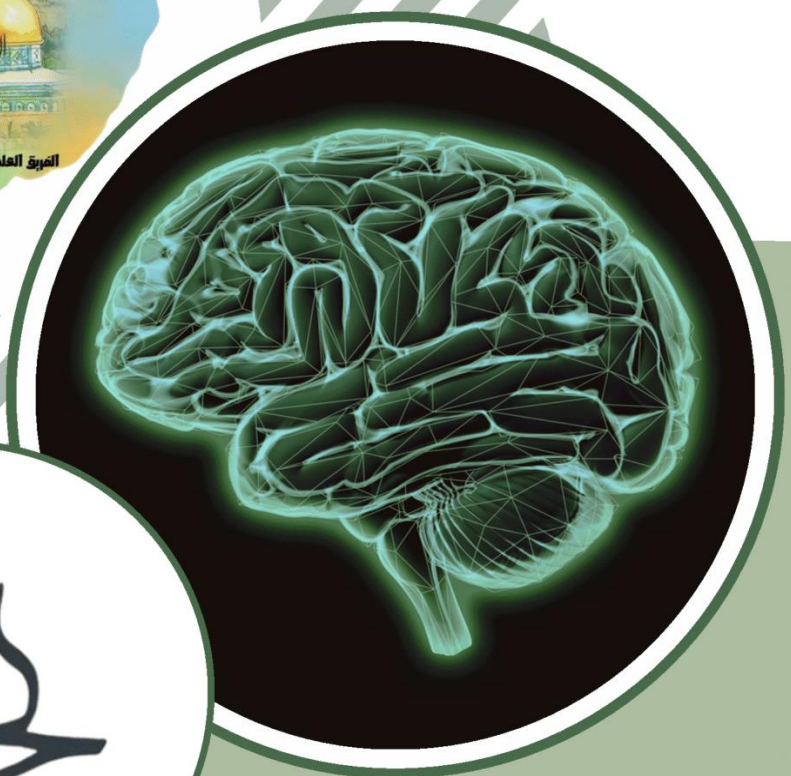
CNS ANATOMY

DOCTOR NOTES



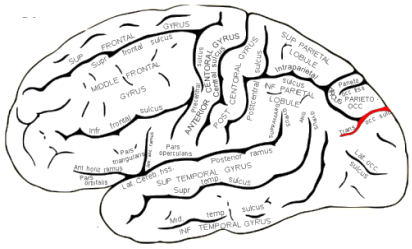
LECTUR NO. 2

BY: Layan Abu Arja & Farah Thaher

2.1 The occipital lobe:

A. Lateral surface: Transverse occipital sulcus (lunate) , lateral occipital sulcus (horizontal): divides the lateral surface of the occipital lobe into a **superior** and an **inferior gyrus**.

Figure (1): Lateral surface



B. Medial surface: Callosal sulcus surrounds CC, contains Anterior cerebral artery, which is responsible for the most medial surface blood supply.

Cingulate sulcus runs parallel to CC and terminates by turning upwards to meet the superomedial border, it gives **ascending branch** above the middle of the body of CC which divides the area above cingulate sulcus into anterior part: **medial frontal gyrus** & paracentral lobule (imp) (around central sulcus), ends above as **marginal sulcus**.
So, the paracentral lobule between the ascending branch & marginal sulcus, in the middle of it there is the central sulcus beginning.
Cingulate gyrus lies between CC and cingulate sulcus.
Subparietal (suprasplenial) sulcus appears as a continuation of cingulate sulcus.
Parieto-occipital fissure between the parietal and occipital lobes.
Calcrine sulcus begins near the occipital pole.
Cuneus is the wedge area between the parieto-occipital fissure & the calcrine sulcus.
Precuneus lies in front the parieto-occipital fissure.
Lingual gyrus below calcrine sulcus.

