



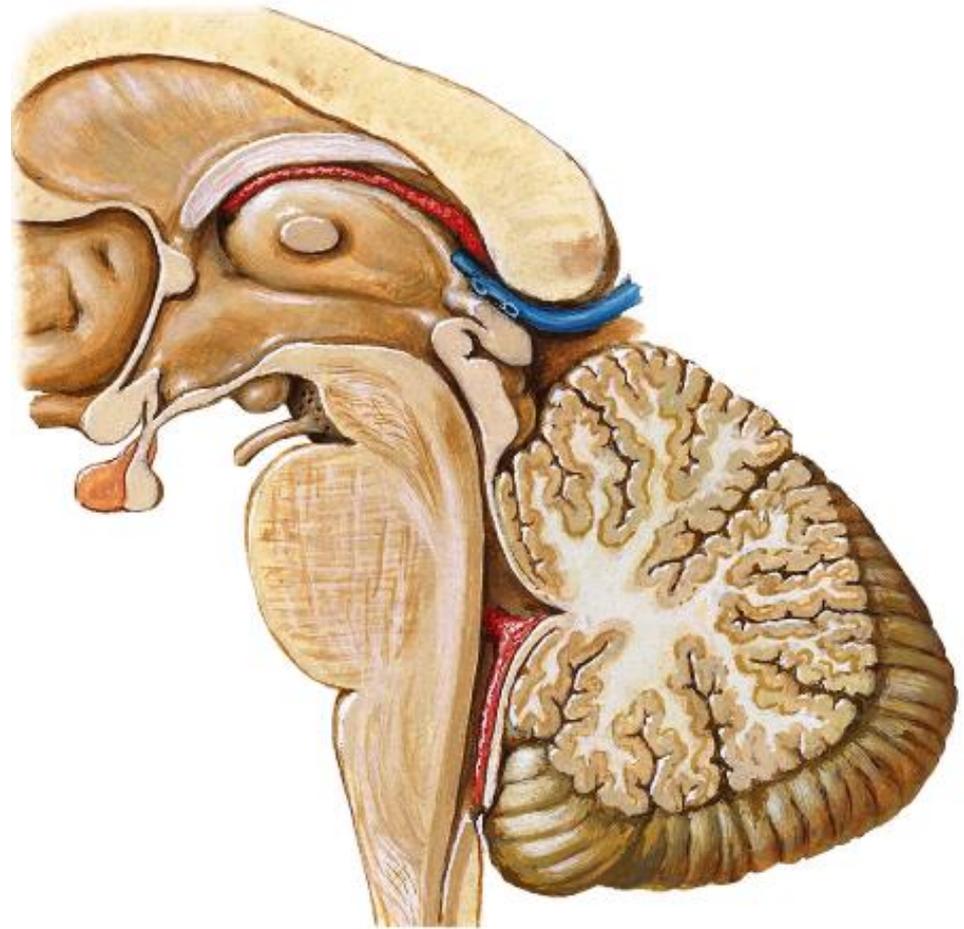
Central Nervous System

Lecture 10: Diencephalon

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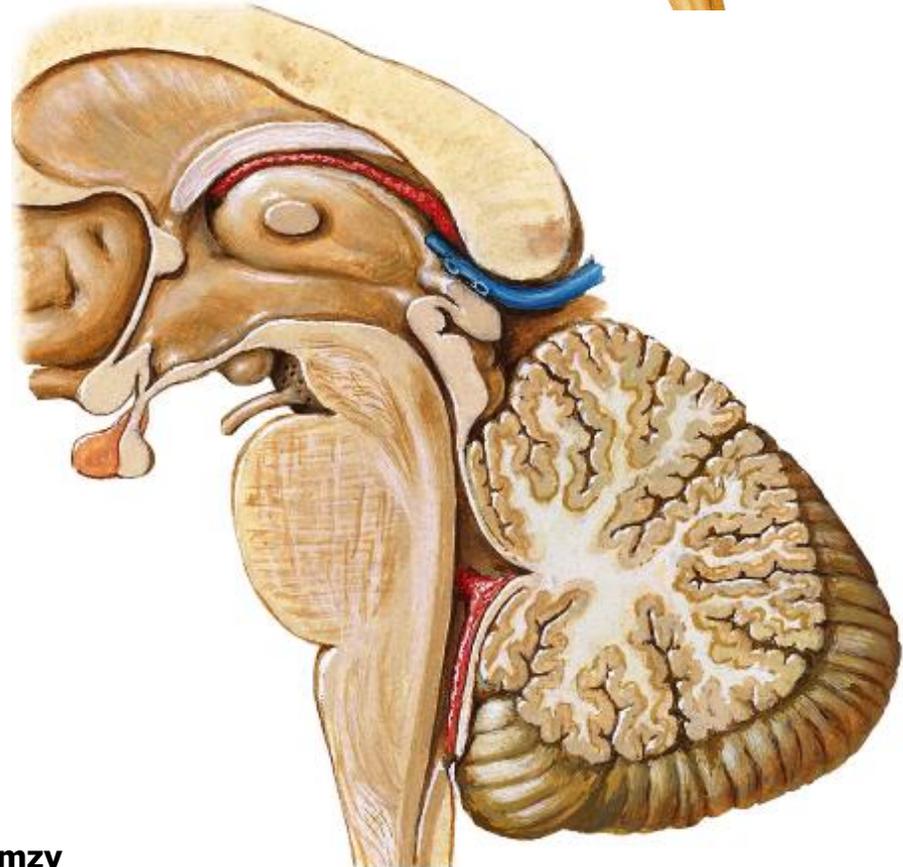
DIENCEPHALON

- ** The diencephalon includes everything with the name thalamus i.e. Thalamus, hypothalamus, epithalamus, metathalamus & subthalamus.
- ** Its cavity is the 3rd ventricle.
- ** It is divided by the **hypothalamic sulcus** (which extends from the interventricular foramen to the mouth of the cerebral aqueduct) **into:**



THALAMUS

- ** It is an oval mass of grey matter which acts as a gateway for the cerebral cortex.
- ** It relays all sensations except smell. It also relays motor and limbic impulses going to the cerebral cortex.
- ** It has 2 ends:
 1. A narrow anterior end which lies posterior to interventricular foramen of Monro.
 2. Its posterior end is expanded to form the **pulvinar**.

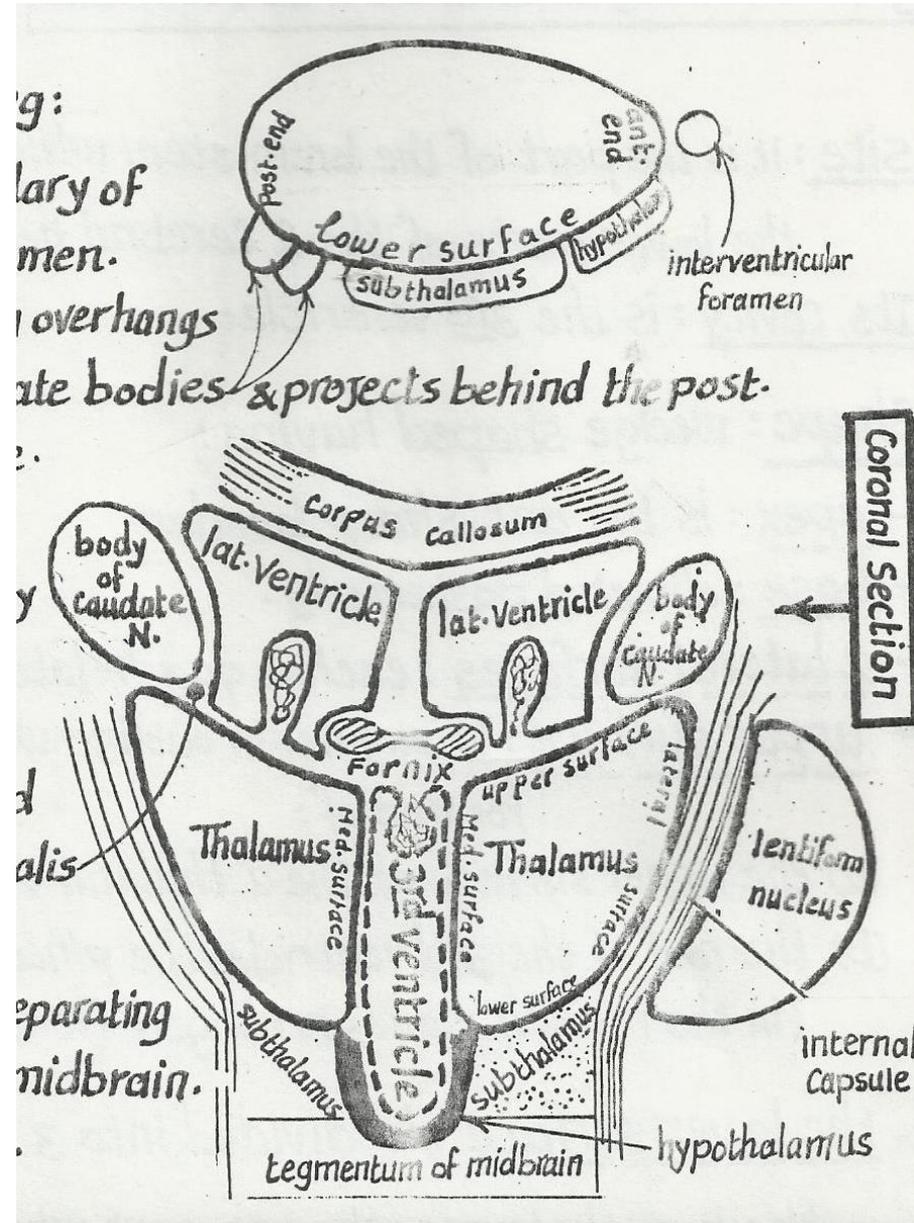


**** It has 4 surfaces:**

1. Superior surface → is free.

It is related to the choroid plexus and forms part of the floor of the body of lateral ventricle.

2. Inferior surface → is separated by hypothalamic sulcus from subthalamus & hypothalamus. The posterior part of this surface shows the medial & lateral geniculate bodies.

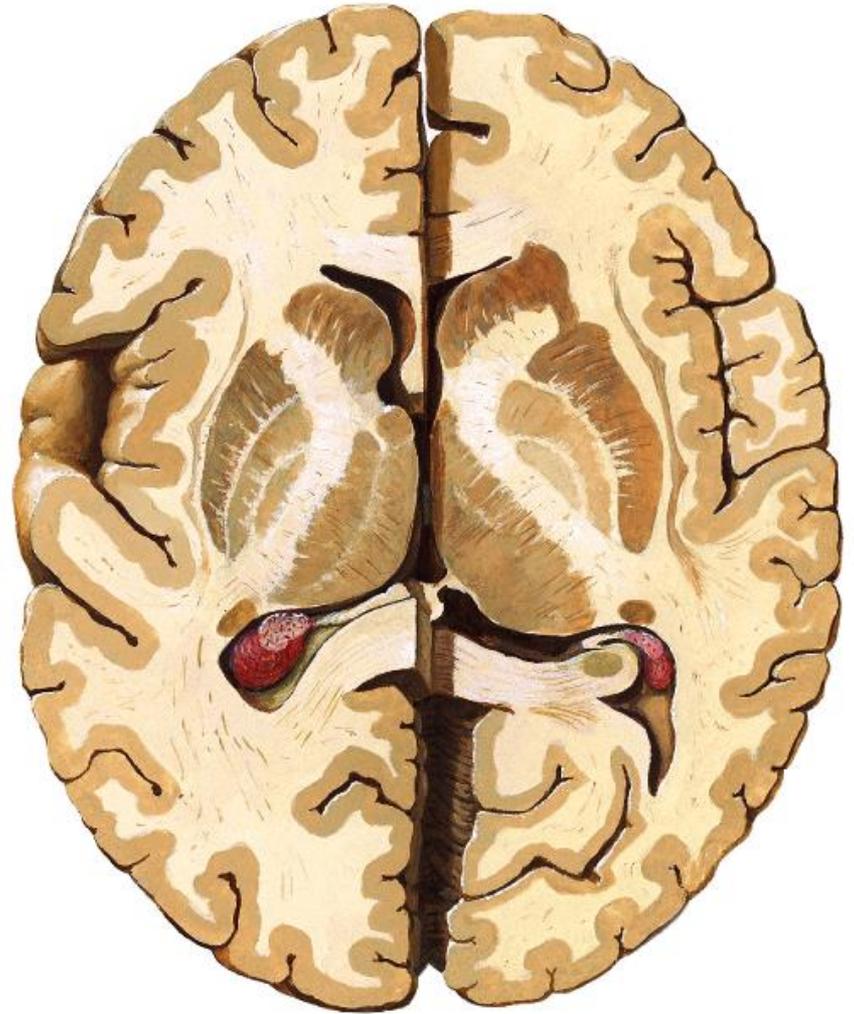


3. Medial surface →

Forms the lateral wall of 3rd ventricle. Both medial surfaces are connected together by the interthalamic adhesion (connexus).

