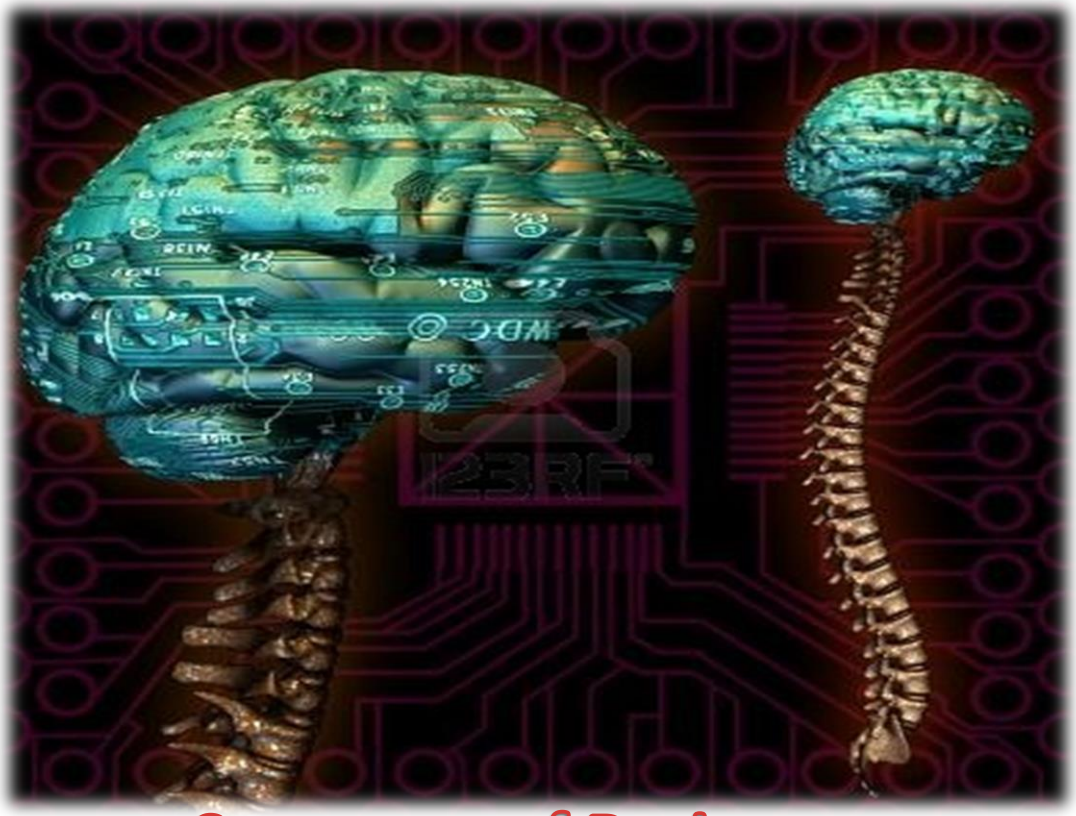
CNS Block



Summary of Brain stem

Done by: Deema al-Turki & Eman al-Bediea& Fahad AlShayhan

<table>
<tr><th></th><th>ventral</th><th colspan="2">dorsal</th></tr>
<tr><td rowspan="2">Medulla</td><td rowspan="2">❑ Ventral median fissure:
• Continuation of ventral median fissure of spinal cord
• Divides the medulla into 2 halves
• Its lower part is masked by decussation of most of pyramidal (corticospinal) fibers (75%-90%).
❑ Pyramid:
• An elevation, lies on either side of ventral median fissure
• Produced by corticospinal tract.
❑ Olive:
• An elevation, lies lateral to the pyramid.
• Produced by inferior olivary nucleus (important in control of movement).
❑ Nerves emerging from Medulla (4 nerves):
• Hypoglossal (12th): from sulcus between pyramid & olive
• Glossopharyngeal (9th), vagus (10th) & cranial part of accessory (11th): from sulcus dorsolateral to olive (from above downwards)</td><td>Closed</td><td>open</td></tr>
<tr><td>❑ Cavity: central canal.
❑ Composed of:
• Dorsal median sulcus: divides the closed medulla into 2 halves.
• Fasciculus gracilis: on either side of dorsal median sulcus.
• Gracile tubercle: an elevation produced at the upper part of fasciculus gracilis, marks the site of <u>gracile nucleus</u>.
• Fasciculus cuneatus: on either side of fasciculus gracilis.
• Cuneate tubercle: an elevation produced at the upper part of fasciculus cuneatus, marks the site of <u>cuneate nucleus</u>.</td><td>❑ Cavity: 4th ventricle
❑ On either side, an inverted V-shaped sulcus divides the area into 3 parts (from medial to lateral):
1. Hypoglossal triangle: overlies <u>hypoglossal nucleus.</u>
2. Vagal triangle: overlies <u>dorsal vagal nucleus</u>.
3. Vestibular area: overlies <u>vestibular nuclei</u>.</td></tr>
<tr><td>Pons</td><td>❑ Basilar sulcus*:
• Divides the pons into 2 halves, occupied by basilar artery.
❑ Transverse pontine (pontocerebellar) fibers:
• Originate from pontine nuclei, cross the midline & pass through the contralateral middle cerebellar peduncle* to enter the opposite cerebellar hemisphere.
❑ Nerves emerging from Pons (4 nerves):
• Trigeminal (5th): from the middle of ventrolateral aspect of pons, as 2 roots: a small medial motor root & a large lateral sensory root.
• Abducent (6th): from sulcus between pons & pyramid.
• Facial (7th) & vestibulocochlear (8th): at cerebellopontine angle (<u>junction between medulla, pons & cerebellum</u>). Both nerves emerge as 2 roots: from medial to lateral: motor root of 7th, sensory root of 7th vestibular part of 8th & cochlear part of 8th</td><td colspan="2">❑ Separated from the medulla by an imaginary line passing between the caudal margins of middle cerebellar peduncle.
• On either side, a sulcus divides the area into 2 parts (from medial to lateral):
▪ Medial eminence & facial colliculus*: overlies <u>abducent nucleus</u>.
▪ Vestibular area: overlies <u>vestibular nuclei</u>.
The dorsal surface of open medulla and pons lie in the caudal 1/3rd and the rostral 2/3rd of the floor of the 4th ventricle respectively</td></tr>
<tr><td>Midbrain</td><td>❑ large column of descending fibers (crus cerebri or basis pedunculi), on either side, separated by a depression called the interpeduncular fossa*.
❑ Nerve emerging from Midbrain (one):
• Occulomotor (3rd): from medial aspect of crus cerebri.</td><td colspan="2">❑ Marked by 4 elevations:
1. Two superior colliculi: concerned with visual reflexes.
2. Two inferior colliculi: forms part of auditory pathway.
❑ Nerve emerging from Midbrain (one):
• Trochlear (4th): just caudal to inferior colliculus (The only cranial nerve emerging from dorsal surface of brain stem).</td></tr>
</table>

INTERNAL

medulla

CAUDAL (closed) MEDULLA

- 1. *Traversed by the Central Canal.*
- *Motor Decussation.*
- *Spinal Nucleus of Trigeminal (Trigeminal sensory nucleus) :*

It is a larger sensory nucleus.

