



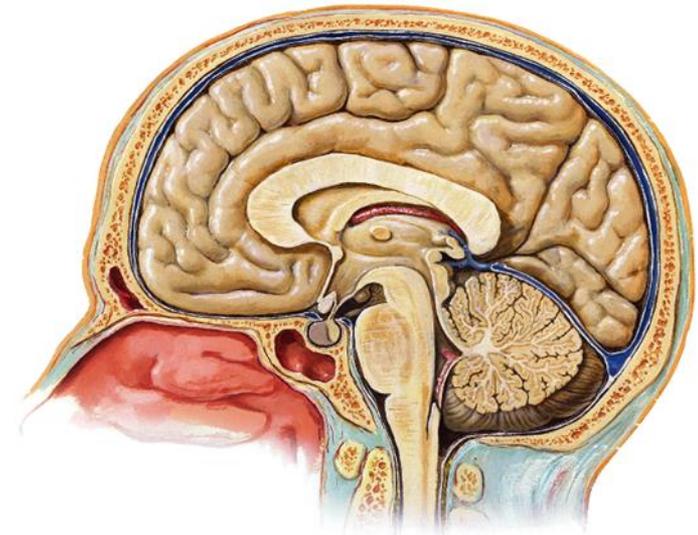
Central Nervous System

Lecture 5: Brain Stem (External Features)

Dr. Ashraf Ramzy
Professor of Anatomy & Embryology
ash-ramzy@hotmail.com

BRAIN STEM

- ** The brain stem is formed of midbrain, pons, and medulla oblongata.**
- ** It connects the cerebrum with the spinal cord.**
- ** It is connected to the cerebellum by 3 peduncles: superior cerebellar peduncle (SCP), middle cerebellar peduncle (MCP), and inferior cerebellar peduncle (ICP) which connect the midbrain, pons & medulla respectively to the cerebellum.**



The Brain stem contains:

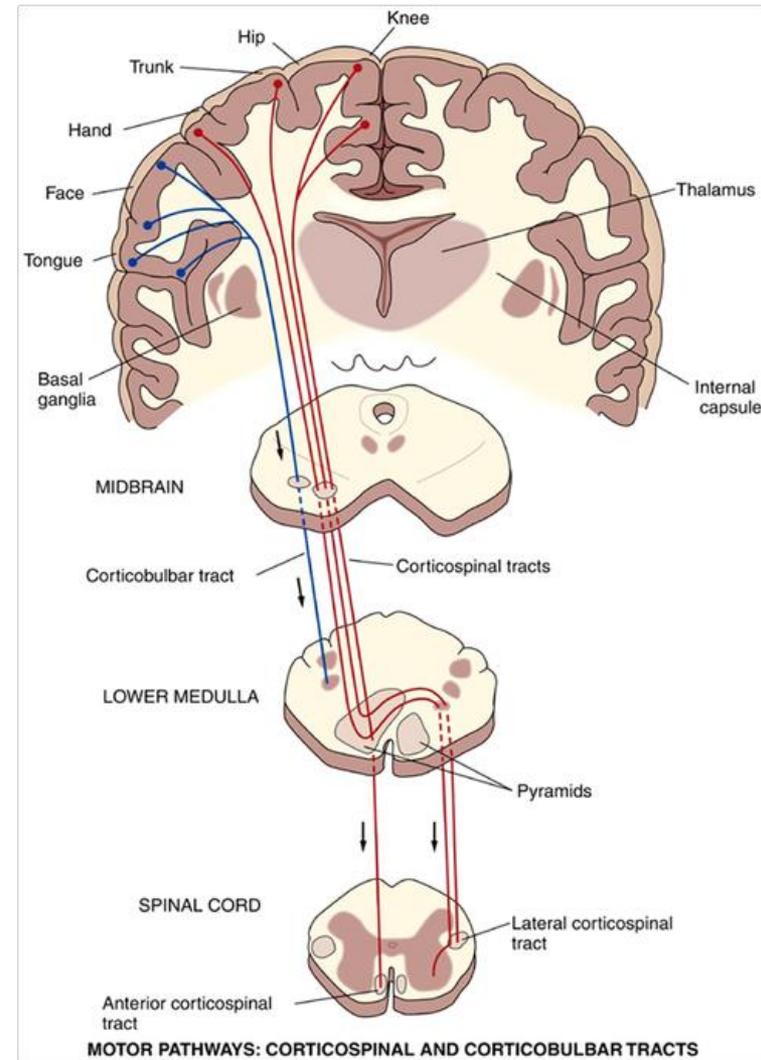
1. White matter: which includes:

**** Longitudinal fibers:**

- Descending tracts: pyramidal, extrapyramidal & corticopontine.
- Ascending tracts in the form of lemnisci.
- Association tract called medial longitudinal bundle (MLB).

**** Horizontal fibers:**

- Decussations (e.g., motor & sensory decussations in medulla).
- Arcuate fibers in the medulla.



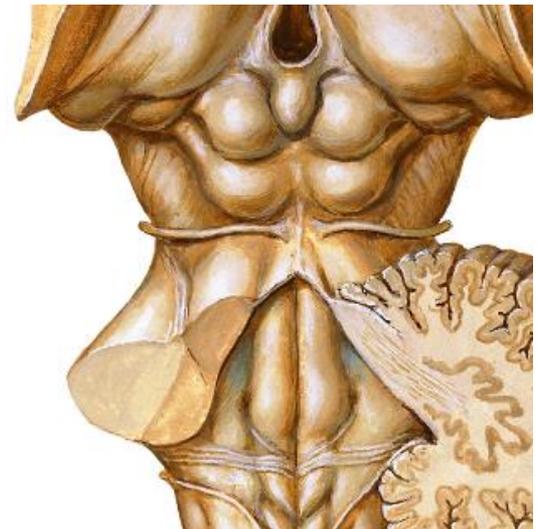
2. **Grey matter:** which forms scattered nuclei that include:

a. **Cranial nerve nuclei:**

- ** All cranial nerves (from III-XII) emerge from ventral surface of brain stem except the trochlear nerve which emerges from dorsal surface
- * Oculomotor nerve III & trochlear nerve IV emerge from midbrain.
- * Trigeminal V, abducent VI, facial VII & vestibulocochlear VIII emerge from pons.
- * Glossopharyngeal IX, vagus X, accessory XI, & hypoglossal XII emerge from medulla.

b. **Other nuclei:** as the olivary nuclei in the medulla, the pontine nuclei in the pons and the red nucleus in the midbrain

3. **Reticular formation:** a core of mixed grey and white matters lying within the brain stem.



