Anatomy Team
MED 439

Revised & Approved

MED439
KING SAUD UNIVERSITY

Anatomy of the Thalamic & Limbic System

CNS Block

Don't forget to check the Editing File

Color index:

Content
Male slides
Female slides
Important
Doctors notes
Extra information, explanation

Contact us:
Anatomy439@gmail.com

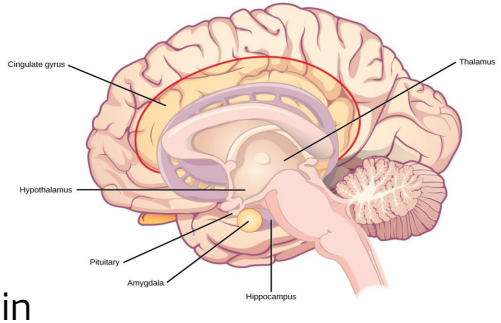
Objectives

At the end of the lecture, students should be able to:

- Describe the anatomy and main functions of the thalamus.
- Name and identify different nuclei of the thalamus.
- Describe the main connections and functions of thalamic nuclei.
- Name and identify different parts of the limbic system.
- Describe main functions of the limbic system.
- Describe the effects of lesions of the limbic system.

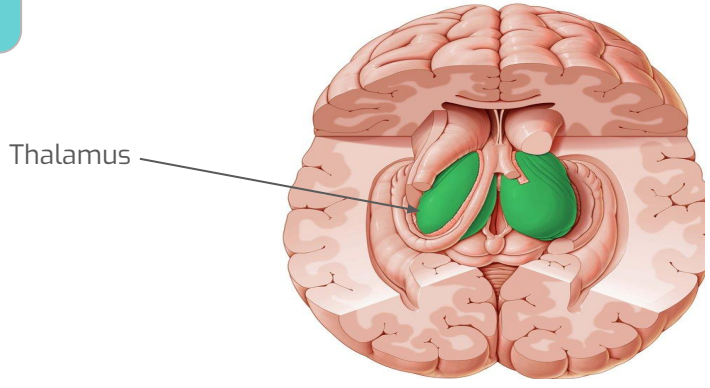
Thalamus

- It is the **largest** nuclear mass of the whole body.
- It is the largest part of the diencephalon
- It is formed of 2 oval masses of grey matter.
- It is the gateway to the cortex.
- Together with the hypothalamus they form the **lateral wall** of the 3rd ventricle.
- It sends the received information to the cerebral cortex from diverse brain regions.
- Axons from every sensory system (except **olfaction**) synapse in the thalamus as the last relay site **'last pit stop'** before the information reaches the cerebral cortex.



There are some thalamic nuclei that receive input from

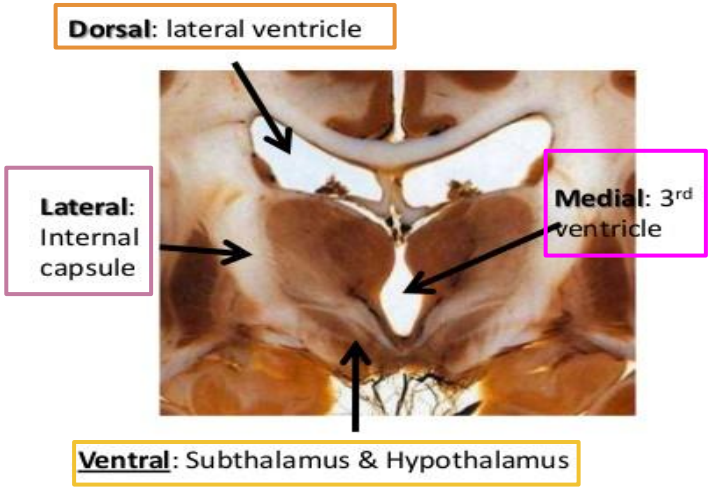
- Cerebellar nuclei
- Basal ganglia
- Limbic- related brain regions



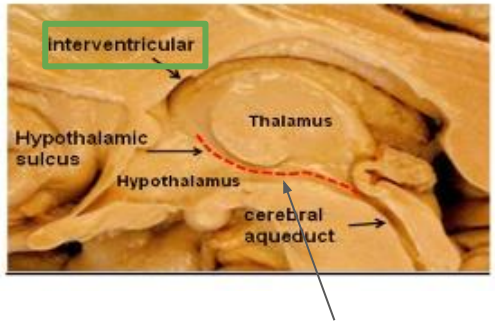
Relations of the thalamus

It has 4 surfaces and 2 ends :

