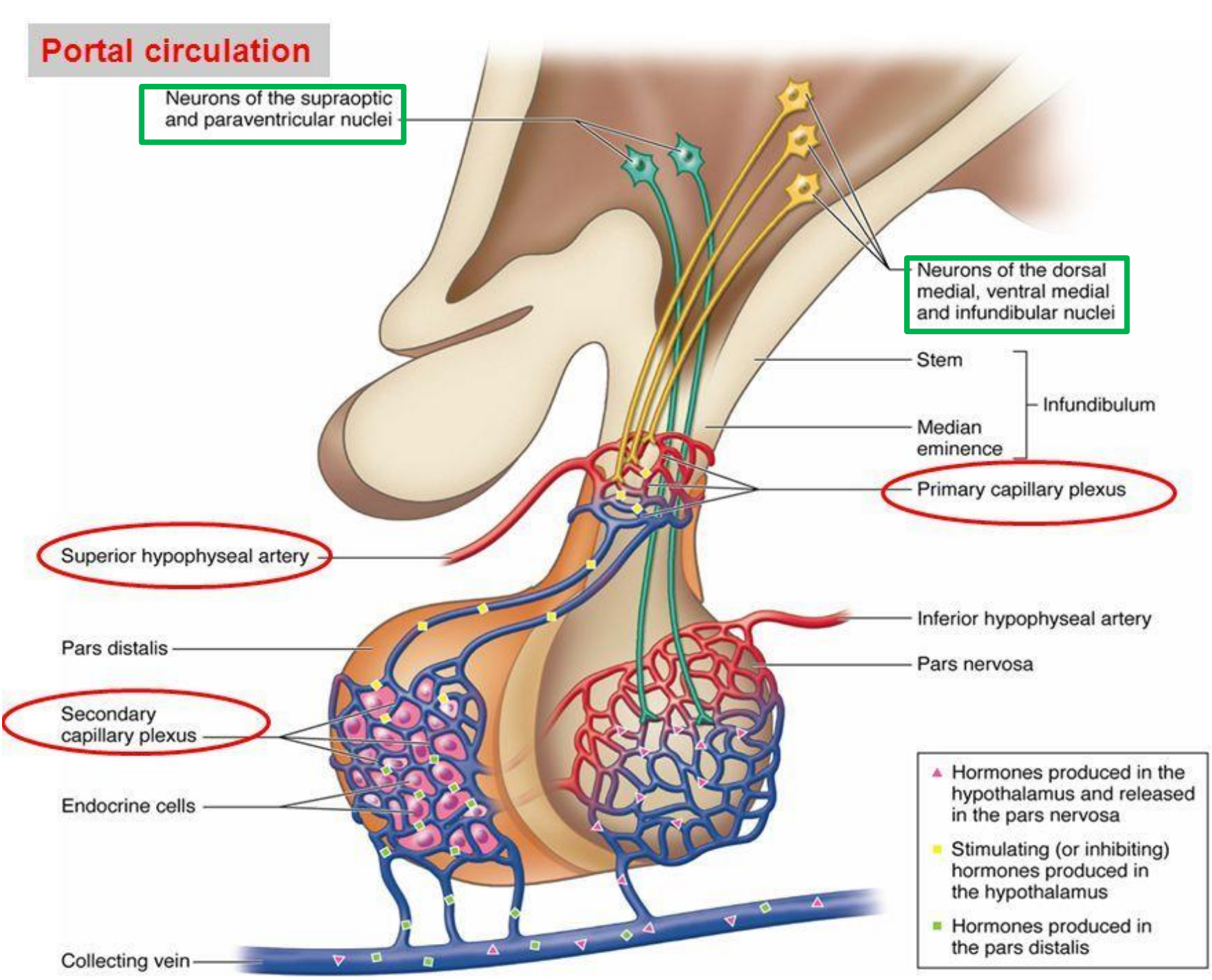
Control the Pituitary Gland

B- The hypothalamo-hypophyseal portal system: vascular network that connect the hypothalamus with capillary plexuses in the **anterior lobe of the hypophysis**.