External Features

A. Ventral Surface

1. MEDULLA OBLONGATA:

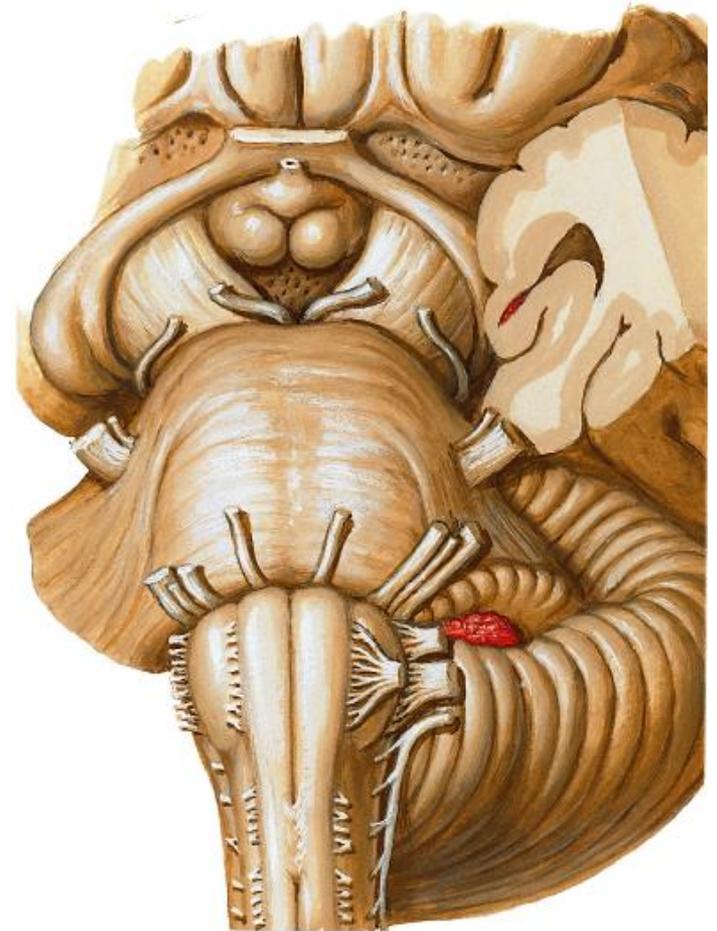
- ** Extends between spinal cord (below) & pons (above).
- ** Shows 3 elevations on each side of anterior median fissure; from medial to lateral:

1. Pyramid: made by the corticospinal tract which forms the motor decussation in the lower medulla.
2. Olive: made by the inferior olivary nucleus.
3. Inferior cerebellar peduncle (ICP): made by fibers connecting the medulla & cerebellum.



**** Shows attachment of last 4 cranial nerves:**

- a. Hypoglossal N. (XII) → its rootlets are attached to the anterolateral sulcus (bet. pyramid & olive).**
- b. Glossopharyngeal N. (IX), Vagus N. (X) & Accessory N. (XI) → its rootlets are attached (from above downwards) to posterolateral sulcus (bet. olive & ICP).**



2. PONS:

- ** A bridge, one inch long, connecting the right & left cerebellar hemispheres by a middle cerebellar peduncle (MCP) on each side.
- ** It extends between the medulla oblongata (below) & midbrain (above).
- ** In the middle, the basis pontis projects anteriorly & shows:
 - a. **Sulcus (groove) for the basilar artery:** in the midline.
 - b. **Transverse grooves:** between bundles of transverse pontine fibers.



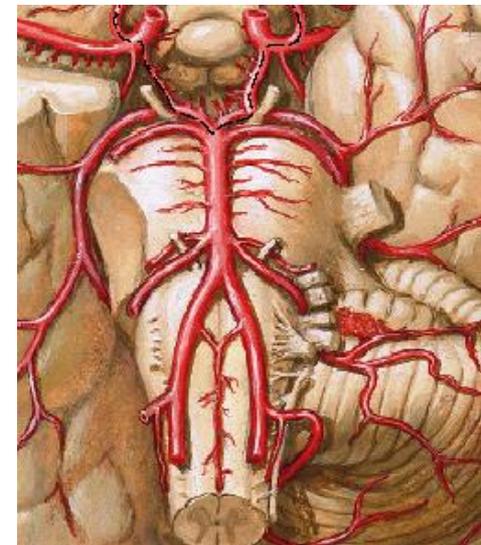
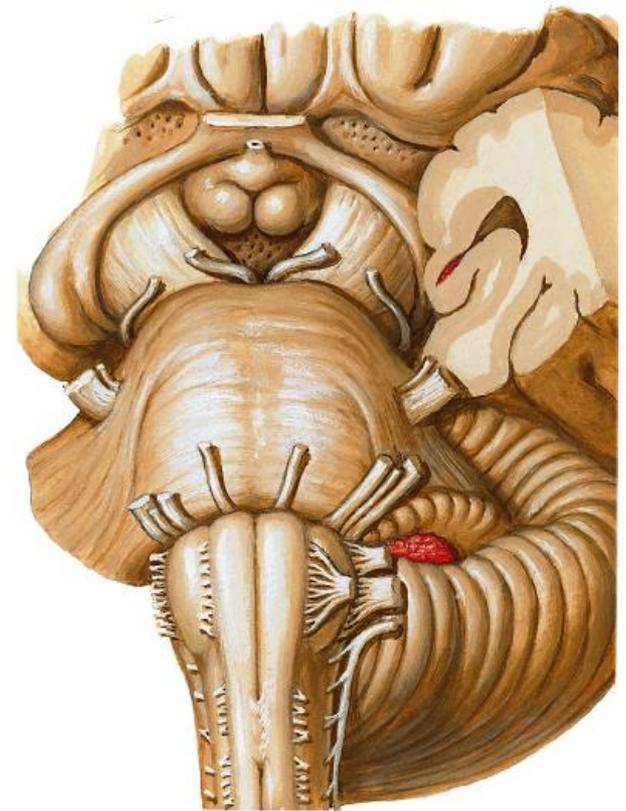
**** Gives attachment to middle 4 cranial nerves:**