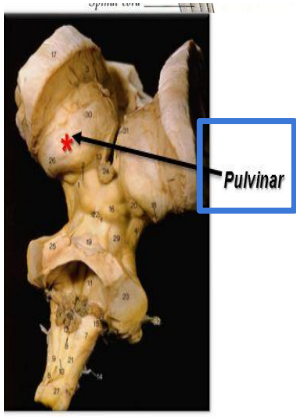
Surfaces			
Lateral	**Medial**	**Superior/ Dorsal**	**Inferior/ Ventral**
Posterior limb of the internal capsule	The 3rd ventricle It is connected to the thalamus of the opposite side by the interthalamic connexus, (adhesion) or Massa intermedia.	Lateral ventricle and fornix.	Hypothalams, anteriorly & Subthalamus posteriorly.



Ends	
Anterior	**Posterior**
Forms a projection, called the **anterior tubercle**. It lies just behind the interventricular foramen.	Broad Forms a projection called Pulvinar which lies above the superior colliculus and the lateral & medial Geniculate bodies.



Margin between thalamus and hypothalamus



Internal Structures of the thalamus

White matter:

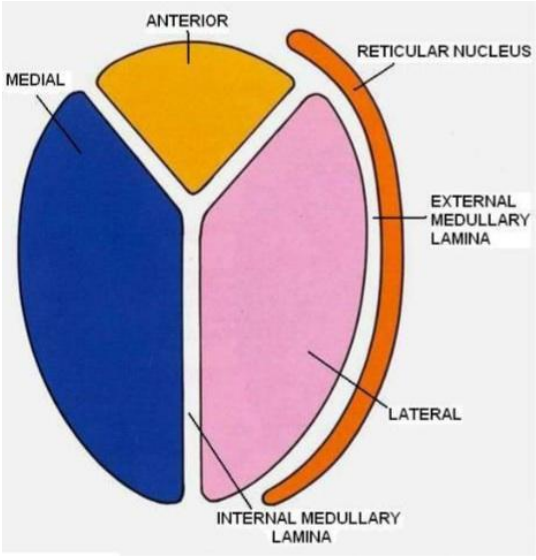
External medullary lamina:

- Covers the lateral surface.
- It consists of thalamocortical & corticothalamic fibers.

Internal medullary lamina:

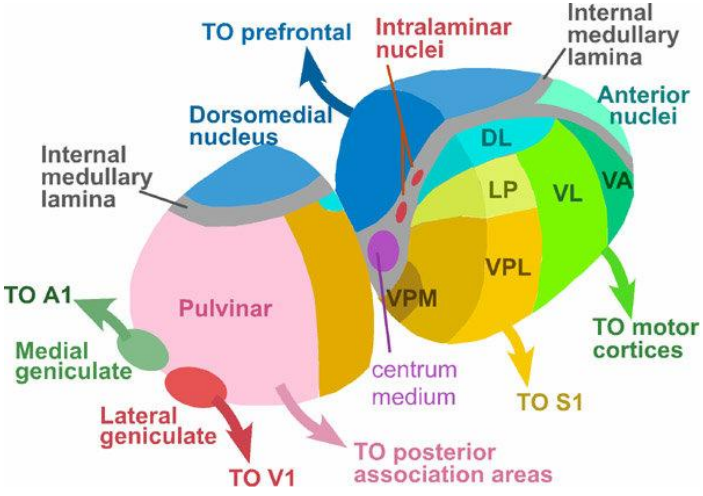
- Bundle of Y- shaped myelinated (afferent & efferent) fibers.
- It divides the thalamus into: anterior , **medial**, lateral nuclear groups.
- Each of these group is subdivided into a number of named nuclei.

Embedded within the internal medullary lamina lie **Intralaminar nuclei.**
The external medullary lamina covers the lateral surface, in which lies thin **reticular nucleus**.



Lateral Nuclear group:

It is divided into: **Dorsal & Ventral tiers.**	
Dorsal Tier	**Ventral Tier**
1- Lateral Dorsal (LD). 2- Lateral Posterior (LP). 3- Pulvinar.	1- Ventral Anterior (VA). 2- Ventral Lateral (VL). 3- Ventral Intermediate (VI). 4- Ventral Posterior (VP) (VPL,VPM / PLVNT , PMVNT). 5- Medial & Lateral geniculate nuclei.

