



Neuroanatomy

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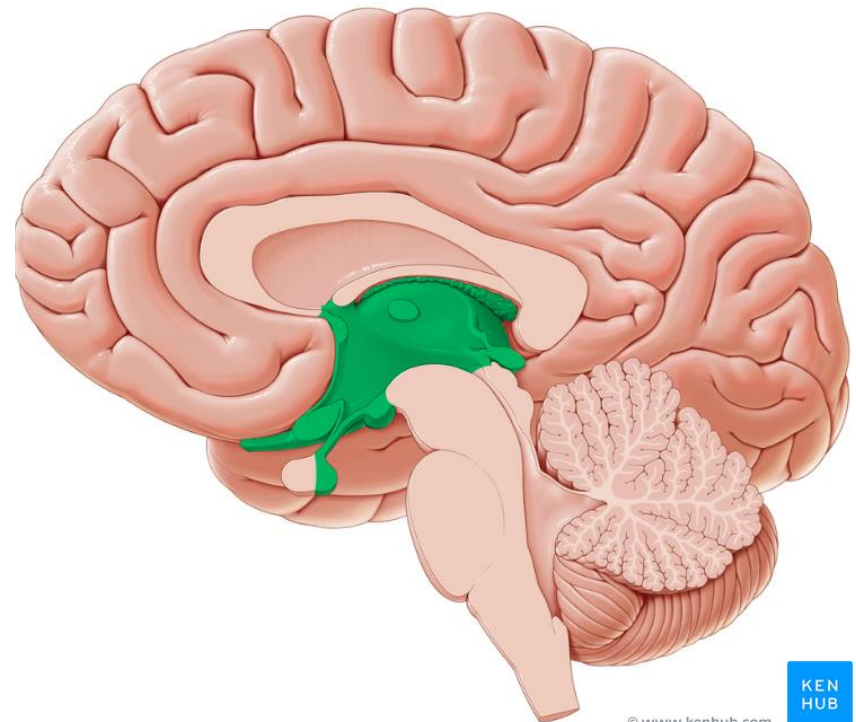
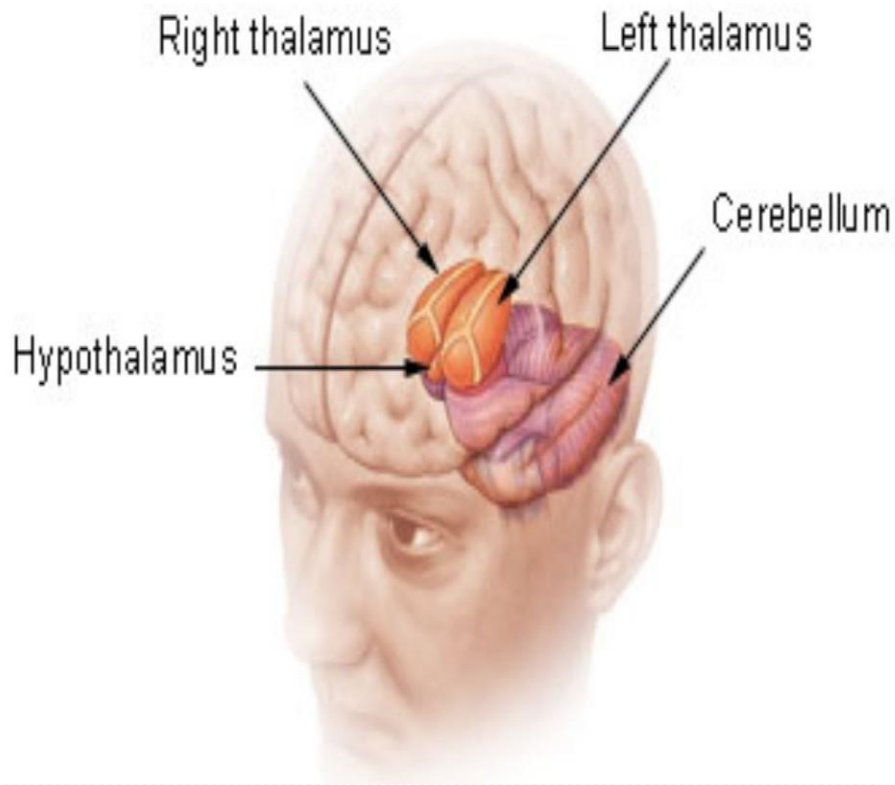
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Objectives

- 1- Identify different anatomical parts of the diencephalon and their embryological origin.
- 2- Distinguish different anatomical parts of the thalamus, anatomical relations, its nuclei, connections, functions ,thalamic radiations and clinical conditions related to the thalamus.
- 3- Differentiate different anatomical parts of the Hypothalamus, anatomical relations, its nuclei, connections, and function.
- 4- Identify different anatomical parts of the Epithalamus, Metathalamus, subthalamus and their functions and clinical significance.

Diencephalon

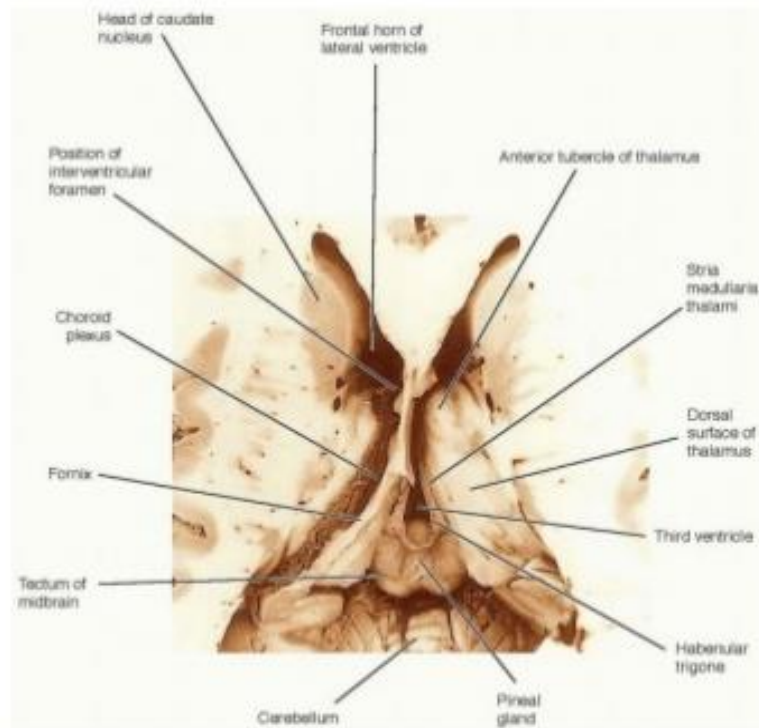
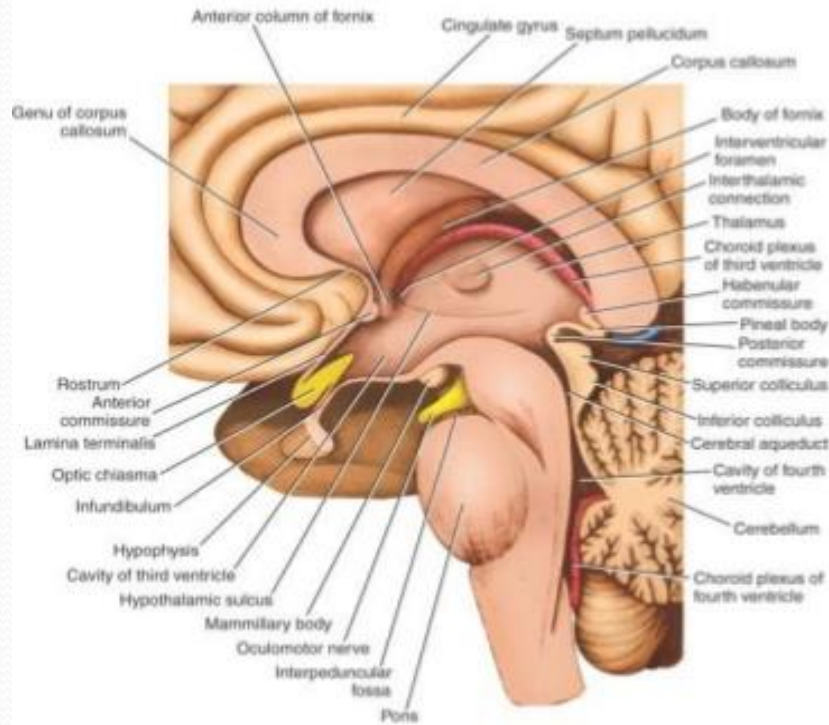
Diencephalon