4. Lateral surface →

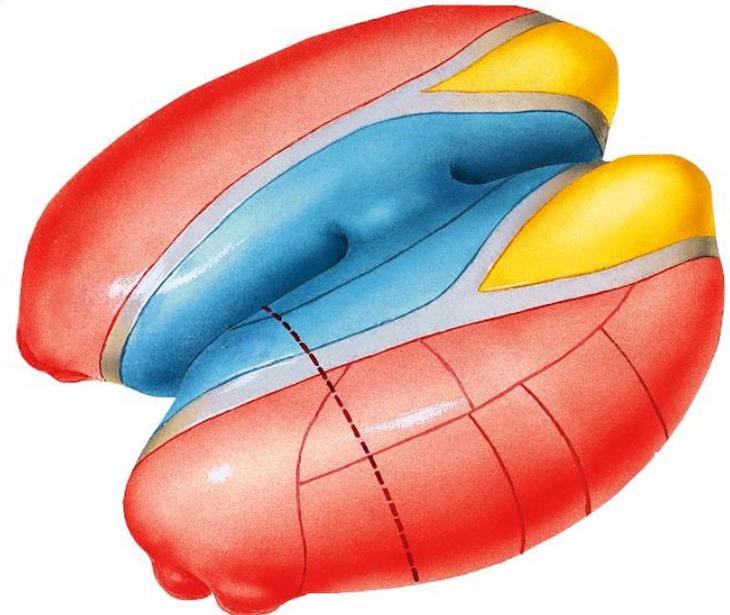
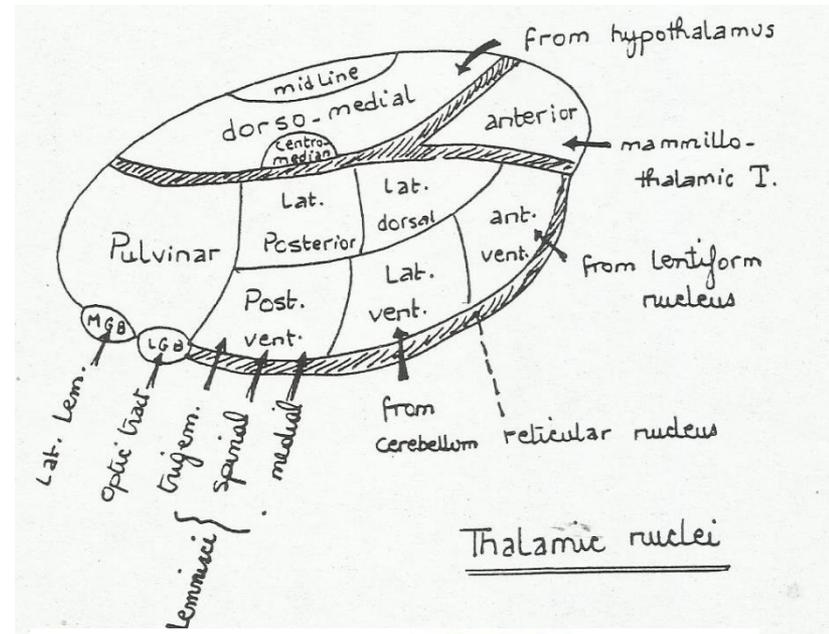
separated from the lentiform nucleus by the internal capsule.



Thalamic nuclei

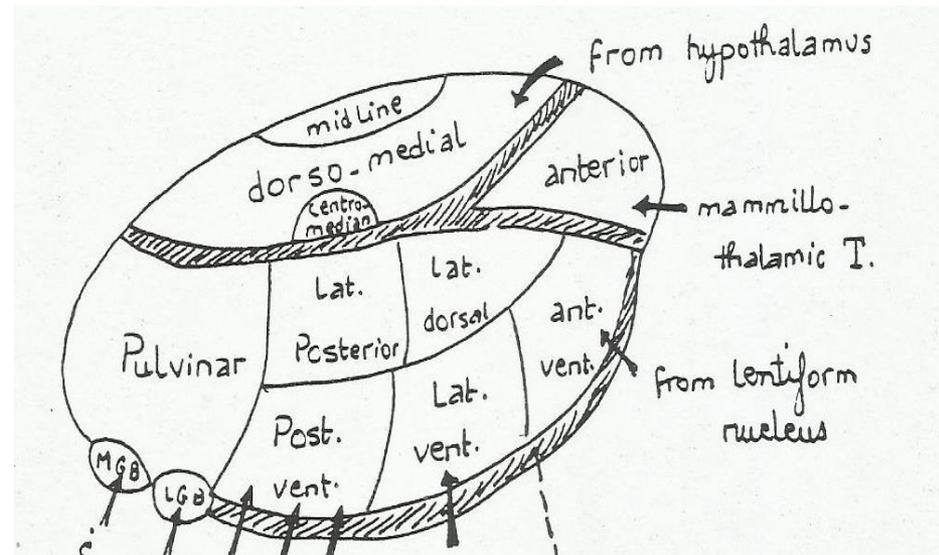
**** The grey matter of thalamus is divided by a Y-shaped sheet of white matter (internal medullary lamina) into:**

- I. Anterior part** → Between the fork of the lamina.
- II. Medial part** → Medial to the lamina.
- III. Lateral part** → Lateral to the lamina.



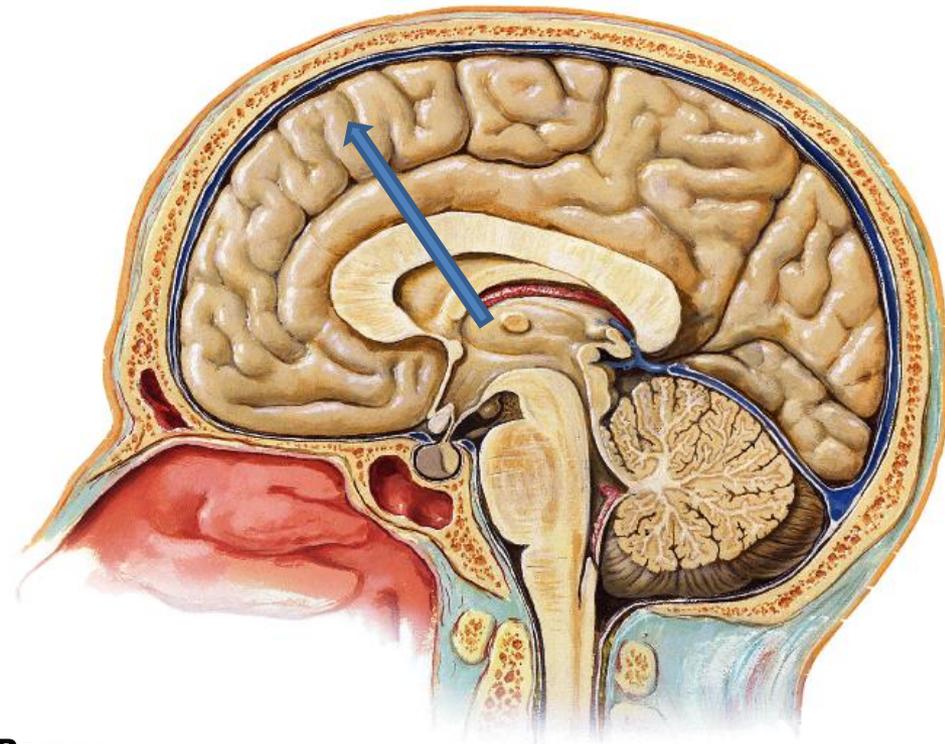
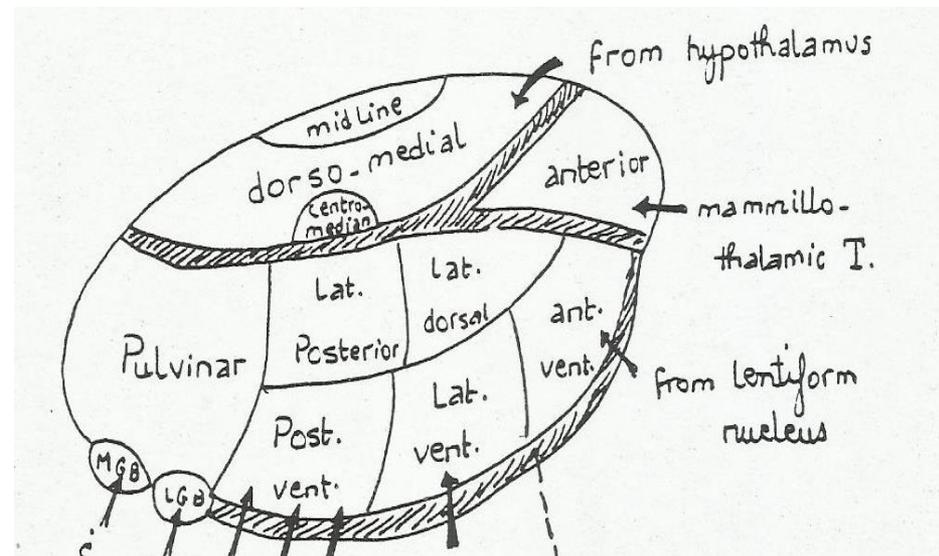
I. Anterior nuclei:

- * Site: between the 2 limbs of the Y-shaped internal medullary lamina.
- * Afferents: receives the mammillo-thalamic tract from the mammillary bodies.
- * Efferents: sends the anterior thalamic radiation to the cingulate gyrus.
- * Function: forms part of the limbic system (Papez circuit) which is concerned with emotions and recent memory.



II. Medial nuclei (Dorso-medial nucleus):

- * Afferents: from the hypothalamus, amygdala & olfactory cortex
- * Efferents: via the medial forebrain bundle to the prefrontal cortex.
- * Function: forms part of the limbic system involved in thinking & mood.



III. Lateral part of thalamus:

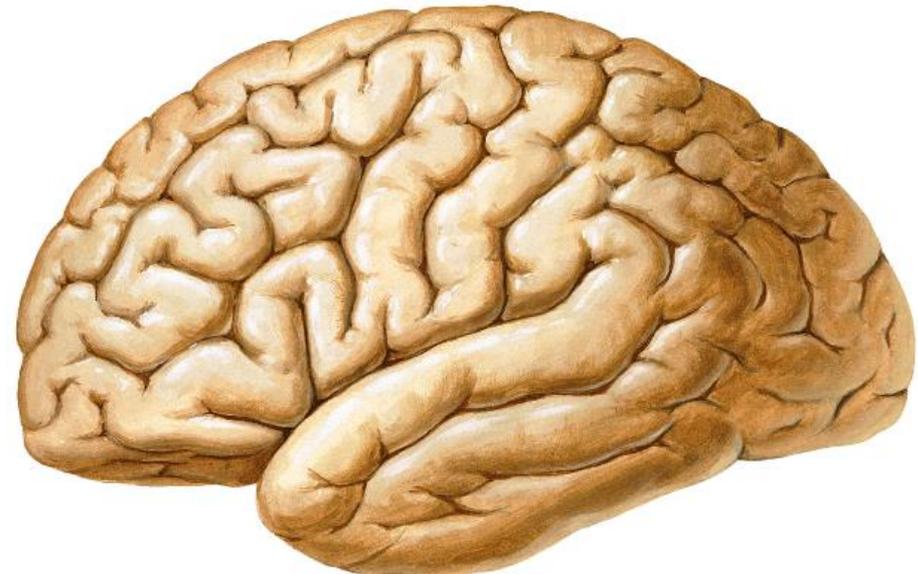
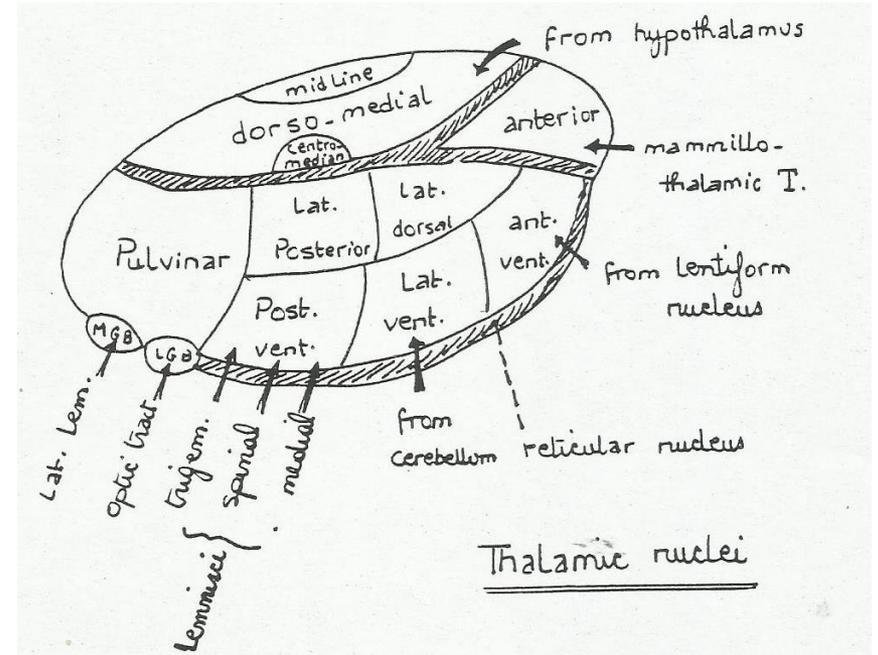
* Divided into:

A. Dorsal tier:

* Includes 3 association nuclei: Lateral-dorsal nucleus, Lateral-posterior nucleus & Pulvinar.