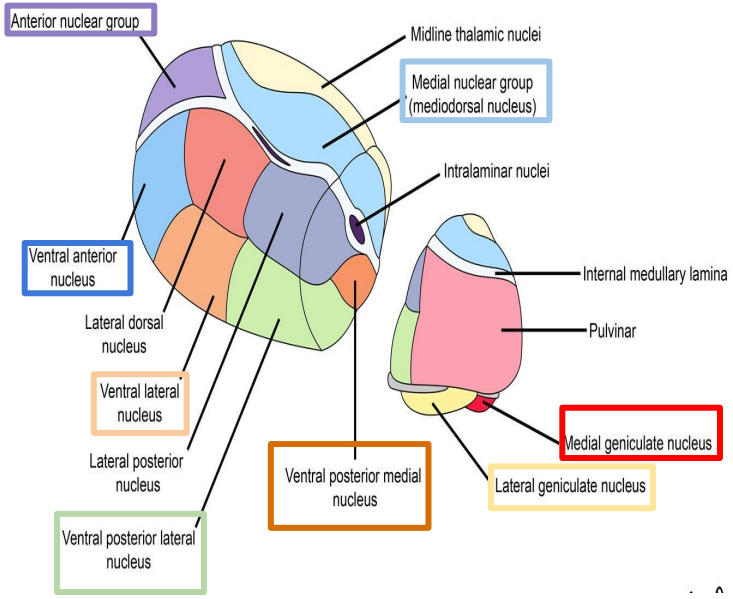


Projection of thalamic nuclei

Nucleus	Afferent	Efferent
Anterior thalamic nucleus	Mammillary body	Cingulate gyrus, (limbic system)
Medial nucleus	Hypothalamus	Prefrontal cortex and frontal
Ventral anterior nucleus	Globus pallidus and substantia nigra	Premotor cortex
Ventral lateral nucleus	Dentate nucleus	Primary motor cortex
Ventral posterior lateral nucleus	Medial and spinal lemniscus	Sensory cortex
Ventral posterior medial nucleus	Trigeminal lemniscus	Sensory cortex
Lateral geniculate nucleus	Optic tract	Visual cortex
Medial geniculate nucleus	Lateral Lemniscus	Auditory cortex

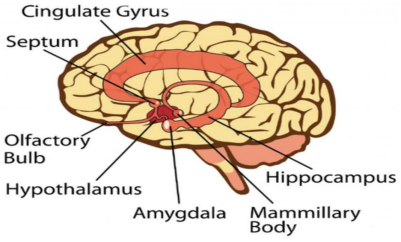
Note:

All posterior nuclei project to the sensory part of the brain.



Limbic system

1. The term "limbic" is from the Latin word Limbus, for "border" or "edge".
2. It separates the medial surface of the cerebral cortex from the diencephalon.
3. It consists of a number of cortical & subcortical structures with looped connections that all project to the hypothalamus (particularly mammilary bodies).



Structures of limbic system

- Limbic cortex (Lobe)
- Hippocampus
- Amygdala
- Septal area

Functions of limbic system

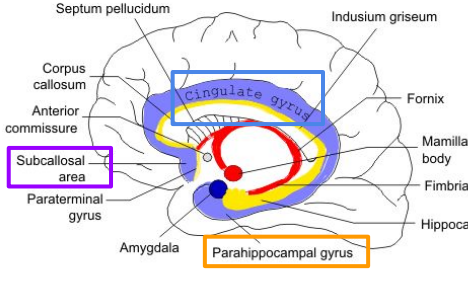
1. Emotions: Emotional responses, Behaviour & Mood (happy, cry, laugh, sad, afraid, aggression, depression)
2. Motivation
3. Memory
4. Visceral & Motor responses involved in (sex, pleasure, hunger,and reproduction).
5. Olfaction

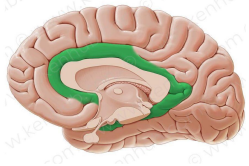
- These structures form connections between the limbic system and hypothalamus, thalamus and cerebral cortex.
- The hippocampus is important in memory and learning, while the limbic system itself is important in the control of the emotional responses.
- Cortical structure:
  1-Limbic lobe. 2-Hippocampal formation.
  3-Septal areas. 4-Prefrontal area (Olfactory cortex).