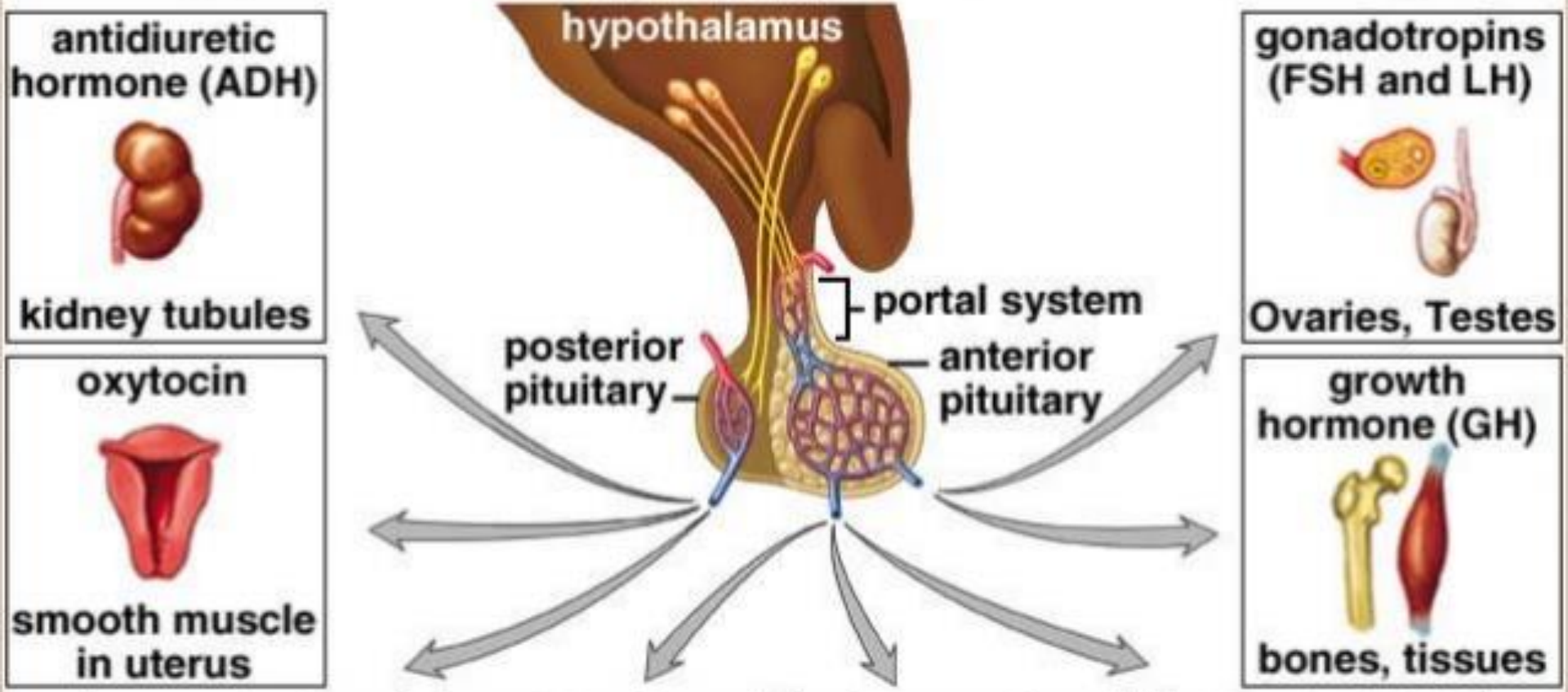
Neurosecretory cells situated mainly in **arcuate nucleus** and other nuclei are responsible for the production of the **releasing hormones and release-inhibitory hormones**. The hormones are packaged into granules and are transported along the axons of these cells into the infundibulum.

Here, the granules are released by exocytosis onto fenestrated capillaries at the upper end of the hypophyseal portal system which carries the hormones to the secretory cells of the anterior lobe of the pituitary gland.

Portal circulation



Hypothalamus and the Pituitary



Hypothalamic Connections and Functions

2- Autonomic Control

Hypothalamus is the brain center for regulation of autonomic nervous system.

Descending fibers from HT to autonomic centers in the brainstem and spinal cord influence the peripheral neurons of the autonomic nervous system.

They descend through a series of neurons in the **reticular formation**.