* Afferents: they receive input from the other thalamic nuclei and integrate them; the thalamus is considered as a multisensory processing unit.

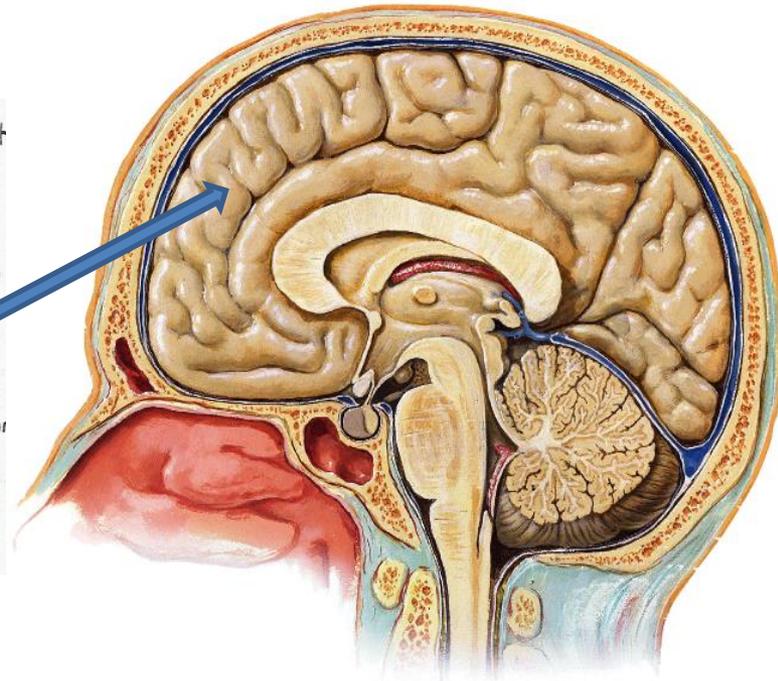
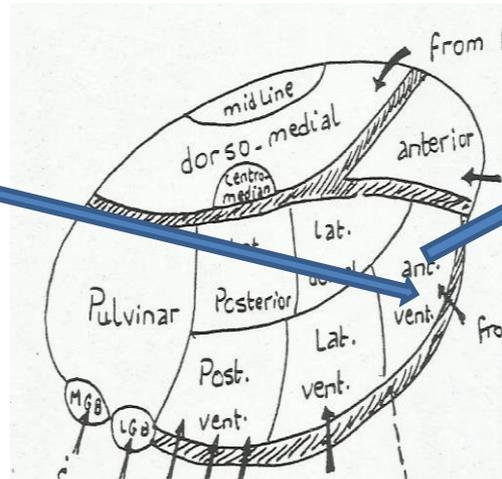
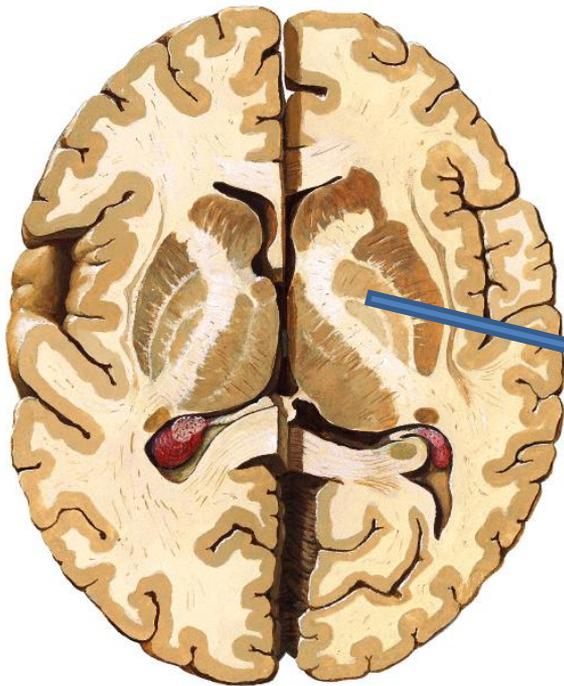
* Efferents: to the sensory association areas of the cortex.



B. Ventral tier: 3 nuclei:

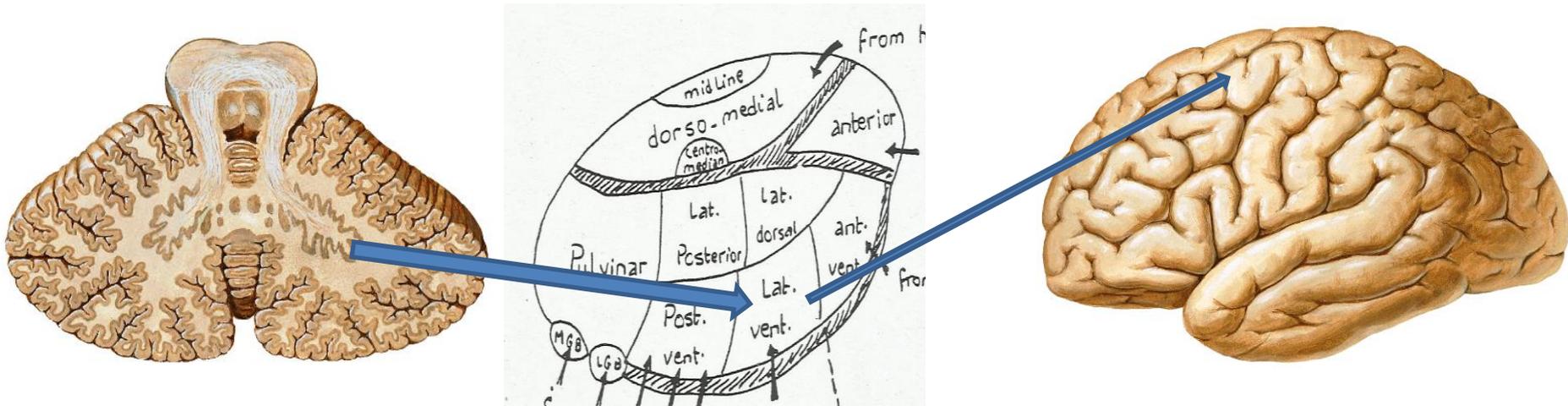
1. Ventral-anterior (VA) nucleus:

- * Afferents: from the basal ganglia (globus pallidus).
- * Efferents: to the supplementary motor area.
- * Function: relays motor circuits.



2. Ventral-lateral or ventral-intermediate (VL or VI) nucleus:

- * Afferents: from the cerebellar nuclei.
- * Efferents: to the motor and premotor areas.
- * Function: relays motor planning of voluntary movement.



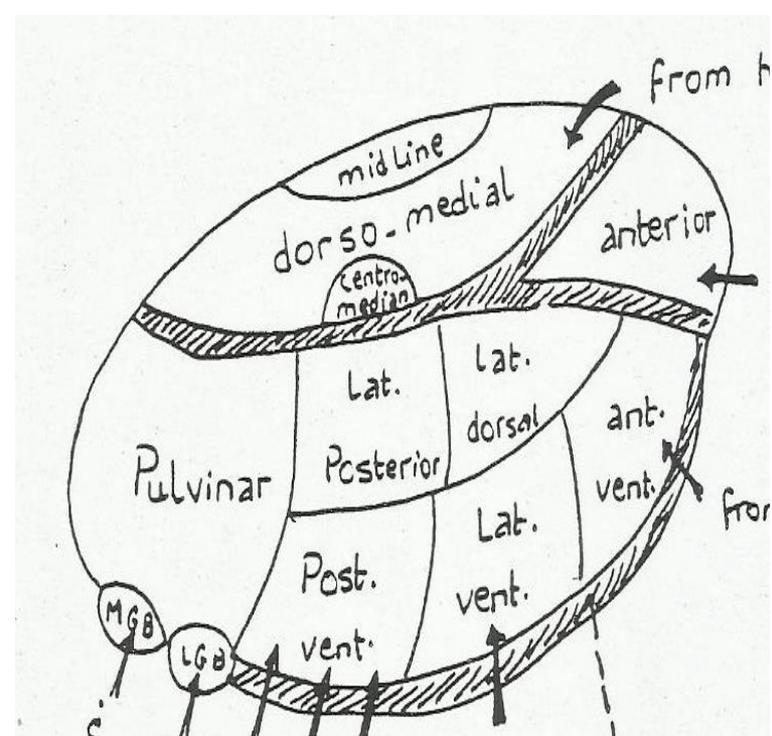
3. Ventral-posterior nucleus (VP nucleus): is sensory & includes 2 parts:

a. VP Lateral (VPL):

- * Afferents: receives the medial & spinal lemnisci.
- * Efferents: to the upper 2/3 (body area) of the postcentral gyrus.

b. VP Medial (VPM):

- * Afferents: receives the trigeminal lemniscus & solitariothalamic tract (carrying taste).
- * Efferents: to the lower 1/3 (head area) of the postcentral gyrus.



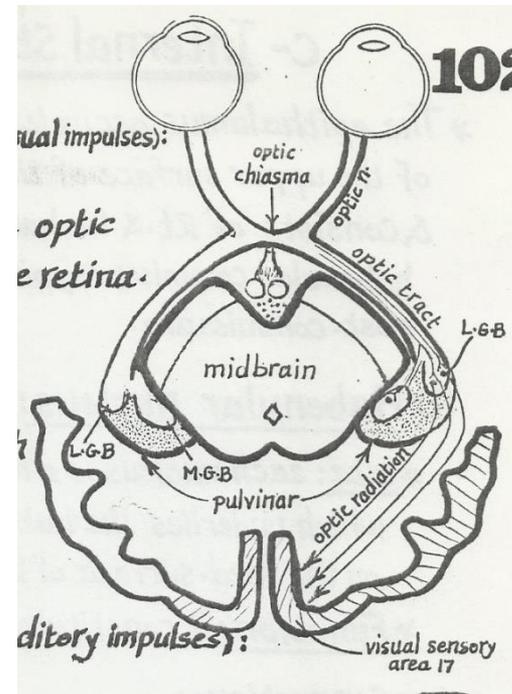
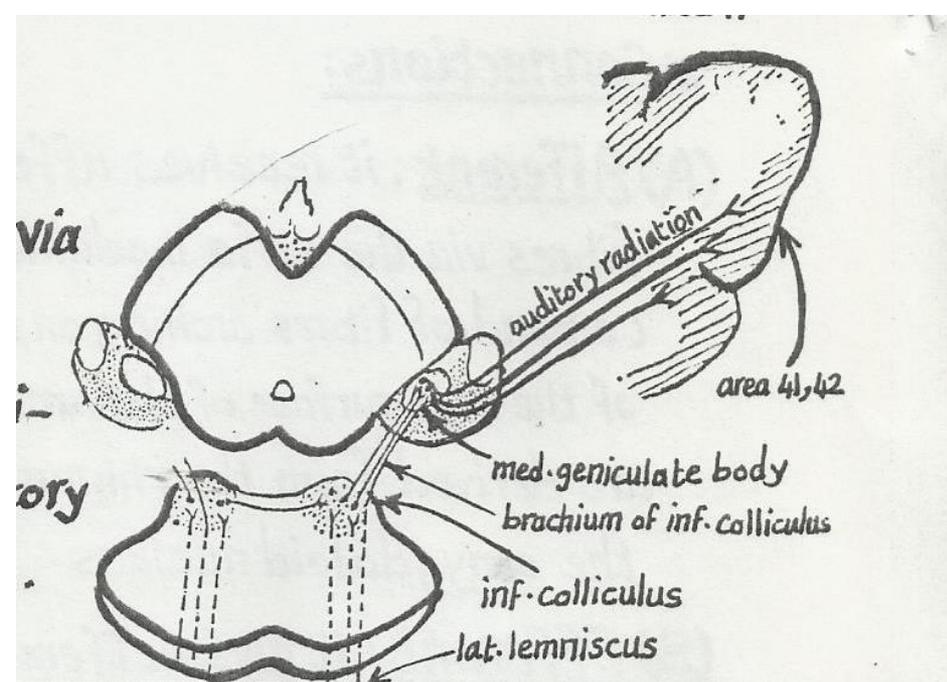
- ** Other thalamic nuclei:
- ** Medial & lateral geniculate bodies: (both are called metathalamus):

1. The medial geniculate body (MGB):

- * Afferents: receives auditory input from the inferior colliculus of midbrain.
- * Efferents: projects auditory radiation to the auditory area of cortex.

