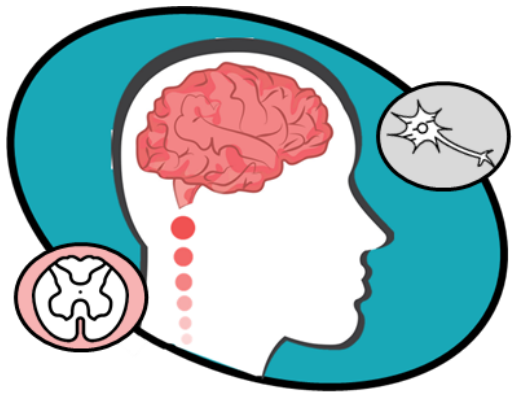

CNS

Anatomy

Sheet Slide

Number

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- Using only section 2 record, I wrote this sheet; as the video is not ready yet.
- Despite pointing the structures, I've tried to include all the scientific bases behind the mentioned stuff; with no pictures included.
- Watch the video whenever it is ready, good luck.

Revision of the most inferior section of the medulla oblongata:

1- As a general rule, the brain stem doesn't contain any sympathetic nucleus; it only contains parasympathetic nucleus. The vagus nerve has a parasympathetic nucleus which innervates the viscera of both the thorax and the abdomen, as far as the distal one third of the transvers colon.

2- Nucleus of tractus solitarius, an elongated nucleus, functions as a relay station for the fibers of taste emerging from the tongue, these cranial nerves are (1) facial {VII} (2) glossopharyngeal {IX} (3) vagus {X}; the vagus nerve has taste buds on the epiglottis.

3- The vagus nerve which emerges from retro-olivary groove, has several nuclei within the brainstem. (1) Parasympathetic nucleus (2) Nucleus of tractus solitarius - bring taste sensation (3) Nucleus Ambiguous, which is settled deep within the reticular formation, which is a motor nucleus that contains lower motor neuron.

4- Nucleus Ambiguous is not exclusively for the vagus nerve, both the glossopharyngeal and the cranial root of accessory are part of this nucleus too.

The section of the medulla just inferior to the pons:

1- Inferior vestibular nucleus doesn't appear at this level of the section; and the lateral vestibular nucleus arises instead.

2- Cochlear nuclei are sensory nuclei for the cochlear part of the vestibulocochlear nerve, from which the acoustic pathway ensues.

The Pons:

Grossly, further details in the lab as the Professor implied.

1- Within the middle of the pons is a groove through which basilar artery passes along.

2- The pons acts as a bridge between cerebrum and cerebellum, cerebro-ponto-cerebellar pathway being the most important.

Sections of the pons:

- Anterior aspect of the pons > basilar part.
- Posterior aspect of the pons > Tegmentum.

How to distinguish? → → using the trapezoid body as a landmark. Anterior to the trapezoid body is the Basilar part, while posterior to it is the Tegementum.

Let us talk briefly about the trapezoid body:

Throughout the auditory pathway, the cells bodies are within the *spiral ganglia,* and the relay station is in the *cochlear nuclei*, both ventral and dorsal separated by the inferior cerebellar peduncle. Before ascending to the higher centers, fibers cross forming what is called ***trapezoid body, then the lateral lemniscus, or so-called acoustic lemniscus, ascends till it reaches the inferior colliculus, through the Medial Geniculate Body within the thalamus and finally to the auditory part of cortex.***

We will study two sections related to the pons:

A- Caudal, inferior:

1- We can see the nuclei of the fascial nerve and the abducent nerve, these nerves emerge from the pontomedullary junction.

2- The basilar (anterior) part contains the pontine nuclei, which are involved in the cerebro-ponto-cerebellar pathway. The fibers of this pathway pile up to form the middle cerebellar peduncle.

3- It is the fibers that emerge from the pontine nuclei towards the cerebellum that cause the corticospinal fibers to scatter and interdigitate, cross-road.

4- The cavity of the section at this level is the fourth ventricle.

5- Laying closely to the floor of the fourth ventricle is the motor nucleus of the abducent, abducent nerve is purely motor, innervating the lateral rectus.

6- Motor nucleus of fascial is just posterior to the medial lemniscus.

7- Fibers of the facial nerve turns around the motor nucleus of the abducent, forming a ***Genu.***

8- These fibers are located at the floor of the fourth ventricle, the collection of these fibers Is called ***fascial colliculus***.