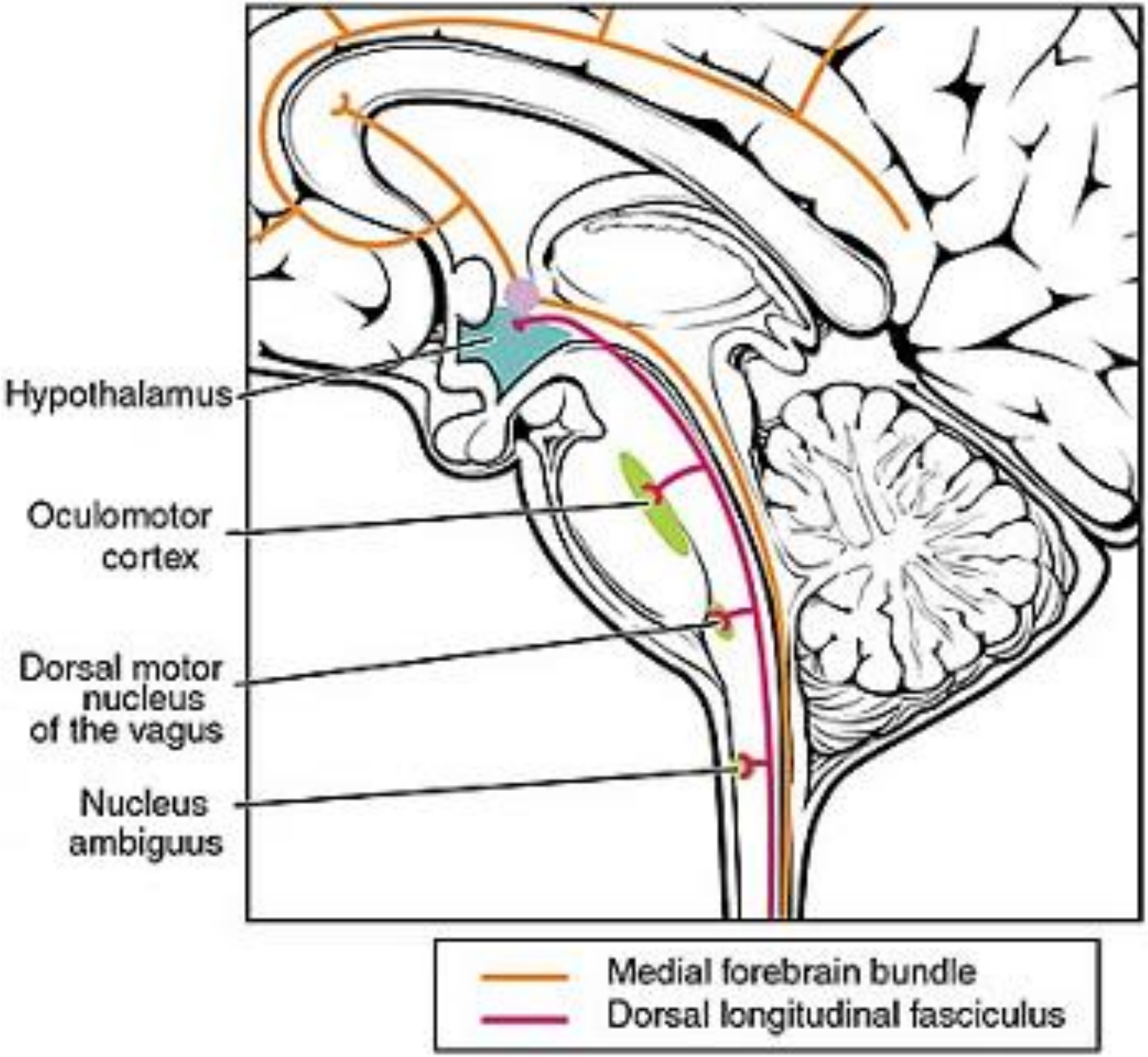
Hypothalamic Connections and Functions

2- Autonomic Control

Anterior nuclei -- Control parasympathetic system

Posterior nuclei -- Control sympathetic system

Inputs to HT that affect autonomic functions come mostly from the amygdala and limbic cortex.


Hypothalamus
Oculomotor cortex
Dorsal motor nucleus of the vagus
Nucleus ambiguus
Medial forebrain bundle
Dorsal longitudinal fasciculus

Hypothalamic Connections and Functions

3- Control of Hunger and Feeding

Feeding center: ***Lateral hypothalamus***

Stimulation increases the appetite

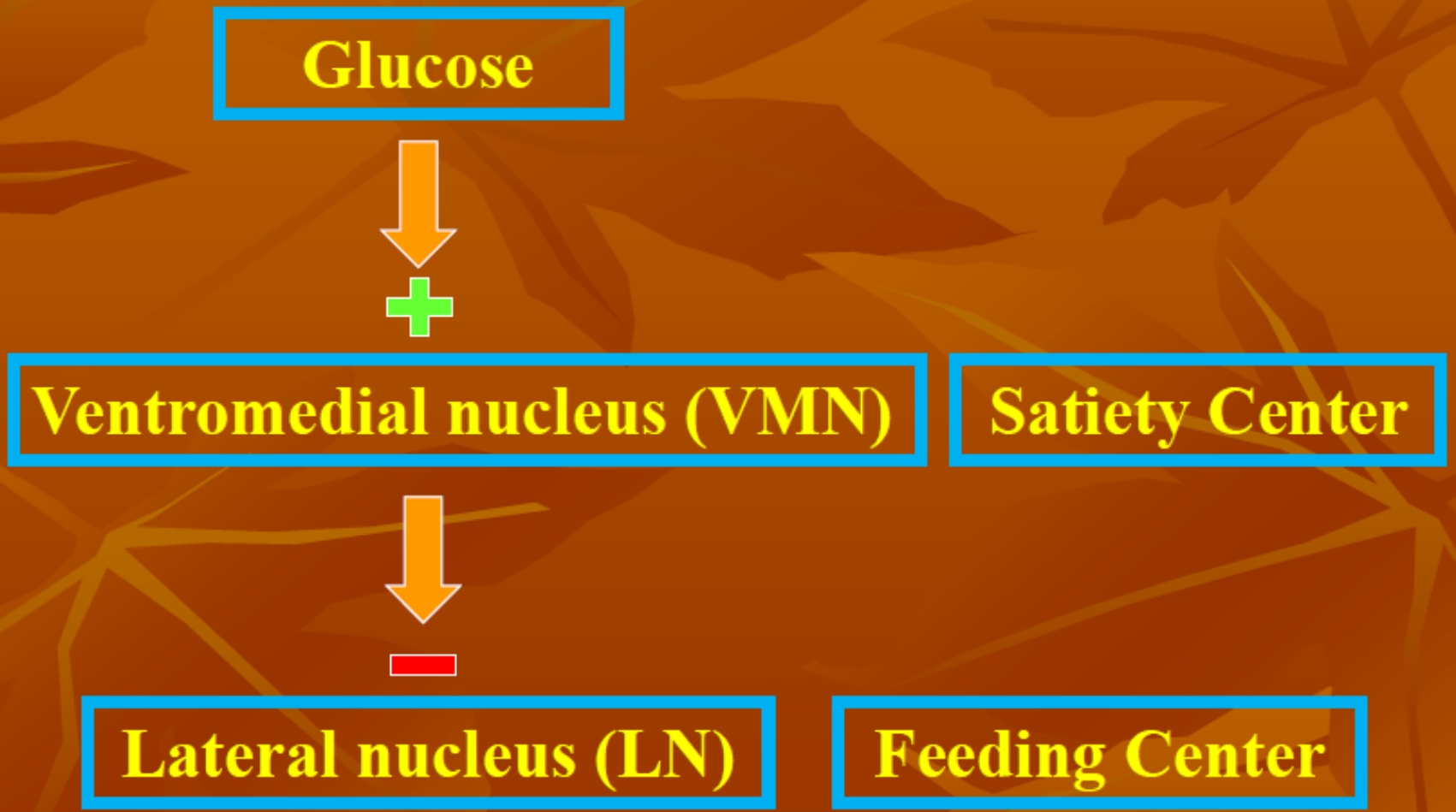
Lesion in this Nucleus makes the animal to starving and Cachexia