It is the brain stem continuation of the Substantia Gelatinosa of spinal cord.

TRIGEMINAL SENSORY NUCLEUS & TRACT

- *The Nucleus Extends :*
- *Through the whole length of the brain stem and into upper segments of spinal cord.*
- *It lies in all levels of M.O, medial to the spinal tract of the trigeminal.*
- *It receives pain and temperature from face, forehead.*

Its tract present in all levels of M.O. is formed of descending fibers that terminate in the trigeminal nucleus

PYRAMIDAL DECUSSATION

- *It is Motor Decussation.*
- *Formed by pyramidal fibers, (75-90%) cross to the opposite side*
- *They descend in the lateral white column of the spinal cord as the lateral corticospinal tract.*

The uncrossed fibers form the ventral corticospinal tract.

MID MEDULLA

- *Traversed by Central Canal.*
- *Larger size Gracile & Cuneate nuclei, concerned with proprioceptive deep sensations of the body.*
- *Axons of Gracile & Cuneate nuclei form the internal arcuate fibers; Sensory Decussation.*
- *Pyramids are prominent ventrally.*

SENSORY DECUSSATION

- *Formed by the crossed internal arcuate fibers*
- *Medial Leminiscus:*
  - *Composed of the ascending internal arcuate fibers after their crossing.*
  - *Lies adjacent to the middle line ventral to the central canal*
  - *Terminates in thalamus.*

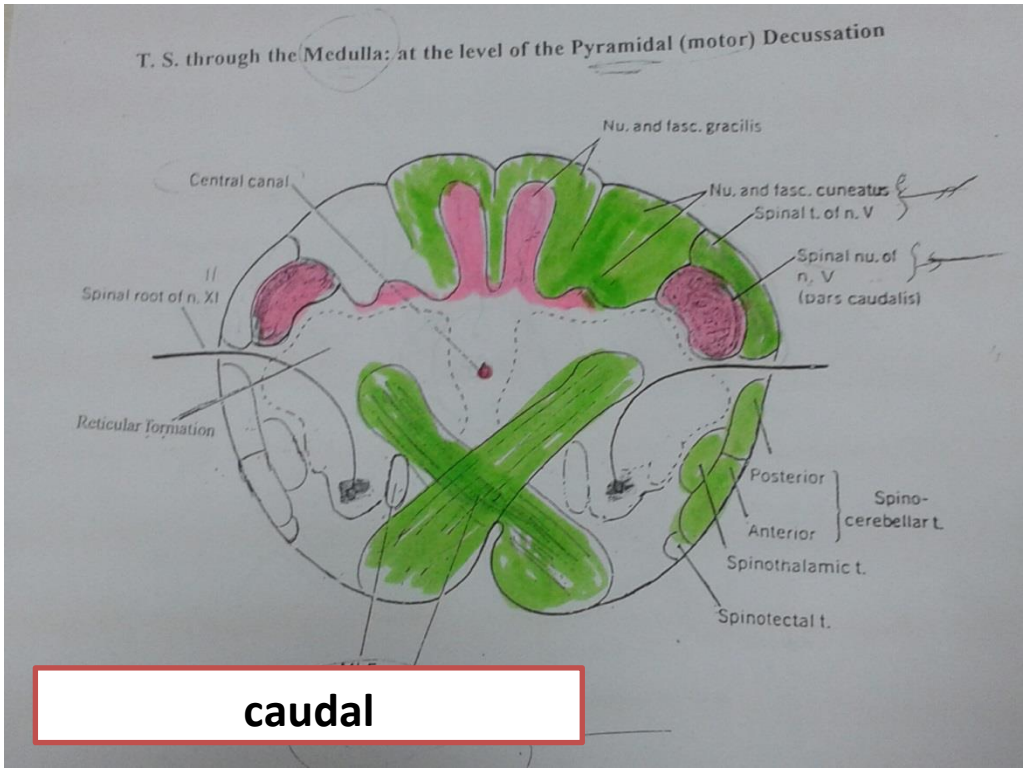
ROSTRAL (open) MEDULLA

On the ventral aspect :

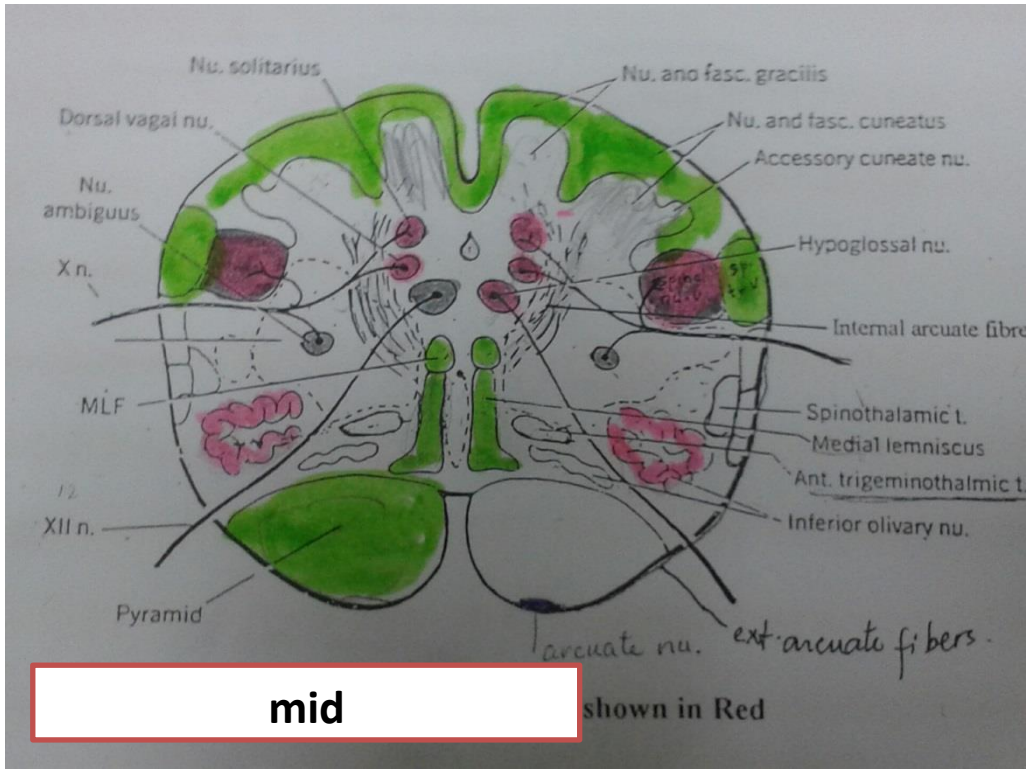
- The pyramid is clear, with medial lemniscus on either sides of middle line dorsal to the pyramid
- Inferior Olivary Nucleus:
  - A convoluted mass of gray matter., lies posterolateral to the pyramids & lateral to the medial leminiscus.
    It is concerned with the control of movement.

