

**CNS Block**

**Anatomy Team-430**



**8<sup>th</sup> Lecture**

**Internal structure of the brain stem**

**This Lecture is done by:**

**Haya Al-Otaibi**

**Mayyadah Al-Abdely**

## MEDULLA

<b>CLOSED MEDULLA Components:</b>	<b>mid medulla components:</b>	<b>Open ( rostral) medulla Components :</b>
1- tranvered by central canal	1- tranvered by central canal	1- <b>its dorsal surface</b> forms the lower part of the fourth ventricle.
2- <b>motor pyramidal</b> decussation	2- large size <b>gracile</b> & <b>cuneate</b> nuclei, their axons form <b>internal arcuate fibers.</b>	2- The Inferior Cerebellar Peduncle is <b>dorsolateral</b> in position.
3- <b>spinal</b> nucleus of trigeminal nerve .	3- pyramids are prominent .	3- <b>Inferior Olivary Nucleus:</b> <b>***Note :</b> <b>(Remember)</b> that anything contain the word " <b>olive</b> " is concerned with the <b>control of movement</b>
	4- sensory decussation which is formed by crossed <b>internal arcuate fibers</b>	4- medial longitudinal fasciculus .

Now we will explain in more details each part and its main components :

### **-Closed medulla:**

IT CONTAINS THE FOLLOWING STRUCTURE:

"WHICH WE SUMMRAISED IN THE PERVIOUS SCHEDUAL" :

#### **A- Spinal Nucleus of Trigeminal nerve :**

- ✓ It is a larger **sensory** nucleus.
- ✓ It is the brain stem continuation of the **SubstantiaGelatinosa** of spinal cord.
- ✓ It is **medial** to the spinal tract of the trigeminal nerve.
- ✓ Extends Through the whole length of the brain stem and into upper segments of spinal cord.
- ✓ Its tract present in **all levels of M.O** is formed of descending fibers that terminate in spinal nucleus of the trigeminal nerve.

**\* Function :** It receives **pain** and **temperature** from face, forehead & the mucous membrane of the mouth & nose.

## B- PYRAMIDAL DECUSSATION:

- ✓ It is **Motor Decussation**,

**NOTE :** REMEMBER THAT IN THE MID MEDULLA THERE IS "**SENSORY 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 :

It contains :

### A-SENSORY DECUSSATION:-

this decussation is formed by the **crossed internal arcuate fibers**.

### B- 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**.

**\*Function :**Responsible for **proprioceptive pathway**

## **-OPEN (ROSTRAL) MEDULLA :**

### **A- Inferior Olivary Nucleus:**

- 1- A convoluted mass of gray matter.
- 2- Has a hilum directed **medially**, lies **posterolateral** to the pyramids & **lateral** to the medial lemniscus.

**\*FUNCTION:** It is **extrapyramidal** nucleus concerned with the **control of movement**.

### **B-MEDIAL LONGITUDINAL FASCICULUS**

- **Composed of:**
  - ✓ Short ascending & descending fibers, lies close to the midline, **ventromedial** to the **hypoglossal nucleus**, **dorsal** to the **medial lemniscus**.
  - ✓ **Receives Afferents from**  
Vestibular Nerve.

**\*FUNCTION : important**

- ✓ It connects Vestibular & cochlear nuclei with the cranial nuclei (**3, 4 & 6**).
- ✓ Responsible for Coordination **of head and eye movements** in response to **vestibulocochlear stimuli**

**NUCLEI BENEATH THE FLOOR OF 4<sup>TH</sup> VENTRICLE: " in the open medulla ":**

<b>Nucleus</b>	<b>location</b>	<b>Function</b>
<b>Hypoglossal Nucleus</b>	<b>Lies just lateral to the midline</b>	<b>Contains motor neurones innervating muscles of tongue via hypoglossal nerve</b>
<b>Dorsal Nucleus of Vagus</b>	<b>Lateral to the hypoglossal nucleus</b>	<b>contains preganglionic parasympathetic fibers that run in vagus nerve</b>
<b>Vestibular nuclei complex is composed of medial, lateral, inferior &amp; superior nuclei</b>		
<b>Nucleus Ambiguus</b>		<b>gives motor fibers via 9,10 &amp; 11 nerves to constrictors of the pharynx &amp; intrinsic muscles of the larynx</b>
<b>SOLITARY NUCLEUS</b>		<b>It is a major sensory nucleus in the brainstem that carry and receive visceral sensation and taste from the facial (VII), glossopharyngeal (IX) and vagus (X) cranial nerves</b>