Satiety center: ***Ventromedial Nucleus***

Stimulation suppresses appetite by inhibiting Lateral nucleus

Lesion makes the animal to become Obese due to voracious appetite —"**Hypothalamic Obesity"**

Glucose Control Theory



Hypothalamic Connections and Functions

4- Temperature Control

Changes in body temperature affect the activity of **thermosensitive hypothalamic neurons** (Receive information from thermoreceptor in and body).

These neurons control the body temperature mainly via their output to the autonomic centers.

Anterior HT domain detects increased body temp. and activates systems of heat dissipation ,like vasodilation, sweating, & panting.

Posterior HT domain functions to conserve heat, by vasoconstriction and shivering of skeletal muscles.

Hypothalamic Connections and Functions

5- Control of Water intake & Thirst

By two mechanisms:

Osmoreceptors in the **Supraoptic N.** are sensitive to osmolarity changes of plasma & ECF.

Increase in plasma osmolartiy - Supraoptic N. secretes vasopressin (ADH)

A thirst center is in the **Lateral Hypothalamus** stimulated by intracellular dehydration - causes water drinking

Hypothalamic Connections and Functions

6- Control of circadian rhythms

Suprachiasmatic N. Control sleep/waking cycle.

Receive some afferent fibers directly from the retina.

Suprachiasmatic nuclei is connected to **pineal gland** which secrete melatonin (responsible for sleep and wake cycle).

Hypothalamic Connections and Functions

7- Memory

Mammillary body in HT is part of limbic system which build and support memory.

8- Emotions and behavior

Through communication with limbic system and prefrontal cortex.

Limbic - hypothalamic interconnections explain why emotional behavior is often accompanied by autonomic activation.

EX:

Blushing when embarrassed

Sweaty palms & dry mouth when anxious or afraid

Region	Nucleus/nuclei
Preoptic region	Preoptic nucleus
Supraoptic region	• Supraoptic nucleus • Anterior nucleus • Paraventricular nucleus
Tuberal region	• Arcuate (infundibular) nucleus • Ventromedial nucleus • Dorsomedial nucleus
Mammillary region	• Posterior nucleus • Mammillary nuclei

Nuclei	Function
Anterio	• Parasymp. Control • Response to heat
Posterior	• Sympath. Control • Response to cold
Lateral	• Hunger center • Thirst center
Medial	• Satiety center
Suprachiasmatic	Sleep and circadian rhyhthme
Supraoptic	ADH secretion
Paraventricular	Oxytocin secretion

Nucleus/nuclei	Functions
Prebiotic nucleus	Regulates release of gonadotrophic hormones
Supraoptic and paraventricular nuclei	– Produce antidiuretic hormone (ADH) and oxytocin – Regulate water balance
Anterior nucleus	– Regulates body temperature by dissipation of heat – Stimulates parasympathetic nervous system
Arcuate (infundibular) nucleus	Produces hypothalamic releasing factors
Ventromedial nucleus	It is considered as a 'satiety centre'. Its stimulation inhibits the urge to eat.
Dorsomedial nucleus	Its stimulation causes obesity and results in savage behaviour
Posterior nuclei	– Regulates body temperature by conservation of heat – Stimulates sympathetic nervous system
Mammillary nuclei	Receives input from hippocampal formation through fornix
Lateral nucleus	Its stimulation induces eating

TABLE 14–6 Components and Functions of the Hypothalamus

Region/Nucleus	Function
Mamillary bodies	Control feeding reflexes (licking, swallowing, etc.)
Autonomic centers	Control medullary nuclei that regulate heart rate and blood pressure
Tuberal nuclei	Release hormones that control endocrine cells of the anterior pituitary gland
Supraoptic nucleus	Secretes ADH, restricting water loss at the kidneys
Paraventricular nucleus	Secretes oxytocin
Preoptic areas	Regulate body temperature
Suprachiasmatic nucleus	Coordinates day–night cycles of activity

