CNS
Brain stem I

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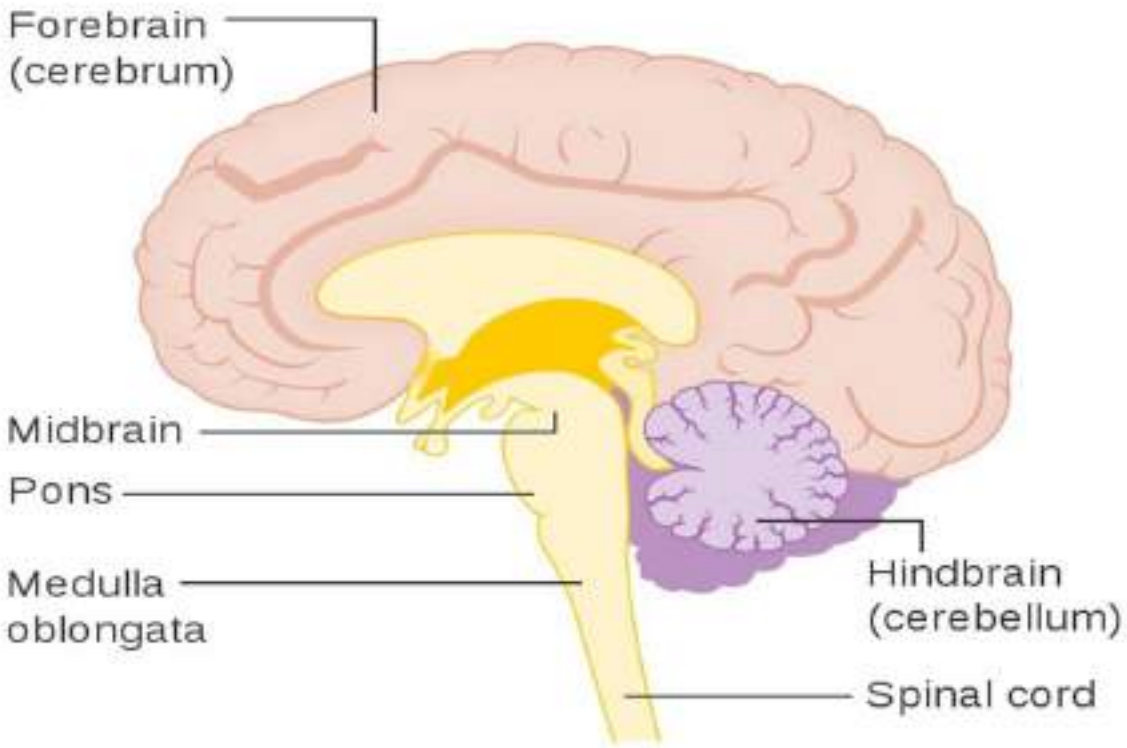
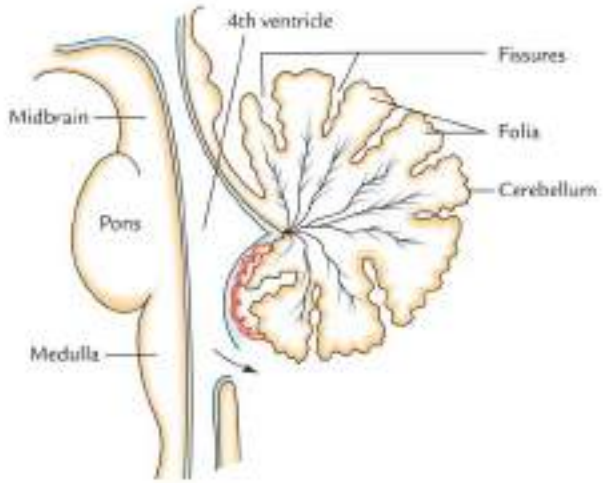
BRAIN STEM

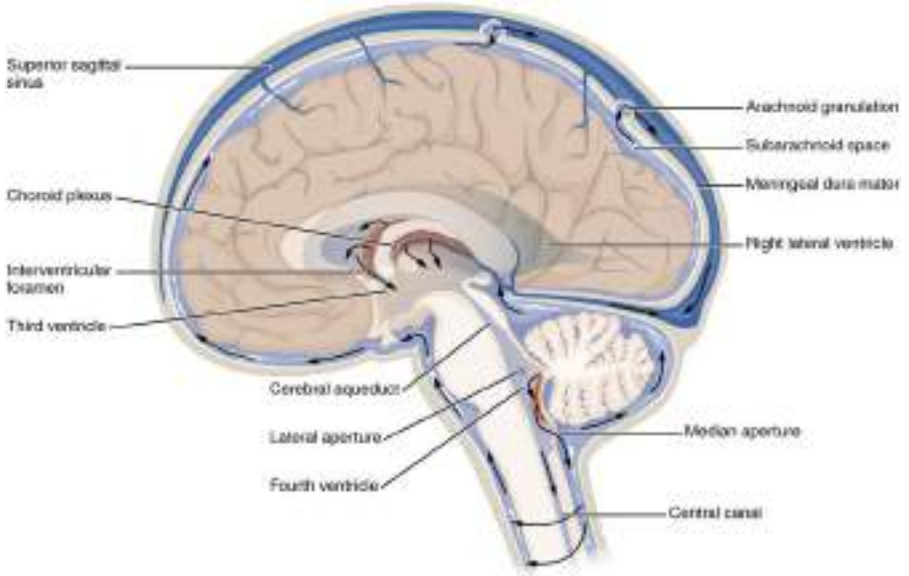
- It is irregular in structure externally and internally.
- It is formed from below upward from: 1- Medulla oblongata (5 cm). 2- Pons (2.5 cm). 3- Midbrain (2 cm).