- * V. (trigeminal):** to the junction of MCP & basis pontis, closer to upper border by 2 roots (sensory: large & lat. + motor: small & med.).
- * VI. (abducent):** to lower border of pons just above pyramid.
- * VII (facial):** to cerebello-pontine angle (bet. MCP & ICP) by 2 roots (motor: large & med. + sensory: nervus intermedius: small & lat.).
- * VIII (vestibulo-cochlear):** to cerebello-pontine angle, lateral to VII, by 2 roots (vestibular medially & cochlear laterally).
- ** Clinically: cerebellopontine angle tumor causes lesion of VII → facial paralysis + lesion of VIII → deafness & vertigo.**



3. MIDBRAIN:

- ** Appears as 2 diverging cerebral peduncles enclosing the interpeduncular fossa.**
- ** The oculomotor nerve emerges from the medial side of the cerebral peduncle.**
- ** 4 structures are seen to wind around cerebral peduncle:**
 - 1. Optic tract.**
 - 2. Trochlear nerve.**
 - 3. Posterior cerebral artery.**
 - 4. Basal vein.**



THE INTERPEDUNCULAR FOSSA

- ** Is a trapezoid depression between the 2 cerebral peduncles.
- ** It does not belong to the midbrain but to the hypothalamus.
- ** Boundaries:
 1. Anteriorly: optic chiasma.
 2. Anterolaterally: optic tract.
 3. Posterolaterally: cerebral peduncle.
 4. Posteriorly: upper border of pons.



** Contents:

1. **Tuber cinereum:** convex mass of grey matter (= the median eminence of hypothalamus).
The infundibulum (or pituitary stalk) connects it with the posterior lobe of pituitary gland.
2. **Mammillary bodies:** two rounded nuclei of hypothalamus.



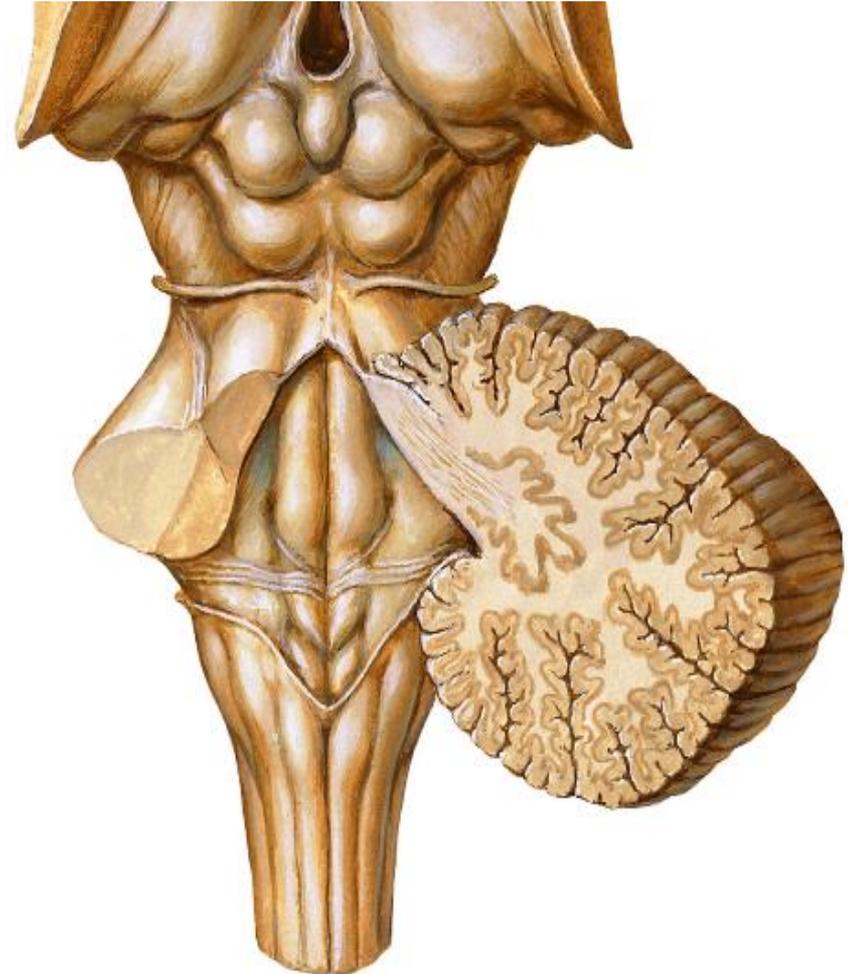
3. **Posterior perforated substance:** an area of grey matter showing small holes pierced by the central branches of posterior cerebral artery.
 4. **Oculomotor nerve:** emerges from the medial surface of the cerebral peduncle.
- ** N.B: an **anterior perforated substance** is situated lateral to the optic chiasma & is pierced by the central branches of anterior & middle cerebral arteries.