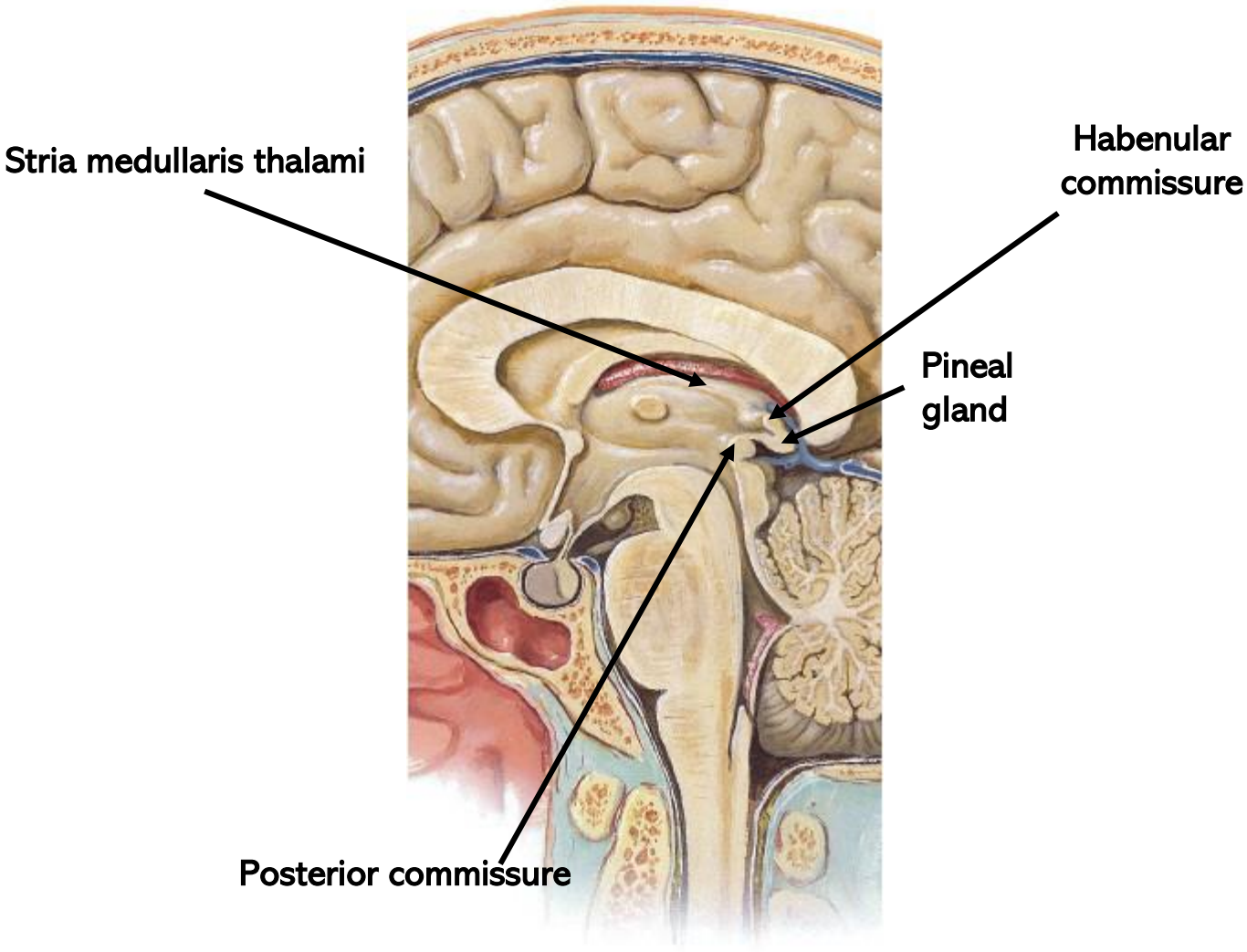
Epithalamus

Relatively small part, located in ***most caudal and dorsal region of the diencephalon***.

Lies immediately rostral to superior colliculus

Consists of:

1. **Habenular nuclei** and their interconnecting fibers the **habenular commissure**
2. **Stria medullaris thalami**
3. **Pineal gland.**


Stria medullaris thalami
Habenular commissure
Pineal gland
Posterior commissure

Habenular Nuclei

Habenular nuclei are medial to the posterior surface of the thalamus

They are part of limbic systems, concerned with mechanisms of **emotion & behavior.**

Connections:

Receive afferents from:

Amygdala and septal area through the ***stria medullaris thalami***.
Hippocampus through the ***fornix***.

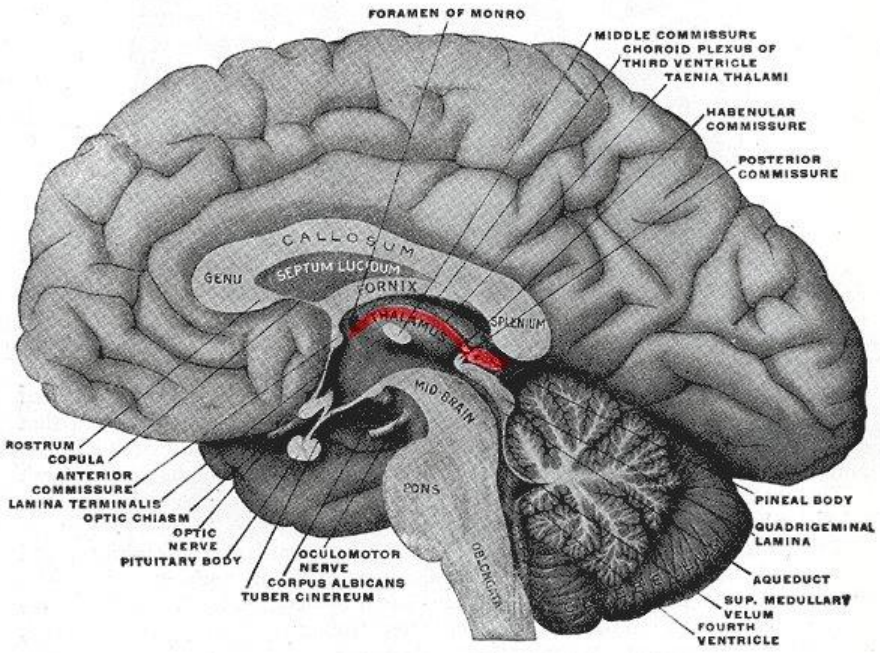
Send efferents to:

Interpeduncular nucleus and reticular formation of the midbrain.