Medulla oblongata

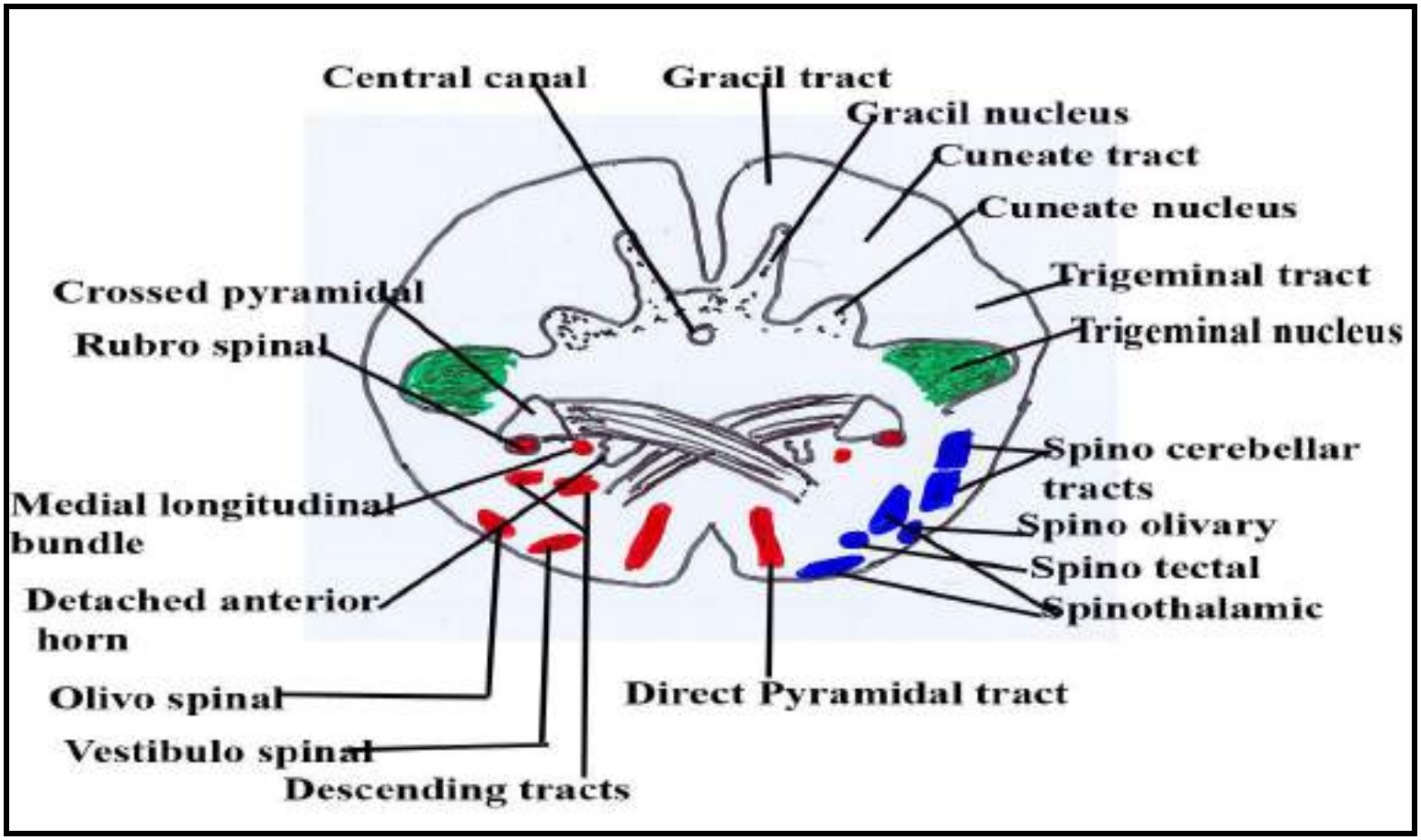
- It is the lower part of brain stem.
- It connects the pons superiorly with the spinal cord inferiorly.
- The lower level contains central a canal and is known as closed medulla.
- The upper level opens in the 4th ventricle and is known as open medulla.





- **The medulla oblongata has three levels from lower to upper (two closed & one open):**

1- Closed medulla (motor decussation):

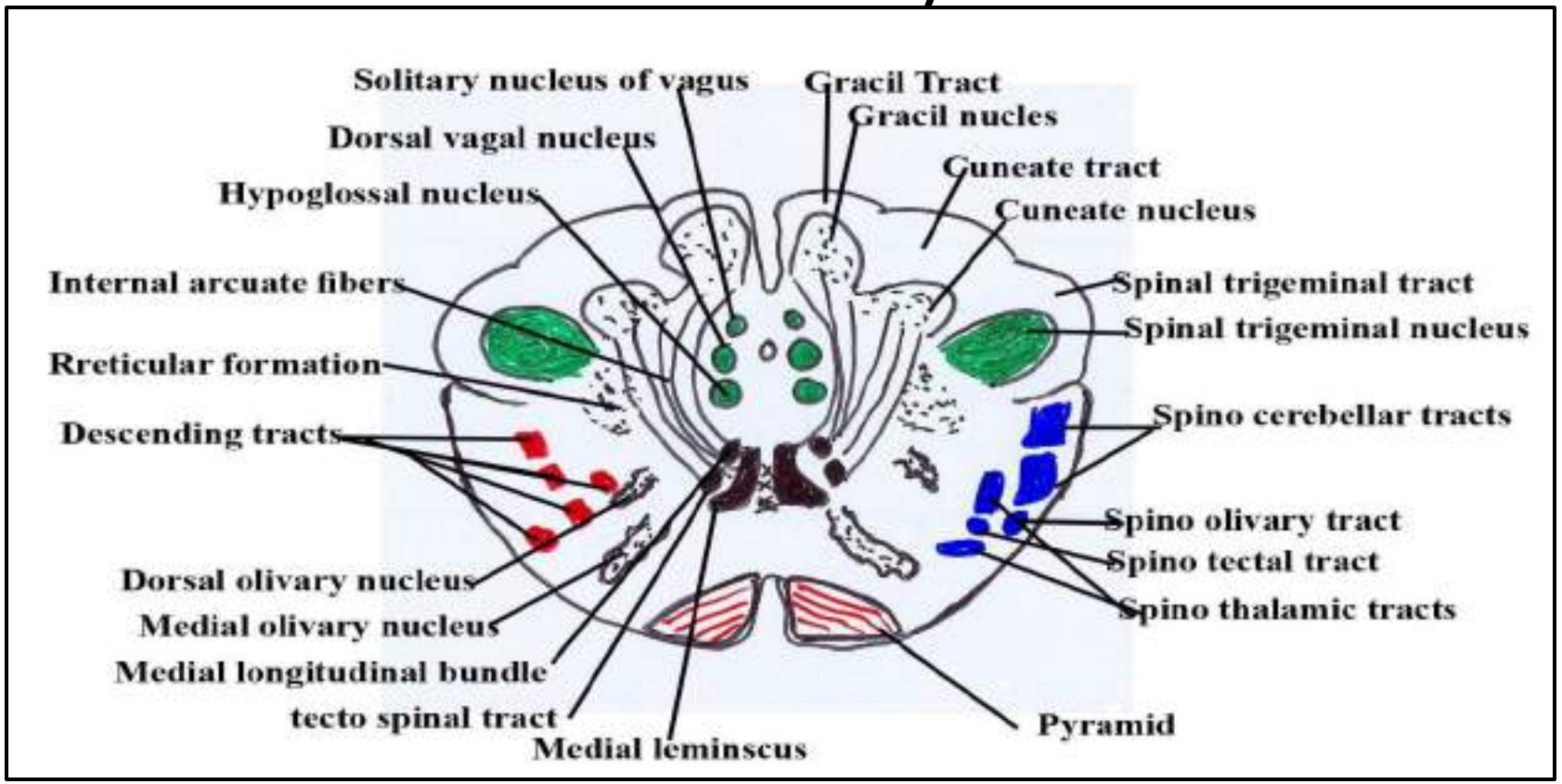


Closed medulla oblongata (motor decussation)

- It contains central canal which is posterior.
- Gracile and cuneate nuclei start to appear and they are small while their tracts are large and start to relay in their nuclei.
- Spinal trigeminal nucleus and tract replace the substantia gelatinosa of Rolandi and Lissauer`s tract carrying pain and temperature sensation from the face

- 80-85 % of pyramidal fibers cross to opposite side forming motor decussation and 10-15 % descend as direct pyramidal tract.
- All descending extrapyramidal tracts present except the ventral (anterior) vestibulo spinal tract and sulcomarginal tract join each other and form medial longitudinal bundle (M.L.B.)

Closed medulla oblongata (sensory decussation):



2-Closed medulla oblongata (sensory decussation)

- It contains central canal which becomes more posterior.
- Gracile and cuneate nuclei are large while their tracts become small.
- Axons from gracile and cuneate nuclei form the internal arcuate fibers which cross to opposite side forming sensory decussation. The crossed sensory fibers ascend in the opposite side as medial lemniscus.
- Medial longitudinal bundle (fasciculus).
- All ascending and descending tracts are present

- Cortico-spinal fibers (pyramidal tract) are present on both sides of anterior median fissure and form two masses on the anterior surface of the medulla (pyramids).