Its dorsal surface forms:

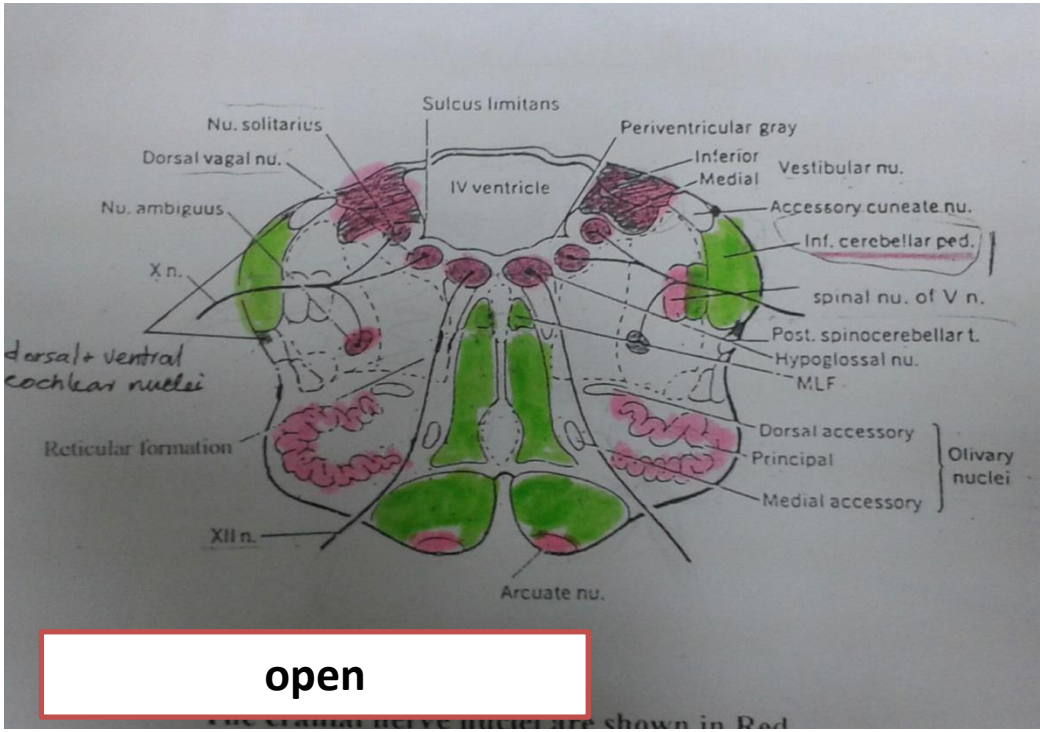
- Lower part of the floor of the 4th ventricle.
- The Inferior Cerebellar Peduncle is, connecting M.O. with cerebellum.
- dorsal and lateral to the Inferior cerebellar peduncle lie the Cochlear nuclei (dorsal and ventral).
- Beneath the floor of 4th ventricle lie :
- *1. Hypoglossal Nucleus.*
- *2. Dorsal Nucleus of Vagus lateral to the hypoglossal nucleus, contains preganglionic parasympathetic fibers.*
- *3. Medial longitudinal fasciculus lies close to the midline, ventromedial to the hypoglossal nucleus, dorsal to the medial lemniscus. It links the vestibular nuclei with nuclei of extraocular ms.(3,4&6) to help coordination of head & eye movements.*
- *4. Vestibular nuclei complex : concerned with equilibrium.*
- *5. Nucleus Ambiguus: lies dorsal to olivary nucleus gives motor fibers to constrictors of the pharynx & intrinsic muscles of the larynx.*
- *6. Solitary nucleus: lies ventrolateral to dorsal nucleus of vagus, receive taste sensation from the tongue along the facial (VII), glossopharyngeal (IX) and vagus (X) cranial nerves.*



