

CNS Block

Anatomy Team-430



8th Lecture

Internal structure of the brain stem

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MEDULLA

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

| Nucleus | location | Function |
|---|------------------------------------|--|
| Hypoglossal Nucleus | Lies just lateral to the midline | Contains motor neurones innervating muscles of tongue via hypoglossal nerve |
| Dorsal Nucleus of Vagus | Lateral to the hypoglossal nucleus | contains preganglionic parasympathetic fibers that run in vagus nerve |
| Vestibular nuclei complex is composed of medial, lateral, inferior & superior nuclei | | |
| Nucleus Ambiguus | | gives motor fibers via 9,10 & 11 nerves to constrictors of the pharynx & intrinsic muscles of the larynx |
| SOLITARY NUCLEUS | | 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 |

*****AREA POSTREMA :-**

- It is the most **caudal** point of the **floor of the 4th 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 |
|---------------------|--|---|---|--|
| Caudal Pons | 1) an anterior part (Basis Pontis) 2) a posterior part (Tegmentum) by the Trapezoid Body (axons of cochlear nuclei). | 1) 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 . 2) Longitudinal fibres : including bundles of pyramidal (corticospinal & corticobulbar) Fibres. | 1) Pontine Nuclei 2) Deep origin of cranial nerve nuclei: - Abducent nucleus : It is encircled by the fibres of facial nerve . - Facial motor nucleus . - Vestibular nuclei . | 1) Motor nucleus of the trigeminal nerve : Lies in the lateral part of the floor of the 4th ventricle . 2) Main sensory nucleus of the trigeminal nerve : Reaches its maximum extent in the pons and it lies lateral to the motor nucleus. 3) Superior cerebellar peduncles : form the lateral boundary of the 4th ventricle |
| Rostral Pons | | | 1) Superior Medullary Velum : Passes between the two superior peduncles & forms the roof of the 4 th ventricle. 2) Medial longitudinal fasciculus : Lie close to the midline beneath the floor of the 4 th ventricle. 3) Level of 4 lemnisci . | |

****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

| | Definition | Components which are at the level of the Inferior colliculus |
|---------------------|--|---|
| Inferior colliculus | <p>-A large nucleus of gray matter that lies in the lower part of the tectum of midbrain, beneath a corresponding surface elevation.</p> <p>-It is part of the auditory pathway.</p> <p>-It receives fibers from the lateral lemniscus.</p> <p>-Its efferent fibers pass to the thalamus.</p> | <p>1)Trochlear nucleus</p> <p>2)Decussation of the superior cerebellar peduncles in the mid line.</p> <p>3) Mesencephalic nucleus of Trigeminal nerve</p> <p>4) Substantia nigra</p> <p>5)CRUS CEREBRI</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 & to cranial nuclei 3, 4, 6, 7 & 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> | <p>✓ Oculomotor nucleus</p> <p>✓ Red nucleus</p> <p>✓ Substantianigra</p> |

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. Temporopontine 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*