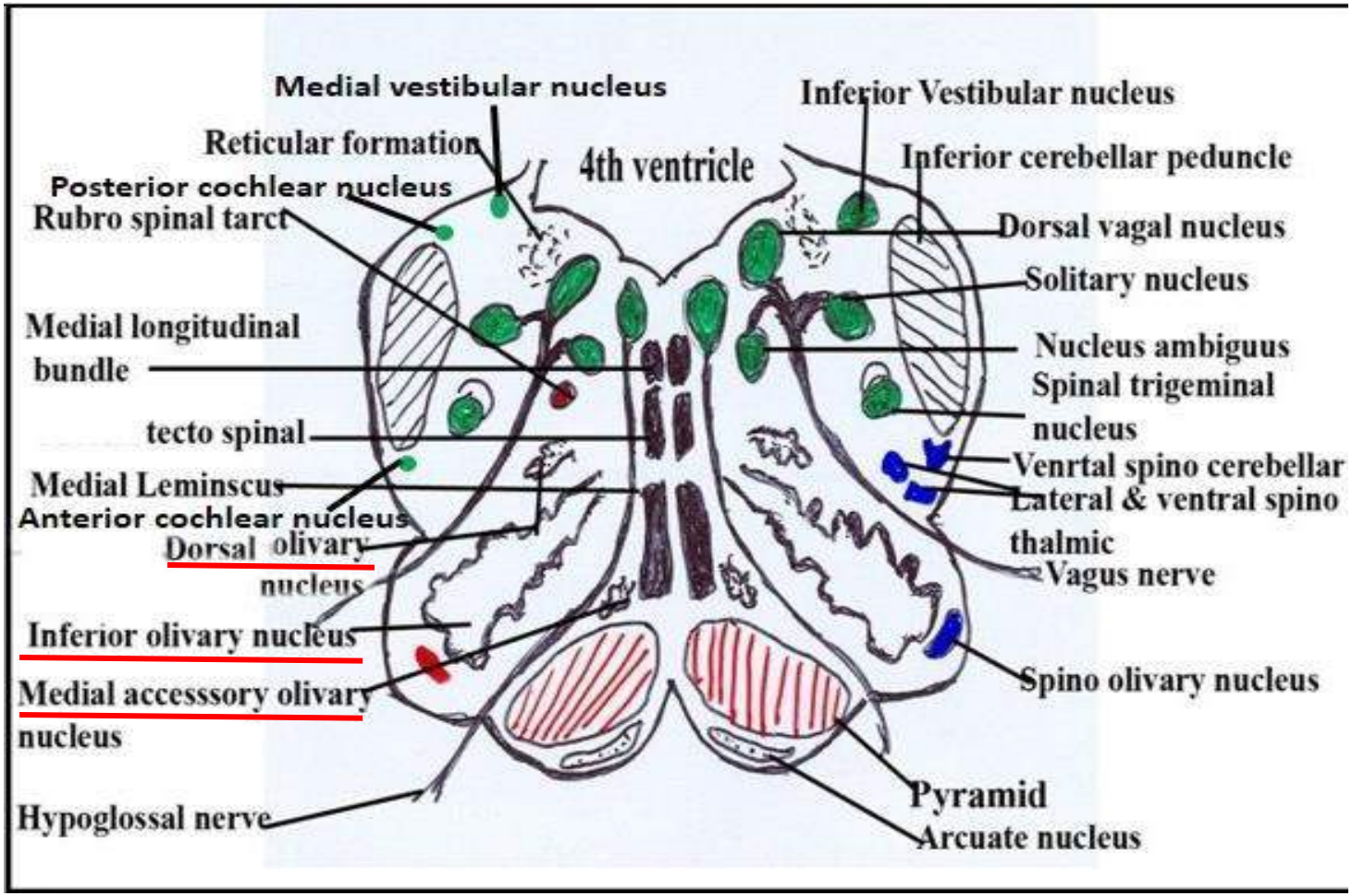
- Lower parts of some cranial nerve nuclei start to appear in the grey matter around the central canal which are:

a) Hypoglossal nucleus.

b) Dorsal vagal nucleus (motor).

c) Sensory vagal nucleus (lower part of solitary nucleus).

3-Open medulla oblongata



Open medulla oblongata

- **No central canal** (the central canal opens posteriorly into 4th ventricle).
- **The pyramids** are present in the anterior part.
- In the **midline** there are:

- Medial longitudinal bundle (posterior)
- Tecto spinal tract (at the middle)
- Medial lemniscus (anterior)

- The grey matter has increased due to the presence of **Olivary complex** which include:

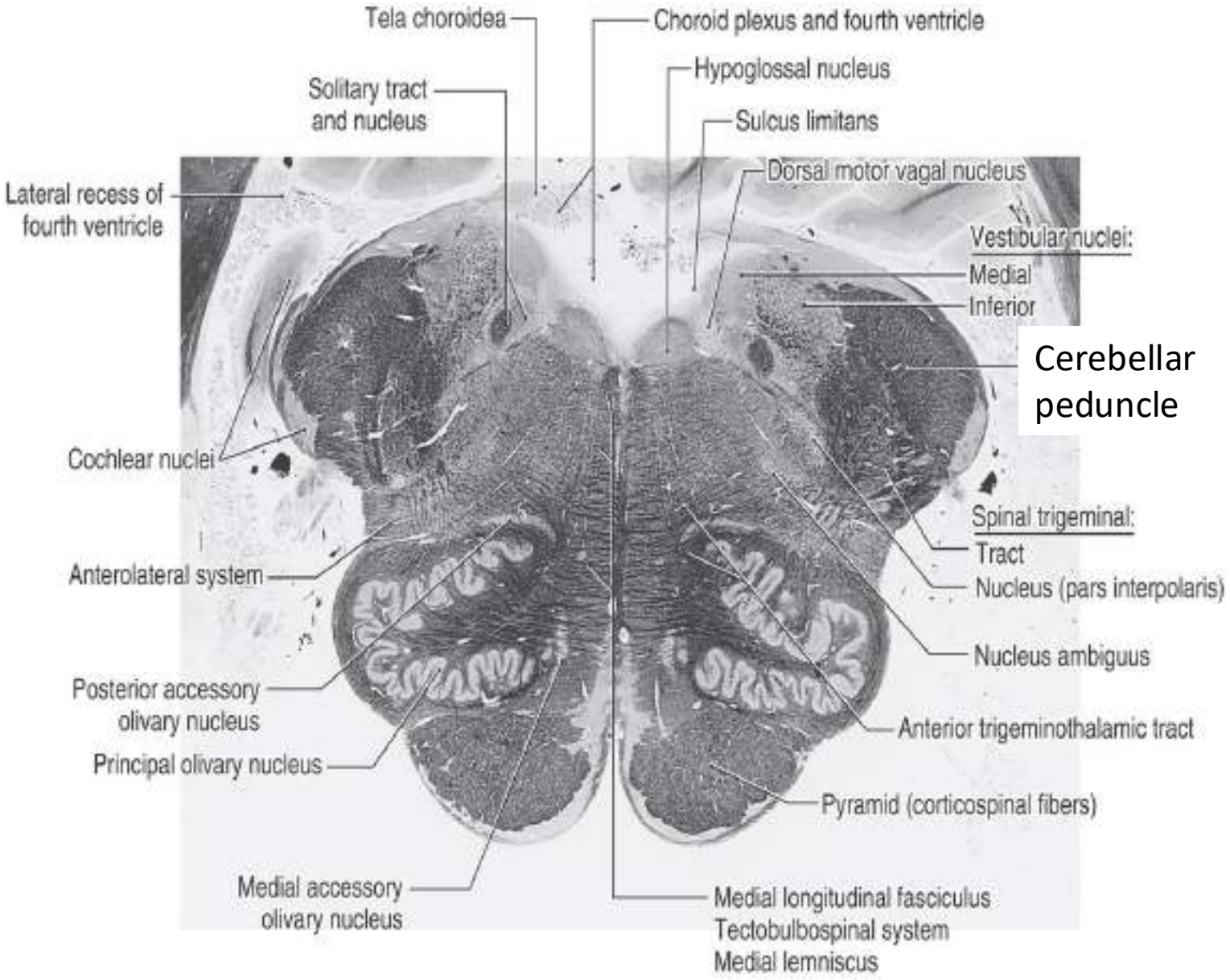
- Inferior olivary nucleus (the largest one).
- Dorsal and medial accessory olivary nuclei which are smaller.