caudal



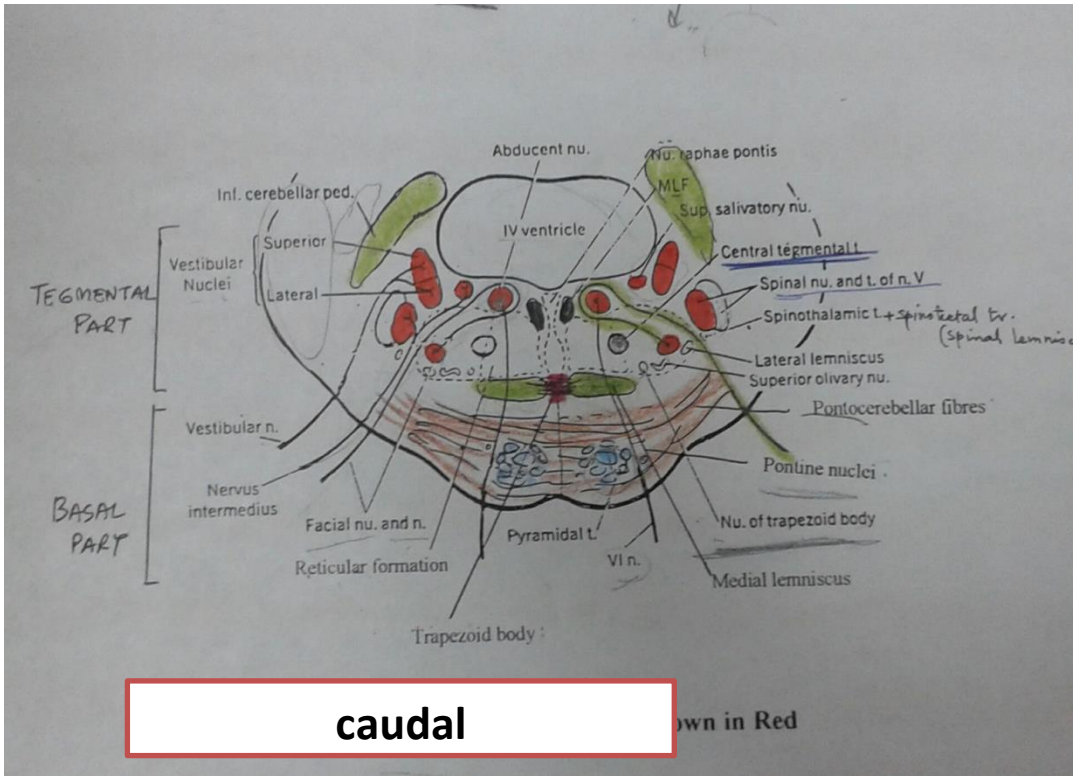
mid



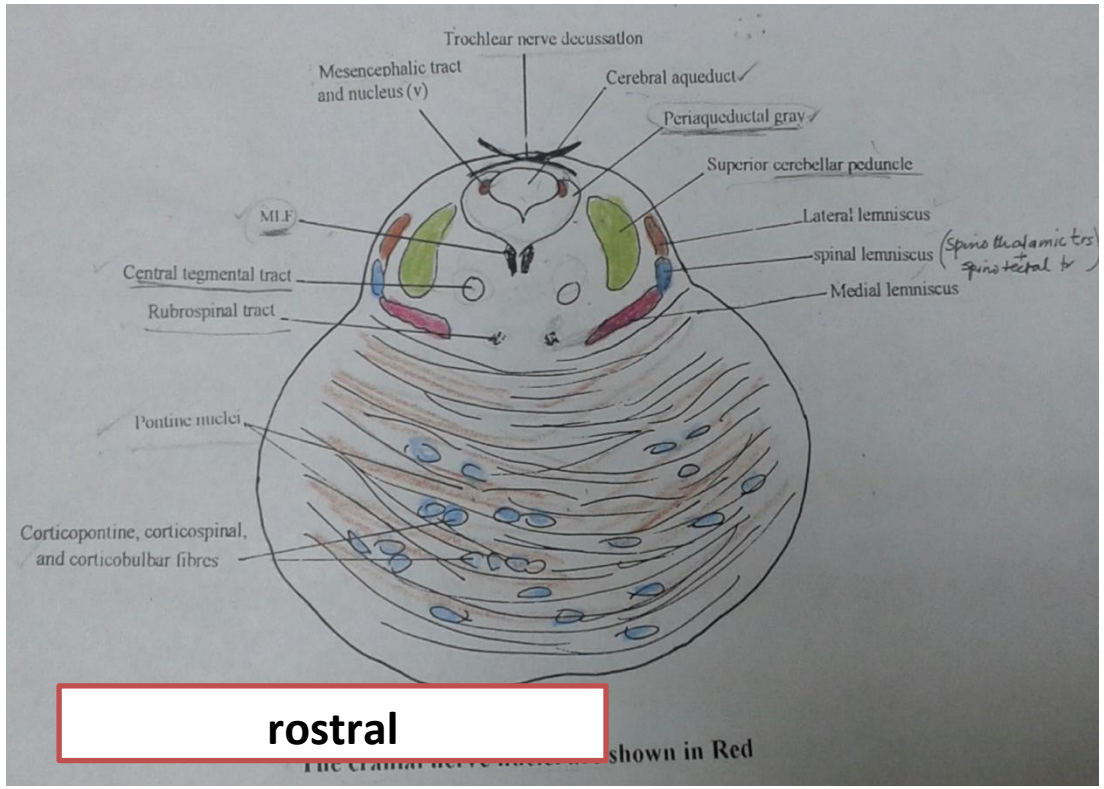
open

Internal

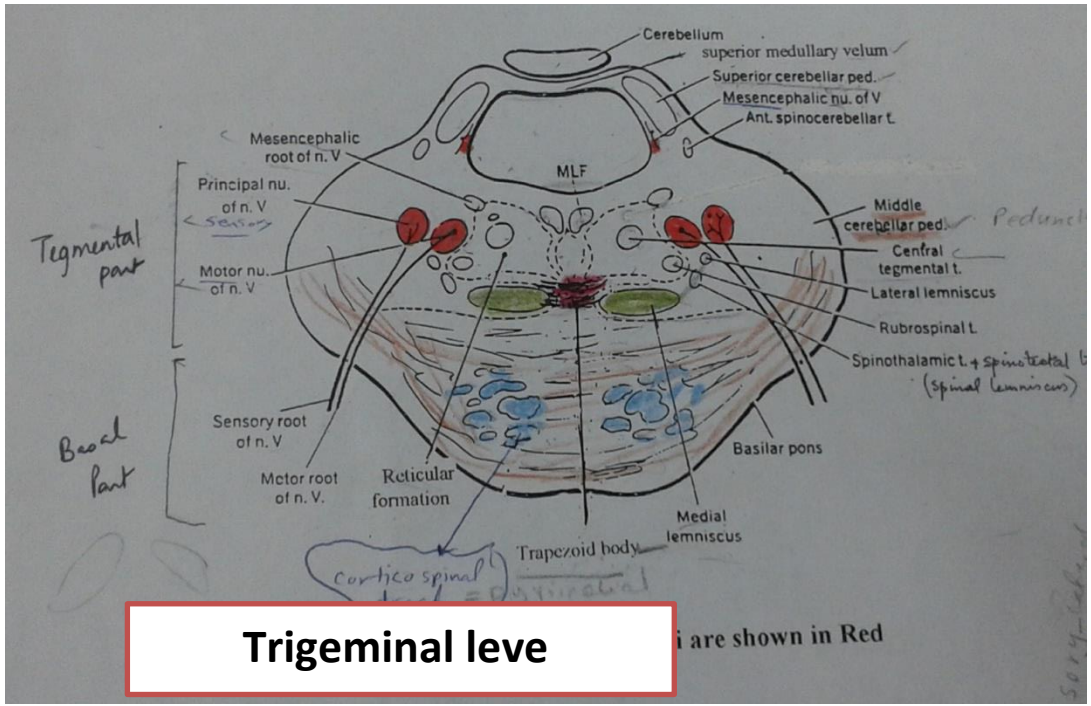
Pons	CAUDAL PART OF THE PONS	AT THE LEVEL OF THE TRIGEMINAL NERVE	ROSTRAL PONS
	⊡ *Divided into an anterior part (Basis Pontis) & a posterior part (Tegmentum) by the Trapezoid Body (consists of acoustic fibres from cochlear nuclei to ascend into midbrain as lateral lemniscus and terminate in inferior colliculus).* ⊡ *The ventral portion is marked by numerous transversely oriented fascicles of pontocerebellar fibres that originate from scattered cell groups, the pontine nuclei, and that pass to the contralateral side of the cerebellum through the massive middle cerebellar peduncle.* ***Pontine Nuclei:*** ⊡ *Are small masses of nerve cells, receive cortico pontine fibers. Their axons form the transverse pontocerebellar fibers which pass to the contra lateral side of the cerebellum through Middle Cerebellar peduncles.* *Bundles of corticospinal & corticonuclear fibres.* ⊡ The ascending fibres of the **medial lemniscus** become separated from the pyramid and displaced dorsally. ⊡ *The Medial Lemniscus rotates 90 degrees and lies almost horizontally.* ⊡ It contains **spinal nucleus & tract of Trigeminal.** ⊡ *Deep origin of cranial nerve nuclei:* ⊡ *Abducent nucleus* ⊡ *Facial motor nucleus*	▪ *Motor nucleus of the trigeminal nerve: Lies in the lateral part of the floor of the 4th ventricle.* ▪ *Main sensory nucleus of the trigeminal nerve: Reaches its maximum extent in the pons and it lies lateral to the motor nucleus.* ▪ *Superior cerebellar peduncles form the lateral boundary of the 4th ventricle*	▪ *Superior Medullary Velum: Passes between the two peduncles & forms the roof of the 4th ventricle.* ▪ *Medial longitudinal fasciculus: Lies close to the midline beneath the floor of the 4th ventricle.*