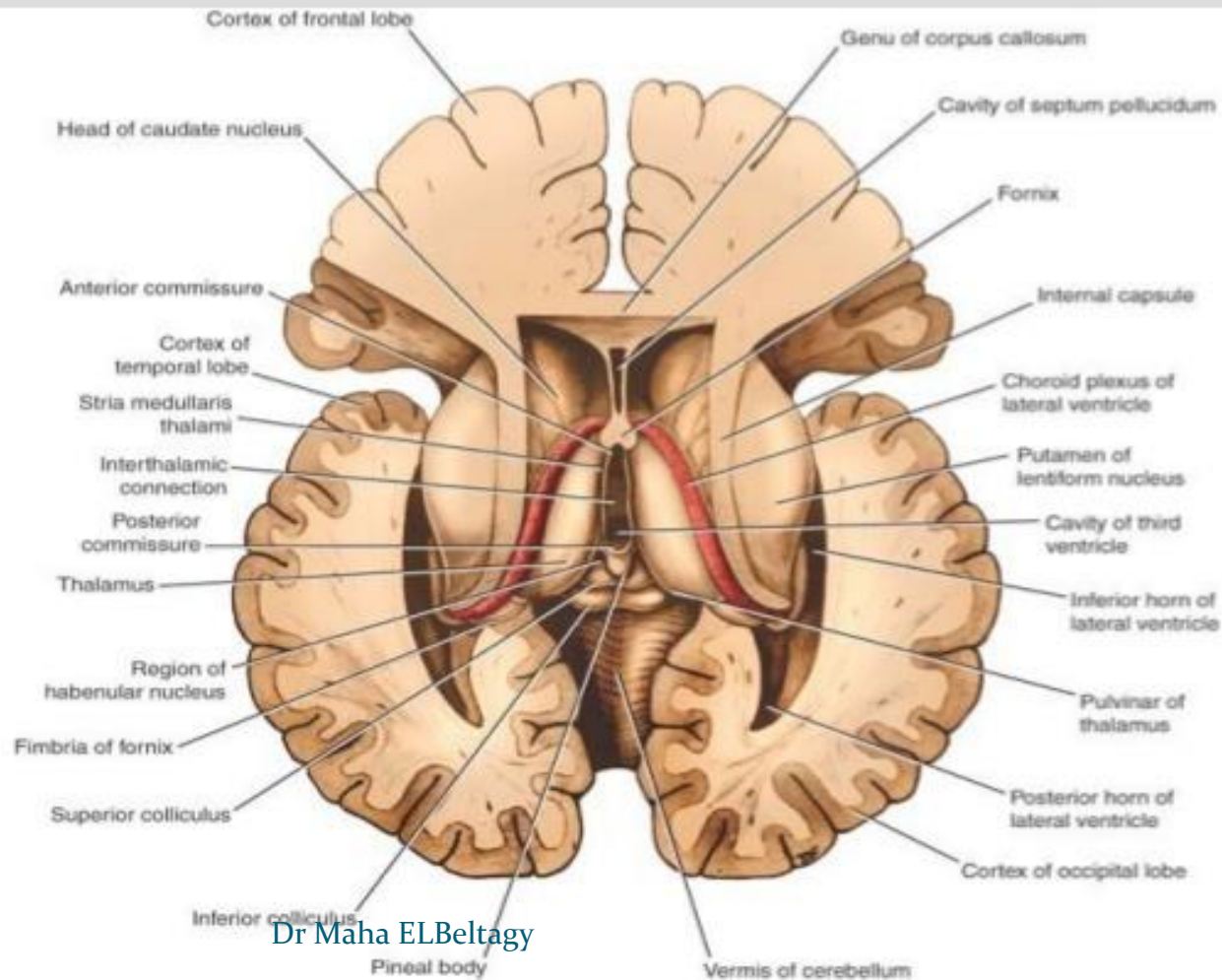
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MEDIAL SURFACE

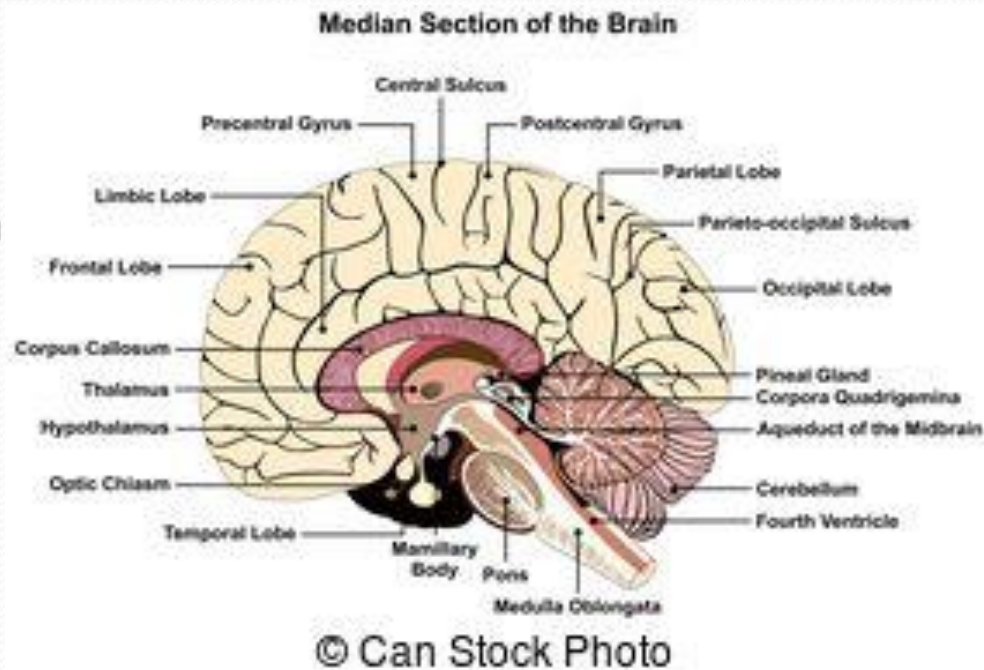


LATERAL SURFACE



Diencephalon

- The Diencephalon is located near the midline of the brain above the midbrain.
- Developed from the forebrain vesicle (prosencephalon).
- More primitive than the cerebral cortex and lies under it.
- Surrounds the third ventricle



The Diencephalon

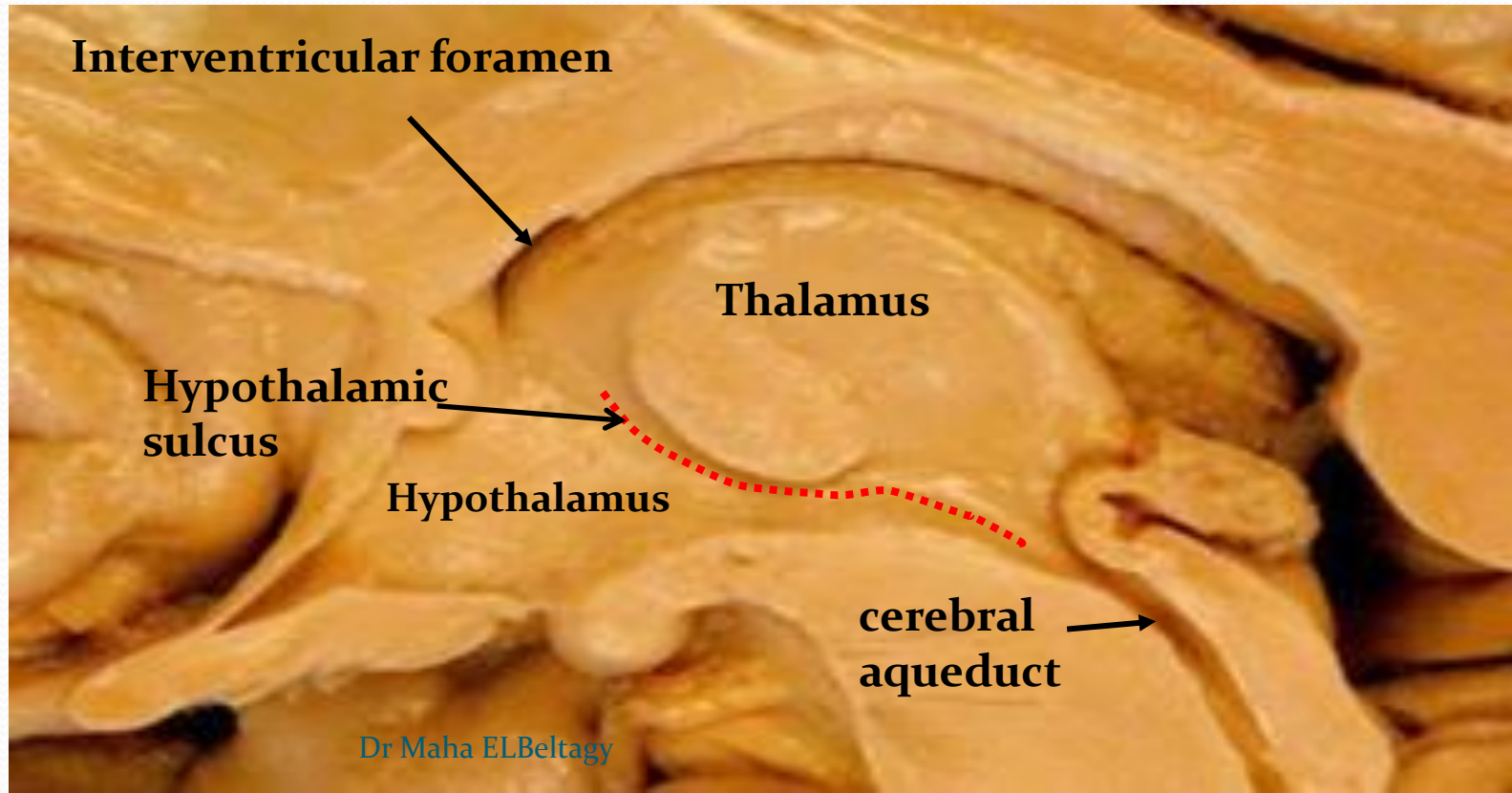
- The cavity of the 3rd ventricle divides the diencephalon into 2 halves.
- Each half is divided by the hypothalamic sulcus (which extends from the interventricular foramen to the cerebral aqueduct) into ventral & dorsal parts:

Dorsal part includes:

- Thalamus, Epithalamus & Metathalamus.