9- Both the facial and the abducent emerge from the pontomedullary junction.

10- Spinal nucleus of the trigeminal, which as an elongated nucleus, starts at the level of substantia gelatinosa of the spinal cord, and appears in all the sections of medulla oblongata, and finally appears in the caudal section of the pons. This nucleus receives fibers related to pain and temperature from more than one cranial nerve (vagus, facial, glossopharyngeal), but mainly trigeminal.

11- The vestibular nuclei are located within the pontomedullary junction, as the vestibulocochlear also emerges from this junction.

12- Reticular formation is also present within the pons.

13- Posterolateral to the **motor** nucleus of facial is the **parasympathetic** nucleus of the facial nerve. The parasympathetic nucleus of facial has multiple names, such as *superior salivatory nucleus*, OR, *salivatory lacrimatory nucleus.* because stimulation of the parasympathetic component of the facial innervates parasympathetic to the submandibular and sublingual glands (salivatory), and to the lacrimal gland (lacrimatory).

14- The salivary branch of facial is the chorda tympani which carries taste fibers from the anterior two thirds of the tongue, while the lacrimal branch of facial is the greater petrosal.

15- The parasympathetic nucleus of facial receives fibers from the hypothalamus, which is the major output pathway of the limbic system.

16- The lacrimal gland receives fibers from the hypothalamus, emotional component (crying accompanied by feelings). And also receives fibers from the trigeminal nuclei as part of a reflex (i.e. Protection against a foreign body, as a reflex, tears are produced. Ophthalmic nerve being the afferent limb).

We've finished talking about the caudal part of the pons.

B- Cranial, or mid-pontine area:

1- At the level of the mid-pontine area, we expect to see the nuclei of the Trigeminal nerve.

2- The trigeminal nerve has 3 sensory nuclei, and 1 motor nucleus.

3- We can find both the lateral and medial lemniscus.

4- Motor nucleus of trigeminal, which innervates muscles of mastication, relays medially, while the main sensory nucleus is lateral.

Remember: spinal nucleus, which is an elongated nucleus, starts at the level of spinal cord till the mid-pontine area. Then, it disappears and main sensory nucleus appears.

Remember: the elongated nuclei, which appear at multiple levels are (1) motor nucleus of hypoglossal (2) dorsal vagal nucleus (3) nucleus Ambiguous, which is the motor nucleus of 9,10, 11 cranial nerves (4) Trigeminal nucleus.

5- Let us talk a bit about the trigeminal lemniscus, but before going any further, it's better to review all the lemnisci we've talked about:
   (a) Medial lemniscus in the posterior column system.
   (b) Spinal lemniscus, which is the collection of the antero-lateral spinothalamic in addition to the spino-tectal.
   (c) Lateral lemniscus, resembles the contralateral ascendance of the acoustic crossed fibers.

   → The motor nucleus of trigeminal is situated medially, while the sensory nuclei are laterally located along the brain stem.

In the midpontine area is the principle (main) sensory nucleus, and above it is the mesencephalic nucleus, which is a sensory nucleus of trigeminal.

→ **Fibers related to pain and temperature**, synapse in the spinal nucleus of trigeminal, but again remember that this nucleus is **not** exclusively for trigeminal nerve. The cell body is within trigeminal ganglia, which is similar to the dorsal root ganglia in spinal nerves. Trigeminal ganglia is present within the cranial cavity at the tip of the petrous portion of temporal.

→ **Fibers related to touch**, have their relay station in the primary sensory nucleus of trigeminal.

→ **Proprioception fibers** from the suffix of teeth, peri-dental ligament and muscles of mastication, their cell bodies are not present in the dorsal root ganglia, rather they are within the mesencephalic nucleus.

All these fibers have to ascend to finally reach the primary somatosensory cortex, at the lower one-quadrant mainly, and their relay station within thalamus is the **V**entro-**P**ostero-**M**edial (VPM), which receive second order fibers ascending from **main sensory** nucleus and **spinal nucleus, which form the trigeminal lemniscus, that ascends contralaterally till they reach VPM.**

Remember: VPL was the relay station for medial and spinal lemniscus.

Note: VPM is a relay station for (1) Trigeminal lemniscus (2) fibers from tractus solitarius.

→ remember the cell bodies that are within the mesencephalic nucleus, it is not clear yet if they have fibers that ascend towards the sensory cortex, or if they act as efferent motor reflexes, jaw jerk being an example.

