Physiology of brain stem

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- Important
- Further Explanation

Physiology Team 434
contact us : physiology434@gmail.com

Contents

Recommended Videos!

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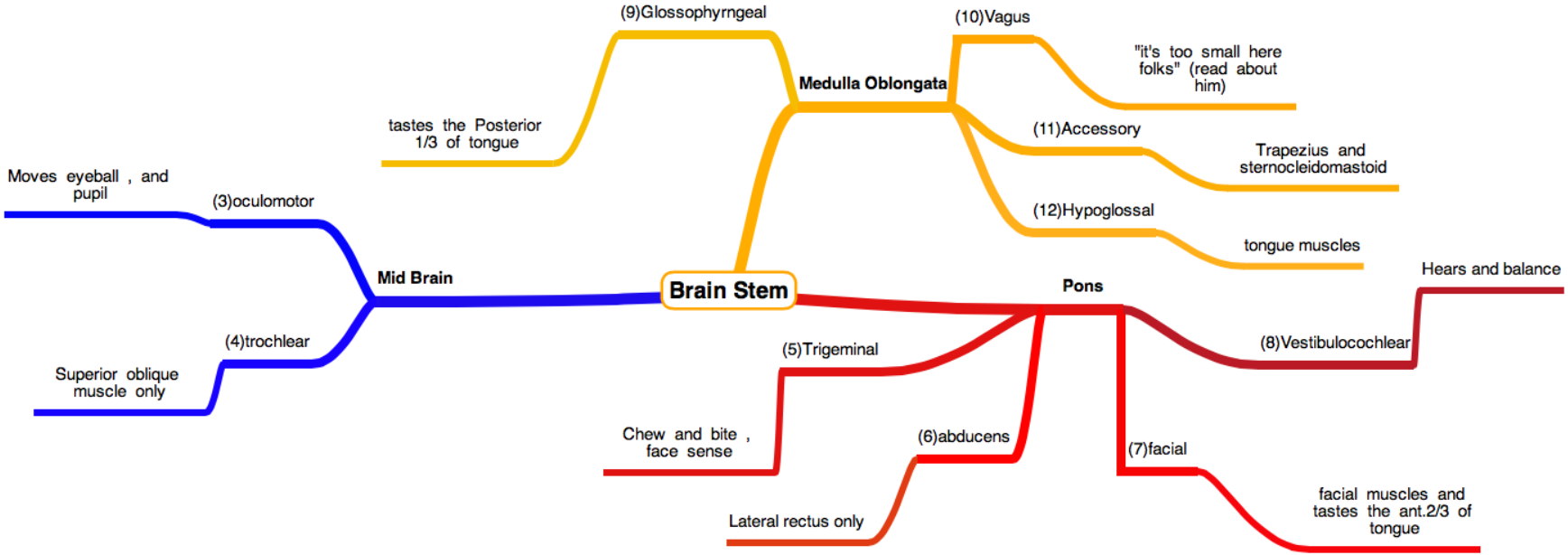
Lecture objectives

UPON COMPLETION OF THIS LECTURE, STUDENTS SHOULD BE ABLE TO DESCRIBE :

- Brain stem components
- Important structures in the brain stem
- The functions of the brain stem
- Signs and symptoms of a lesion in the brain stem
- Brain stem function tests


Brain Stem
Mid Brain
Moves eyeball , and pupil
(3)oculomotor
(4)trochlear
Superior oblique muscle only
Medulla Oblongata
(9)Glossophyrngeal
tastes the Posterior 1/3 of tongue
(10)Vagus
"it's too small here folks" (read about him)
(11)Accessory
Trapezius and sternocleidomastoid
(12)Hypoglossal
tongue muscles
Pons
(5)Trigeminal
Chew and bite , face sense
(6)abducens
Lateral rectus only
(7)facial
facial muscles and tastes the ant.2/3 of tongue
(8)Vestibulocochlear
Hears and balance

Mind Map

So, what's the brain stem ?

- Brain stem is the area which is located in the lower part of the brain, gives connection and serves as bridge between the lower part and the upper part of the CNS.
- Brain stem is composed of three structures from cranial to caudal
  - Midbrain
  - Pons
  - Medulla Oblongata
- Brain stem connects to the cerebellum via 6 peduncles, one pair arising from each brain stem component. So ,
  - Superior peduncle arises from Mid brain
  - Middle peduncle arises from pons
  - Inferior peduncle arises from Medulla Oblongata
- The ventral layer of brain stem is motor in function , while the middle layer is sensory in function

Mid brain

<u>The Tectum</u> has two structures :

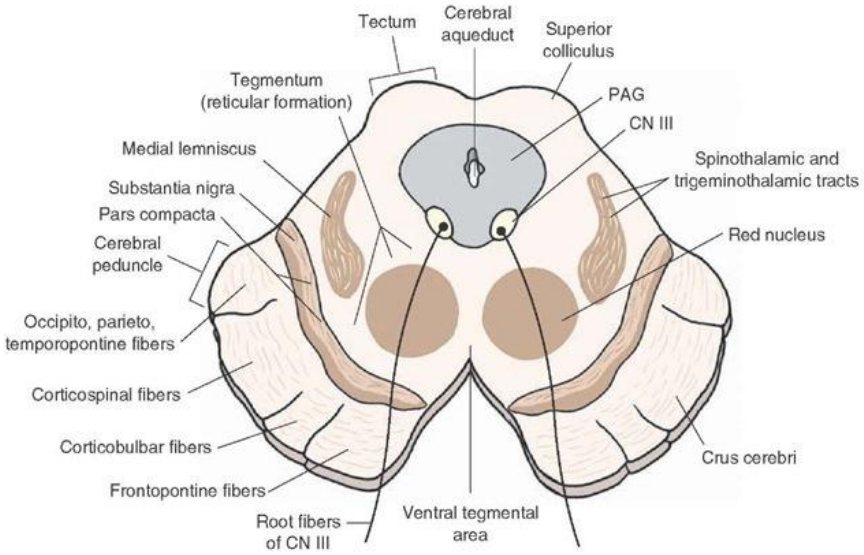
1)The superior colliculi :
- involved in the special sense of vision
- It sends neurons to --> lateral geniculate nucleus of the thalamus.