- **The arcuate nuclei:** they lie anterior to the pyramids. These nuclei act as relay station for the proprioceptive pathway.
- **Inferior cerebellar peduncles** (I.C.P) are laterally located.

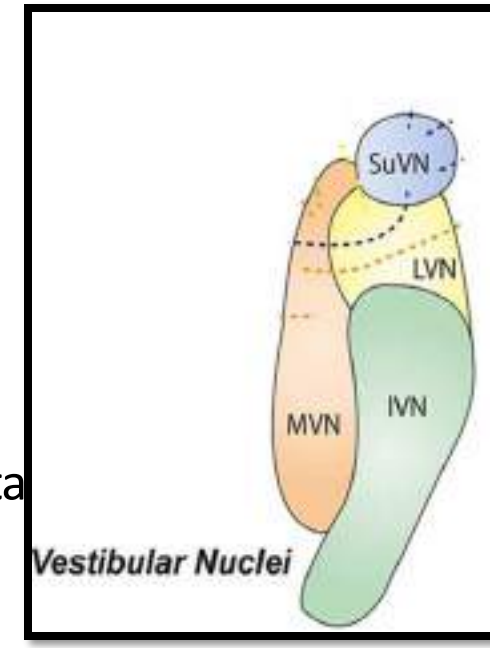
(the structure connecting the cerebellum to the brain stem and the cerebrum)

- **Reticular formation**

- **Presence of cranial nerve nuclei** of the lower 4 cranial nerves (9, 10, 11 &12)
- **5th** (trigeminal) spinal nucleus and tract.
- **8th** (vestibular) and cochlear nuclei start to appear.


Tela choroidea
Choroid plexus and fourth ventricle
Hypoglossal nucleus
Solitary tract and nucleus
Sulcus limitans
Dorsal motor vagal nucleus
Lateral recess of fourth ventricle
Vestibular nuclei:
Medial
Inferior
Cerebellar peduncle
Cochlear nuclei
Spinal trigeminal:
Tract
Anterolateral system
Nucleus (pars interpolaris)
Nucleus ambiguus
Posterior accessory olivary nucleus
Anterior trigeminothalamic tract
Principal olivary nucleus
Pyramid (corticospinal fibers)
Medial accessory olivary nucleus
Medial longitudinal fasciculus
Tectobulbospinal system
Medial lemniscus

VESTIBULAR NUCLEI



- Four cranial nuclei of the vestibular nerve
- They are located at the floor of the 4th ventricle
- These nuclei are:

❖ **The inferior vestibular nuclei** present in the medulla oblongata

❖ Three vestibular nuclei are present in the pons

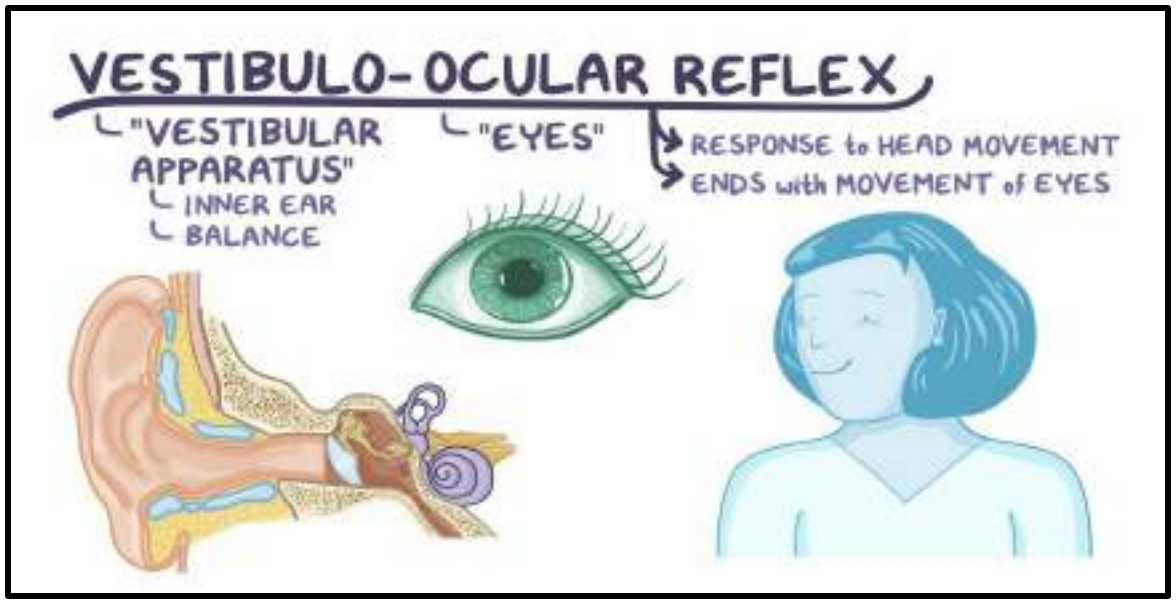
- The **superior** vestibular nucleus

- The **medial** vestibular nucleus: it is the largest nucleus (dorsal or chief vestibular nucleus)

- The **lateral** vestibular nucleus: called nucleus of Deiters, as it contains an extremely large nerve cells called the giant cells of Deiters in addition to smaller neurons.

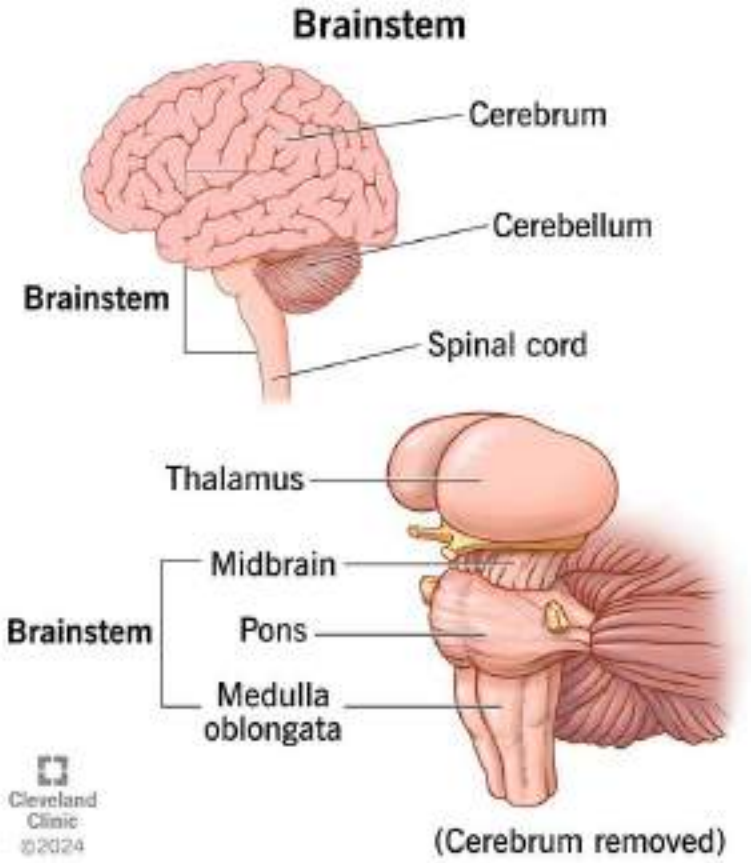
- They are responsible for maintenance of equilibrium and posture, perception of head position and acceleration, as well as general muscle tone.