### **\*\*\*AREA POSTREMA :-**

- It is the most **caudal** point of the **floor of the 4<sup>th</sup> ventricle**
- It is the site of action of centrally acting **emetics**
- because at this site **Blood Brain Barrier** is lost that limits the passage of certain chemicals from the blood to the brain

## PONS

Site	Division	The ventral portion is marked by	Components	AT THE LEVEL OF THE TRIGEMINAL NERVE
<b>Caudal Pons</b>	<p>1) an anterior part (<b>Basis Pontis</b>)</p> <p>2) a posterior part (<b>Tegmentum</b>) by the <b>Trapezoid Body</b> (axons of cochlear nuclei).</p>	<p>1) Numerous transversely oriented fascicles of <b>pontocerebellar fibres</b> that originate from scattered cell groups, the <b>pontine nuclei</b>, and that pass to the contralateral side of the cerebellum through the massive <b>middle cerebellar peduncle</b>.</p> <p>2) Longitudinal fibres : including bundles of pyramidal (<b>corticospinal &amp; corticobulbar</b>) Fibres.</p>	<p>1) <b>Pontine Nuclei</b></p> <p>2) Deep origin of cranial nerve nuclei:            - <b>Abducent nucleus</b> : It is encircled by the fibres of <b>facial nerve</b>.            - <b>Facial motor nucleus</b>.            - <b>Vestibular nuclei</b>.</p>	<p>1) <b>Motor nucleus of the trigeminal nerve</b>:            Lies in the lateral part of the <b>floor of the 4<sup>th</sup> ventricle</b>.</p> <p>2) <b>Main sensory nucleus of the trigeminal nerve</b>:            Reaches its maximum extent in the <b>pons</b> and it lies lateral to the motor nucleus.</p> <p>3) <b>Superior cerebellar peduncles</b>:            form the <b>lateral boundary of the 4<sup>th</sup> ventricle</b></p>
<b>Rostral Pons</b>			<p>1) <b>Superior Medullary Velum</b>:            Passes between the two superior peduncles &amp; forms the roof of the 4<sup>th</sup> ventricle.</p> <p>2) <b>Medial longitudinal fasciculus</b> :            Lie close to the midline beneath the floor of the 4<sup>th</sup> ventricle.</p> <p>3) <b>Level of 4 lemnisci</b>.</p>	

## **\*\*Pontine Nuclei:**

-Are small masses of nerve cells, receive **corticopontine fibers**. Their axons form the **transverse pontocerebellar fibers** which pass to the contra lateral side of the cerebellum through **Middle Cerebellar peduncles**.

## **\*\*At the caudal pons :**

-The ascending fibres of the **medial lemniscus** become separated from the pyramid and displaced dorsally, together with the **spinal lemniscus** and **trigeminothalamic tract**, by intervening transverse pontocerebellar fibres.

- Medial lemniscus :- rotates **90 degrees** and lies almost horizontally.

## Midbrain

	<b>Definition</b>	<b>Components which are at the level of the Inferior colliculus</b>
Inferior colliculus	<p>-A large nucleus of gray matter that lies in the lower part of the <b>tectum</b> of midbrain, beneath a corresponding surface elevation.</p> <p>-It is part of the <b>auditory pathway</b>.</p> <p>-It receives fibers from the <b>lateral lemniscus</b>.</p> <p>-Its efferent fibers pass to the thalamus.</p>	<p>1)<b>Trochlear nucleus</b></p> <p>2)<b>Decussation of the superior cerebellar peduncles in the mid line.</b></p> <p>3) <b>Mesencephalic nucleus of Trigeminal nerve</b></p> <p>4) <b>Substantianigra</b></p> <p>5)<b>CRUS CEREBRI</b></p>

### 1. Trochlear nucleus:

\*lies in the central gray matter (periaqueductal 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

**\*\*Very important Note:** this nerve is the only one that decussate in superior medullary velum and originate from the dorsal surface of brain stem )

**1. Mesencephalic nucleus of Trigeminal nerve** :lies in the tegmentum, lateral to the aqueduct. It is a sensory nucleus that receives proprioceptive sensations from ms. of mastication. It extends down into rostral pons.