Ventral part includes:

- Hypothalamus & Subthalamus



THALAMUS



THALAMUS

- It is a large egg shaped mass of grey matter which forms the main sensory relay station for the cerebral cortex.
- It forms part of the lateral wall of the 3rd ventricle & the part of the floor of the body of the lateral ventricle.
- The 2 thalami are connected by interthalamic adhesion.



THALAMUS

Shape and relations:

Oval shape has 2 ends and 4 surfaces:

Anterior end: narrow and forms the posterior boundary of the IVF.

Posterior end: Pulvinar overhanging the MGB and LGB.

Upper surface: floor of body of lateral ventricle.

Medial surface: lateral wall of third ventricle

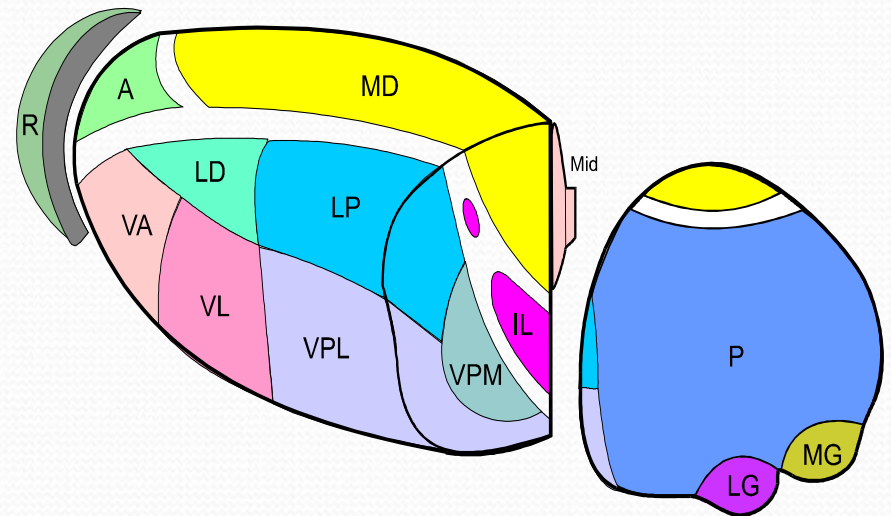
Lateral surface: caudate above & lentiform below separated from it by posterior limb of internal capsule

Lower surface: hypothalamus anterior and subthalamus posterior

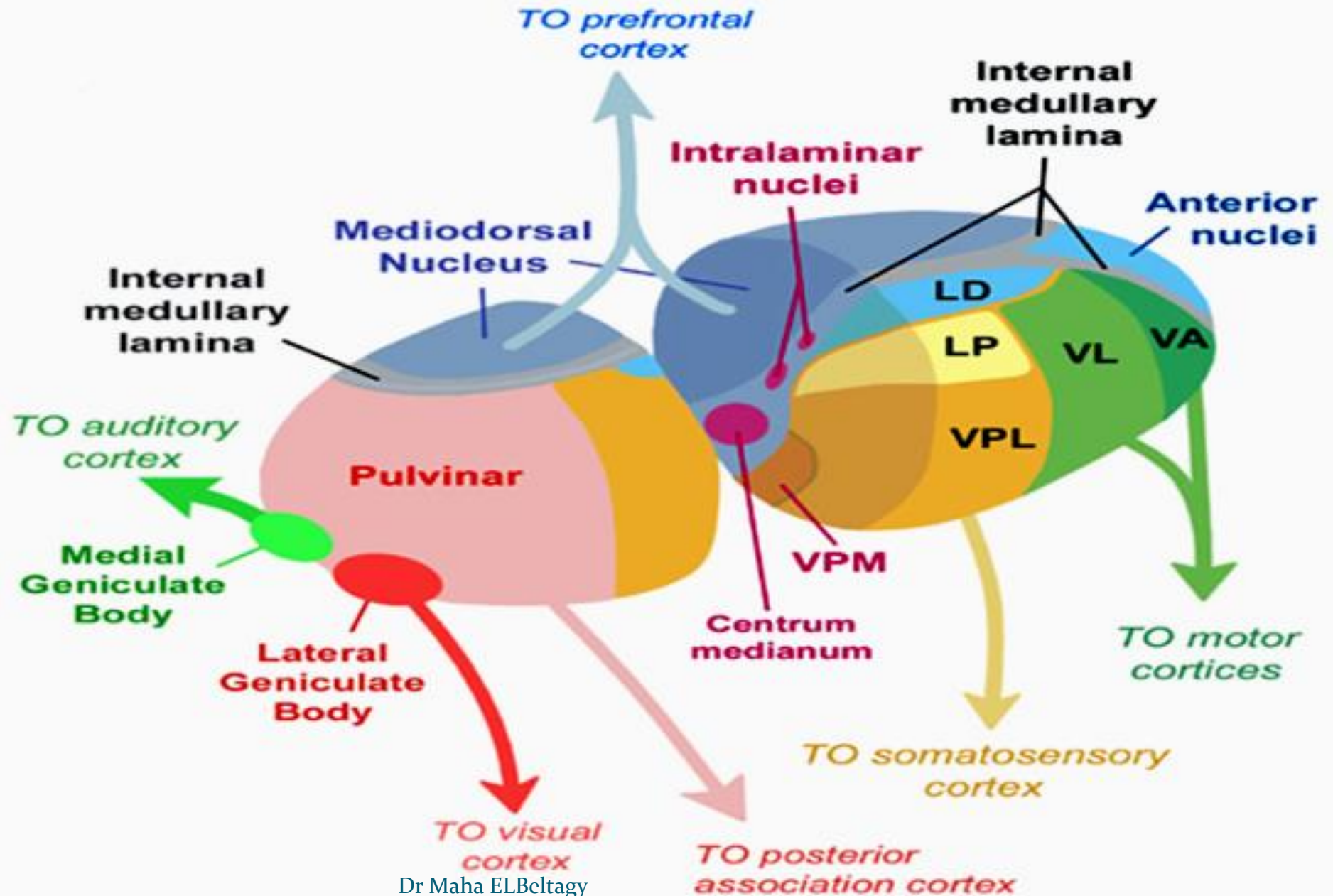


Classification of Thalamic Nuclei

- I. Lateral Nuclear Group
- II. Medial Nuclear Group
- III. Anterior Nuclear Group
- IV. Posterior Nuclear Group
- V. Metathalamic Nuclear Group
- VI. Intralaminar Nuclear Group
- VII. Thalamic Reticular Nucleus



Thalamic Nuclei



LATERAL NUCLEAR GROUP

Ventral Nuclear Group

Dorsal Nuclear Group

Lateral dorsal (LD)

Lateral posterior (LP)

Pulvinar

1- Ventral Posterior Nucleus (VP)

Ventroposterolateral
(VPL)