B. Dorsal Surface

1. BACK OF MEDULLA OBLONGATA:

** Its lower part or closed medulla: shows 3 elevations on each side of posterior median sulcus:

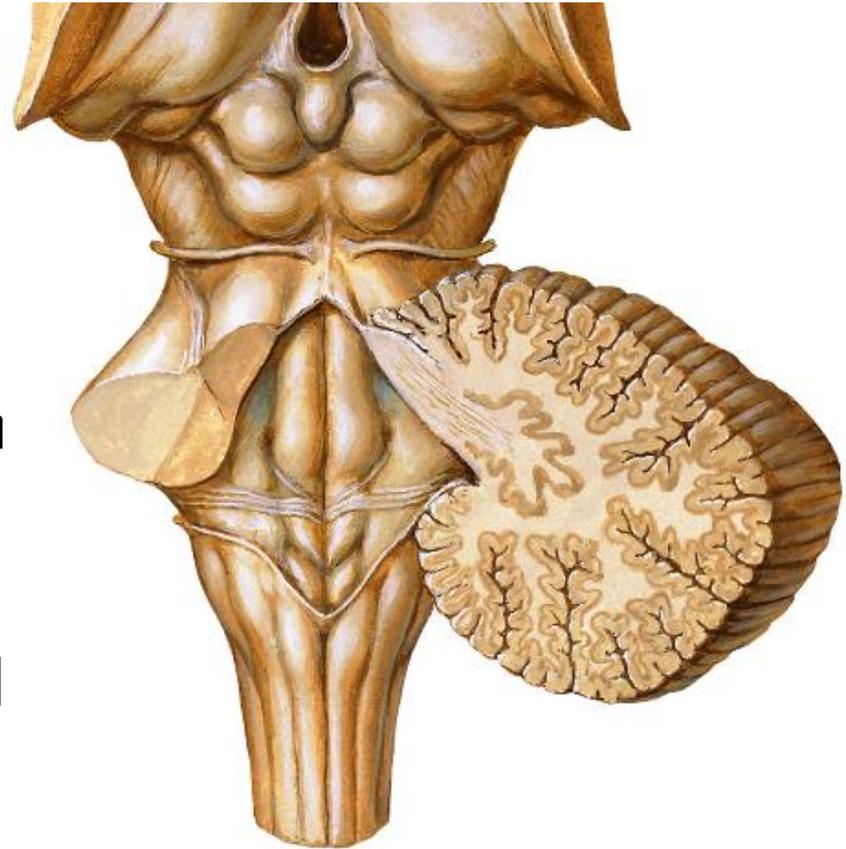
1. Gracile fasciculus (tract) ending in gracile tubercle (nucleus).
2. Cuneate fasciculus ending in cuneate tubercle.
3. ICP.



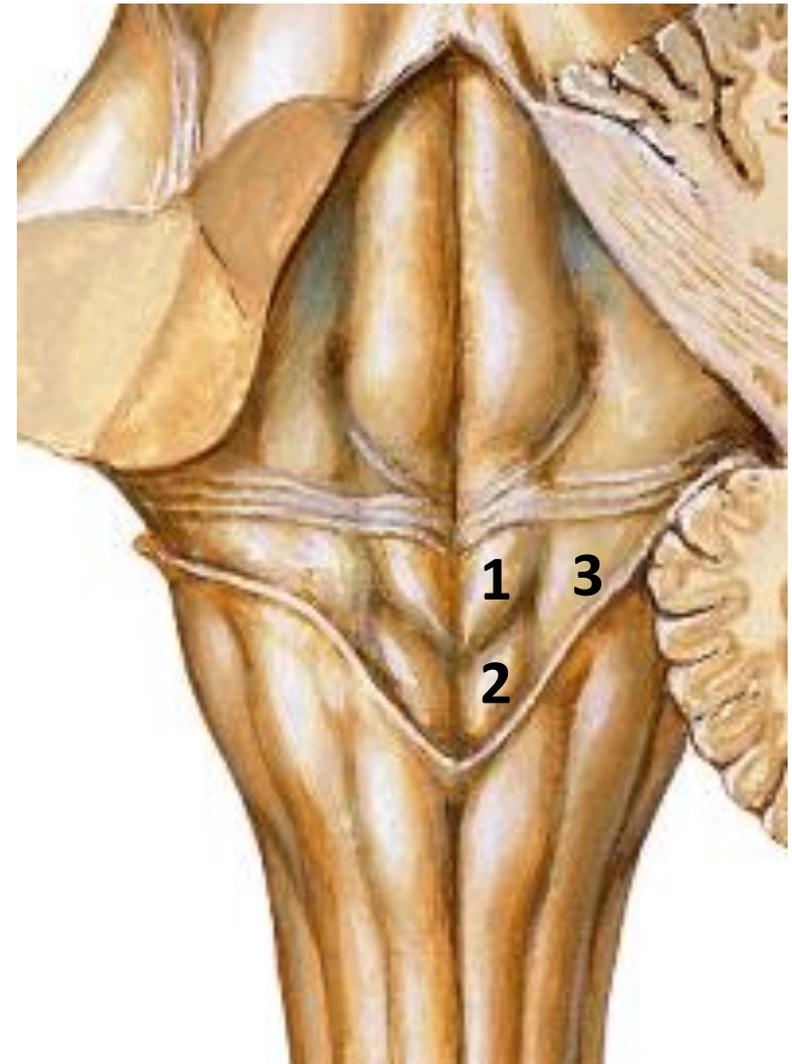
**** Its upper part or open Medulla: forms the lower part of the floor of 4th ventricle.**

**** It is triangular in shape; having:**

- 1. Base (above) separated from pons by medullary stria.**
- 2. Apex (below) continuous with central canal.**
- 3. Floor: On each side of the median sulcus lies an inverted V-shaped depression, the **inferior fovea**, separating three elevated triangles (trigones):**



- 1. Hypoglossal Trigone:** overlies hypoglossal nucleus. It lies medial to the fovea.
 - 2. Vagal Trigone:** overlies dorsal vagal nucleus and lies between the two limbs of the inferior fovea.
 - 3. Vestibular Trigone:** overlies vestibular nuclei and lies lateral to the fovea.
- ** The lower part of inferior fovea presents the area postrema (chemoreceptor trigger zone) which contains vomiting center.**