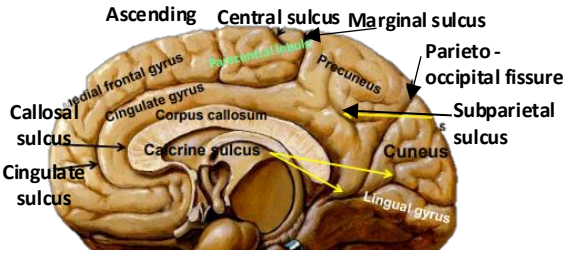


Figure (2): Medial surface

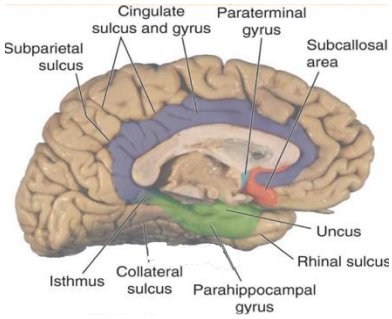
Paracentral area:

1- posterior part responsible for sensory activity below the knee contralaterally.

2- anterior part responsible for motor activity below the knee contralaterally.
- sphincter control for urine and stool.
Lesion here will cause paralysis below the knee + incontinence.

2.2 The limbic loop (6th loop):

-Cingulate gyrus (in purple) v.imp since it is the major part of the limbic system **locates medially**, mainly for **emotions,** but it has other functions like: memory, smell, sexual functions. It works closely with the hypothalamic nuclei.



It will be completed **inferiorly** as the **hippocampus (in green).**
-Function of the hippocampus: short memory.

The hippocampus located inside the parahippocampal gyrus.

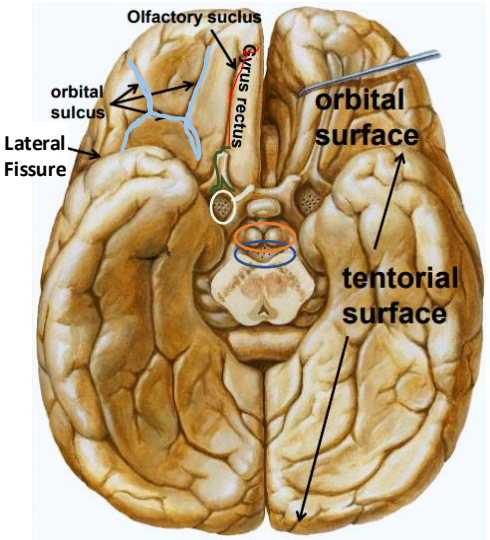
Other limbic parts: phornix, hypothalamic nuclei, some thalamus nuclei.

2.3 inferior surface:

Lateral fissure starts on the inferior surface (stem in the inferior, posterior ramus, ascending and anterior rami in the later surface)
The stem divides this surface into orbital part and tentorial part

A.The orbital surface:

Figure (3): Orbital surface



1.Olfactory sulcus: near & parallel to the median fissure, it is overlapped by the olfactory bulb & tract.

In the olfactory sulcus(in red) the tract finally divides into medial and lateral olfactory stria (in green), which has an anterior perforated substance (by branches of anterior cerebral artery)

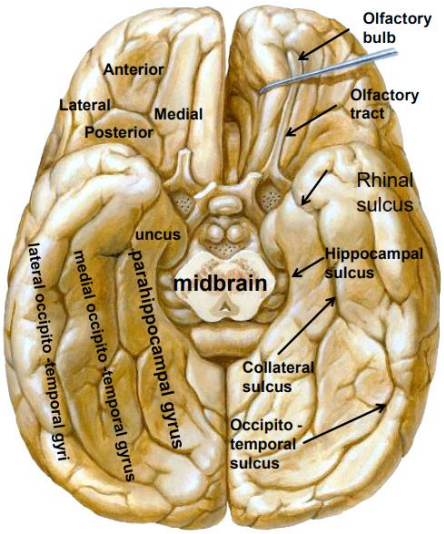
-posterior perforated substance (in dark blue) in front of the midbrain, (by branches of posterior cerebral artery)
-mammillary bodies from hypothalamus nuclei(in orange)

2.H shaped orbital sulci(in light blue), it divides the remaining part into **anterior, posterior, lateral & medial orbital gyri.**
-Medial to the olfactory sulcus is the **gyrus recuts** which is responsible for the sexual function of the body, and it continuous with the **superior frontal gyrus.**

-Orbital gyri are **connected with limbic system** especially nucleus accumbens (reward reinforcement)

A.The tentorial surface:

Figure (4): Tentorial surface



1.Hippocampal sulcus separates the parahippocampal gyrus from the midbrain.

2.Collateral sulcus: below & parallel to the calcrine sulcus.

3.Rhinal sulcus separates the temporal pole from the uncus.