Structures of Limbic system

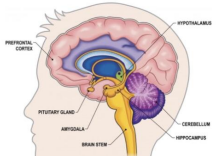
01 Limbic cortex (lobe)

- C-shaped ring of grey matter on the medial side of each cerebral hemisphere, surrounding the corpus callosum.
- It includes:
  1- Subcallosal area
  2- Cingulate gyrus
  3- Isthmus
  4- Parahippocampal gyrus
  5- Uncus

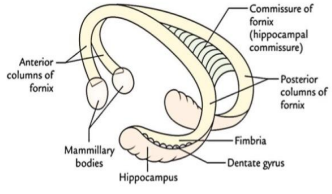




02 Hippocampus



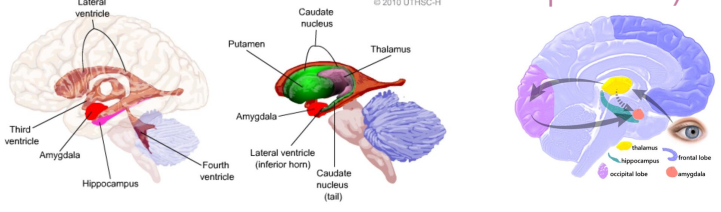
- It is a limbic system structure that is involved in: Formation, Organization, and Storing of memories. It is important in forming new memories and It connects emotions and senses, such as smell and sound, to memories.
- It is a horseshoes paired structure, one in each cerebral hemisphere. It acts as a memory indexer by sending memories to the appropriate part of the cerebral hemisphere for long-term storage and retrieving them when necessary.
- Site: It is a scrolled (infolding) inferomedial part of temporal lobe.
- Function:
  1- Memory (file new memories as they occur).
  2- The hippocampus & its connections are necessary for consolidation of new short-term memories.
  3- Its principal efferent pathway is called the fornix.
- FORNIX: It is C-shaped group of fibers connecting the hippocampus with mammillary body and then to the anterior nuclei of thalamus.
  - It consists of: 2 Fimbria, 2 Crus, 1 Body & 2 Column.
  - The Fornix is an important component of PAPEZ CIRCUIT (based on connecting the limbic system with hypothalamus to control emotions)



Structures of Limbic system

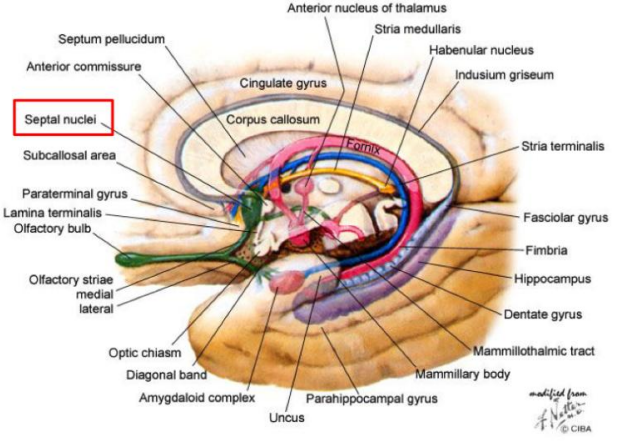
03 Amygdala

- Site: almond shaped mass of nuclei that lies near the temporal pole, deep within the temporal lobes, close to the tail of the caudate nucleus.
- Function: It is involved in: mnemonic FEAR
  1- Fear
  2- Emotions
  3- Anger, aggression
  4- Release of Hormonal
- CONNECTIONS OF AMYGDALA:
  - Inputs: Association areas of visual, auditory & somatosensory cortices.
  - Outputs: Hypothalamus & Autonomic nuclei in the brainstem.
- Lesion:
  1- Lack of emotional responses.
  2- Docility (reduced emotional expression).



04 Septal nuclei

- Site: Located anterior to the interventricular septum (septum pellucidum) and anterior to hypothalamus.
- Function: It is the pleasure zone.
- Main connections: It sends projections to
1. Hypothalamus
2. Habenular nuclei (lie in epithalamus of diencephalon).



Lesions associated with limbic lobe disorders

Korsakoff's psychosis

Korsakoff syndrome is a chronic memory disorder caused by severe deficiency of thiamine (vitamin B-1) & alcoholic intoxication.

Inability to remember recent events and long-term memory gaps.

Anterograde amnesia= Inability to gain new memories.

Retrograde=loss of new memories at the time of lesion and loss of retained old memories occurred before the injury.

Temporal lobe epilepsy

The hippocampus is a common focus site in epilepsy, and can be damaged through chronic seizures.

It is sometimes damaged in diseases such as herpes encephalitis.

Alzheimer's disease

Hippocampus is one of the first brain areas to show damage in Alzheimer's disease.

Anterograde amnesia= the inability to form and retain new memories.

Schizophrenia

Mental disorder with abnormal behavior + inappropriate actions and feelings.