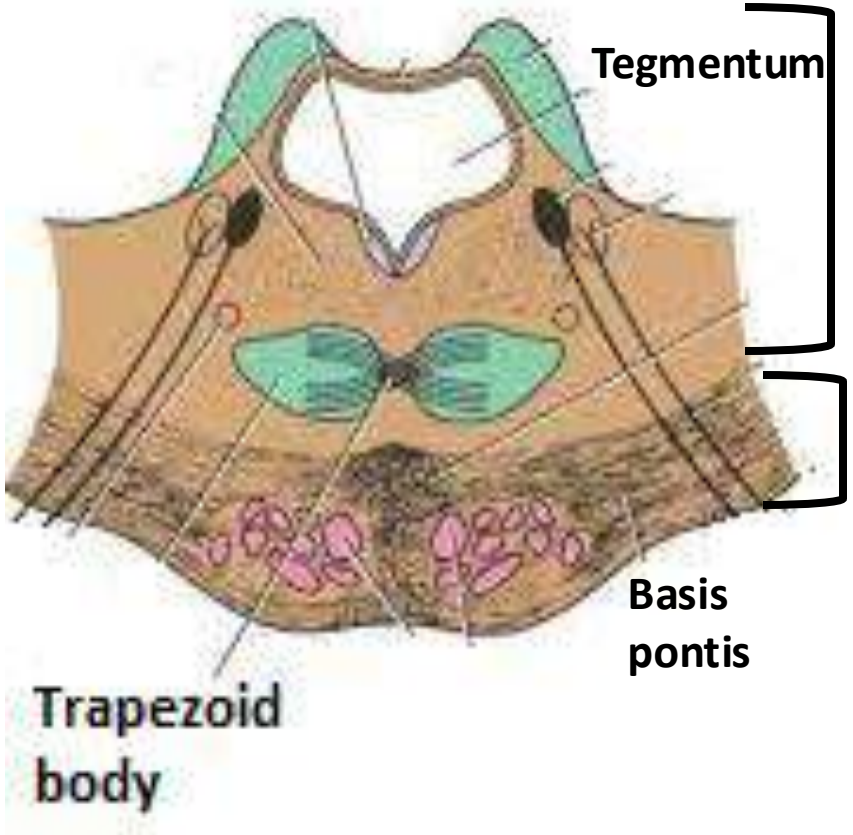
- All nuclei is consist of grey matter (bodies of nerve cells, dendrites, unmyelinated axons and neuroglia).



The pons

- The pons is divided into posterior part, tegmentum and an anterior part, basis pontis by the transversely running fibers of the trapezoid body.





The pons

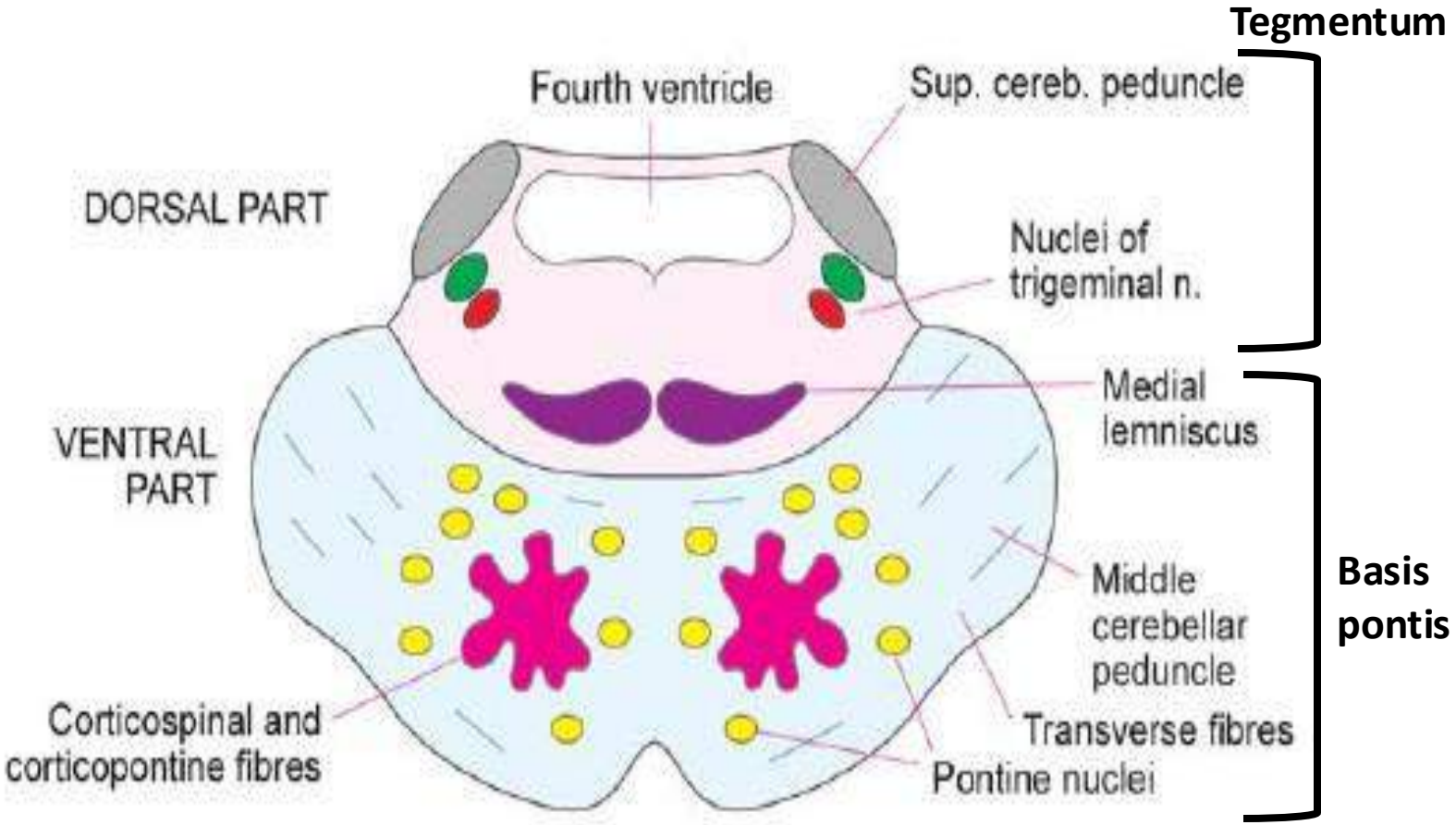


Fig. 6.7. Main features to be seen in a transverse section through the upper part of the pons (Level C in Fig. 6.2)

A- The Basis Pontis:

- It is the same for all levels and contains:

1. **Pontine nuclei:** receive the corticopontine fibers from the cerebral cortex. They are motor nuclei and give pontocerebellar connections in the corticocerebellar pathway.

2. **Transverse pontine fibers**: they are axons from the pontine nuclei to the cerebellum through the middle cerebellar peduncle (M.C.P).

3. **Pyramidal tract bundles:** they are descending corticopontine fibers (which end on the pontine nuclei), cortico spinal fibers & cortico bulbar fibers which are separated into bundles by transverse pontine fibers.

4. **Middle cerebellar peduncles.**

B- The Tegmentum:

- In all levels of pons the tegmentum contains the following structures:

1– Medial longitudinal bundle.

2– Tectospinal tract.

3– Medial lemniscus which **rotates so that its axis runs transversely**.

4 – Spinal lemniscus (dorsal& ventral spinothalamic tracts).