2. The lateral geniculate body (LGB):

- * Receives: visual input from the optic tract.
- * Projects: optic radiation to the visual area of cortex.



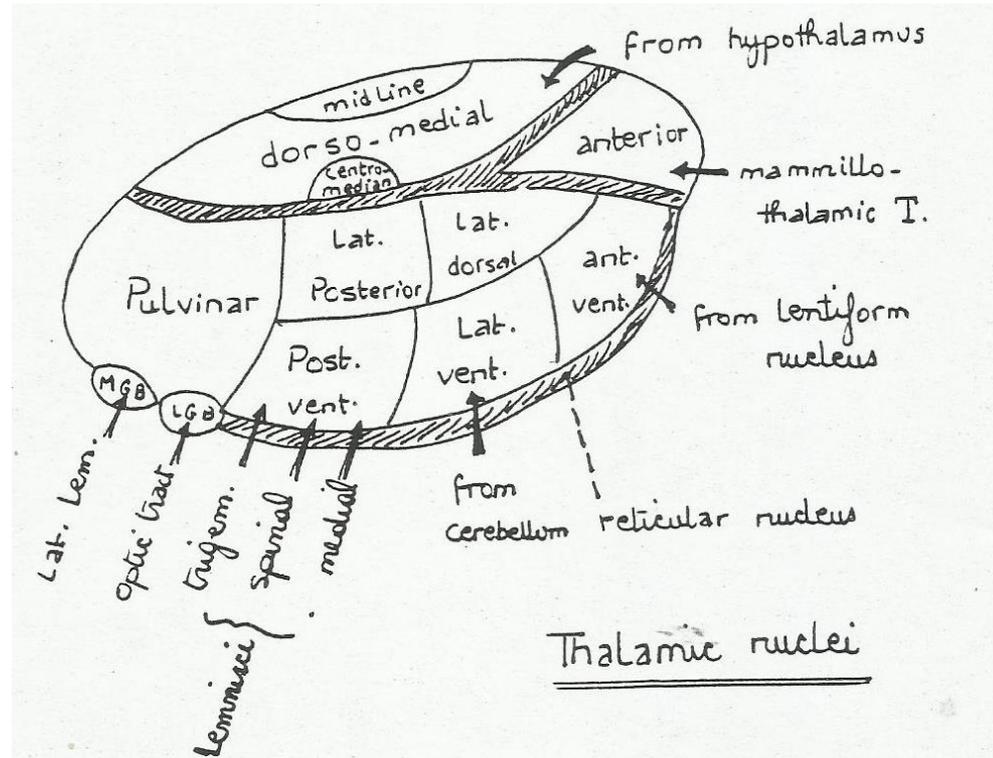
**** 3 Non-specific nuclei which occupy strategic positions in the thalamus:**

- 1. Intralaminar nuclei: (within the internal medullary lamina).**
- 2. Midline nuclei: (on the medial surface of thalamus beneath the ependyma of 3rd ventricle):**

*** Afferents: from the reticular formation of the brain stem.**

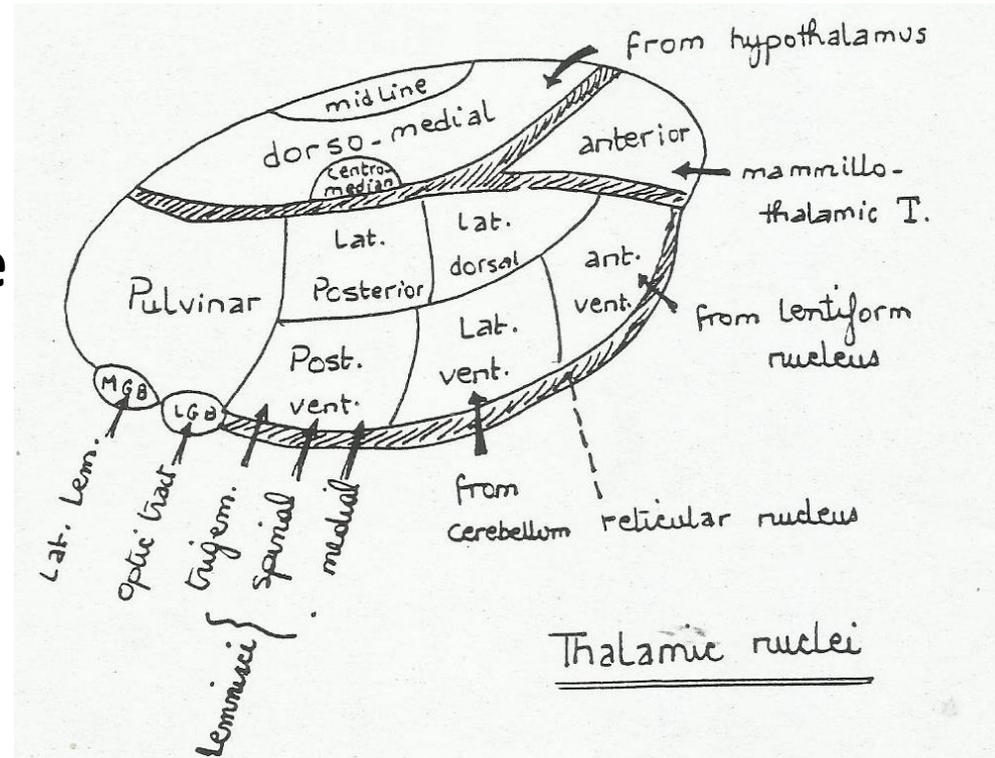
*** Efferents: to the whole cortex non-specifically; increases its activity.**

*** Functions: part of RAS responsible for alertness.**



3. Reticular nucleus:

- * Site: on the lateral surface of the thalamus.
- * Afferents: from whole cerebral cortex.
- * Efferents: do not leave the thalamus but end on the thalamic nuclei.
- * Functions: inhibits the thalamic nuclei during sleep.



**** Blood Supply:**

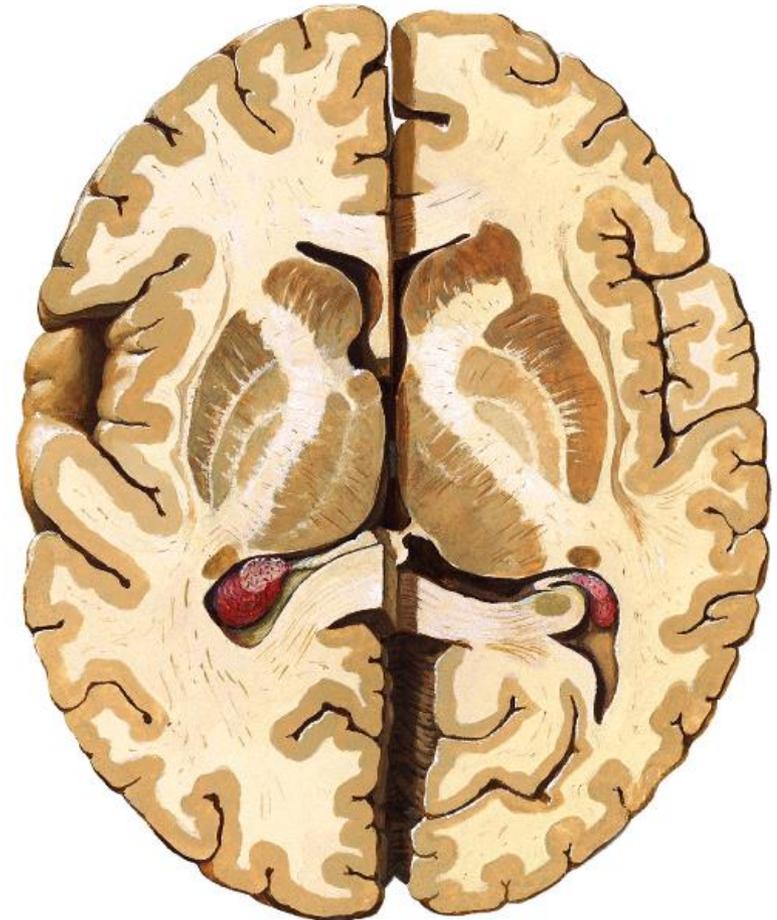
A. Arterial:

*** Medial & anterior regions:**

by posteromedial group of posterior cerebral artery.

*** Lateral & posterior parts:**

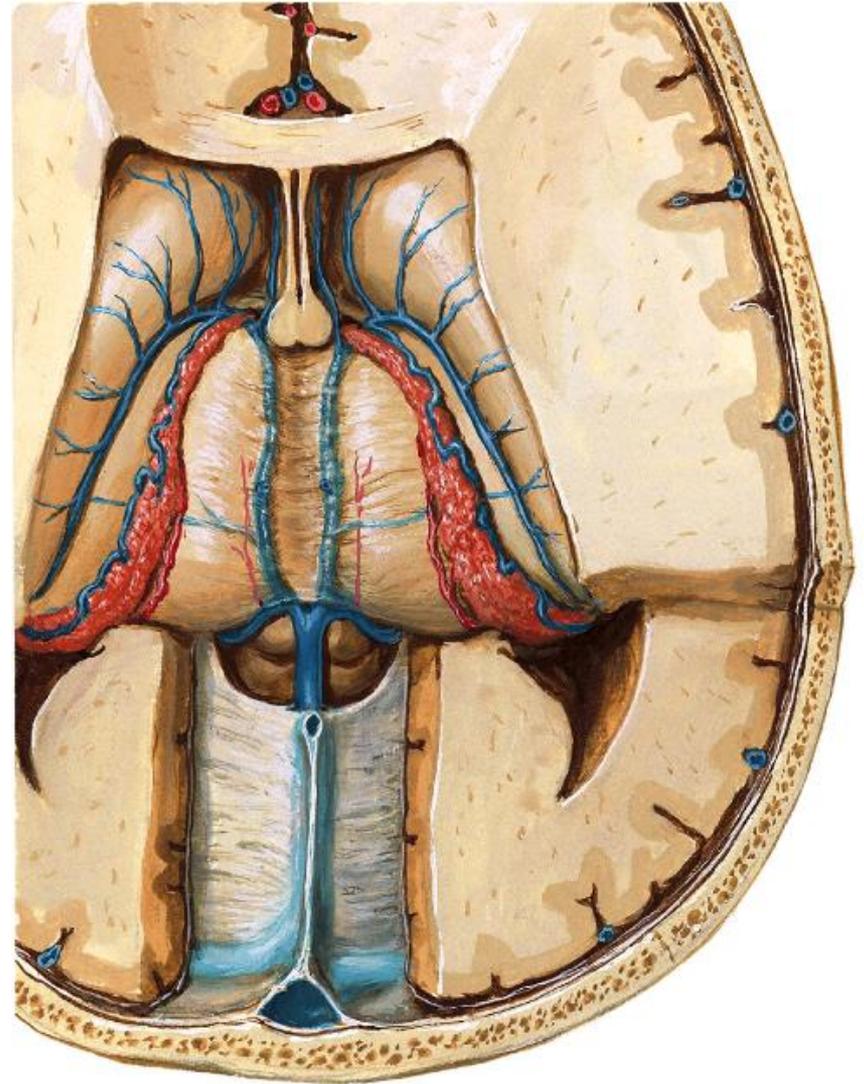
by posterolateral group of posterior cerebral artery (thalamo-geniculate artery).