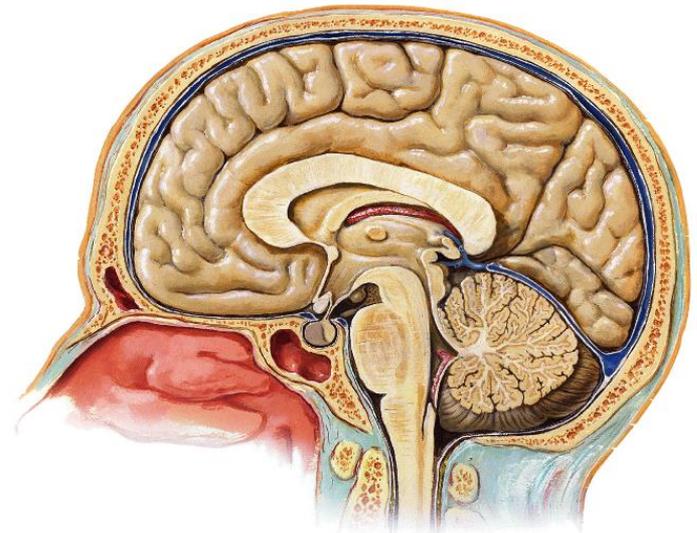
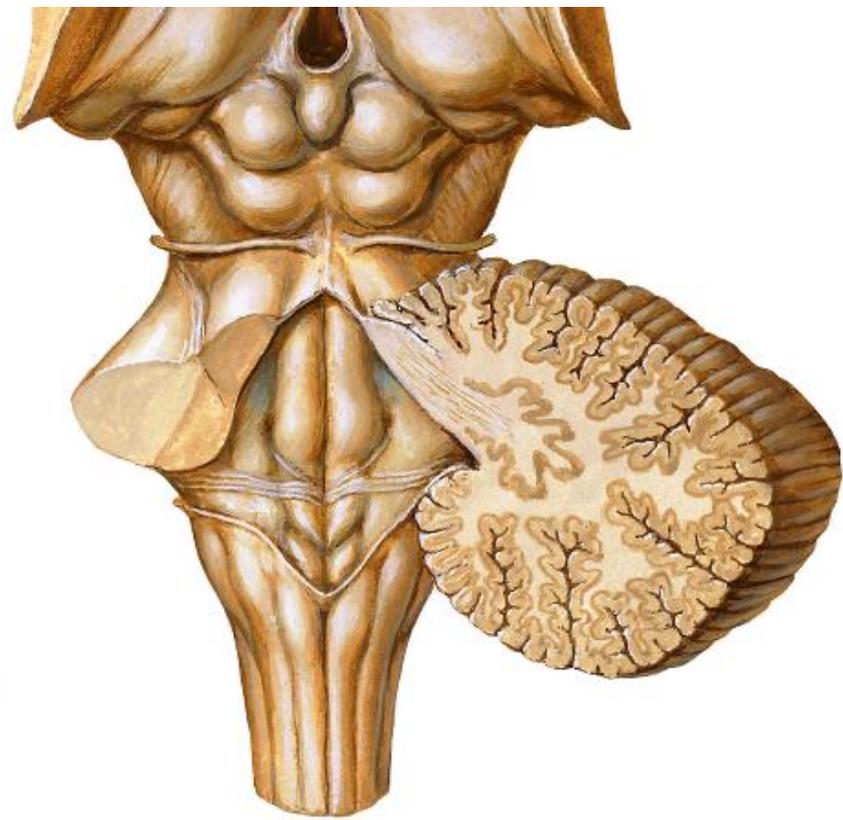


2. BACK OF PONS:

**** Forms the upper part of floor of 4th ventricle.**

**** It is triangular, having:**

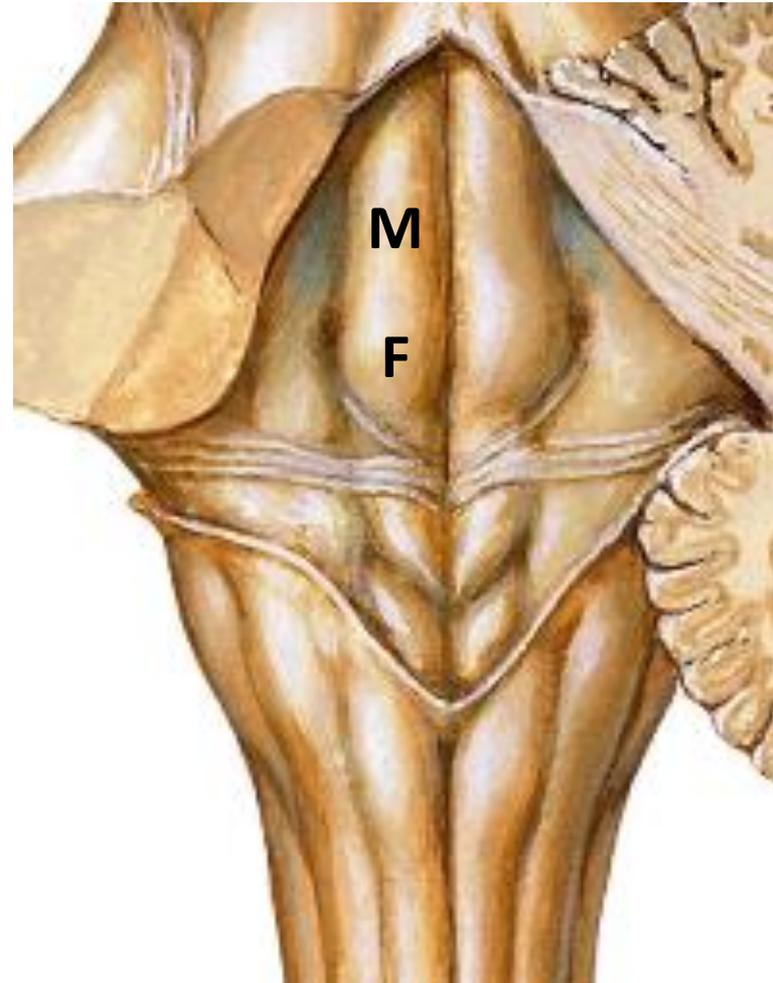
- 1. Base (below): made by medullary stria.**
- 2. Apex (above): continuous with cerebral aqueduct of Sylvius.**
- 3. Floor: Shows a medial eminence (M) on each side of the median sulcus; the medial eminence overlies the abducent nucleus.**



**** The lower part of median eminence is expanded to form the facial colliculus (F). The latter is produced by the motor fibers of the facial nerve looping over the abducent nucleus.**