Stria Medullaris Thalami

Part of limbic system

It arises from the **septal area (medial olfactory area)** and run backward along the dorsomedial region of thalamus to terminate in the **habenula**



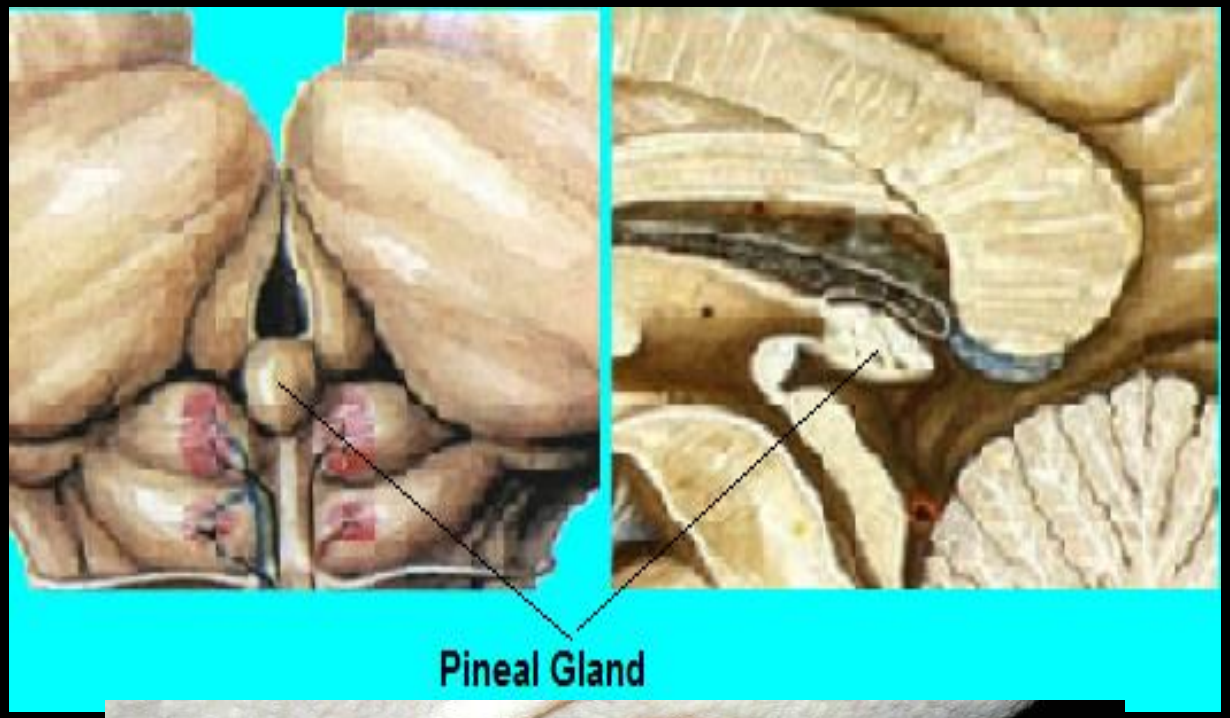
Pineal Gland

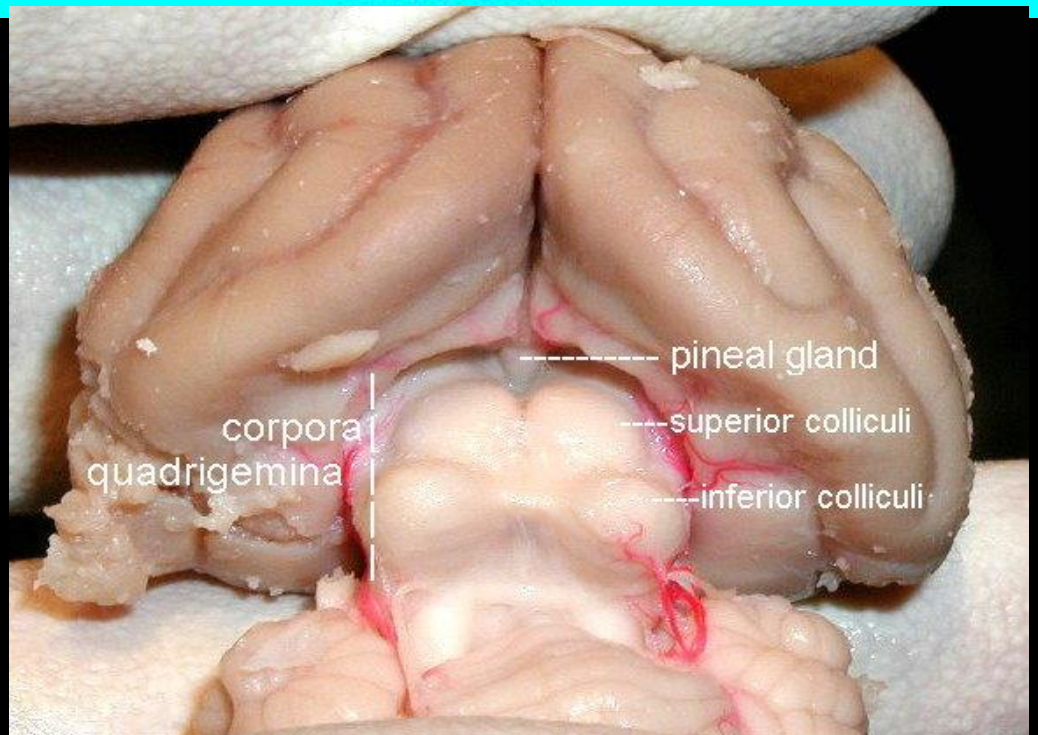
Single midline structure lies behind thalami and above superior colliculi.