caudal



rostral



Trigeminal leve

Mid brain

- *It is divided into a dorsal part (Tectum) and a ventral part (Tegmentum) at the level of the cerebral aqueduct.*
- *The cerebral aqueduct is surrounded by a pear shaped periaqueductal (central) gray matter.*
- *The most ventral part of the tegmentum is the massive fibrous mass (Crus Cerebri).*

INFERIOR COLLICULUS Level

- *Inferior colleculus is a large nucleus of gray matter that lies beneath a corresponding surface elevation.*
- *It is part of the auditory pathway.*
- *It receives fibers from the lateral lemniscus.*
- *Its efferent fibers pass to the thalamus*

1. ***Trochlear nucleus:***
   - *lies in the central gray matter close to the median plane just posterior to the medial longitudinal bundle.*
   - *The fibers of the trochlear nerve decussate in the superior medullary velum.*
2. ***Decussation of the superior cerebellar peduncles in the mid line.***
3. ***Substantia nigra:***

- *Occupies the most ventral part of the tegmentum.*
- *It consists of pigmented, melanin containing neurones.*
- *It projects to the basal ganglia. Its degeneration is associated with Parkinson's disease.*

Ascending leminisci

- *Composed Of:*
  - *Medial lemniscus.*
  - *Spinal (Lateral & anterior spinothalamic tracts)*
  - *Trigeminal (Lateral & medial).*
  - *Lateral lemniscus.*

Crus cerebri

- **It is a massive mass ventral to the substantia nigra.**
- **It consists entirely of descending cortical efferent fibers (Frontopontine, Corticospinal & corticobulbar and Temporopontine Fibres) to the motor cranial nerve nuclei and to anterior horn cells.**
- **Involved in the coordination of movement.**

SUPERIOR COLLICULUS Level

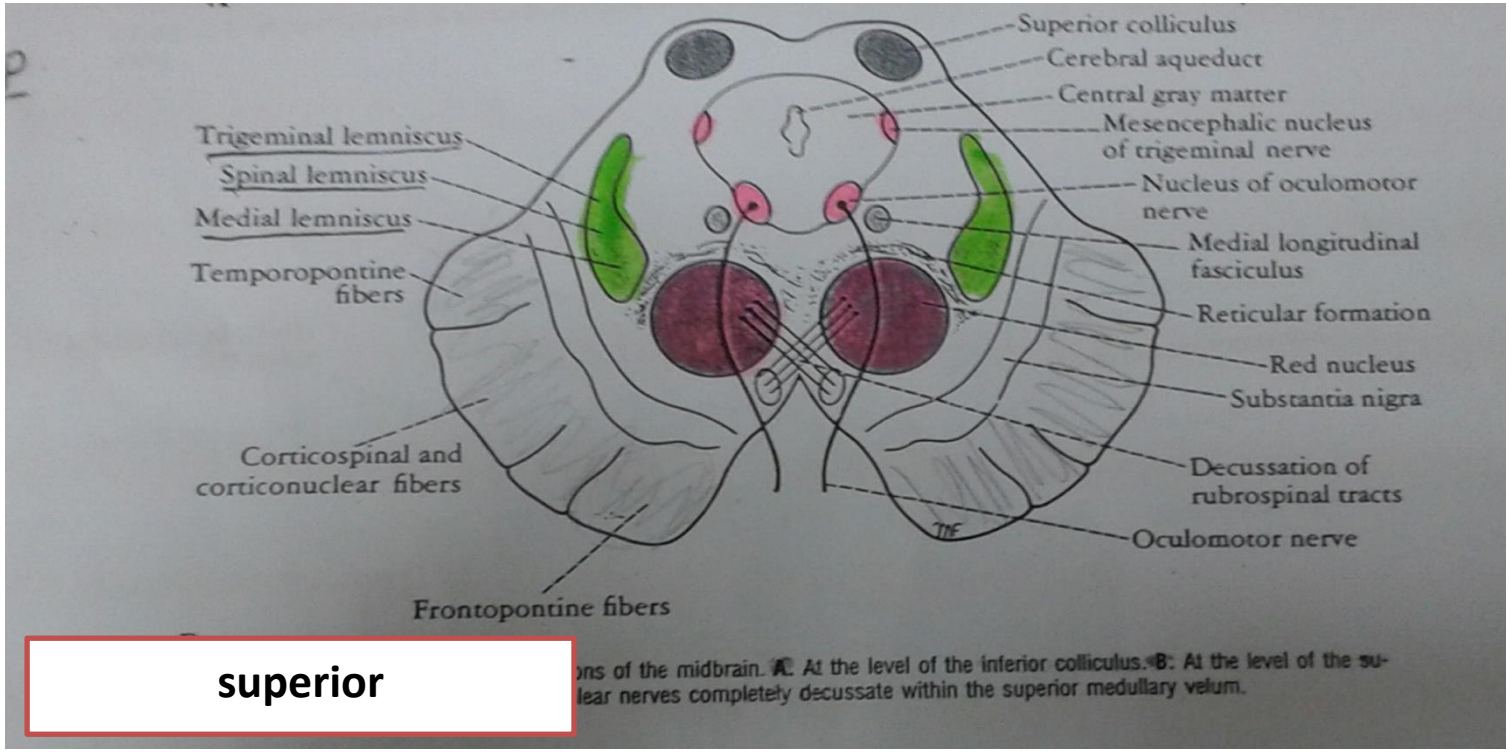
- *A large nucleus of gray matter that lies beneath corresponding elevation.*
- *It forms part of the visual reflexes.*
- *Its efferent fibers go to the anterior horn cells & to cranial nuclei 3, 4, 6, 7 & 11 .(*
- *It is responsible for the reflex movements of the eyes, head and neck in response to visual stimuli, as in following a moving object or altering the direction of the gaze.*