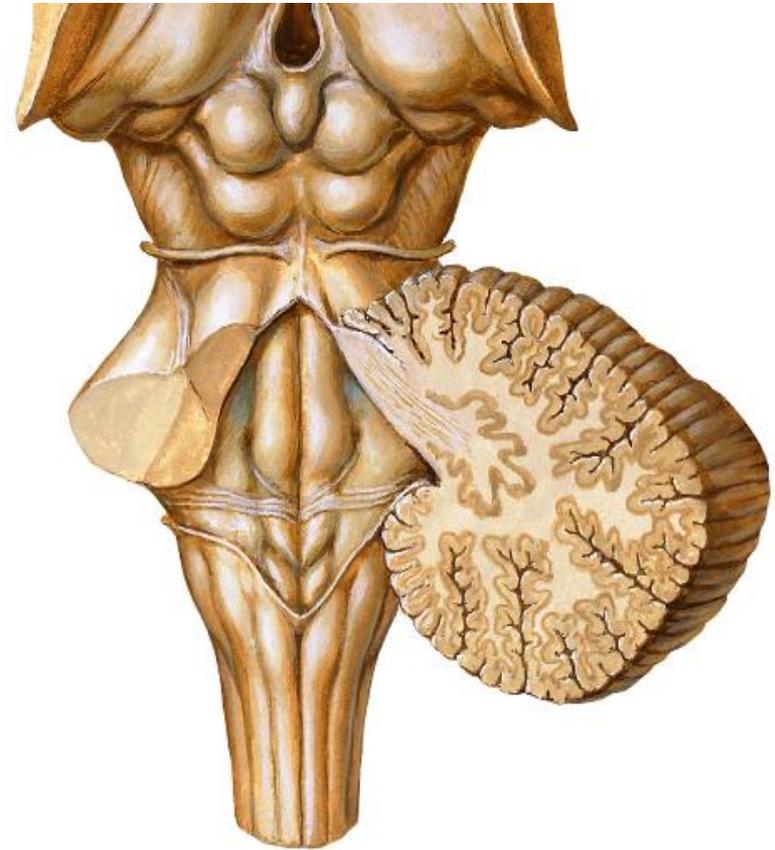
**** Lateral to the medial eminence is the sulcus limitans whose upper part shows a bluish area called **locus ceruleus** which is rich in norepinephrine while its lower part forms the **superior fovea**.**

**** The vestibular area lies lateral to the superior fovea & overlies some vestibular nuclei.**



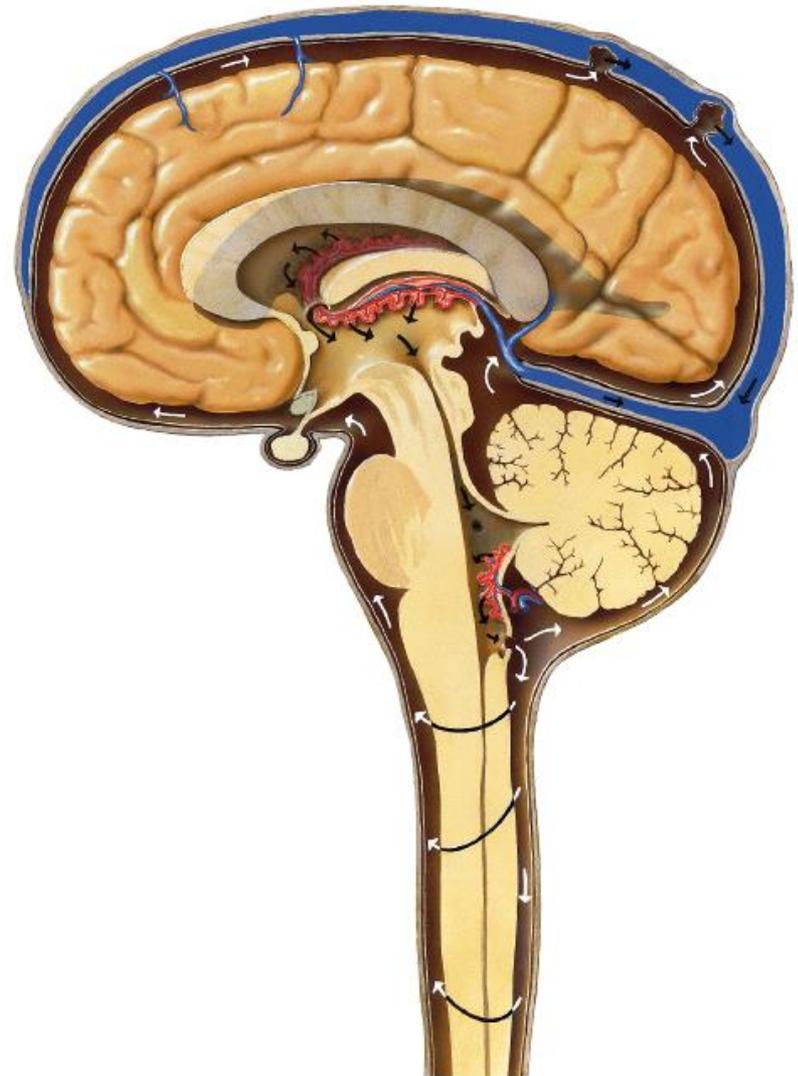
3. BACK OF MIDBRAIN:

- ** Shows 4 colliculi (corpora quadrigemina): 2 sup. & 2 inf.**
- ** Each colliculus has a brachium:**
 - 1. The brachium of sup. colliculus passes to lat. geniculate body (LGB).**
 - 2. The brachium of inf. colliculus passes to med. geniculate body (MGB).**