Its stalk is attached to **habenular commissure** above and **posterior commissure** below.

The pineal gland secretes **Melatonin** which regulate body's circadian rhythms "wake/sleep cycle".

It becomes calcified in old age (around 20 years)


Pineal Gland


pineal gland
superior colliculi
inferior colliculi
corpora quadrigemina

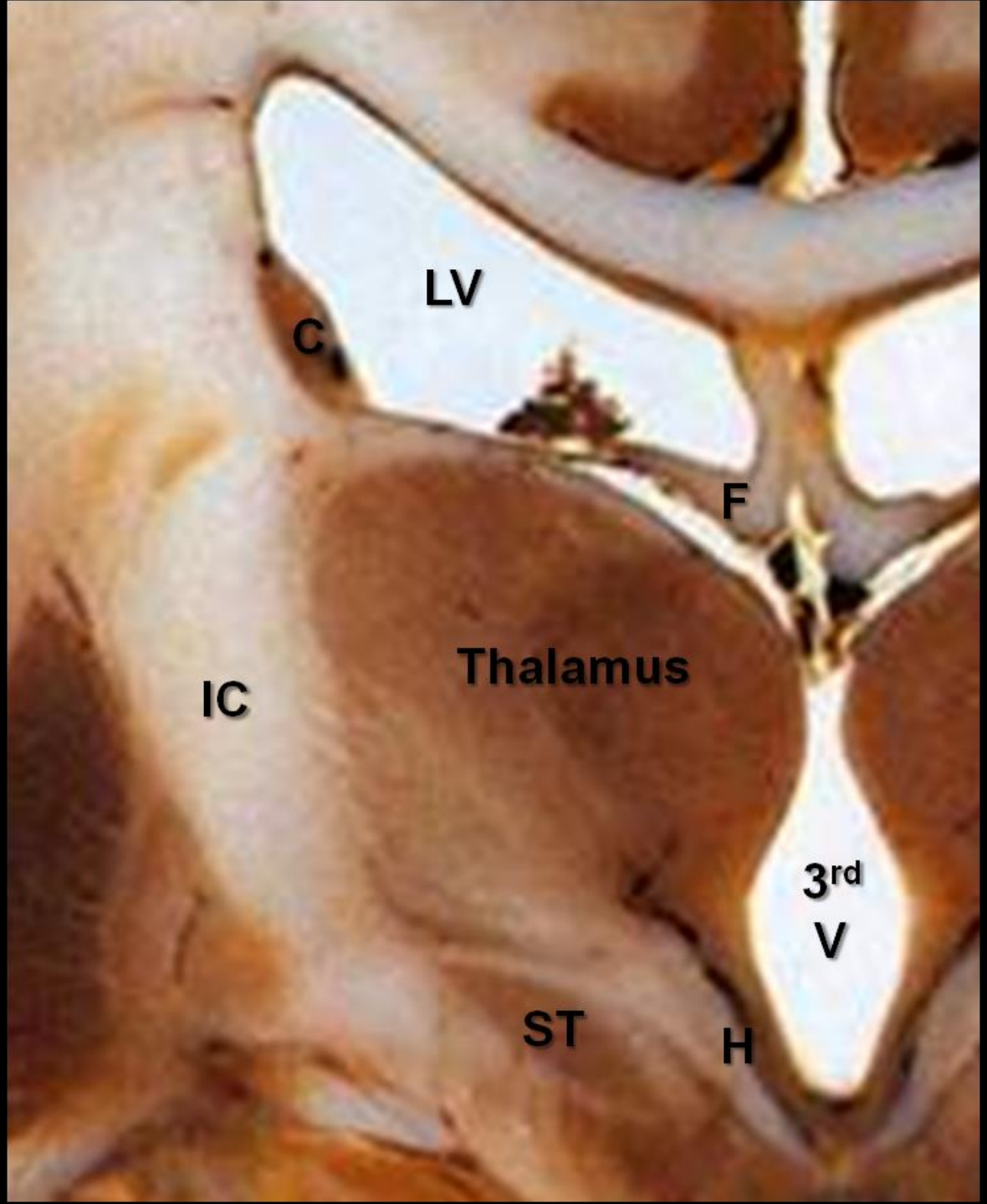
Subthalamus

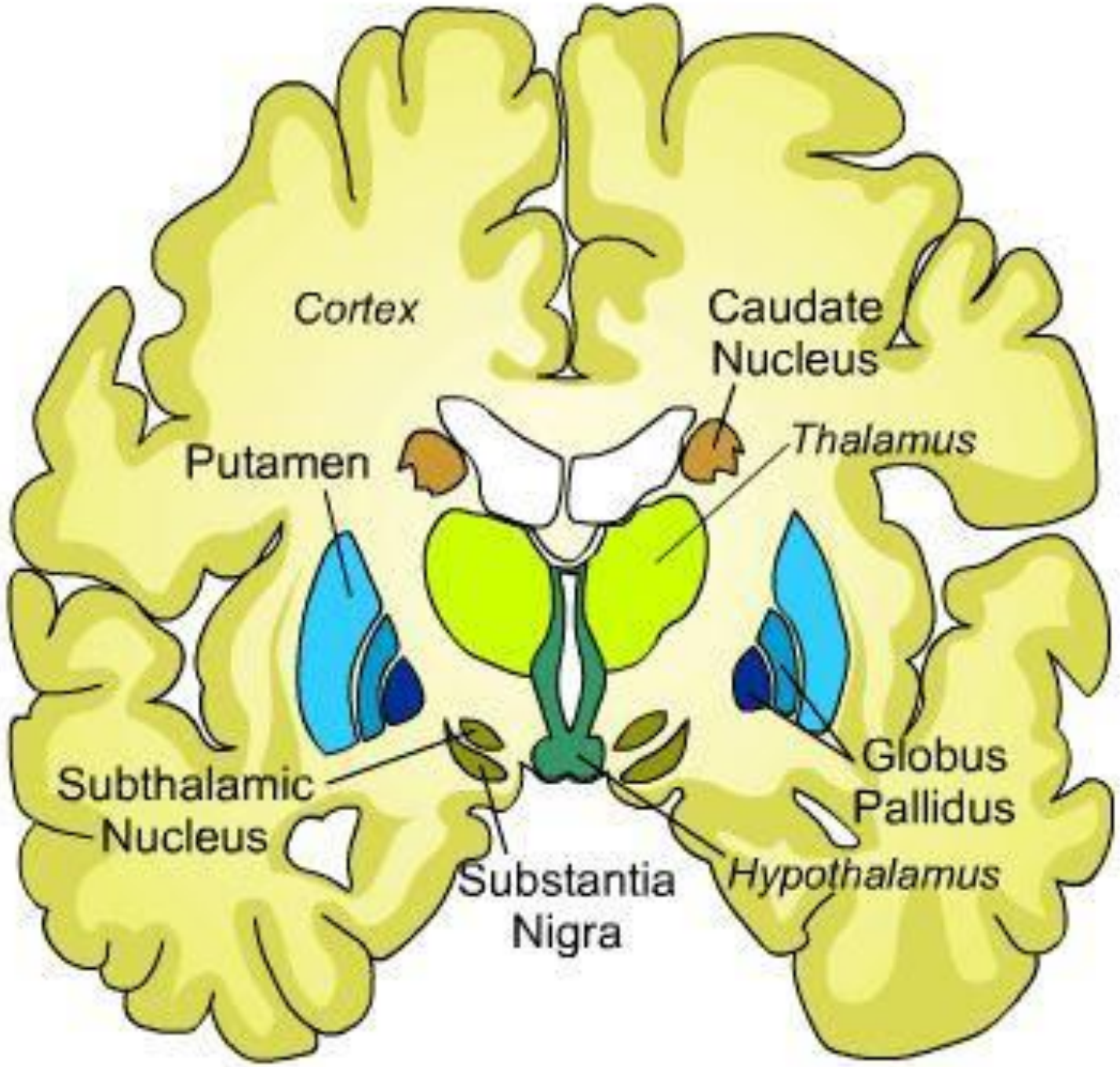
It is the area between the thalamus above and midbrain below, looks like a biconvex lens in coronal section.

Lies between the hypothalamus medially and the lower part of internal capsule laterally.

It contains 3 nuclei:

1. **Subthalamic nucleus** (part of basal ganglia)
2. **Upper end of red nucleus,**
3. **Upper end of substantia nigra**


LV
C
F
Thalamus
IC
3rd
V
ST
H


Cortex
Caudate Nucleus
Thalamus
Putamen
Subthalamic Nucleus
Substantia Nigra
Globus Pallidus
Hypothalamus

Connections of the specific thalamic nuclei

Nucleus	Afferents	Efferents	Functions
Ventral posterior (VP)			
• Ventral posteromedial (VPM)	Trigeminal lemniscus Solitariothalamic tract	To postcentral gyrus (area 3, 1, and 2)	Relay station for impulses from face and head, and taste buds
• Ventral posterolateral (VPL)	Medial lemniscus Spinal lemniscus	To postcentral gyrus (area 3, 1, and 2)	Relay station for exteroceptive (pain, touch, and temperature) and proprioceptive sensations from whole of body except face and head
Ventral anterior (VA)	From globus pallidus through subthalamic fasciculus	To premotor cortex (area 6 and 8)	Relay station for striatal impulses
Ventral lateral (VL) (also called ventral intermediate (VI))	From cerebellum (dentatorubrothalamic fibres and dentatothalamic fibres)	To motor and premotor areas of cerebral cortex (area 4 and 6)	Relay station for cerebellar impulses
Medial geniculate body	Auditory fibres from inferior colliculus	To primary auditory area (area 41 and 42)	Relay station for auditory impulses
Lateral geniculate body	Optic tract	To primary visual cortex (area 17)	Relay station for visual impulses

- For further inquiries ***PLZ*** feel free to contact at any time through email

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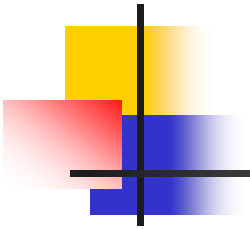

Thank You