1- ***Oculomotor nucleus:***

- *Situated in the central gray matter close to the median plane.*
- *The fibers of the oculmotor nerve passes anteriorly through the red nucleus to emerge on the medial side of the crus cerebri.*

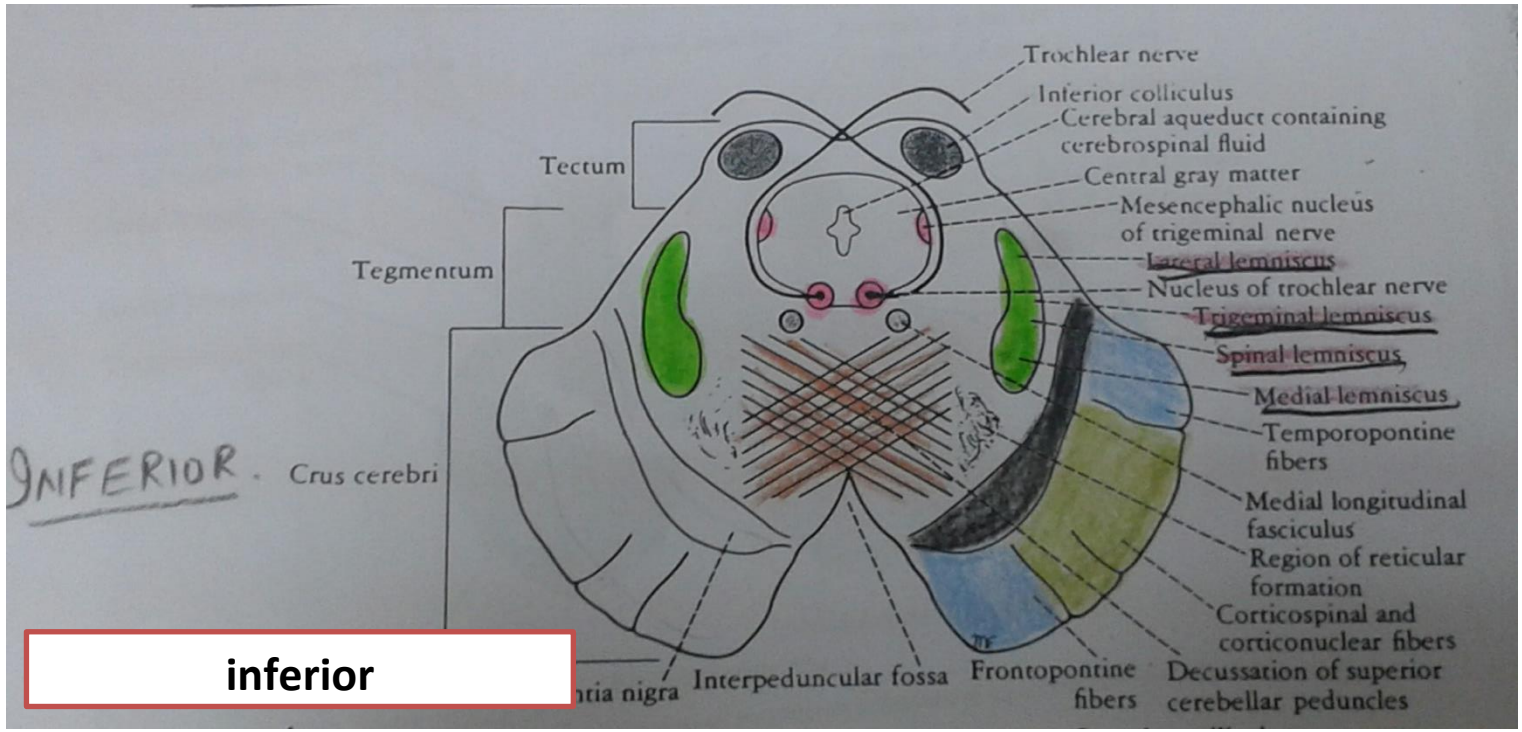
2- **Red nucleus :**

- **A rounded mass of gray matter** that lies in the central portion of the tegmentum.
- Its red coloration is due to its vascularity and the presence of an iron containing pigment in the cytoplasm of its neurons.
- It is involved in **motor control.**



ons of the midbrain. A. At the level of the inferior colliculus. B. At the level of the su-
lear nerves completely decussate within the superior medullary velum.

superior



inferior

RETICULAR FORMATION

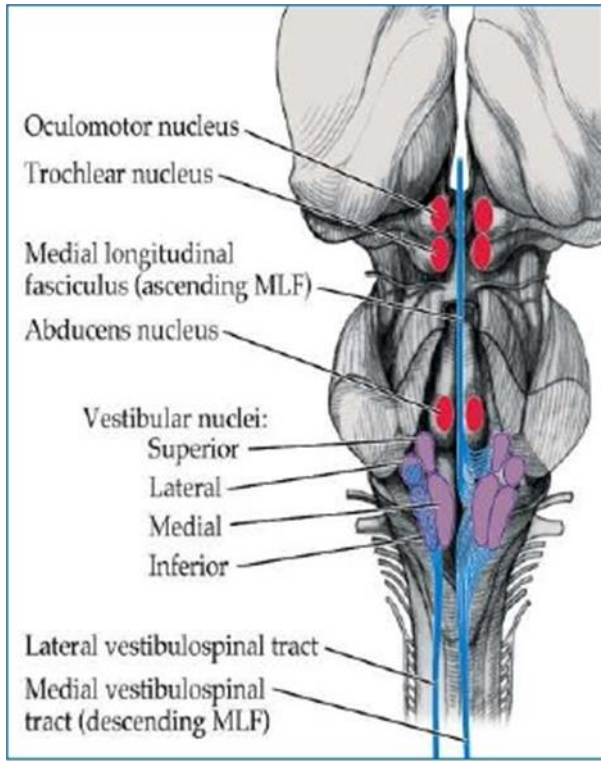
- It is a complex matrix of nerve fibers & small groups of nerve cells that extends throughout the brain stem.
- It has a number of important functions i.e. Respiratory and Cardio-vascular centers are located in the medullary and caudal pontine reticular formation