### 3. Substantia nigra:

\*An **extrapyramidal nucleus** at the level of **inferior & superior colliculi**.

- ✓ 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:

**Note: this lemniscus already started at the rostral pons and continued )**

**-Composed Of:**

**Spinal (Lateral & anterior spinothalamic tracts), Trigeminal ,Lateral & medial lemniscus .**

**-Position:**

**Deeply placed lateral to the medial longitudinal fasciculus.**

## **5) Crus cerebri:**

- ✓ It is a massive mass ventral to the substantia nigra
- ✓ It consists entirely of descending cortical efferent fibers to the motor cranial nerve nuclei and to anterior horn cells (corticobulbar&corticospinal fibres,Temporopontine, frontopontine) >> very important

**\*FUNCTION :** Involved in the **coordination of movement.**

## Midbrain

	Definition	Componenets at the level of the Superior colliculus
Superior colliculus	<p>-large nucleus of gray matter that lies in the upper part of tectum ,beneath corresponding elevation.</p> <p>-It forms part of the visual reflexes.</p> <p>-Its efferent fibers go to the anterior horn cells &amp; to cranial nuclei 3, 4, 6, 7 &amp; 11).</p> <p>-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.</p>	<ul style="list-style-type: none"><li>✓ Oculomotor nucleus</li> <li>✓ Red nucleus</li> <li>✓ Substantianigra</li></ul>

### 1. Oculomotor nucleus :

- Situated in the central gray matter close to the median plane, just posterior to the medial longitudinal bundle.
- The fibers of the oculomotor nerve pass 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 between the substantia nigra and the cerebral aqueduct 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.
- Its major source of afferents is the motor cortex of the frontal lobe.

## RETICULAR TRACTS

### 1) Reticulo spinal tracts:

Influence muscle tone & posture

### 2) Reticular Activating system:

\* Formed of some of the ascending fibers of the reticular formation. Their neurons receive input from multiple sensory sources.

\* They activate the cerebral cortex through the thalamus.

## RETICULAR NEURONES

### ▣ Raphe Nuclei:

- Midline reticular nuclei 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**.

### ▣ 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.
- involved in **neural mechanisms regulating sleep**.

### \*\*\*Note:

There are **3 extrapyramidal nuclei** in the brain stem :-

- 1- **Inferior olivary nucleus** , located in the **open medulla**
- 2- **Red nucleus** , located in the mid brain at the **level of the superior colliculus**
- 3- **Substantia nigra** , located in the mid brain at the **level of superior & inferior colliculi** .

## Questions :-

**1. The extrapyramidal nucleus lying in the tegmentum of midbrain is :**

- a. Oculomotor nucleus.
- b. Trochlear nucleus.
- c. Substantia nigra.**
- d. Mesencephalic nucleus of trigeminal.

**2. Parkinson's disease results from degeneration of:**

- a. Red nucleus.
- b. Pyramid.
- c. Substantia nigra.**
- d. Inferior olivary nucleus.

**3. Which is the entirely contents in the crus cerebri of midbrain :**

- a. Corticospinal fibres.**
- b. Tectospinal fibres.
- c. Frontopontine fibres.
- d. Temporo-pontine fibres.

**4. Substantia nigra is concerned with :**

- a. Hearing sensation.
- b. Visual sensation.
- c. Motor function.**

d. Neural mechanisms regulating sleep

**5. Which extrapyramidal nucleus is lying in the open medulla oblongata?**

a. Facial nucleus.

b. Abducent nucleus.

**c. Inferior olivary nucleus**

d. Red nucleus.

**6. The axons of the cochlear nuclei are represented in :**

**a. Trapezoid body.**

b. Medial longitudinal bundle.

c. Tectospinal tract.

d. Spinal lemniscus.

**7. Which one of these nuclei is lying in the tegmentum of the midbrain ?**

a. Oculomotor nucleus .

b. Trochlear nucleus.

**c. Red nucleus.**

e. Facial nucleus.

*\*GOOD Luck*