**** Venous drainage: by the thalamo-striate vein.**

**** Applied: Thalamic syndrome:**

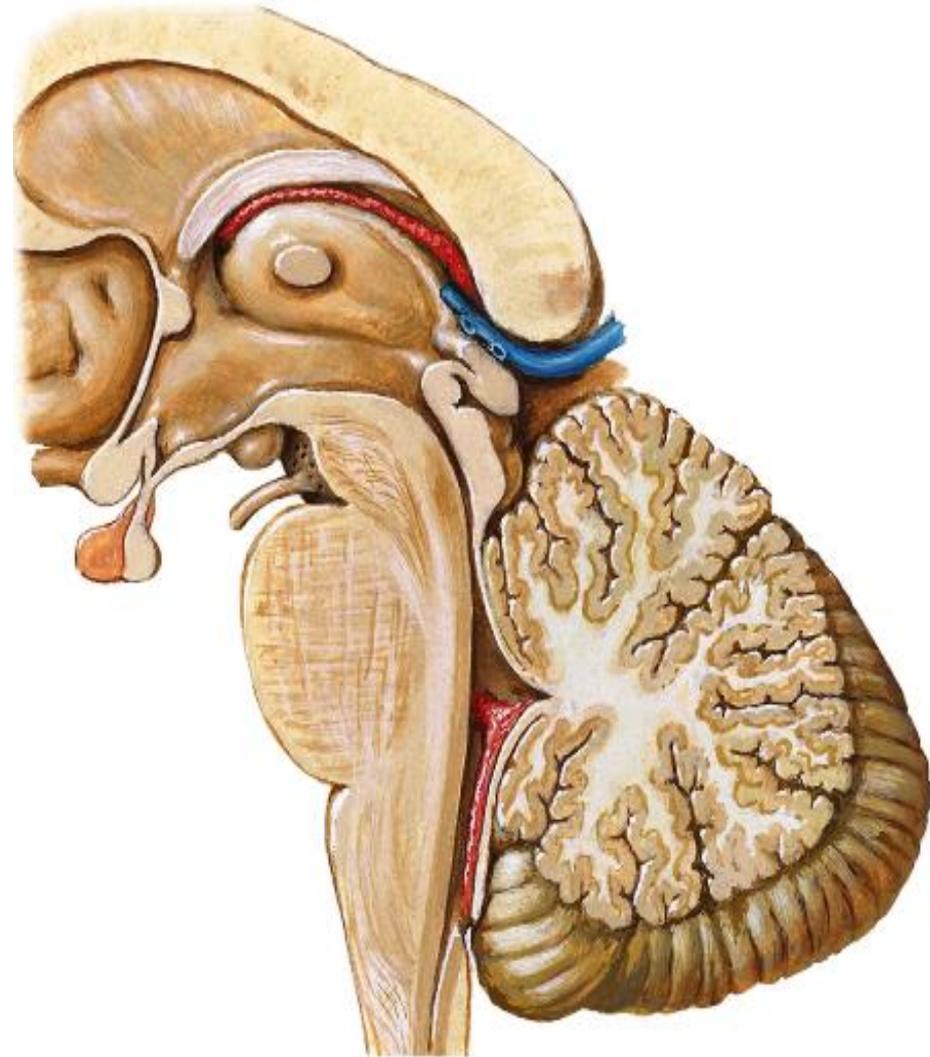
*** Vascular lesions of the thalamus (thalamo-geniculate artery) → decreased threshold to pain with overreaction to painful stimuli & spontaneous pains.**



HYPOTHALAMUS

**** Site & extent:**

- * It lies below the thalamus separated from it by the hypothalamic sulcus.
- * Anteriorly: it extends till the lamina terminalis
- * Posteriorly: it extends till a vertical plane posterior to mammillary bodies
- * Superiorly: it extends till the hypothalamic sulcus.
- * Inferiorly: it forms the base of the brain beneath the 3rd ventricle (the floor of the interpeduncular fossa).



**** Parts:**

- 1. Optic chiasma.**
- 2. Tuber cinereum (median eminence) & infundibular stalk.**
- 3. Mammillary bodies.**

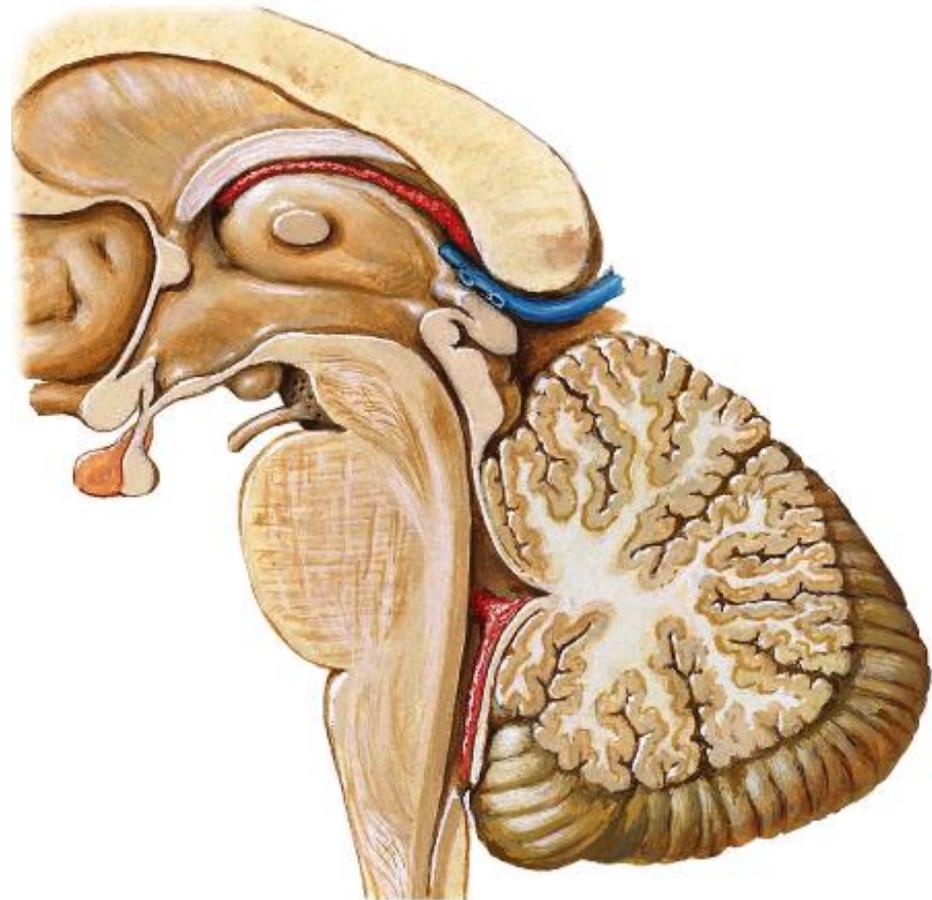


**** Nuclei:**

- * The hypothalamus contains many nuclei related to the above mentioned parts such as: suprachiasmatic N., supraoptic N., tuberal N., infundibular N., paraventricular N., mammillary nuclei, etc.).**

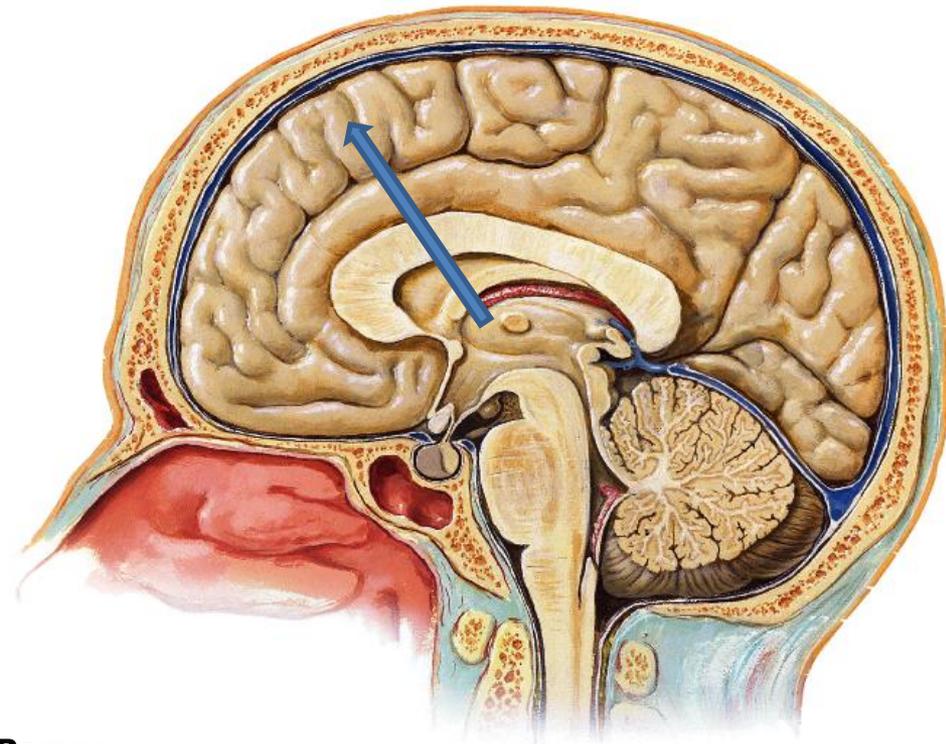
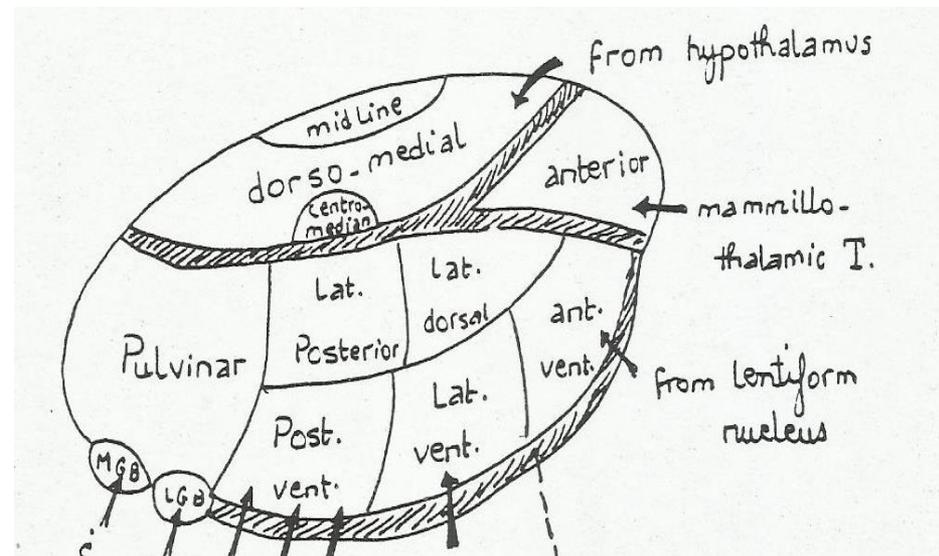
**** Functions:**

- 1. It controls the autonomic nervous system and endocrine system (pituitary).**
- 2. It regulates fluid intake, food ingestion and body temperature.**
- 3. It controls emotions, reproduction and biological clock.**