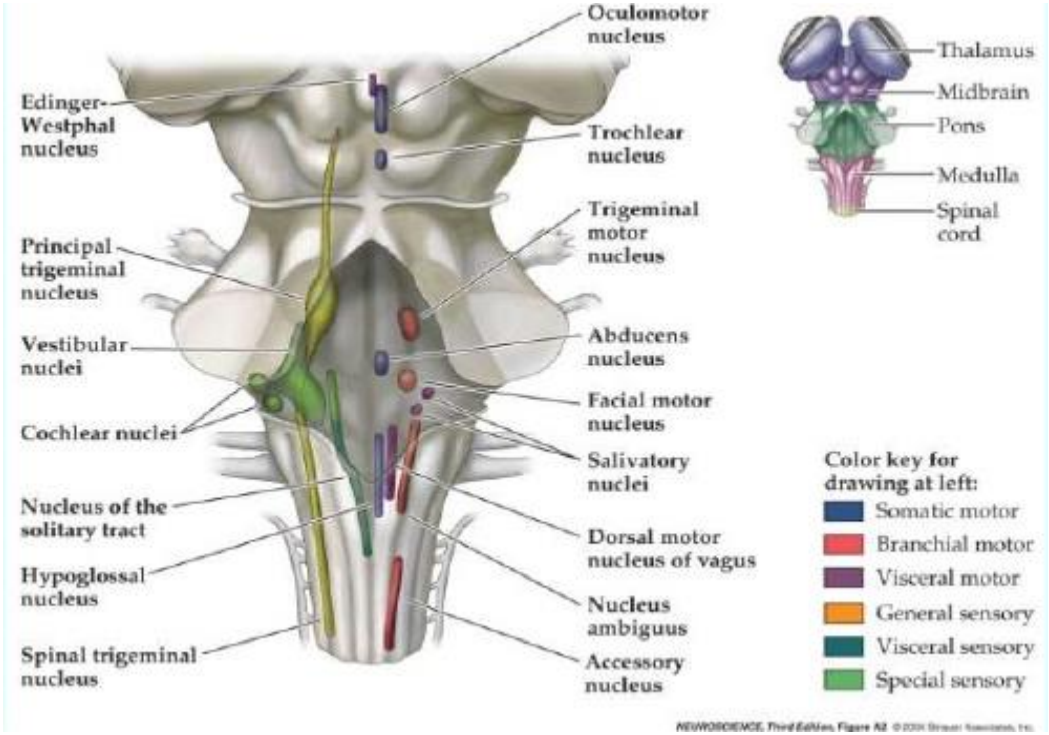
RETICULAR TRACTS

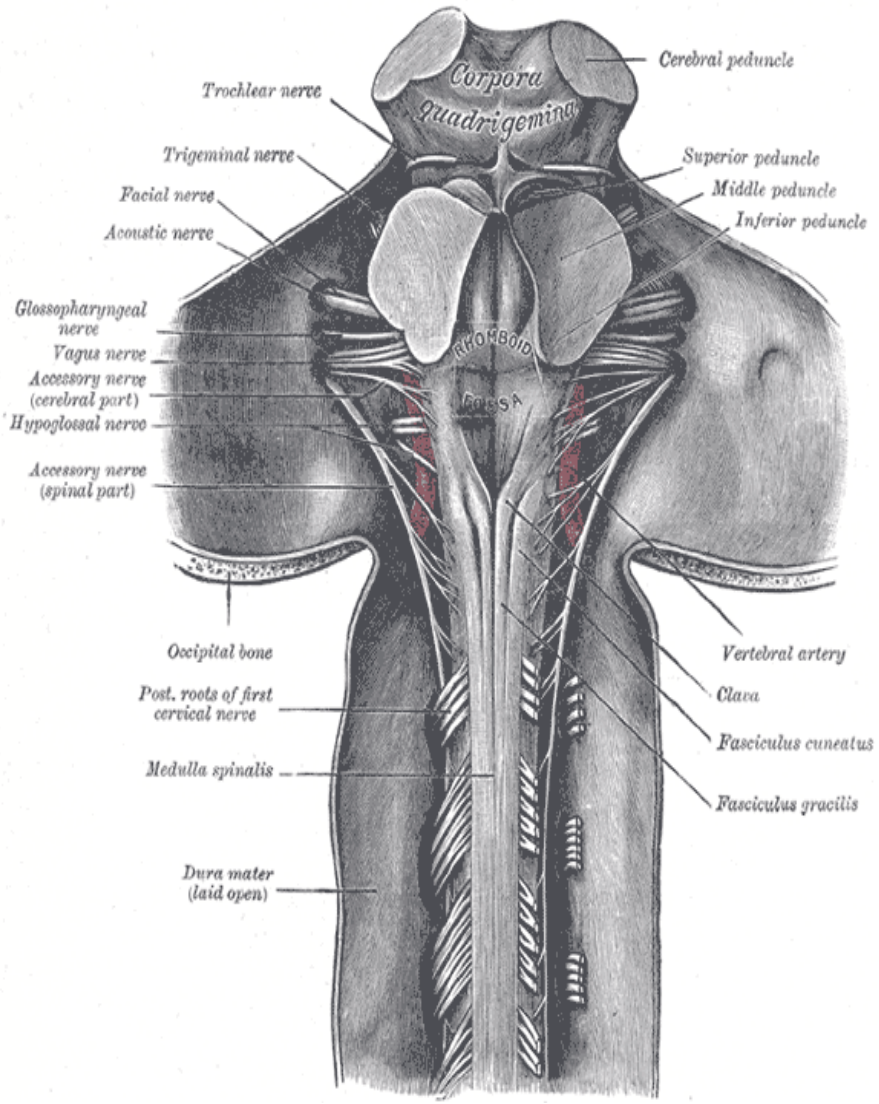
- Reticulo spinal tracts:
  - Influence a muscle tone & posture
- Reticular Activating system:
  - Formed of some of the ascending fibers of the reticular formation.
  - They activate the cerebral cortex through the thalamus.