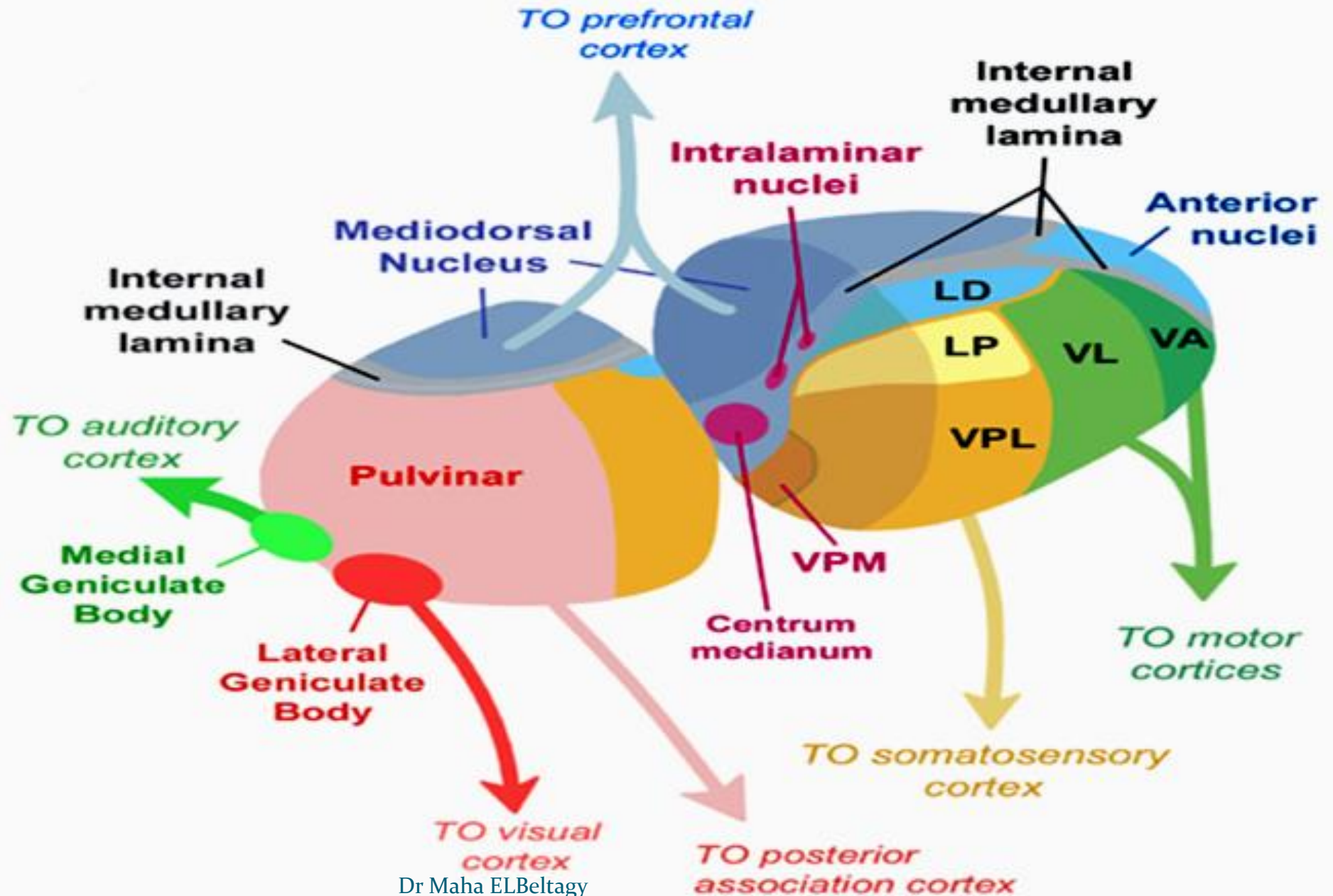
Ventroposteromedial
(VPM)

Ventroposteroinferior
(VPI)

2- Ventral Anterior Nucleus (VA)

3- Ventral Lateral Nucleus (VL)

Thalamic Nuclei



Summary of Thalamic Connectivity and function

I. Sensory Input

general sensation

special sensation

taste, equilibrium, hearing, vision

II. Motor Input

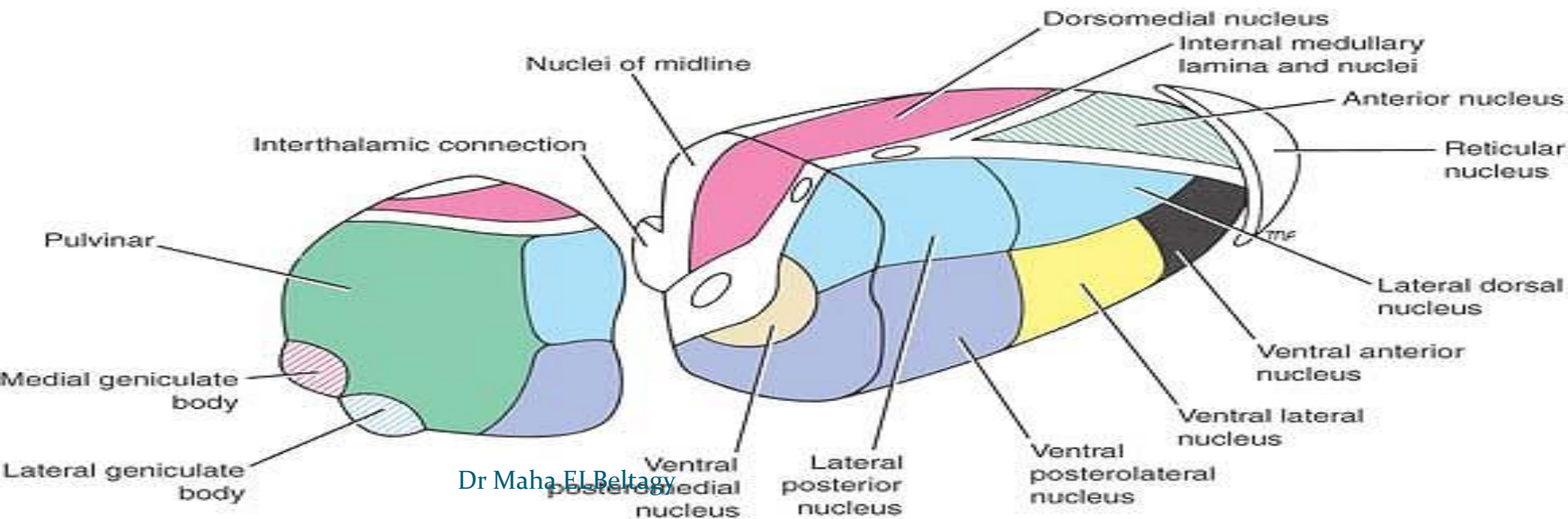
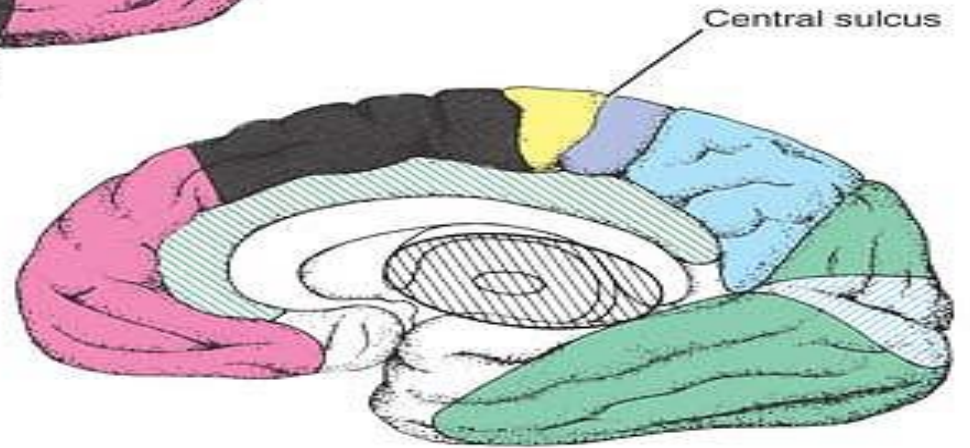
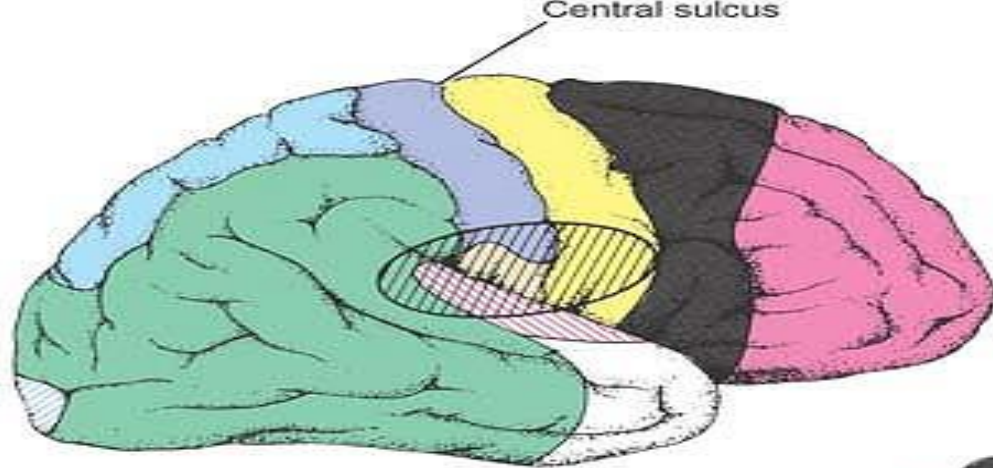
cerebellum, basal ganglia

III. Reticular Formation

IV. Limbic System

mammillary nucleus

hippocampal formation



Nucleus	Afferent	Efferent	Function
Anterior	Mammillothalamic tract, cingulate gyrus, hypothalamus	Cingulate gyrus, hypothalamus	Emotion and memory
Dorsomedial	Prefrontal cortex, hypothalamus	Prefrontal cortex, hypothalamus	Integration of somatic, visceral, olfaction
LD & LP	Cerebral cortex	Cerebral cortex	unknown
VA	Premotor cortex, BG	Premotor cortex, BG	Motor activity
VL	Premotor cortex, cerebellum	Premotor cortex, cerebellum	Motor activity
VPM	Trigeminal lemniscus	Area 3,1,2	general sensation
VPL	Medial & spinal lemnisci	Area 3,1,2	general sensation
Intralaminar	Reticular formation	Cerebral cortex	Alertness
Reticular	Cerebral cortex	Other thalamic nuclei	Regulate thalamus
MGB	Lateral lemniscus	Superior temporal gyrus	hearing
LGB	Optic tract	Visual cortex	Vision

Thalamic radiations

Thalamocortical (Anterior thalamic radiation)

fibers connect the anterior nucleus of thalamus to the frontal lobes and cingulate gyrus.