4.Occipito-temporal sulcus

Posteriorly we have the tentorium cerebelli (folding of dura), which is an invagination of the meningeal layer of the dura mater that separates the occipital and temporal lobes of the cerebral hemispheres from the cerebellum and brainstem.

1.Parahippocumpus gyrus : Its anterior part has a round shape structure called the uncus, it's important since it has a nucleus impeded inside its cortex (amygdala) which is anatomically part of the basal nuclei that are responsible for programming the smooth motor activity side by side with cerebellum (balance), it's function specifically **fear** sensation and **smell** since it is functionally a **part of the limbic system**.

2.Medialhippocumpus gyrus

3.Lateralhippocumpus gyrus which is said to be a continuation of the inferior temporal gyrus on the lateral surface

2.4 Functional Localization of Cerebral Cortex:

1.Sensory areas: primary sensory area (post centeral gyrus), secondary sensory area.

2.Motor areas: primary motor area 4 (precenteral gyrus), secondary premotor area 6, supplementary motor area (SMA).

3.Association areas: parietal, occipital and temporal cortex prefrontal (frontal) cortex, it is spread in the whole cortex, responsible for higher functions that give sense to the order (e.g: identifying objects by only touching their 3D shape and sensing their textures, locates inside the frontal lobe and besides any primary area (e.g: primary area 4 with prefrontal association area, primary 312 sensory area with preparietal association area, primary visual 17 with visual association area).
-A lesion in preparietal association area would make the person lose his ability to identify an object despite the unmissed sensory function is known as **Astereognosis**.

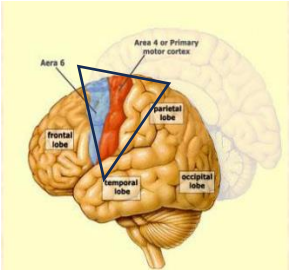
Primary area lesion → defect, Association area lesion → Agnosia

2.5 Primary motor area 4:

-Location: in front the central sulcus between the central and precentral sulcus.

In the precentral gyrus of the lateral surface (the main and largest part) and the anterior part of the paracentral lobule, the upper 1 cm around the central sulcus (its posterior part gives rise to sensory function), both are responsible for the contralateral motor function of the area below the knee.
-Betz cells in area **5** play a significant role in this process, till extending to the corticobulbar tract so these structures give rise to the pyramidal tract axons.(check the figure)

Figure (5)

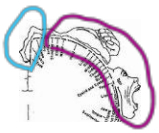


The triangle represents the areas which send pyramidal tract.

-Function: These areas are responsible for fine, precise motor activity, meaning they control individual muscles rather than groups of muscles (e.g., flexion and extension of finger muscles).

-This is represented in the motor homunculus, which indicates the level of motor control, not the size of the area. The largest representations are in the hands and face, with the lower limbs generally occupying a smaller area.
The representation is upside down, with the head located in the lower part of the cortex and the lower limbs, particularly the foot muscles, located medially below the knee.

-It's important to differentiate between the blood supply of the precentral gyrus supplied by the middle cerebral artery, and the anterior part of the paracentral lobule is supplied by the anterior cerebral artery.



A stroke in each artery will result in different conditions:
•A stroke in the anterior cerebral artery can cause loss of motor function on the contralateral side, below the knee, and may also affect the ability to control **sphincter muscles**.[on the medial side]
•If the stroke is posteriorly located, it can lead to loss of sensation below the knee.
•A stroke in the middle cerebral artery can cause loss of motor function on the contralateral side, above the knee[on the lateral side]
-Lesions: can result from the "4 Ts": Thrombus, Toxins, Tumors, and Trauma. These can lead to injury in the upper motor neuron, resulting in **contralateral hemiplegia** (hemiplegia: paralysis of one side, specifically the lower limbs). *UMN: spastic, hyperreflexia, no atrophy unless ubuse.

2.6 Premotor area 6:

-Location: In the frontal lobe on the lateral surface in front of area 4, like an inverted triangle.

-Function: 1.Responsible for **coordination of groups** of muscles (not specific muscles) mainly trunk and proximal body parts like hips and shoulders in both sides, besides the cerebellum and basal nuclei. **2.Storing motor programs**, 3.Inhibitory to muscle tone, 4.sending inputs to M4.