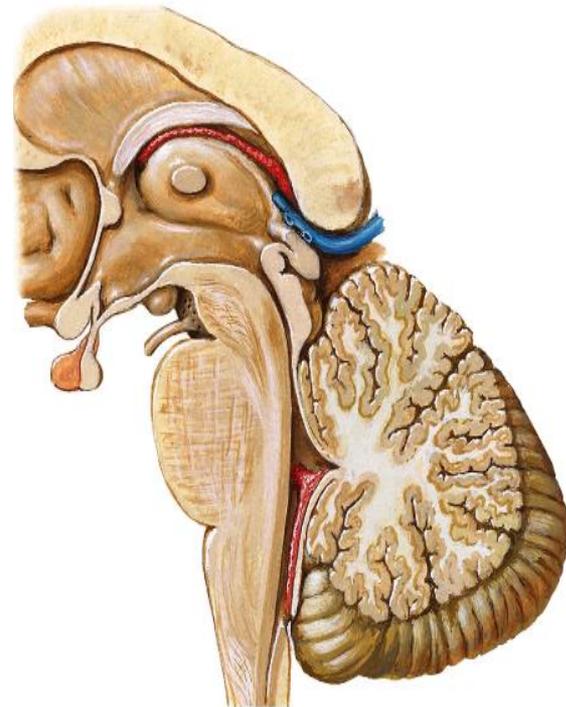
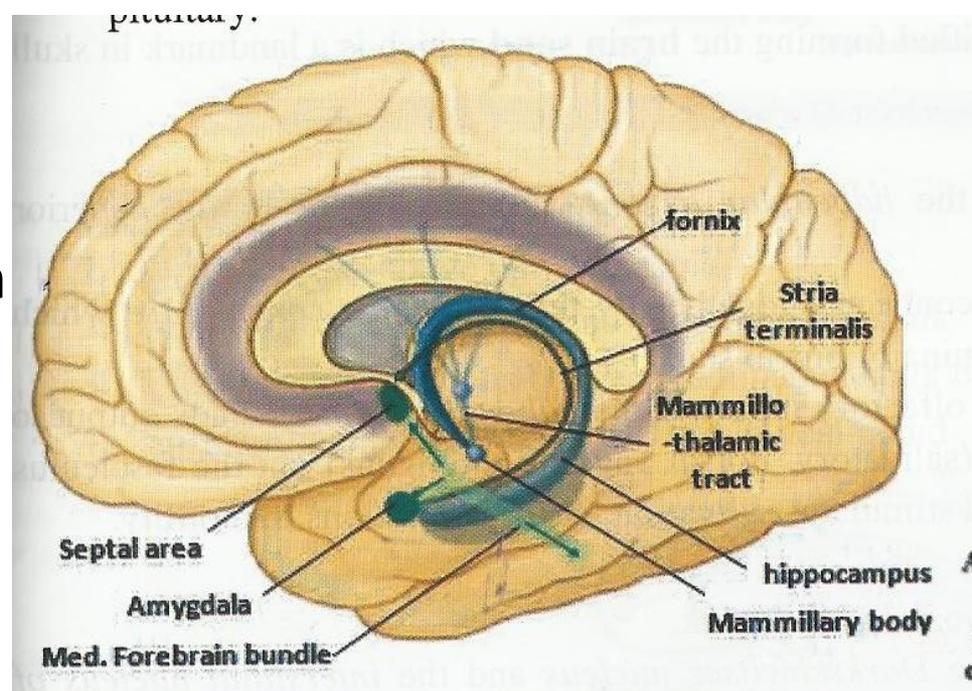
**** Connections:**

1. With the prefrontal cortex: The periventricular system of fibers connects it (both-ways) with the dorsomedial nucleus of thalamus.



2. With the limbic system:

- a. The medial forebrain bundle (both-ways): connects the central grey of the brain stem with the hypothalamus, the amygdala & the septal areas. It contains most serotonergic & noradrenergic fibers.
- b. The fornix: carries fibers from the hippocampus to the mammillary bodies, which send efferent fibers to the anterior nucleus of thalamus via the mammillo-thalamic tract [Papez circuit concerned with memory].
- c. The stria terminalis: brings afferent fibers from the amygdala to the preoptic nucleus.

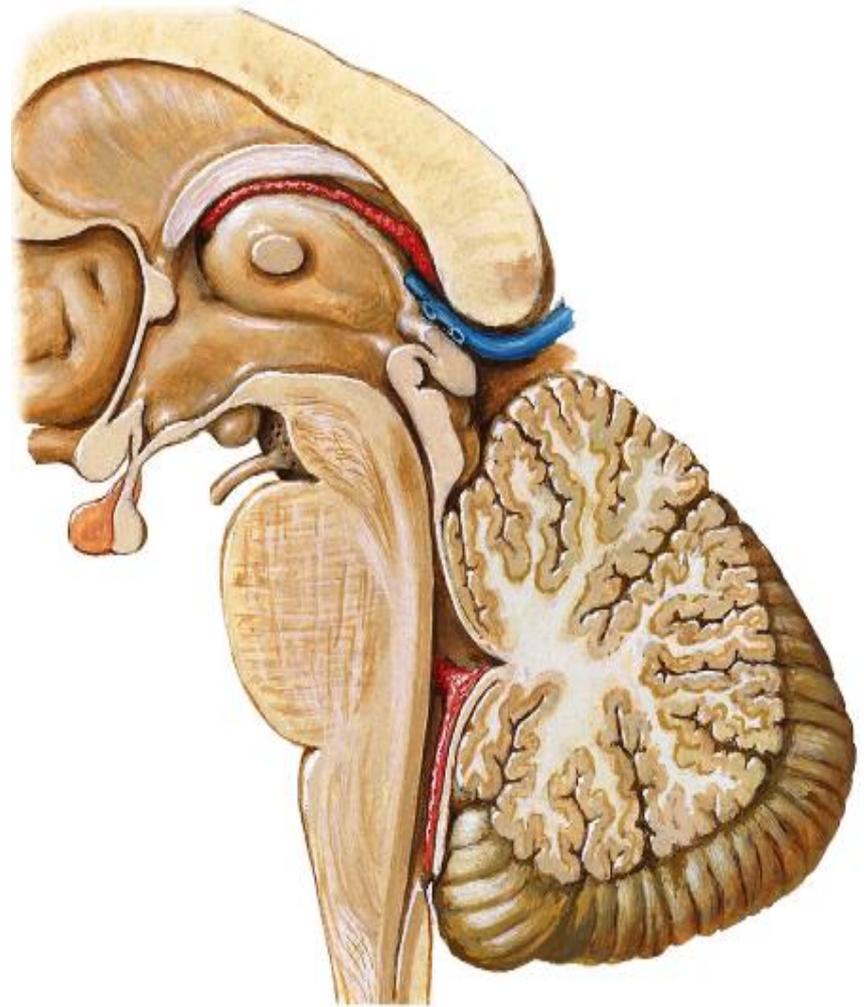


3. With lower centers:

a. Tegmentum of midbrain:

- * Mammillary peduncle [Afferent].
- * Mammillo-tegmental tract [Efferent].

- #### b. The posterior longitudinal fasciculus (in the central grey): carries efferents to the vital autonomic nuclei of the brain stem & spinal cord [LHCs].



4. With pituitary gland:

A. Hypothalamo-hypophyseal tracts:

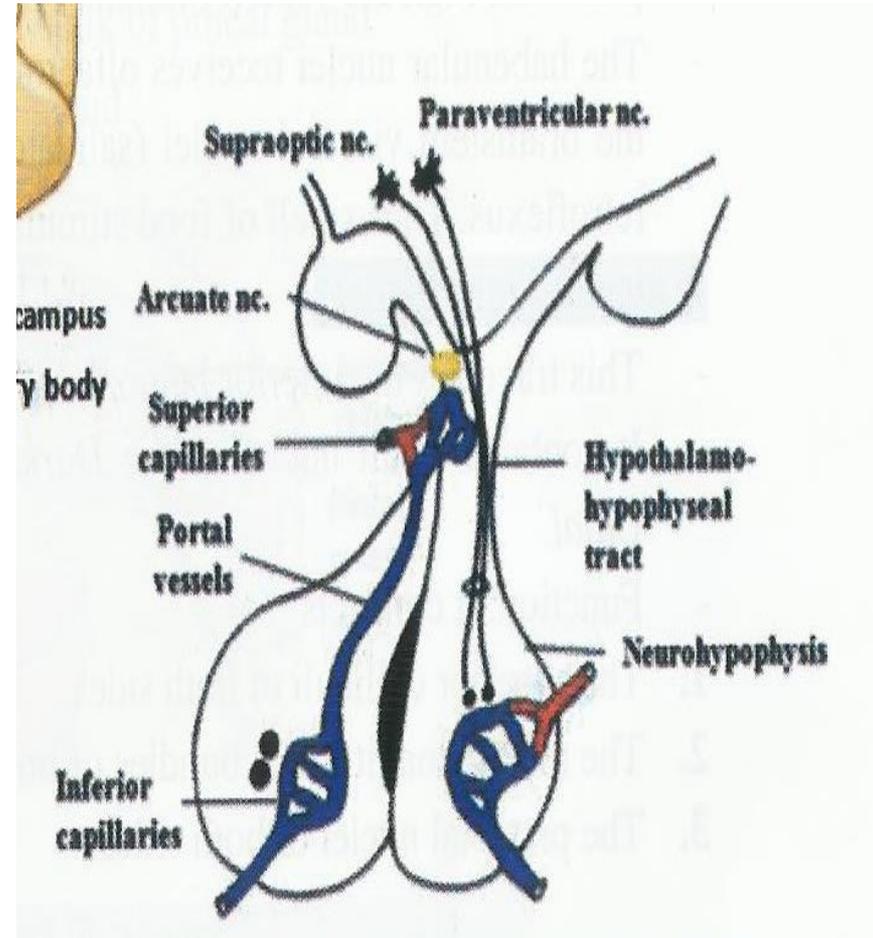
a. Supraoptic-hypophyseal:

Supraoptic N. secretes vasopressin which passes through axons to posterior pituitary where they are absorbed by blood capillaries.

b. Paraventricular-hypophyseal:

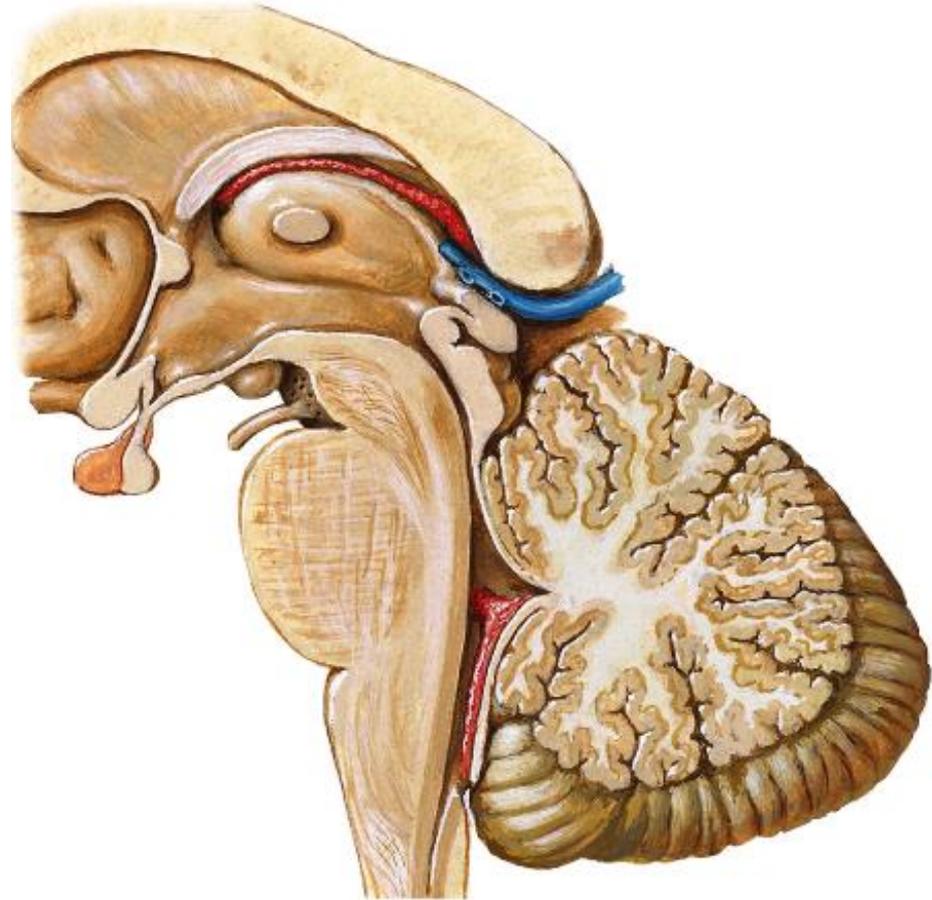
Paraventricular N. secretes oxytocin which passes through axons to posterior pituitary where they are absorbed by blood capillaries.

B. Infundibular (Arcuate) N.: secretes the release- and release-inhibiting hormones taken by blood capillaries in the superior set of capillaries → (portal veins) → inferior set of capillaries in anterior pituitary where hormones pass to specific cells in the anterior pituitary.



SUBTHALAMUS

- ** Site:** it is inferior to thalamus, separated from it by the hypothalamic sulcus. It lies between thalamus and tegmentum of mid brain.
- ** It contains:** subthalamic nucleus which is closely related to the basal ganglia (involved in control of muscular activity).
- ** Its lesion** → Hemiballismus (severe violent involuntary movement on one side of the body).