Ascend in the anterior limb of the internal capsule.

(superior thalamic radiation) or sensory radiation

from VP of thalamus to post central gyrus.

Ascend in the posterior half of the posterior limb of the internal capsule.

optic radiation (posterior thalamic radiation)

From LGB to occipital lobe (visual cortex)

Retrolentiform part of the internal capsule.

auditory radiation (Inferior thalamic radiation)

From MGB to the auditory area in the superior temporal lobe.

Sublentiform part of the internal capsule

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Clinical Syndromes of the Thalamus

Posterolateral thalamic syndromes

sensory disorders

Thalamic (Dejerine-Roussy) syndrome numbness and burning on the opposite side

VP nucleus – pain (hypersensitivity to pain) thalamic pain

Thalamic hand

pronation and flexion of wrist, flexion of metacarpophalangeal and extension of interphalangeal (altered muscle tone).

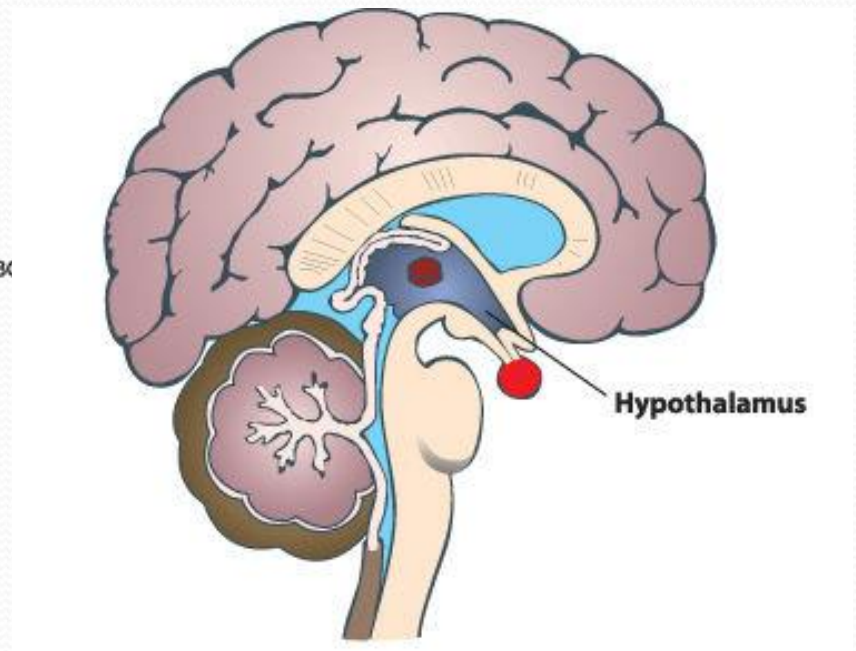
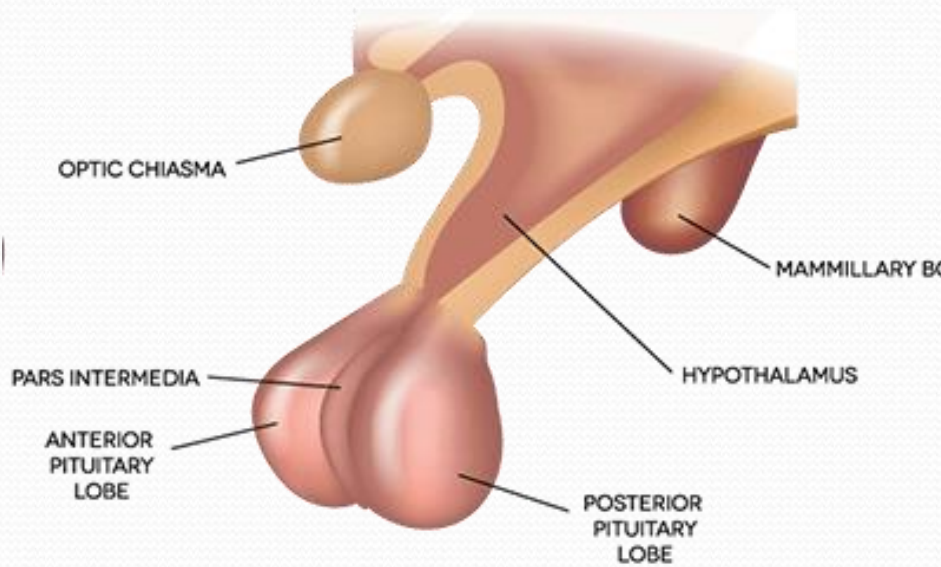
Anterolateral thalamic syndromes

motor disorders

paresis, ataxia, motor incoordination, dysphagia



HYPOTHALAMUS



HYPOTHALAMUS

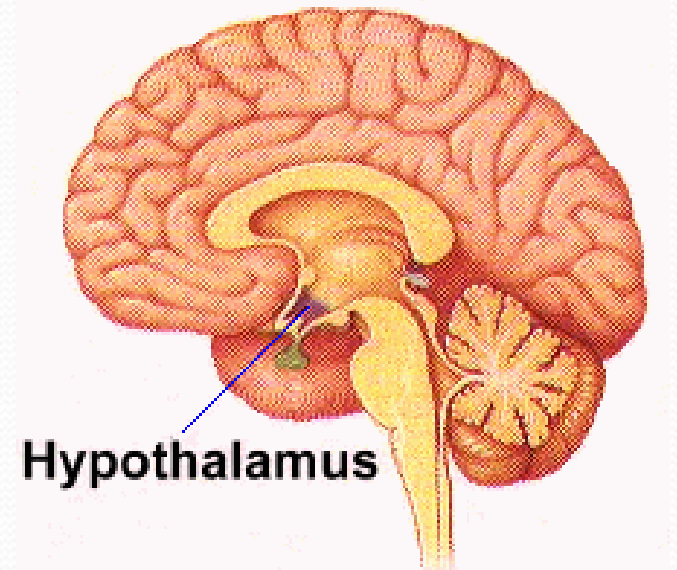
Part of the Diencephalon.

Extends from optic chiasma to the mammillary bodies.

Forms the floor of the third ventricle.

Preoptic area is extending from optic chiasma to lamina terminalis and anterior commissure.

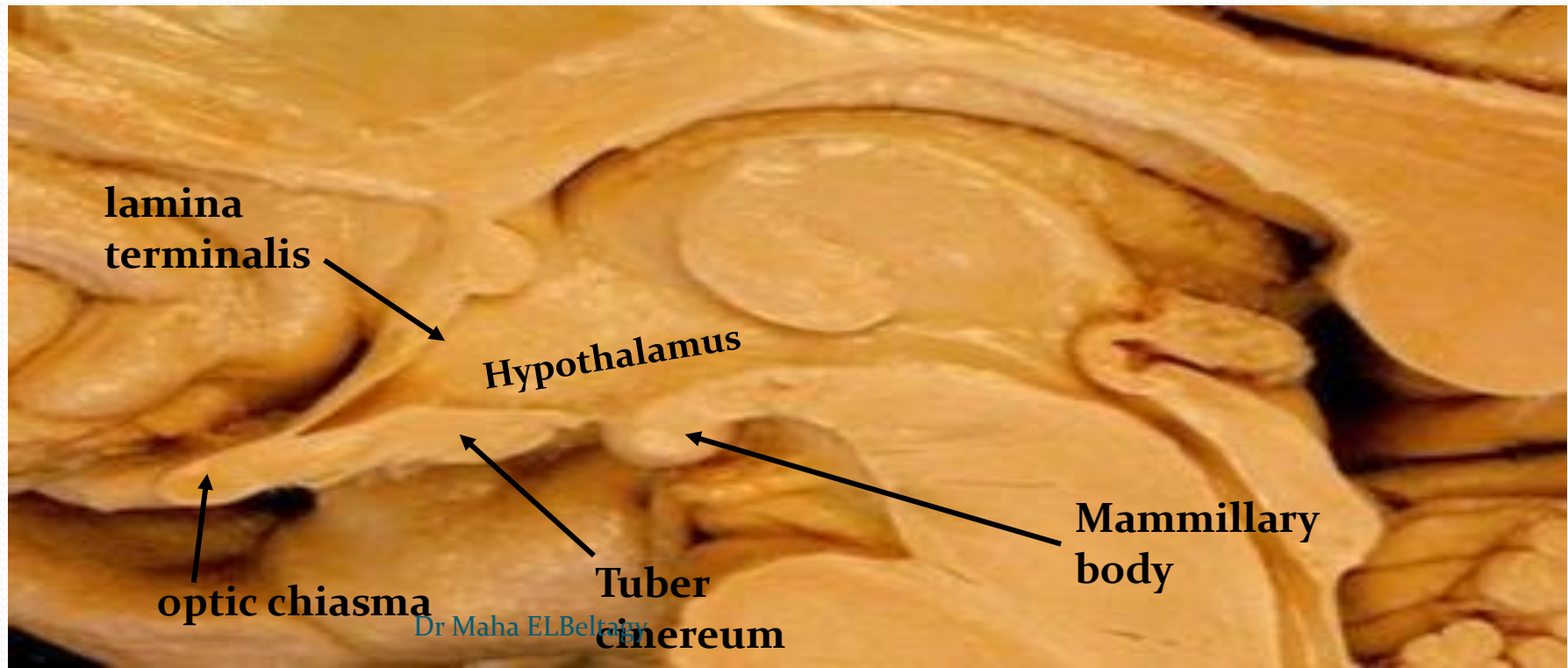
Bounded laterally by the internal capsule.