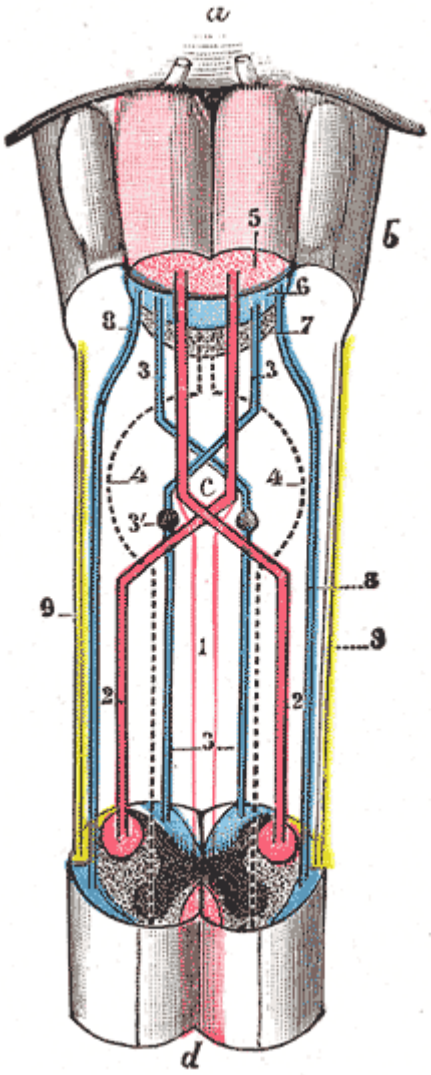
RETICULAR NEURONES

- Raphe Nuclei:
  - Midline reticular nuclei.
  - They are serotonergic.
  - Its ascending fibers to the cerebral cortex are involved in the mechanisms of sleep.
  - Its descending fibers to the spinal cord are involved in the modulation of Pain.
  - So , inhibit pain sensation
- Locus Ceruleus:
  - Pigmented neurons that lie in the tegmentum of the caudal mid brain & rostral pons
  - It is the main noradrenergic cell group of the brain.
  - Helps in arousal and sleep-wake cycles.









1. Anterior cerebrospinal fasciculus (in red). 2. Lateral cerebrospinal fasciculus (in red). 3. Sensory tract (fasciculi gracilis et cuneatus) (in blue). 3'. Gracile and cuneate nuclei. 4. Antero-lateral proper fasciculus (in dotted line). 5. Pyramid. 6. Lemniscus. 7. Medial longitudinal fasciculus. 8. Ventral spinocerebellar fasciculus (in blue). 9. Dorsal spinocerebellar fasciculus (in yellow)

Important notes :

1-4th ventricle formed by :
#floor>> open medulla and pons
#Roof >> Superior Medullary Velum
#lateral boundaries >> Superior cerebellar peduncles

2-medial lemniscus formed by the ascending internal acoustic fibers.
Lateral lemniscus formed by the ascending acoustic fibers from cochlear nuclei .
Both lemnisci terminate into THALAMUS
.
3-any defect occurs To Substantia nigra or basal ganglia will lead to
((Parkinson's disease))
4- fibers of the trochlear nerve decussate in the ((superior medullary velum))
5-Substantia nigra contains Melanin pigment .
6-the ascending lemnisci :
-Medial lemniscus.
-Lateral lemniscus.
-Spinal (Lateral & anterior spinothalamic tracts)
-Trigeminal (Lateral & medial).

7-The most ventral part of the tegmentum is (Crus Cerebri).

8-the reticular formation extends throughout the brain stem.

9-in the reticular formation :
#R a p h e N u c l e i :
Midline reticular nuclei..
They are serotonergic >> it's neurotransmitter Serotonin ..
Its ascending fibers involved in the mechanisms of sleep..
Its descending fibers involved in the modulation of Pain >> So , inhibit pain sensation...
#L o c u s C e r u l e u s :
Pigmented neurons..
lie in the tegmentum of the caudal mid brain & rostral pons..
It is the ((main noradrenergic)) cell group of the brain..
Helps in arousal and sleep-wake cycles..

THE DOCTOR FOCUSED ON THESES 3 POINTS:
#MEDIAL LONGITUDINAL FASICULUS .
#MEDIAL LEMNISCUS .
#THE COURSE OF OCULOMOTOR NERVE (passing anterior to the red nucleus and medial to crus cerebri)

Questions:

1- Trigeminal nucleus is a continuation of which of the following:
   a- Substantia nigra
   b- Nucleus dorsalis (Clarks nucleus)
   c- Substantia gelatinosa
   d- Nucleus gracilis

2- Trigeminal tract is extended to the level of:
   a- Medulla oblongata
   b- Pons
   c- Midbrain
   d- Whole length of brain stem

3- The pyramidal decussation is formed by:
   a- Anterior corticospinal
   b- Lateral corticospinal
   c- Posterior corticospinal
   d- Medial corticespinal

4- Which one of the following is not present at level of closed medulla:
   a- Medial leminscus
   b- Inferior olivary nucleus
   c- Fasciculus gracilis
   d- Nucleus cuneatus

5- Dorsal and ventral Choclear nucles are present between:
   a- Superior peduncle
   b- Middle peduncle
   c- Inferior peduncle
   d- None of them

6- Which one of the following nucleuses is not present at level of open medulla:
   a- Nucleus gracilis
   b- Vagal nucleus
   c- Solitary nucleus
   d- Nucleus ambiguous

7- Acoustic fibers that formed trapezoid body are ascend as:
   a- Medial lemniscus
   b- Lateral lemniscus
   c- Spinal lemniscus
   d- Trigeminal lemniscus

8- Pontocerebellar fibers are pass to cerebellum through:
   a- Superior peduncle
   b- Middle peduncle
   c- Inferior peduncle
   d- a,b

9- At which level medial luminiscus rotate 90 degree horizontally:
a- Rostral medulla
b- Caudal pons
c- Rostral pons
d- Inferior coliculus (Midbrain)

10- Main sensory nucleus of the trigeminal nerve Reaches its maximum extent in:
   a- Medulla
   b- Midbrain
   c- Pons
   d- Thalamus

11- Decussation of trochlear nerve fibers in :

a- Superior peduncle
b- Middle peduncle
c- Inferior peduncle
d- Superior medullary velum

12- Degeneration of which nucleus lead to Parkinson's disease:

a- Substantia gelatiosa
b- Trochlear nucleus
c- Red nucleus
d- Substantia nigra

13- Efferent fibers of superior coliculus go to :

a- Anterior horn cells of spinal cord
b- Thalamus
c- Cranial nuclei (III, IV, VI, VII & XI)
d- Cortex

14- Reticular formations fibers are present in:

a- Medulla
b- Pons
c- Midbrain
d- Whole brain stem

15- Which of the following is responsible for sleep & modulation of Pain:

a- Locus Ceruleus
b- Raphe Nuclei
c- Both
d- None of them

16- Which of the following links the vestibular nuclei with nuclei of extraocular muscles:

a- Medial longitudinal fasciculus

b- Medial leminscus

c- Pyramidal tract

d- Lateral leminscus

Question	Answer
1	C
2	D
3	B
4	B
5	C
6	A
7	B
8	B
9	B
10	C
11	D
12	D
13	C
14	D
15	B
16	A

GOOD LUCK ☺