-Lesion: A lesion here **does not cause paralysis** (imp.), but rather results in **uncoordinated movements (motor apraxia)**, spasticity, **loss of postural stability**.
-Another part we discussed in the previous lecture: If a lesion occurs in this area, it can lead to motor apraxia, which involves the corpus callosum (CC)—a bundle of about 30 million axons that connect the two hemispheres (split-brain condition).

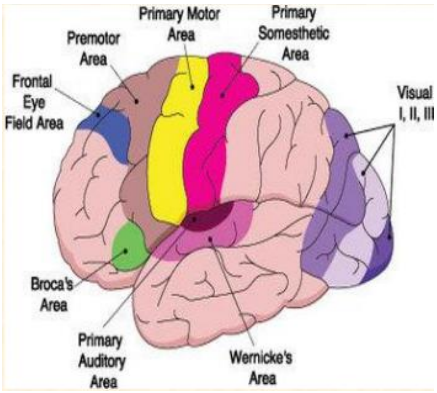


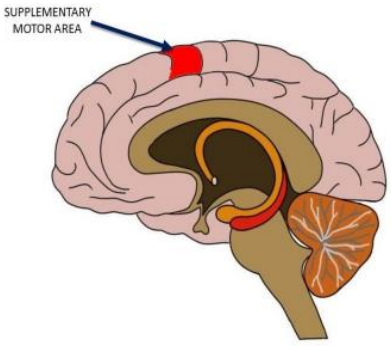
Figure (6)

2.7 Supplementary motor areas:

-Location: medially(since the cc can be seen)
In front of the paracentral lobule and posterior to the medial frontal gyrus, its continuation on the lateral surface will give rise to the premotor area.

-The body is presented laterally here. This area is still under investigation, and its function remains unknown. However, studies on **monkeys**' brains have shown that this area is much more developed, suggesting it may be involved in the coordination of **sequences** of movements.

Figure (7)



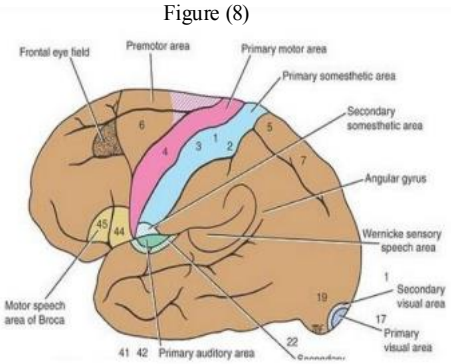
2.8 Frontal Eye Field 8: Imp there will be a question in the exam about it:

-Location: laterally in the middle of the middle frontal gyrus, in front of area 6.

-Function: Voluntary eye movement to the opposite side (the occipital eye field area is responsible for involuntary or reflex tracking eye movements of both eyes to the opposite side, e.g., moving your eyes while reading).

-Ipsilateral Lesion: deviation of both eyes to the same side of lesion, ex: if the lesion on the left,both eyes won't move to the right.
Remember, a lesion in the posterior dorsal column system & cerebellum will cause a similar effect ipsilaterally.

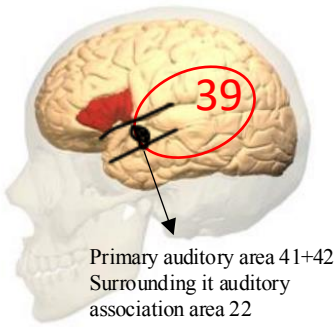
Figure (8)



2.9 Motor Broca's area of speech 44,45:

Imp there will be a question in the exam about it:

-Location: inferior frontal gyrus, mainly on the **left (should be there)** dominant hemisphere.
*dominant hemisphere processes often are assigned to the left hemisphere.



Primary auditory area 41+42
Surrounding it auditory association area 22

-Function: coordination of different muscles of larynx, mouth, tongue and palate. (muscles produce speech)
Connected to **wernicke's area (22 auditory association area posteriorly +39 angular +40 supramarginal gyrus)** through arcuate fasciculus which is the sensory area of speech (inside the red circle).
Wernicke's area responsible for understanding written and spoken words.