- Reticular formation

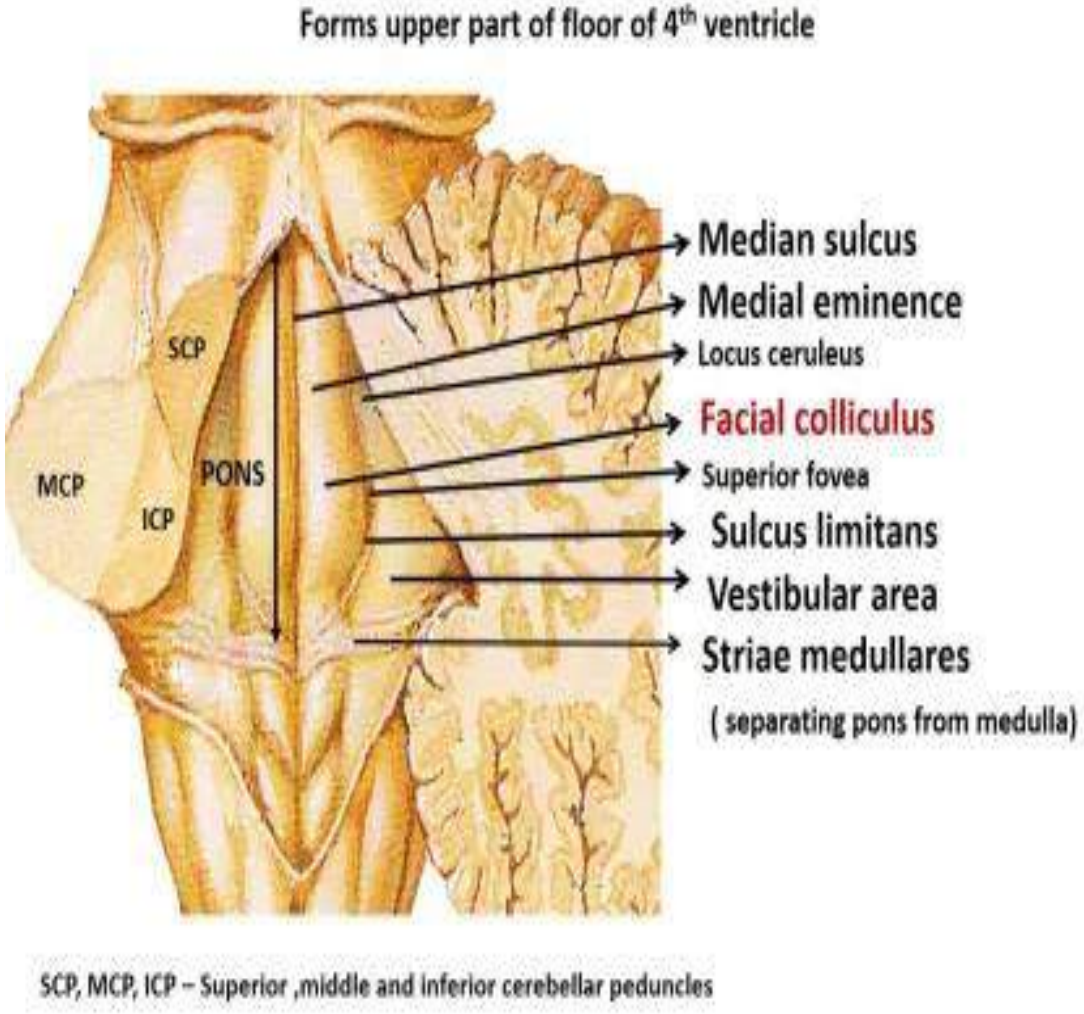
Levels of the pons:- In addition to previous structures there are other structures which characterize each level of pons.

1- Lower level at facial colliculus.

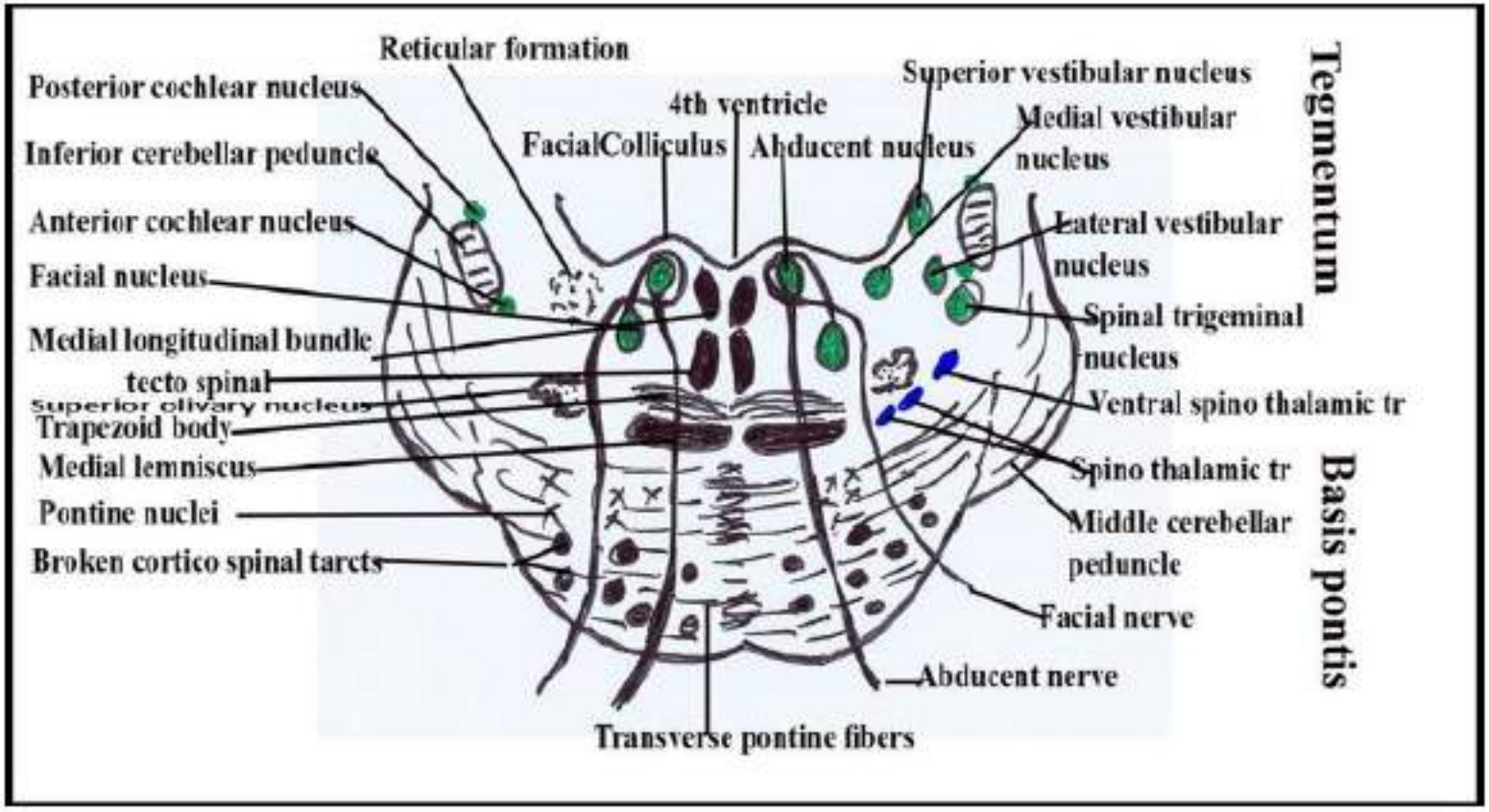
2- Middle level at trigeminal nuclei.

3- Upper level at the site of the four lemnisci.

1-Inferior level of pons (at facial colliculus):



1-Inferior level of pons (at facial colliculus):



1-Inferior level of pons (at facial colliculus):

It is characterized by the presence of:

1- Cavity of the 4th ventricle.