FOURTH VENTRICLE

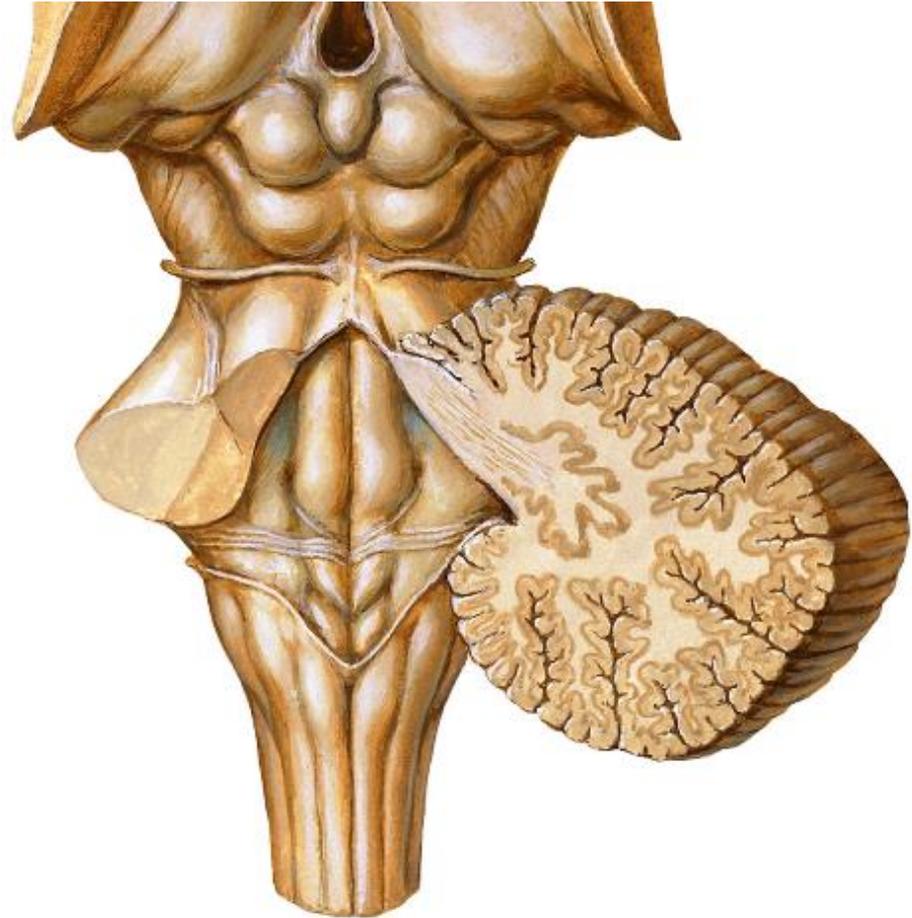
- ** It is the cavity of the Rhombencephalon (Hind brain).
- ** It lies between cerebellum (posteriorly) and brain stem (anteriorly).
- ** It communicates with:
 1. Third ventricle via cerebral aqueduct of Sylvius.
 2. Central canal of medulla oblongata inferiorly.
 3. Subarachnoid space via 3 foramina: one median & two lateral.
- ** In sagittal section, it appears triangular in shape.



**** Roof:**

- 1. Superiorly:** Superior Cerebellar Peduncles (SCPs) and Superior Medullary Velum (layer of ependyma).
- 2. Inferiorly:** Inferior Medullary Velum (layer of ependyma) covered by pia mater forming choroid plexus of fourth ventricle.

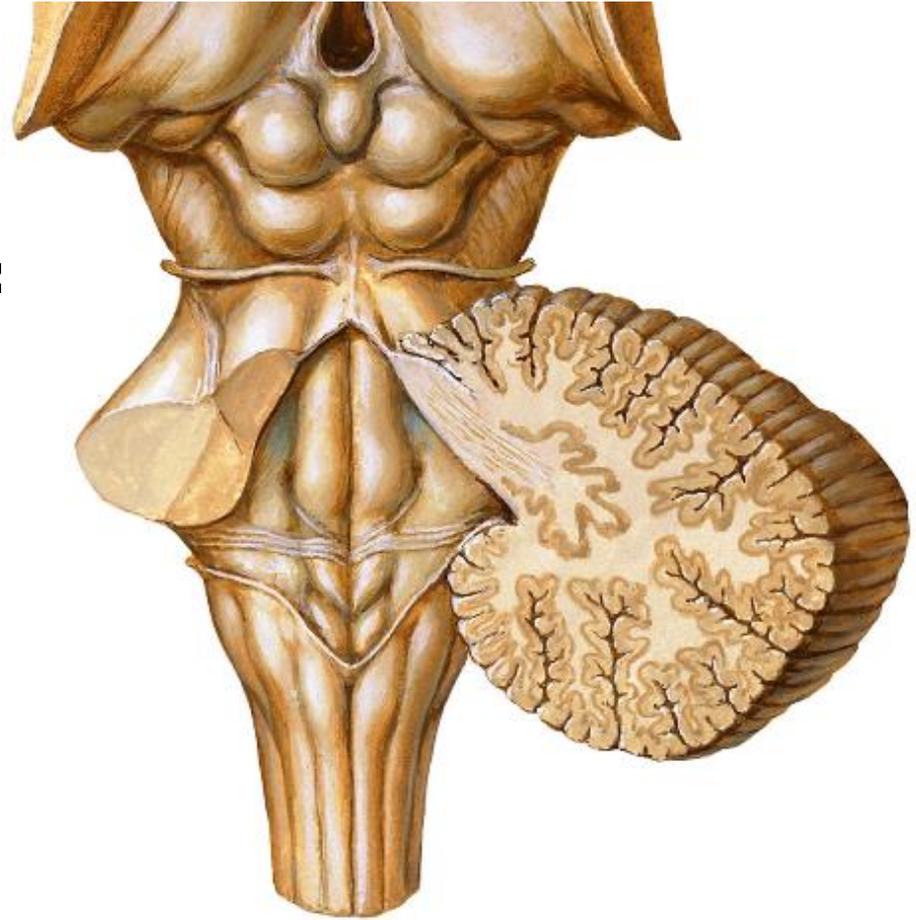
**** This part of roof has a large median foramen “Foramen of Magendie” which connects the interior of the ventricle with the subarachnoid space.**