-Lesion: **(motor aphasia) non fluent aphasia** (mainly comes with contralateral hemiplegia since both are supplied by the middle cerebral artery, and both are located on the lateral surface of the brain

A lesion here will result in contralateral hemiplegia, as both the motor cortex and the affected area are supplied by the middle cerebral artery. This lesion may also cause Broca's aphasia (non-fluent/expressive aphasia), in which the patient understands language but struggles to produce coherent speech. They may use incorrect or random words but are aware of their difficulty, which often leads to frustration and anxiety.
This contrasts with Wernicke's aphasia (fluent/sensory aphasia), caused by a lesion in Wernicke's area, where the patient produces fluent but meaningless speech and is typically unaware of their language deficit. They may use made-up or nonsensical words (neologisms) without recognizing the issue.

2.10 Primary sensory area 312:

-Location: post centeral gyrus. Extends on the paracenteral lobule Representation of the body as motor area (upside down so the last part represents areas below the knee).

-Function: contralateral localize, discriminates different sensations. Gives 20% of pyramidal tract.

-Lesion: **contralateral hemianathesia**
Secondary sensory area (parietal association area 5+7) Lowermost part of postcenteral gyrus (depth of lateral sulcus), lesion here will cause astereognosis + hemineglect.

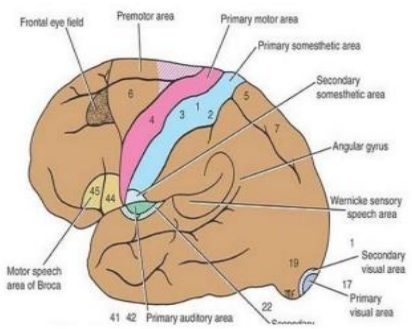


Figure (10)

2.11 Visual cortex:

Imp there will be a question in the exam about it:

V I: area 17
-Location: around the calcarine sulcus lips (notice 17) (between the cuneus above and lingual below) → receives visual radiations from LGB .

-Function: perception of the opposite visual field.

Figure (11)

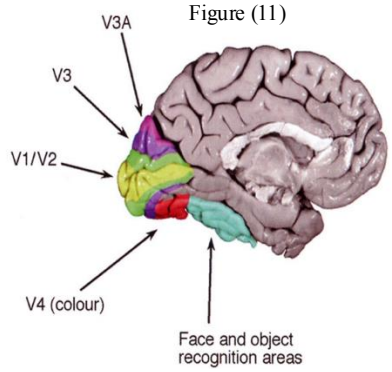
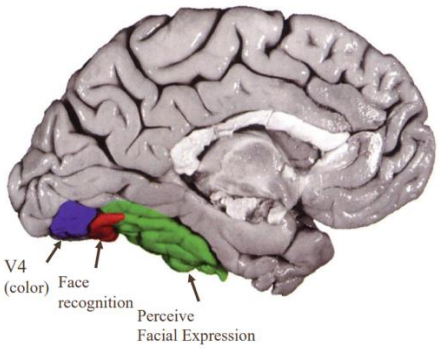


Figure (12): Visual association areas



-Lesion: contralateral homonymous hemianopia in the half of the visual field at the same side of the retina that projects to the opposite visual field.

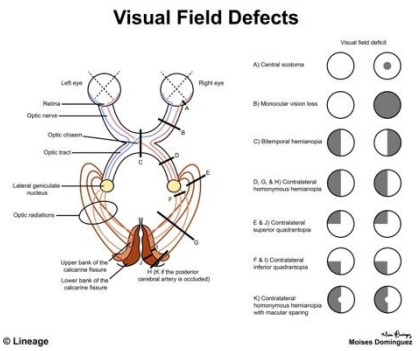
V II : 18, 19 (visual association area)

-Location: remainder of cuneus and lingual gyri.

-Function: Interpretation of visual stimulus with past experience.

-Lesion: loss of vision on the opposite side. This may be an exam question
Loss of vision can affect the upper (superior) quadrants in the left-hand quadrant or the right-hand quadrant.
Loss of vision can affect the lower (inferior) quadrants in the left-hand quadrant or the right-hand quadrant.

Lesion in the right lingual will cause left superior quadrantanopia.
Lesion in the right cuneus will cause left inferior quadrantanopia.



Auditory Areas

1- Primary auditory area 41,42

Lesion: reduction of hearing acuity on both ears mainly on opposite side.

2- auditory association area 22

Lesion: auditory agnosia

V2: Page 5 as numbered in the file...

Broca's aphasia (non-fluent/expressive aphasia),
Wernicke’s aphasia (fluent/sensory aphasia).