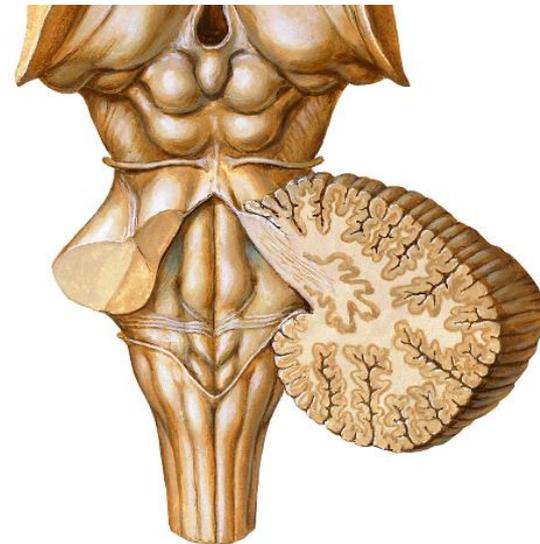
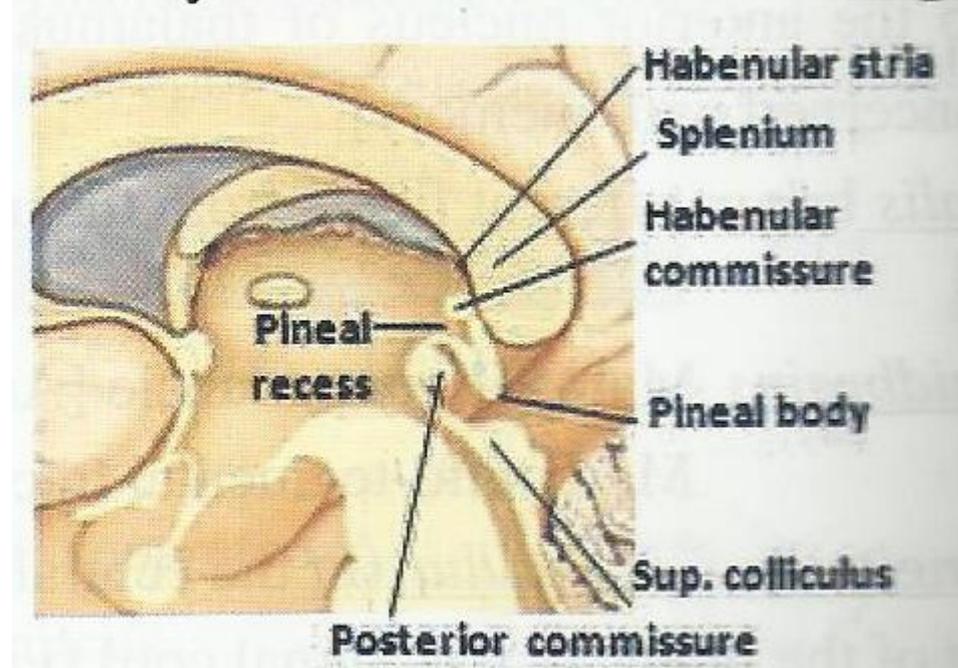


EPITHALAMUS

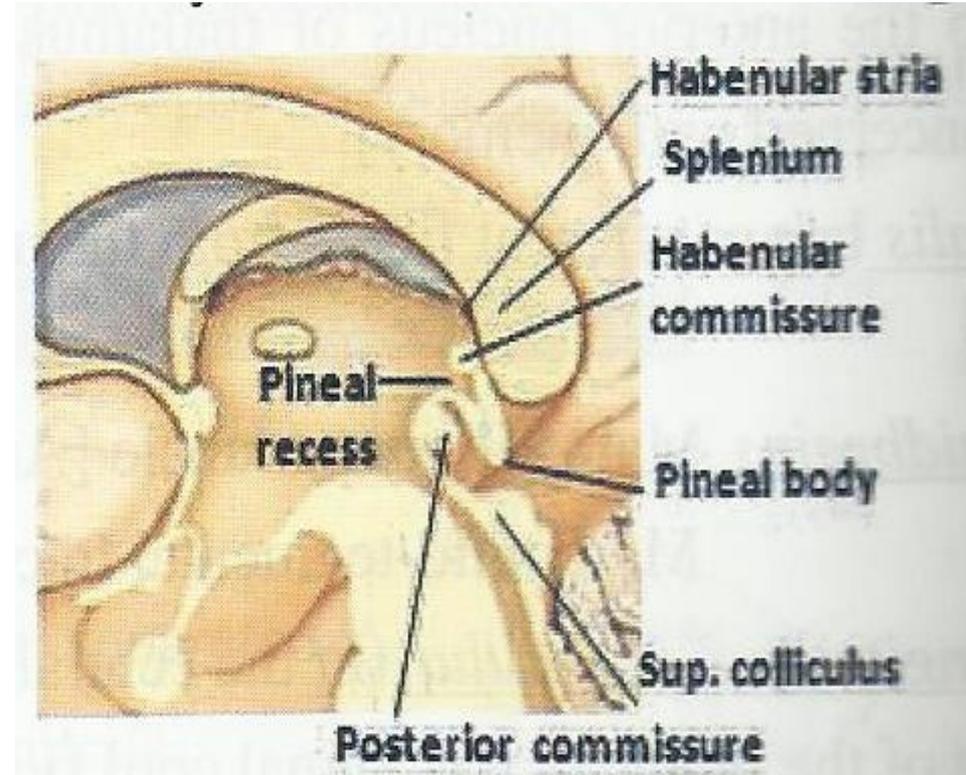
**** The epithalamus includes the pineal body, habenular nuclei and the posterior commissure.**

A. Pineal body:

*** It is a small reddish grey organ, 8 mm in length which hangs between the two superior colliculi. It lies inferior to the splenium of corpus callosum. Its base (stalk) is directed anteriorly and forms two laminae; a superior and an inferior laminae.**

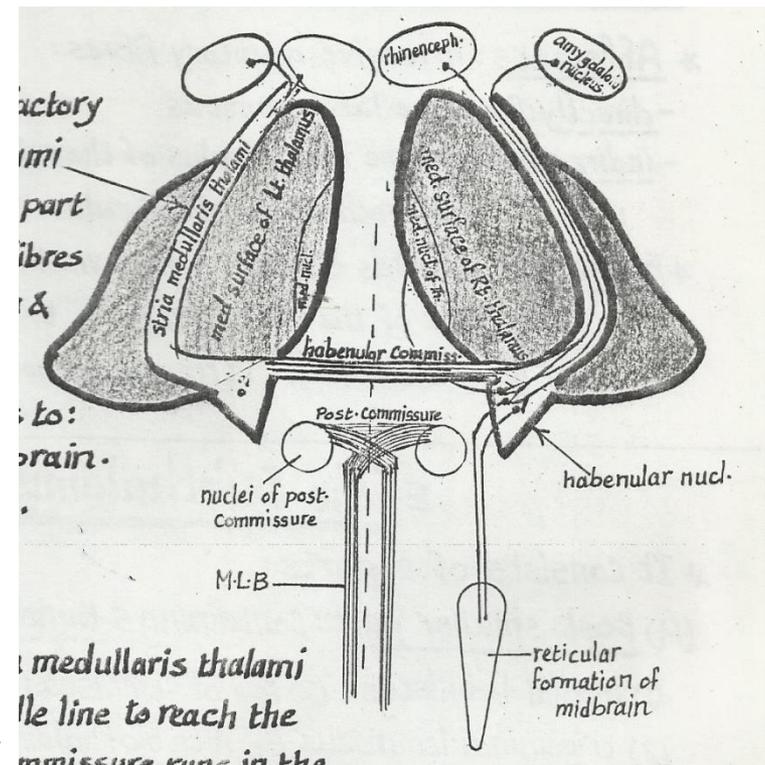
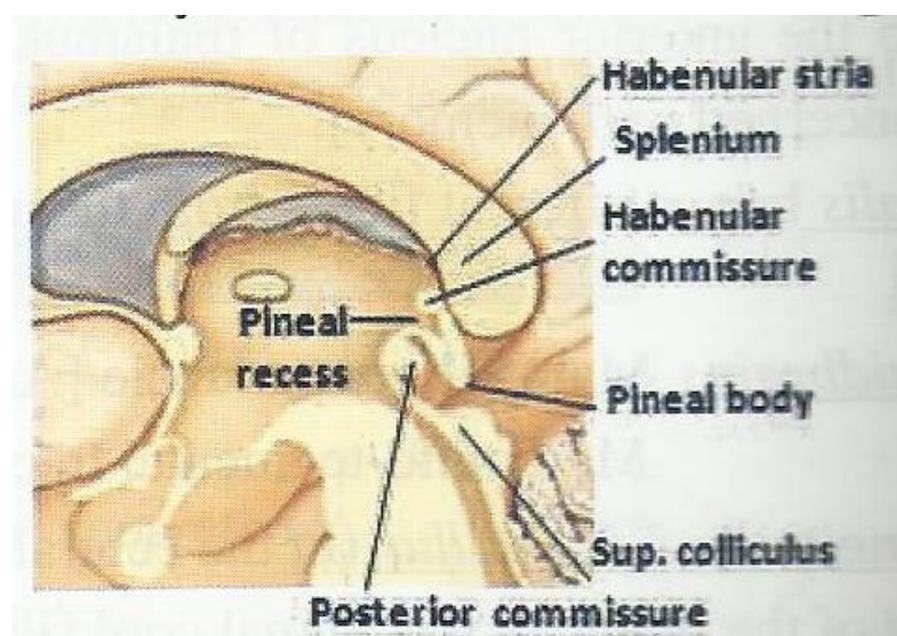


- * The superior lamina contains habenular commissure while the inferior lamina contains the posterior commissure. The space between the two laminae of the stalk is a recess (pineal recess) of the 3rd ventricle.
- * Function: It is an endocrine gland that inhibits the pituitary gland, pancreas, parathyroids, adrenal cortex and gonads. It is active in the dark secreting melatonin hormone by its pinealocytes.
- * After puberty, it becomes calcified forming the brain sand which is a landmark in skull x-rays.



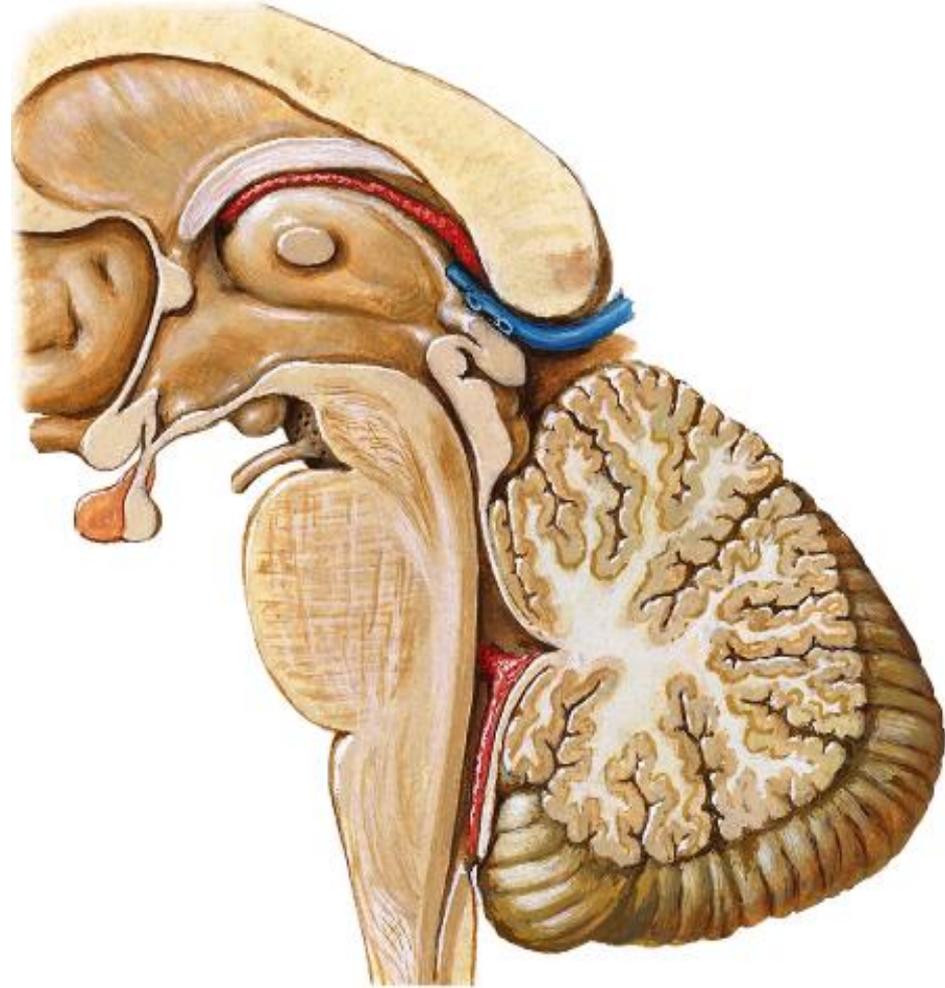
B. Habenular nuclei:

- * The habenular nuclei lie in the habenular trigone, antero-superior to the superior colliculus.
- * The right and left nuclei are connected together by the habenular commissure which passes through the superior lamina of pineal stalk.
- * The habenular nuclei receives olfactory input via the habenular stria & sends output to the brainstem visceral nuclei (salivatory, dorsal vagal & ambiguus) via the fasciculus retroflexus. Thus smell of food stimulates salivation, gastric secretions & motility.