2- Spinal nucleus of trigeminal nerve (V), abducent nucleus (VI), Facial nerve nucleus (VII) and vestibulo-cochlear nerve nuclei (VIII).

NB. Facial nerve fibers loop around abducent nucleus to form facial colliculus.

3- Lateral lemniscus starts to appear: axons from ventral (anterior) cochlear nucleus cross to opposite side and ascend as lateral leminiscus. (auditory pathway)

4-Trapezoid body between tegmentum & basis pontis: axons from ventral and dorsal cochlear nuclei decussate in midline of pons. It also contains trapezoid nuclei. (auditory pathway)

5- Presence of inferior cerebellar peduncle (I.C.P.).

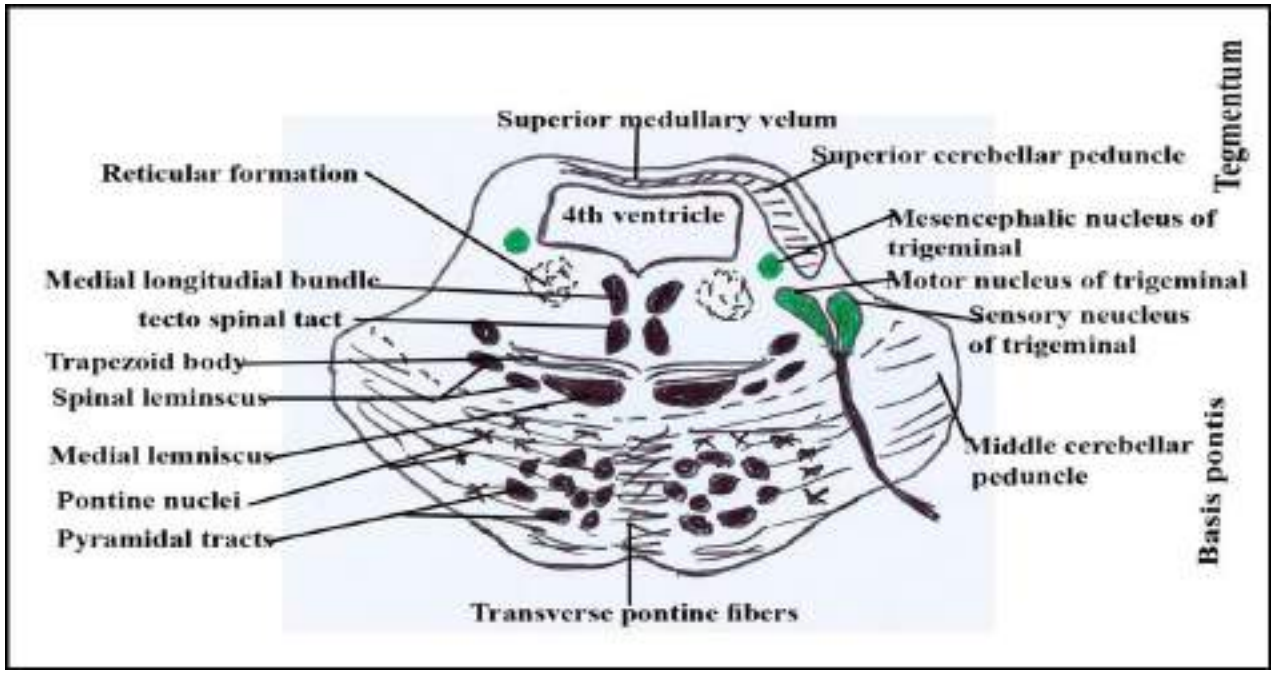
Middle level of pons (at the trigeminal nuclei)

It is characterized by the presence of:

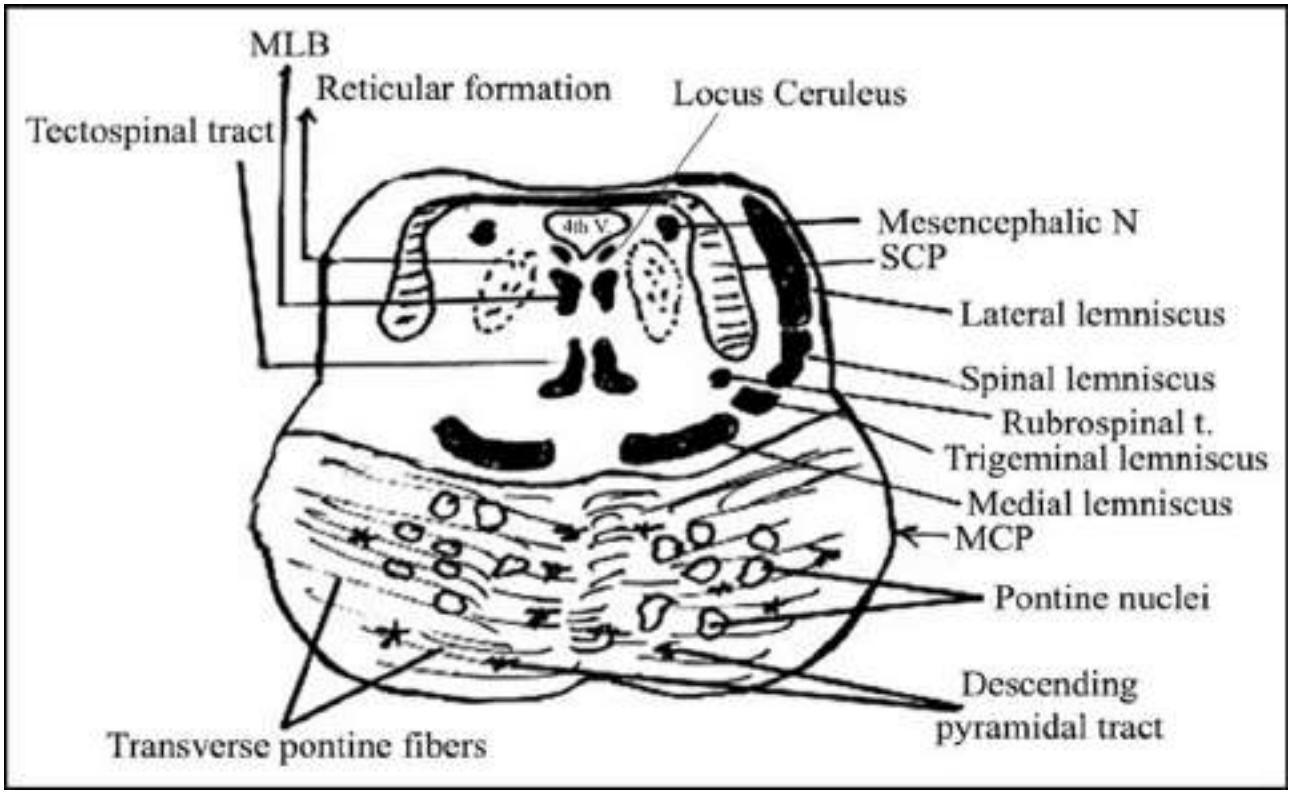
1. 4th ventricle is closed. 2. Lateral lemniscus well be seen.

3. Trigeminal nuclei (motor, main sensory & mesenchephalic nuclei).

4. Trapezoid body. 5. Superior cerebellar peduncle (S. C. P.).



Superior level of pons (site of the four lemnisci)



Superior level of pons (site of the four lemnisci)

- This level is characterized by:

1. Trapezoid body disappears. 2. Well-developed lateral lemniscus.

3. Presence of S. C. P.

4. Presence of 4 lemnisci (Medial, trigeminal, spinal & lateral leminisci).

- **Trigeminal leminiscus:** fibers from trigeminal nuclei (spinal, main sensory and mesencephalic) cross to opposite side, ascend in pons and midbrain to thalamus.