Hypothalamus

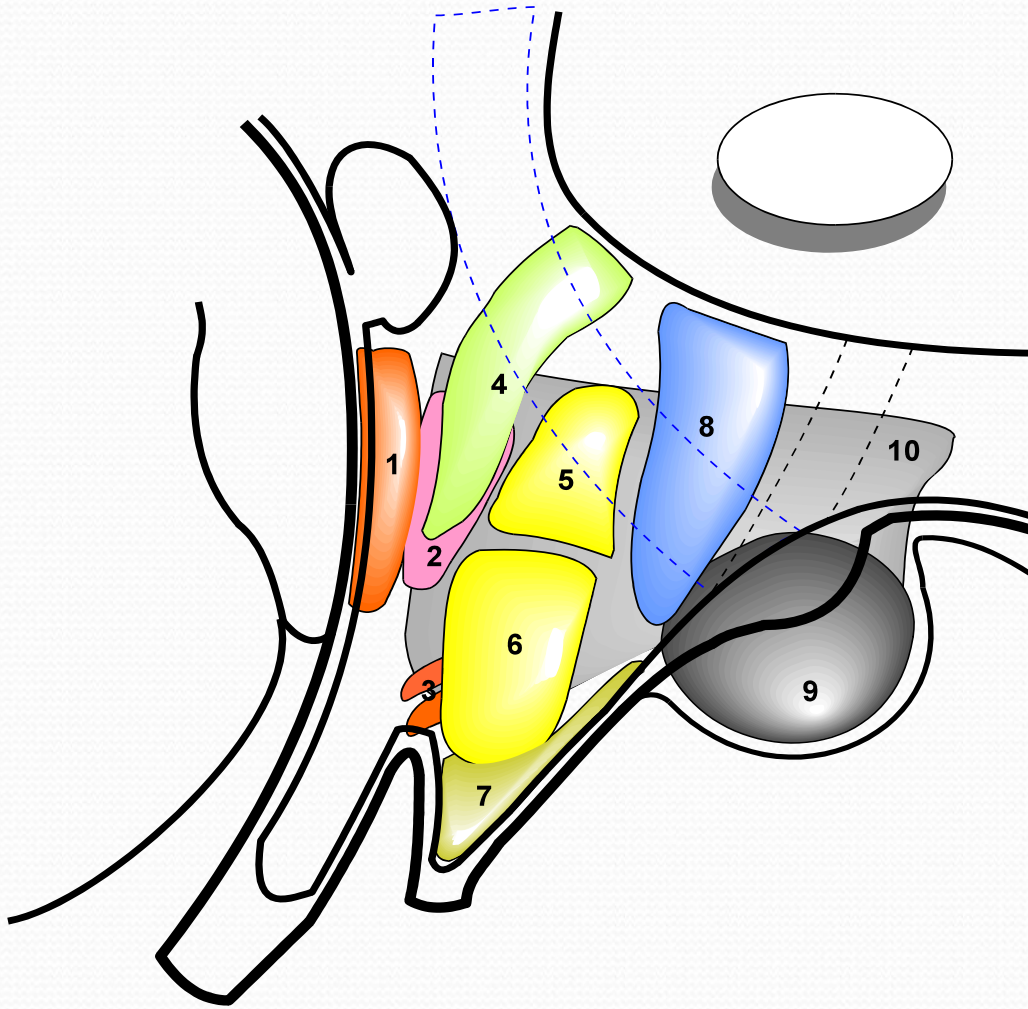
Major constituents :

- Mammillary bodies. ← **Horizontal part (contents of interpeduncular fossa)**
- Tuber cinereum & infundibulum. ← **Horizontal part (contents of interpeduncular fossa)**
- Nervous tissue adjacent to optic chiasma ← **Vertical part**
- Preoptic region adjacent to lamina terminalis ← **Vertical part**



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COMPONENTS OF HYPOTHALAMUS



MEDIAL ZONE

Preoptic Region

- 1. Preoptic Nucleus

Anterior (Supraoptic) Region

- 2. Anterior Nucleus
- 3. Supraoptic Nucleus
- 4. Paraventricular Nucleus

Intermediate (Tuberal) Region

- 5. Dorsomedial Nucleus
- 6. Ventromedial Nucleus
- 7. Infundibular or Arcuate Nucleus

Posterior Region

- 8. Posterior Nucleus
- 9. Mammillary Nucleus

LATERAL ZONE

- 10. Lateral Hypothalamic Nucleus

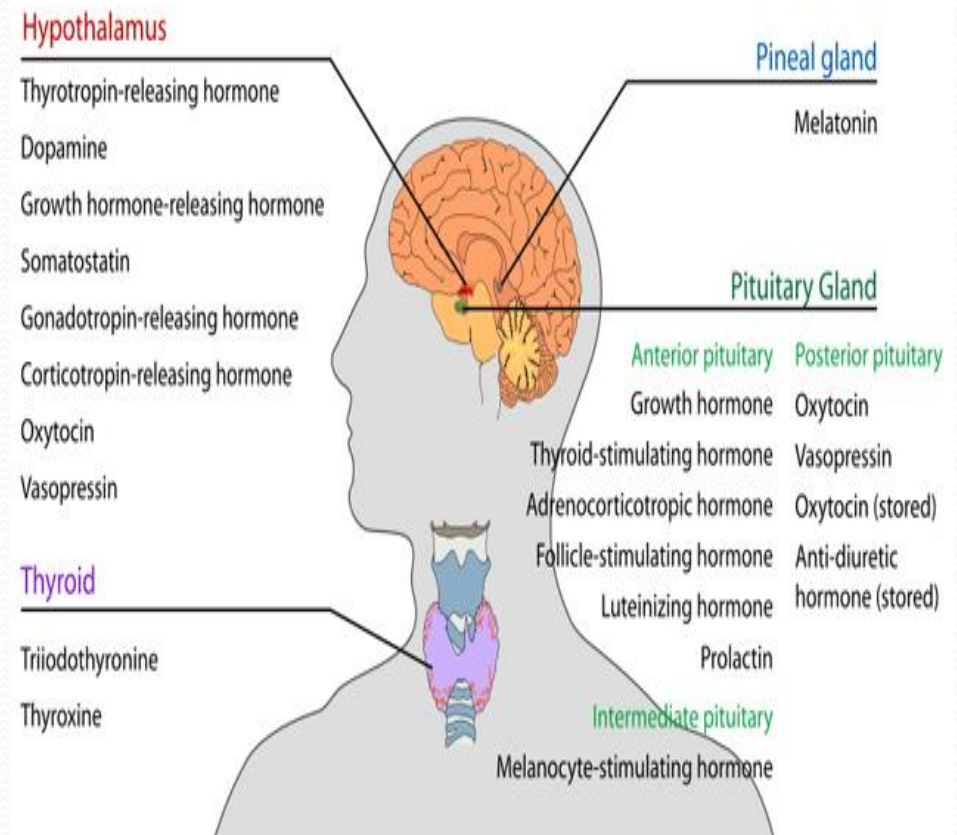
Function of hypothalamus

Homeostasis (food intake, water and electrolyte balance, temperature regulation and circadian rhythm).

Endocrine control via pituitary gland (Growth hormone, reproductive hormones, stress hormones).

Autonomic control (sympathetic and parasympathetic responses).

Limbic function (memory and emotions).