**** Floor: (Rhomboid fossa):**

**** It is formed by the dorsal surface of pons & upper part of medulla.**

**** It is divided by the medullary stria into a superior pontine part and an inferior medullary part.**



A. Pontine part:

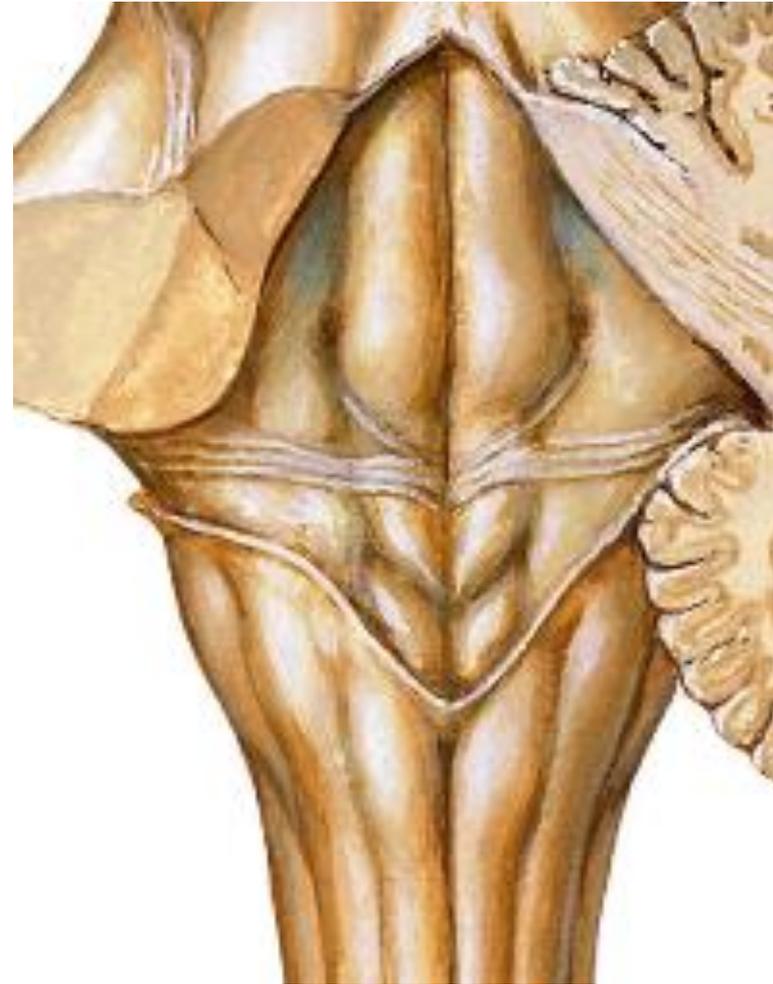
- ** Shows a medial eminence on each side of the median sulcus.**
- ** The lower part of median eminence is expanded to form the facial colliculus. The latter is produced by the motor fibers of the facial nerve looping over the abducent nucleus.**
- ** Lateral to the medial eminence is the sulcus limitans whose upper part shows a bluish area called locus ceruleus which is rich in norepinephrine while its lower part forms the superior fovea.**
- ** The vestibular area lies lateral to the superior fovea & overlies some vestibular nuclei**



B. Medullary part:

**** On each side of the median sulcus lies an inverted V-shaped depression, the inferior fovea, separating three elevated triangles (trigones):**

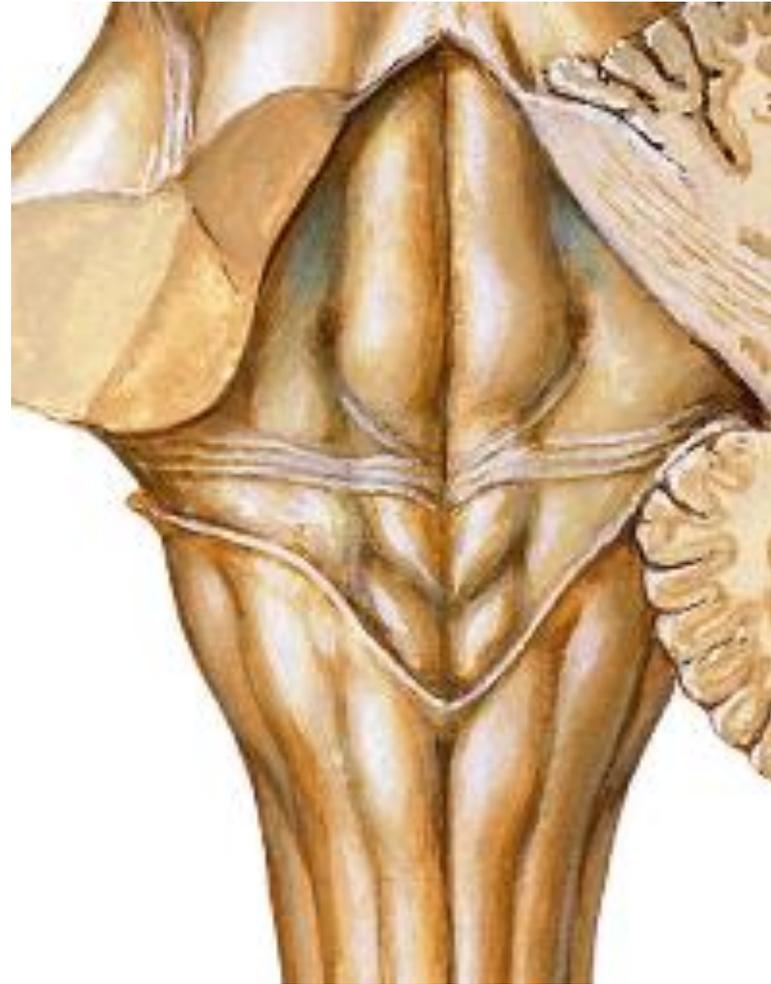
- 1. Hypoglossal Trigone: overlies hypoglossal nucleus. It lies medial to the fovea.**
- 2. Vagal Trigone: overlies dorsal vagal nucleus and lies between the two limbs of the inferior fovea.**
- 3. Vestibular Trigone: overlies vestibular nuclei and lies lateral to the fovea.**



**** Lateral Boundaries:**

- 1. Superiorly: Superior Cerebellar Peduncles**
- 2. Inferiorly: Inferior Cerebellar Peduncles + Gracile & Cuneate Tubercles**

- ** Lateral Recess: A recess from the cavity of fourth ventricle extends laterally over the surface of ICP. The lateral recess opens on each side into the subarachnoid space by a lateral aperture (Foramen of Luschka).**
- ** The choroid plexus of the fourth ventricle lies at lower part of roof of fourth ventricle.**



THANK

THANK

YOU

YOU