5. Mesenchephalic nucleus of V cranial nerve (trigeminal).

6. Presence of Locus Ceruleus nucleus (noradrenergic neurons)

Locus Ceruleus

1. It is a nucleus located in the posterior area of the rostral (superior) pons at the lateral edge of the 4th ventricle.

2. It is composed of medium-size pigmented neurons containing melanin granules.

3. Locus ceruleus is the main source of noradrenaline supplying all the neuraxis that utilize norepinephrine as their primary neurotransmitter:

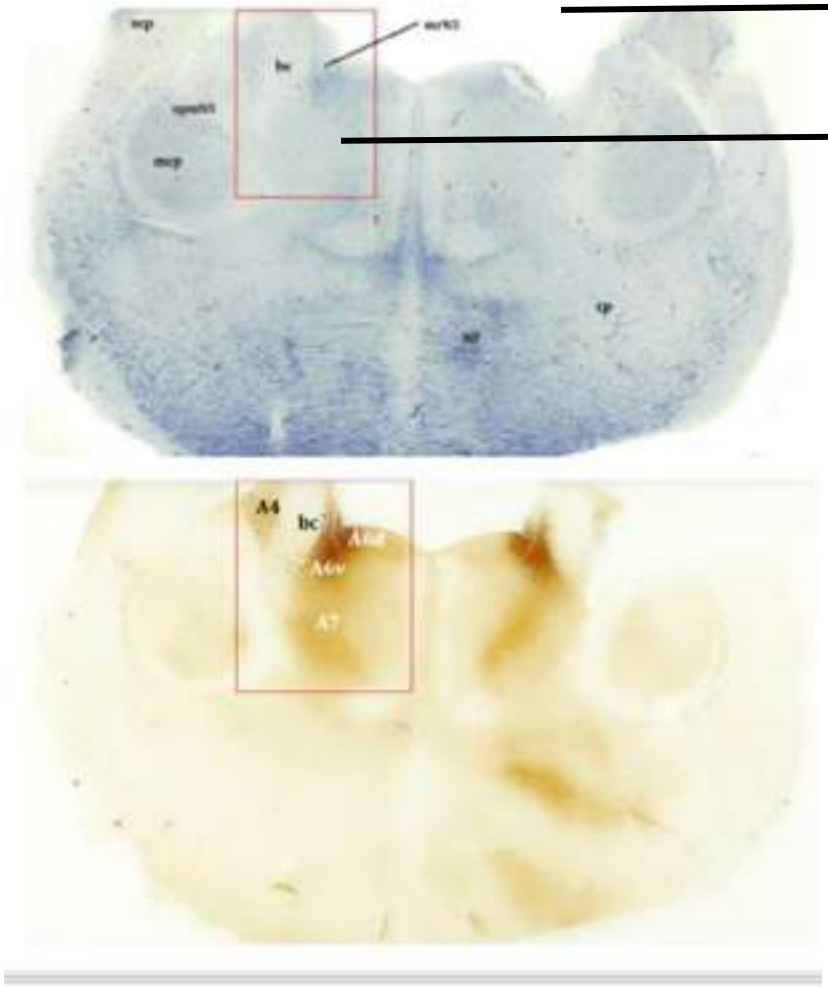
a) Cerebral Cortex b) Cerebellar cortex c) Thalamus, subthalamus

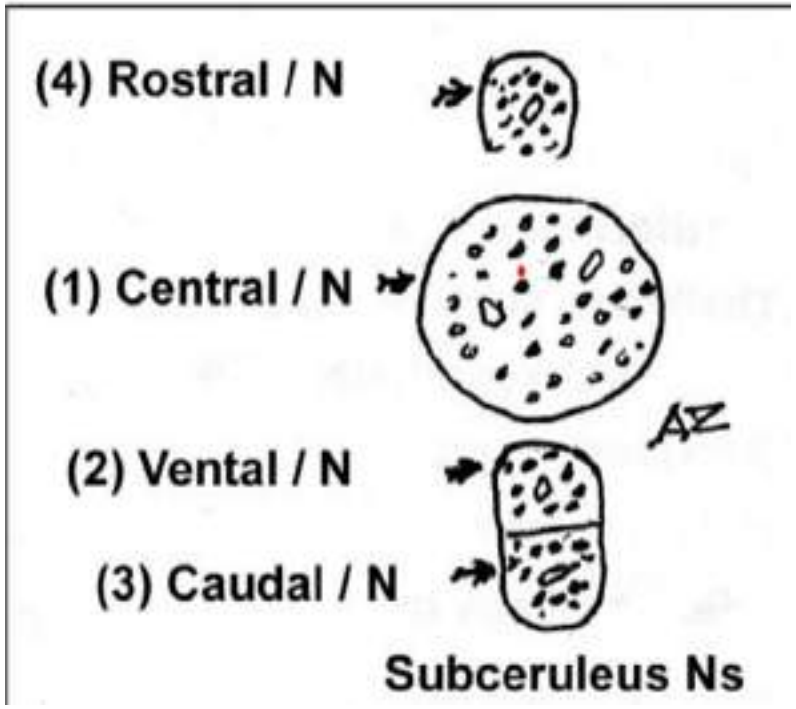
and hypothalamus d) Brain stem e) Spinal cord (sympathetic nuclei)

4. It is subdivided into four nuclei: 1- Central nucleus 2, 3- Subceruleus

nuclei (ventral and caudal) 4- Rostral nucleus.

- They contain 16.000 - 18.000 cells on each side

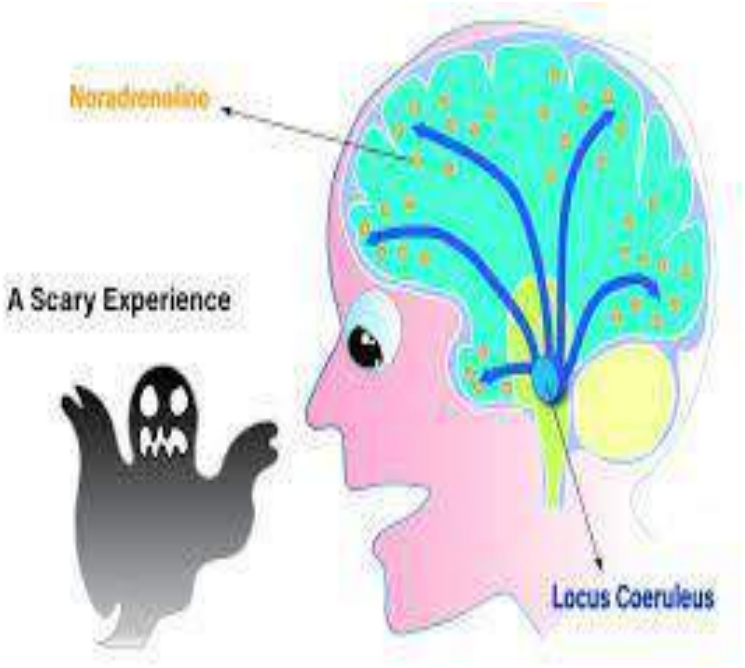

4th Ventricle
Locus cerulus
lc
A4
A6v
A7


(4) Rostral / N
(1) Central / N
AZ
(2) Vental / N
(3) Caudal / N
Subceruleus Ns

6. Microscopically, it consists of grey matter (bodies of nerve cells, dendrites, unmyelinated axons and neuroglia).

7. It is a part of the reticular activating system and involved with physiological responses to stress and panic.

N.B: The Reticular Activating System (RAS) is a network of neurons in the brainstem that acts as a filter and gatekeeper for sensory information, crucial for consciousness, attention, arousal, and the sleep-wake cycle, by activating the cerebral cortex, allowing us to focus on important stimuli while ignoring background noise

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