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Detailed functions of hypothalamus

Paraventricular and supraoptic nuclei

- regulate water balance
- produce ADH and oxytocin
- destruction causes diabetes insipidus
- paraventricular nucleus projects to autonomic nuclei of brainstem and spinal cord

Anterior nucleus

- thermal regulation (dissipation of heat)
- stimulates parasympathetic NS
- destruction results in hyperthermia

Preoptic area

- contains sexually dimorphic nucleus
- regulates release of gonadotropic hormones

Suprachiasmatic nucleus

- receives input from retina
- controls circadian rhythms

Dorsomedial nucleus

- stimulation results in obesity and savage behavior

Posterior nucleus

- thermal regulation (conservation of heat)
- destruction results in inability to thermoregulate
- stimulates the sympathetic NS

Lateral nucleus

- stimulation induces eating
- destruction results in starvation

Mammillary body

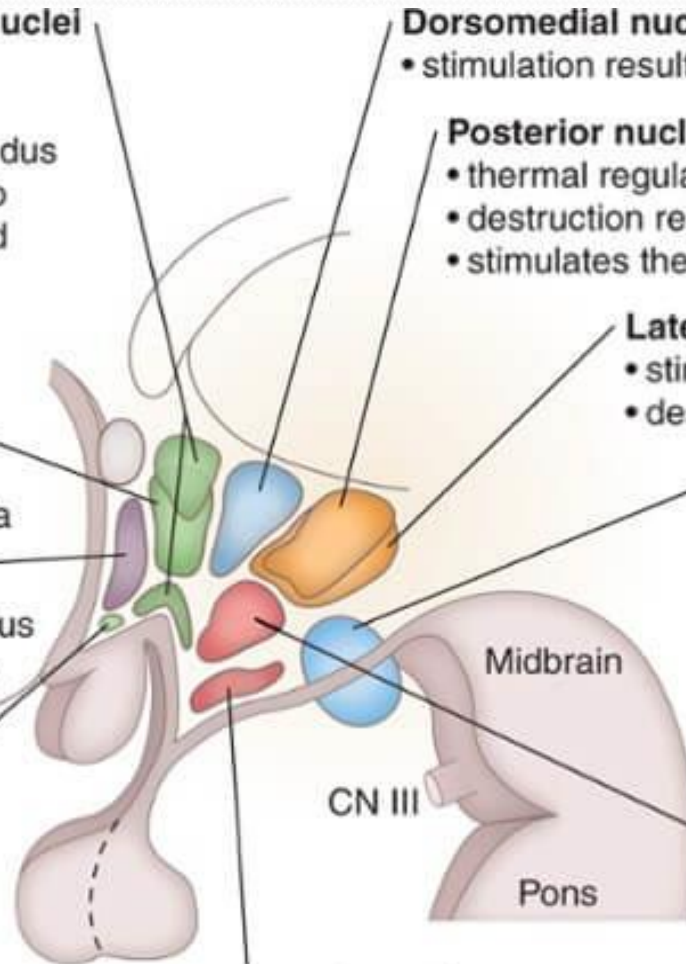
- receives input from hippocampal formation via fornix
- projects to anterior nucleus of thalamus
- contains hemorrhagic lesions in Wernicke's encephalopathy

Ventromedial nucleus

- satiety center
- destruction results in obesity and savage behavior

Arcuate nucleus

- produces hypothalamic releasing factors
- contains DOPA-ergic neurons that inhibit prolactin release



Hypothalamic Connections

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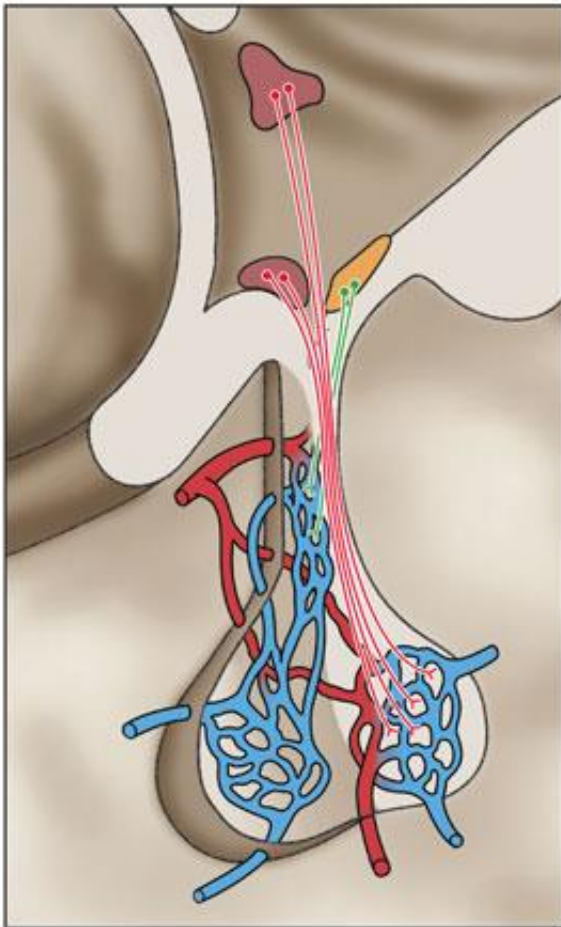
Anterior pituitary

From Pre-optic nucleus

Hypothalamo-hypophyseal portal circulation

Tubero-infundibular tract to Median eminence, then via Portal veins

Gonadotropic releasing hormone



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Hypothalamic Connections

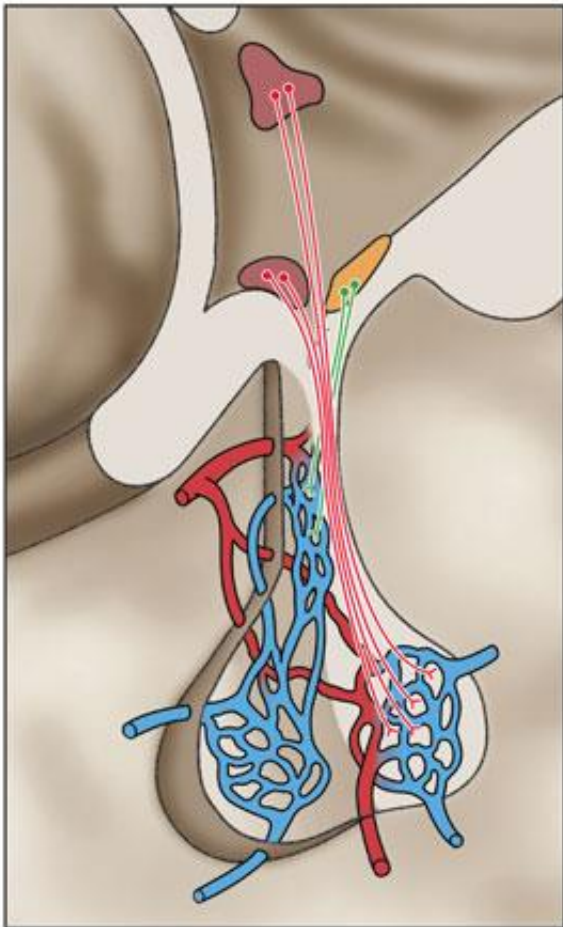
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Posterior pituitary

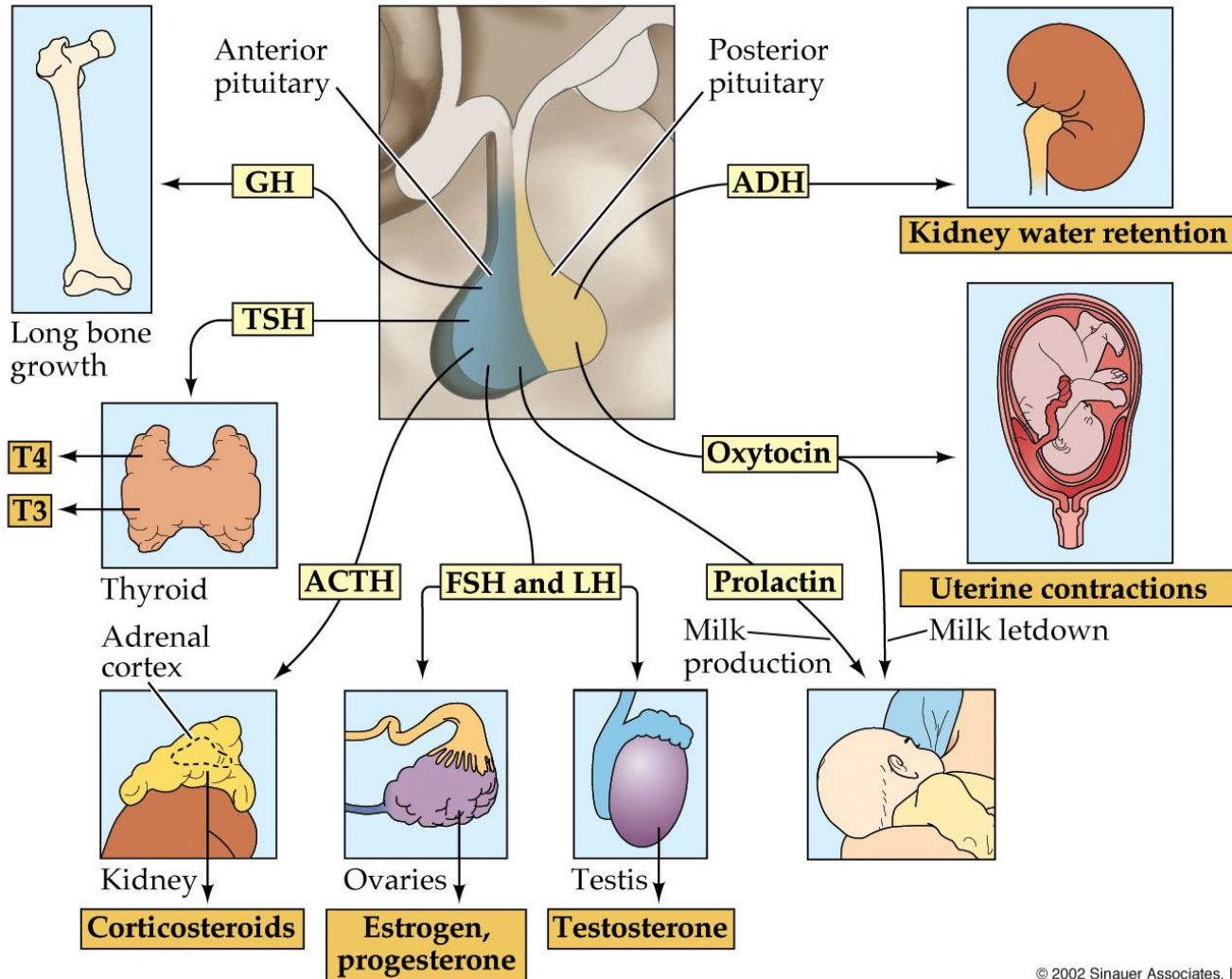
Supraoptic-hypophyseal tract
(neurohypophysis) through
infundibulum