MCQ

Q1: The thalamus is related inferiorly by ?			
A: Hypothalamus posteriorly	B: Posterior limb of lateral ventricle	C: Epithalamus	D: Hypothalamus anteriorly
Q2: What's behind the inter-ventricular foramen ?			
A: Corpus callosum	B: Hypothalamus	C: Choroid plexus	D: Anterior tubercle
Q3: Which of the following is not considered of the nuclear groups ?			
A: Anterior	B: Posterior	C: Lateral	D: Medial
Q4: External medullary lamina consists of ?			
A: Thalamocortical fibers	B: Corticothalamic fibers	C: Intralaminar nuclei	D: A&B
Q5:Afferent of the medial geniculate body ?			
A: Trigeminal lemniscus	B: Spinal lemniscus	C: Medial lemniscus	D: Lateral lemniscus
Q6:Efferent of ventral anterior nucleus ?			
A: Primary motor cortex	B: Premotor cortex	C: Sensory cortex	D: Prefrontal cortex

Answer key:
1 (D) , 2 (D) , 3 (B) , 4 (D) , 5 (D) , 6 (B)

MCQ

Q7: It is a limbic system structure that is involved in: Formation, Organization, and Storing of memories:			
A: Hippocampus	B: Amygdala	C: Limbic cortex	D: Septal nuclei

Q8: The limbic lobe includes:			
A: Subcallosal area	B: Isthmus	C: Uncus	D: All of them

Q9: Almond shaped mass of nuclei that lies near the temporal pole, deep within the temporal lobes ,close to the tail of the caudate nucleus.			
A: Amygdala	B: Hippocampus	C: Limbic cortex	D: Septal nuclei

Q10: Which of the following it is the pleasure zone:			
A: Limbic cortex	B: Hippocampus	C: Septal nuclei	D: Amygdala

Q11: Inability to gain new memories:			
A: Retrograde	B: Schizophrenia	C: Anterograde amnesia	D: Alzheimer's disease

Q12: Which of the following it is a function of limbic system:			
A: Smell	B: Hearing	C: Motivation	D: All of them

Answer key:
7(A) , 8(D) , 9(A) , 10(C) , 11(C) , 12(C)

SAQ

Q1: From where does some thalamic nuclei receive input from ?

Q2: List the dorsal tier of the lateral nuclear group :

Q3: List the structures of limbic system:

Q4: List the functions of amygdala:

Answers

1 : Cerebellar nuclei , basal ganglia , and limbic related brain regions

2 : Lateral Dorsal , Lateral Posterior , amd Pulvinar

3 : -Limbic cortex (Lobe) -Hippocampus -Amygdala -Septal area.

4: It is involved in Emotions, Fear, Anger, aggression, Hormonal secretions.

Team leaders

Rayan jabaan

Abeer Awwad

A special thanks to Mohamed Alquhidan

Reviser
Norah Alasheikh

Organizer
Shaden Alsaiedan

Note taker
Mohammed Aldehaim

Team Members

- Alaa Assulmi
- Albandari Alanazi
- Aljoud Algazlan
- Afnan Almohsen
- Arwa Alqahtani
- Aseel Alshehri
- Asma Alamri
- Bodoor Almubarak
- Deemah Alotaibi
- Fatimah Saad
- Ghada Alabdi
- Ghaida Alassiry
- Joud Alnujaidi
- May Barakah
- Norah Alasheikh
- Nouf Alsubaie
- Raghad Alasiri
- Raghad Soaeed
- Renad Alosaimi
- Sara Alharbi
- Sarah Almuqati
- Sarah Alqahtani
- Shaden Alsaiedan
- Shahad Almezel
- Shayma Alghanoum
- Sumo Alzeer

- Abdullah Alburikan
- Abdullah Aldosari
- Abdulaziz Alghuligah
- Abdulaziz Alkraida
- Abdulaziz Alomairy
- Abdulaziz Alrabiah
- Abdulaziz Alsuhaim
- Abdulrahman Almugren
- Ahmed Alkhayatt
- Bader Alrayes
- Basel Fakeeha
- Fahad Alajmi
- Faisal Alotaibi
- Fayez Altabbaa
- Feras Alqaidi
- Hadi Alhemsi
- Hesham Alsqabi
- Mohammed Aldehaim
- Mohamed Alquhidan
- Mohammed Beyari
- Mubarak Alanazi
- Musab Alamri
- Nawaf Alghamdi
- Osama Alharbi
- Raed Alnutaifi
- Saad Aldohaim
- Saleh Algarni