We've finished talking about the pons.

Midbrain

1- Anterior aspect of the midbrain is called **Crus Cerebri**, and the fossa between the two Crus Cerebri on either side is called **Interpeduncular fossa (IPF), from which the third cranial nerve emerges, the later innervates all the extraocular muscles of the eyeball; except the lateral rectus (Abducent) & the superior oblique (Trochlear).**

2- Cerebral peduncles are pieces of white matter related to the **IPF**.

3- Trochlear nerve (IV), is the only nerve that emerges from the posterior aspect of the midbrain.

Remember → *the posterior aspect of the midbrain, or so-called **Tectum**, is characterized by the presence of four colliculi. Superior colliculi related to visual system and reflexes, and the inferior colliculi related to auditory system.*

Remember → *The connection between the inferior colliculus and the medial geniculate body is called Inferior Brachium. While the connection between the superior colliculus and the lateral geniculate body is called Superior Brachium*.

4- The emergence of the Trochlear nerve is the dividing limit between the midbrain and the pons.

5- The cavity of the section in the midbrain is the cerebral aqueduct, which separates the third ventricle (above) from the fourth ventricle (below).

6- The area behind the cerebral aqueduct is the Tectum, which contains the four colliculi.

7- The area in front of the cerebral aqueduct is the Cerebral Peduncle.

8- The cerebral peduncle is further divided according to its relation with the substantia nigra to (1) Crus Cerebri, the anterior part. (2) Tegmentum, the posterior part till the cerebral aqueduct.

We will study the midbrain using two sections at two different levels, superior and inferior colliculi.

A- Level of Inferior Colliculus.

1- The cavity of this section is the cerebral aqueduct, at either side of this cavity is the **Mesencephalic Nucleus, one of the sensory nuclei of Trigeminal.**

2- Motor nucleus of the Trochlear nerve is seen medially to the inferior colliculus.

3- The fibers of the trochlear nerve pass posteriorly between two colliculi and curve to the opposite side. Through its route, it passes within the Cavernous sinus and the superior orbital fissure, and finally innervates the superior oblique.

4- Anterior to the trochlear nerve, is the decussation of the superior cerebellar peduncle. ***This landmark is what distinguishes the superior colliculus section from the inferior colliculus section***.

Remember → within the superior cerebellar peduncle are many connections between the cerebellum and the higher centers i.e. (1) Dentothalamic. (2) Globose-Emboliform-Rubral pathway. Etc…

5- Medial longitudinal fasciculus can be readily seen within this section.

6- Middle 3/5 of the crus cerebri is occupied by the corticospinal descending tract.

7- While the medial and the lateral one fifths of Crus cerebri are occupied by the cerebro-ponto-cerebellar pathway. Fronto-pontine medially, Tempro-pontine laterally.

8- Substantia Nigra (SN), the black substance, is functionally part of the basal ganglia; and initiating movement is its main function.

9- Posterior to the SN is the tegmentum, and within the tegmentum are the Lemnisci stated previously.

10- **Medial lemniscus** (closest to midline), the **spinal lemniscus** laterally, and more laterally is the **Trigeminal lemniscus**, while the lateral most lemniscus is the **Lateral lemniscus**, most of the fibers of the lateral lemniscus will eventually reach the inferior colliculus.

B- Level of superior colliculus:

1- The first important landmark to notice is the Red nucleus.

2- The decussation that can be seen here is that of the Rubrospinal tract (early decussation).

3- The order of the lemnisci is the same, but the lateral lemniscus won't be visible anymore; as it has passed through the inferior colliculus. Although they might slightly appear in some sections.

4- Mesencephalic nucleus is still prominent, and the cavity is the cerebral aqueduct.

5- The next thing to notice other than the red nucleus, is the motor nucleus of the oculomotor.

6- The oculomotor nerve has both motor and parasympathetic nuclei. The parasympathetic nucleus of the oculomotor nerve is called **Edinger Westphal**.

7- Fibers that are coming from both the main motor nucleus and Edinger Westphal, will pass through the red nucleus; without any synapse, and then both will emerge from the interpeduncular fossa to reach the extra ocular muscles of the eye, except the lateral rectus and the superior oblique. And the parasympathetic part will eventually reach the ciliary body, to control the autonomic light reflexes of the eyes.

8- Median longitudinal fasciculus is seen approaching the motor nucleus of the oculomotor nerve.