ADH / Vasopressin (supraoptic nuclei)

Oxytocin (paraventricular nuclei)



Function of the Pituitary



Epithalamus ⇒ Limbic System

Major constituents:

Habenular Nucleus

Medial Habenular Nucleus

Lateral Habenular Nucleus

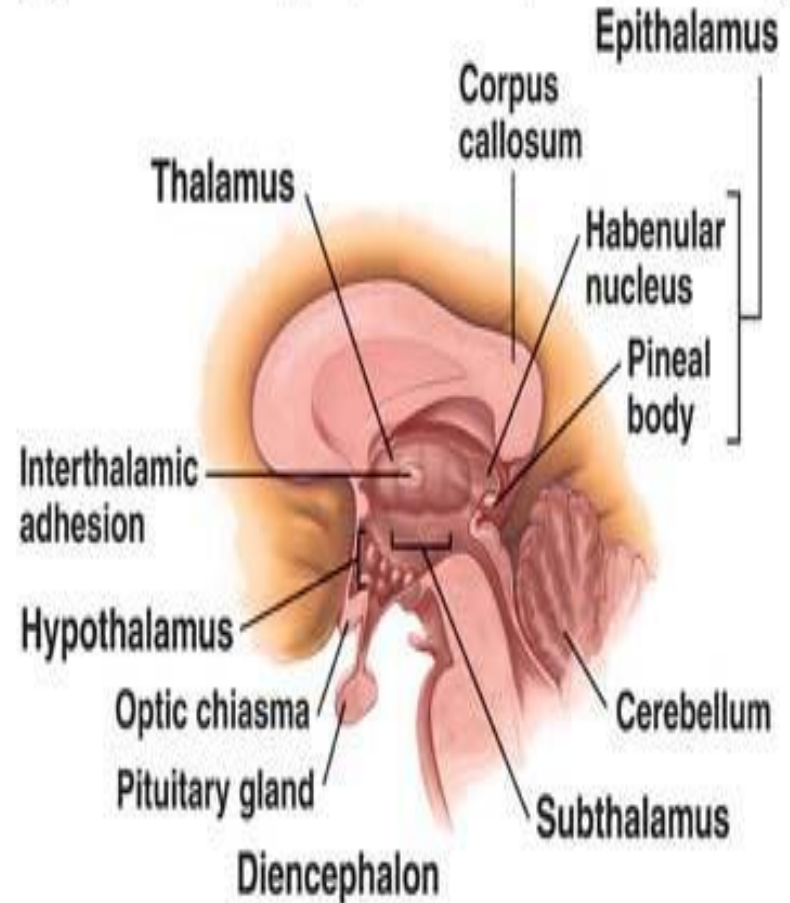
Habenular Commissure

Pineal Gland (habenular commissure above and posterior commissure below)

Function:

- Connects the limbic system and other parts of the brain.
- Secretion of melatonin by the pineal gland.
- Regulation of pituitary gland through hypothalamus (pineal gland)

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Metathalamus (Geniculate bodies)

Placed under pulvinar of the the thalamus

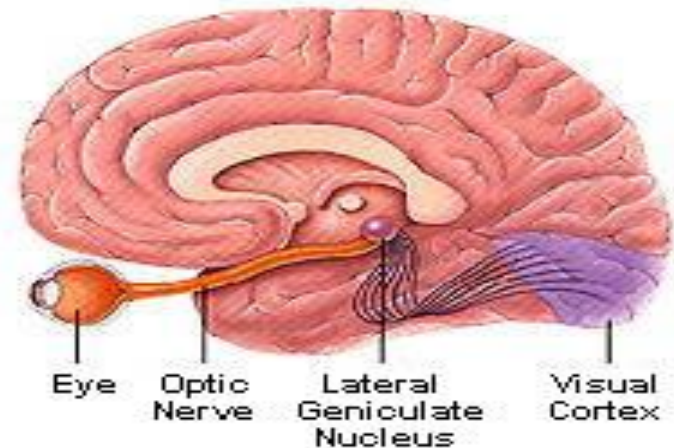
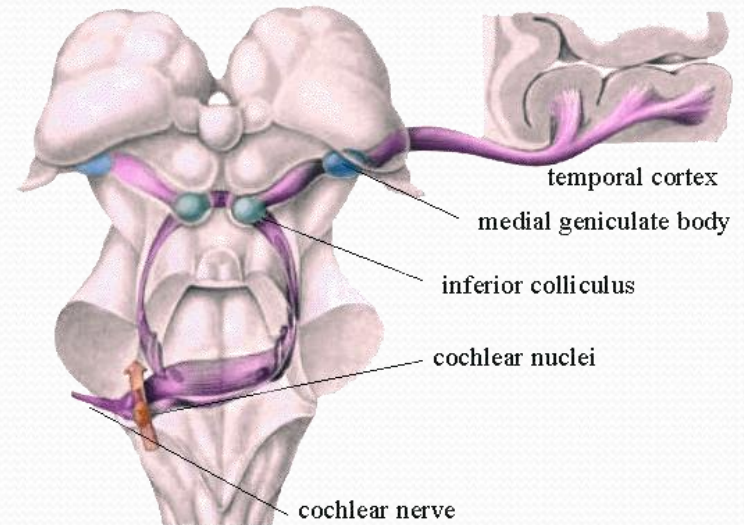
1- Medial Geniculate Body (MGB):

Receives **afferents** from medial lemniscus and inferior colliculus through inferior brachium.

Gives **efferents** (auditory radiation) in sublentiform part of the internal capsule to auditory area in superior temporal gyrus.

2- Lateral Geniculate Body (LGB):

Receives **afferents** from optic tract
Gives **efferents** (optic radiation) in retrolentiform part of internal capsule to visual center in the occipital lobe
3rd order neuron in visual pathway.



Subthalamus ⇨ Basal Ganglia

Lies between thalamus & tegmentum of midbrain.

Considered motor zone of the diencephalon

Major constituents (3 nuclei and 3 bundles)

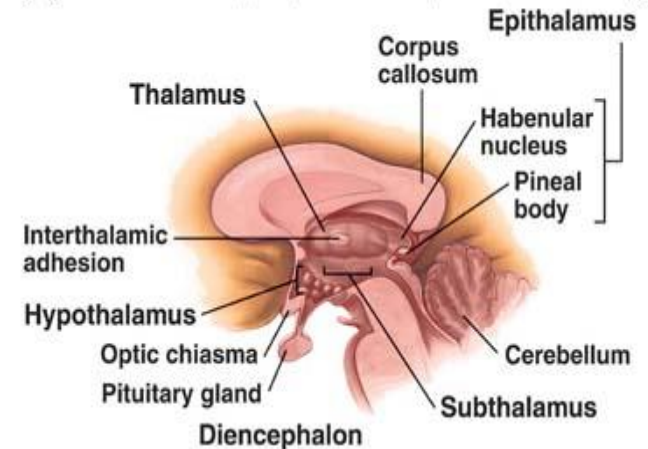
Nuclei

- Subthalamic nucleus
- Substantia nigra and red nucleus extend from midbrain to subthalamus.
- zona incerta (grey matter inside the subthalamus) Its connections project extensively over the brain from the cerebral cortex down into the spinal cord (plays role in controlling pain).

• 3 bundles called Fields of Forel (white matter)

H	ansa lenticularis	
H ₁	thalamic fasciculus	(between the subthalamus, thalamus and
H ₂	lenticular fasciculus	Glopus pallidus)

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