C. Posterior commissure:

- * This traverses the inferior lamina of pineal stalk.**
- * It contains small nuclei as the Darkschwitscz nucleus and the interstitial nucleus of Cajal.**
- * Function: it connects**
 - 1. The superior colliculi of both sides.**
 - 2. The medial longitudinal bundles of both sides.**
 - 3. The pretectal nuclei of both sides.**

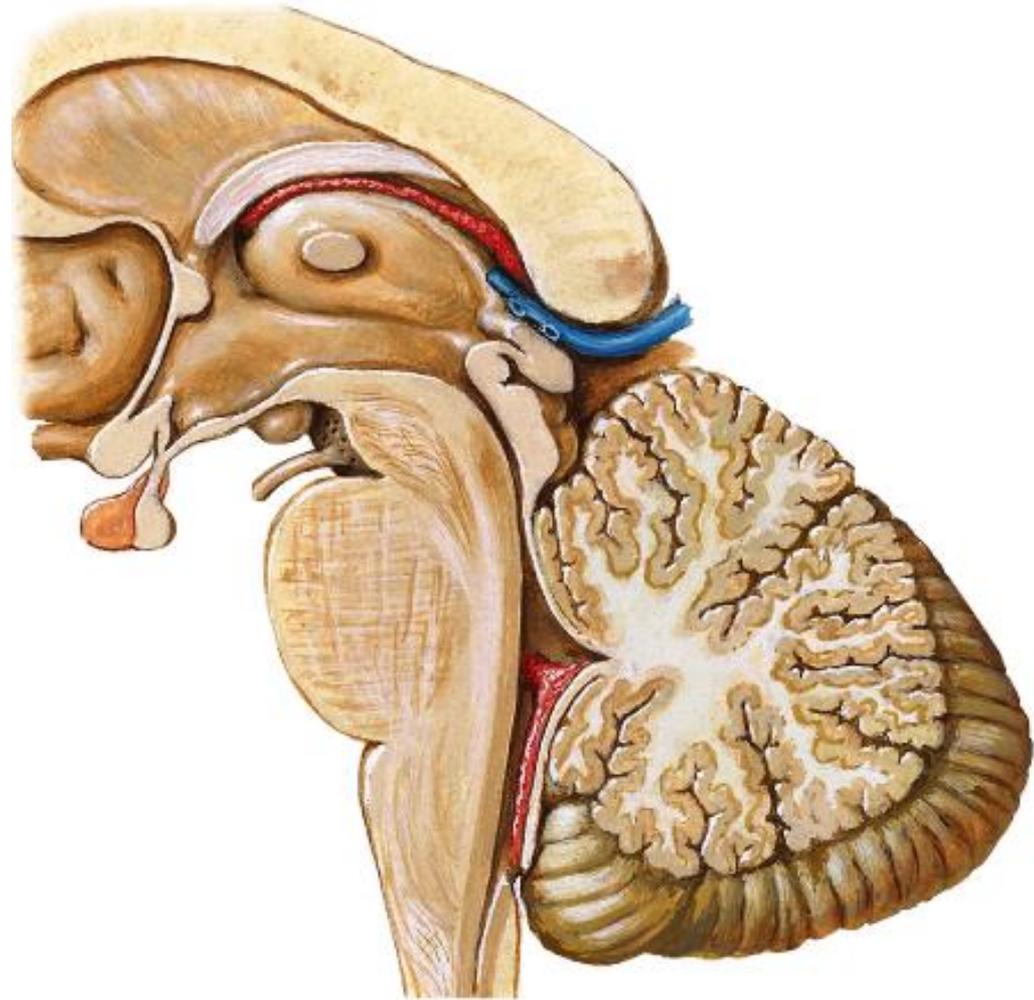


THIRD VENTRICLE

**** It is the cavity of the Diencephalon.**

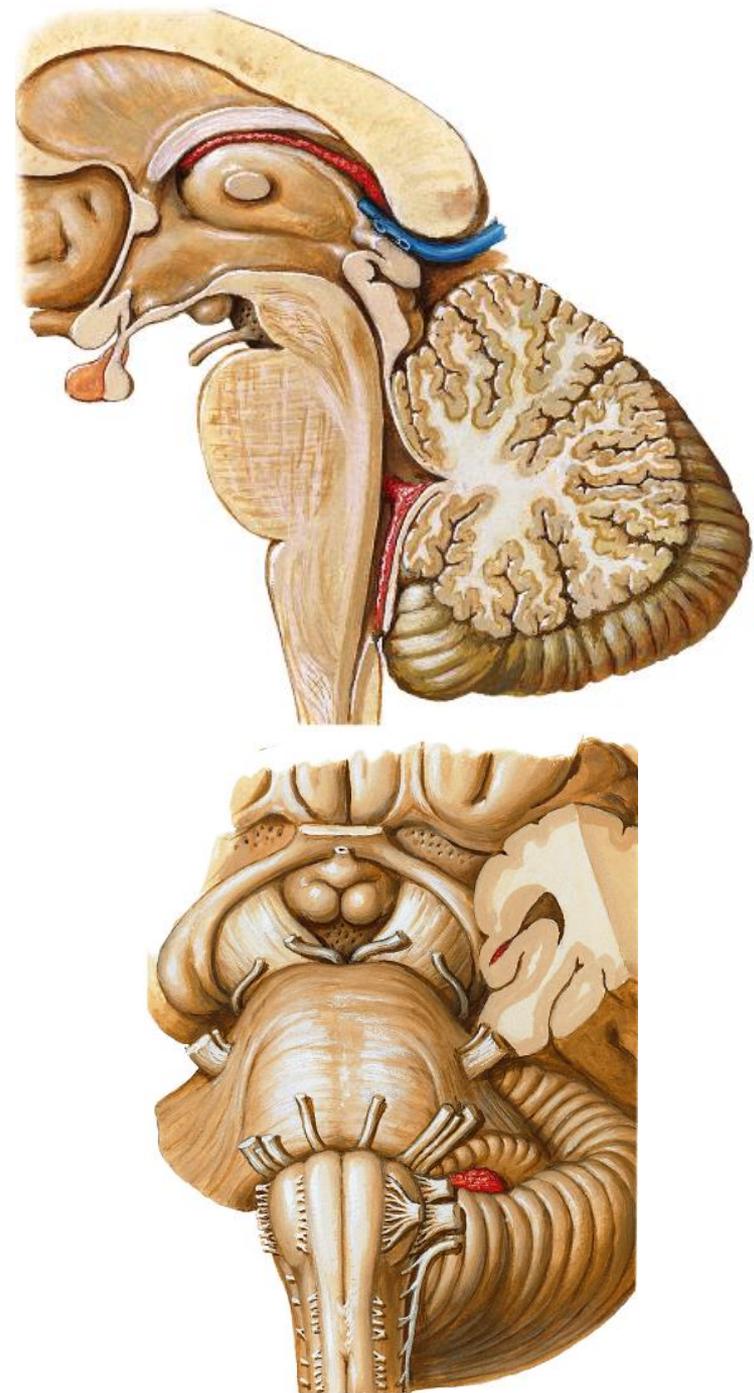
**** Communications:**

- 1. With the lateral ventricles via the interventricular foramen of Monro.**
- 2. With the fourth ventricle via the cerebral aqueduct of Sylvius.**



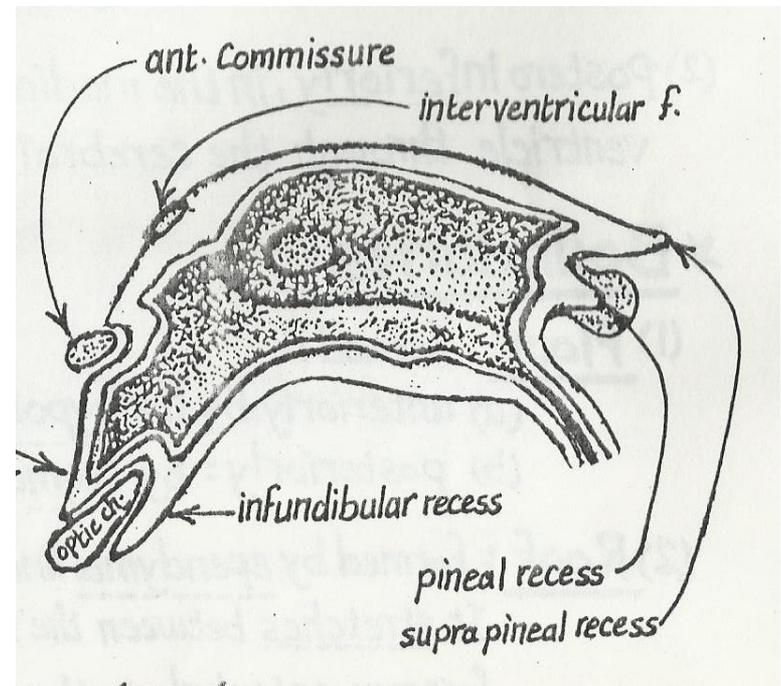
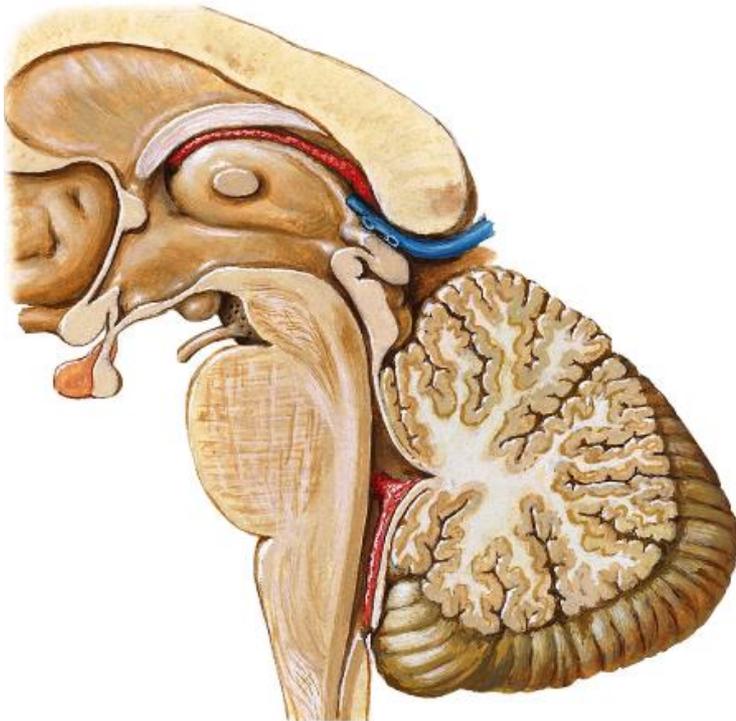
**** Boundaries:** It has a roof, floor, anterior, posterior & lateral walls.

1. **Lateral Wall:** Thalamus and hypothalamus.
2. **Roof:** Layer of ependyma covered by the tela choroidea of the third ventricle. Choroid plexus of third ventricle hangs from its roof as two longitudinal elevations.
3. **Floor:** Formed mostly of hypothalamic structures (optic chiasma, infundibulum, tuber cinereum, mammillary bodies), posterior perforated substance + tegmentum of midbrain.
4. **Anterior Wall:** Lamina terminalis, column of fornix, anterior commissure.
5. **Posterior Wall:** Posterior commissure, pineal body, suprapineal recess.



**** Recesses of third ventricle:**

- 1. Optic recess: above optic chiasma.**
- 2. Infundibular recess: extends into pituitary stalk.**
- 3. Pineal recess: extends between laminae of stalk of pineal gland.**
- 4. Suprapineal recess: extends above pineal gland.**



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