2)The inferior colliculi:
"NOT seen in the section"
- Involved in a special sense of hearing
- It send neurons to --> medial geniculate nucleus

The Tegmentum has several nuclei and the reticulatar formation is found here.

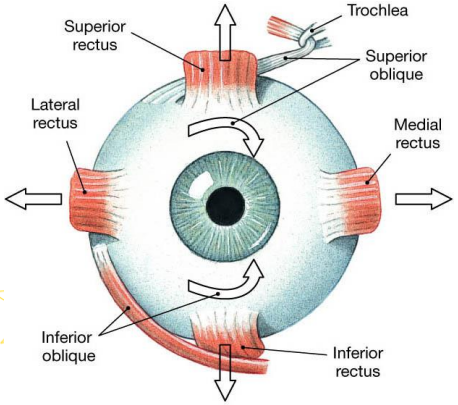
The Cerebral peduncles (Crus cerebri) transmits axons of upper motor neuron

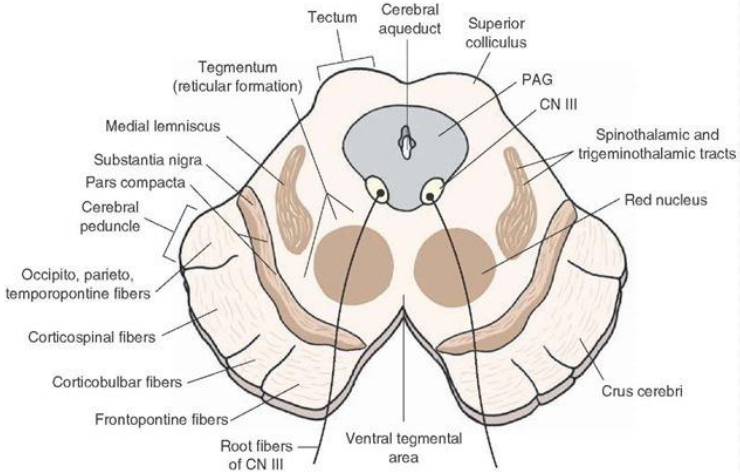
Mid brain is divided into Three segments :
1) Tectum (most posterior)
2) Tegmentum (in between)
3) Cerebral peduncle (Crus cerebri)



Focus on the red colored text

Mid brain





1)Periaqueductal Gray:
contains neurons involved in the pain desensitization pathway (to be become less sensitive)

2)Occulomotor Nerve (CN III) nucleus.

3)Trochlear Nerve (CN IV) nucleus.

- **Occulomotor** → superior rectus , Inferior rectus , medial rectus , inferior oblique.
- **CN III** contsricts the pupils (sympathetic action), accommodates.
- **Trochelar** → superior oblique

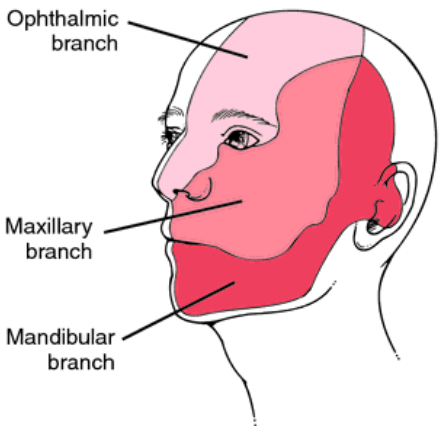
4)Red nucleus:
sends a descending tract to the lower motor neurons. (Rubrospinal tract)

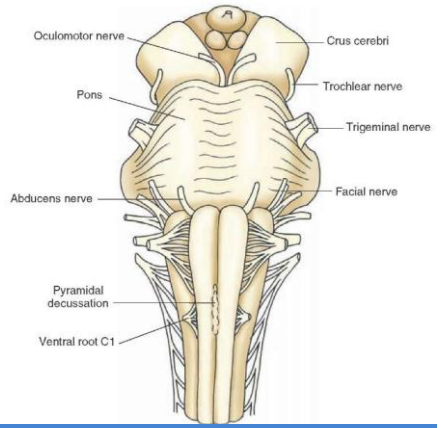
5)Substantia Nigra:
in the ventral portion of the midbrain that is involved in motor function.

6) Central Tegmental Tract :
a pathway by which many tracts project up to the cortex and down to the spinal cord

7) Reticular Formation

PONS





Four cranial nerve arise from the pons :

The cranial Nerve	Functions
CN V (trigeminal) 3 branches (Ophthalmic, Maxillary, Mandibular)	• Chewing (Muscle of mastication) • Sensation over the face
CN VI (abducens)	• Moves eyes (Lateral rectus muscle)
CN VII (facial)	• Moves the face • Taste (2/3 of the anterior tongue) • Salivation (submandibular + sublingual glands)
CN VIII (acoustic)	• Hearing • Balance

Medulla Oblongata

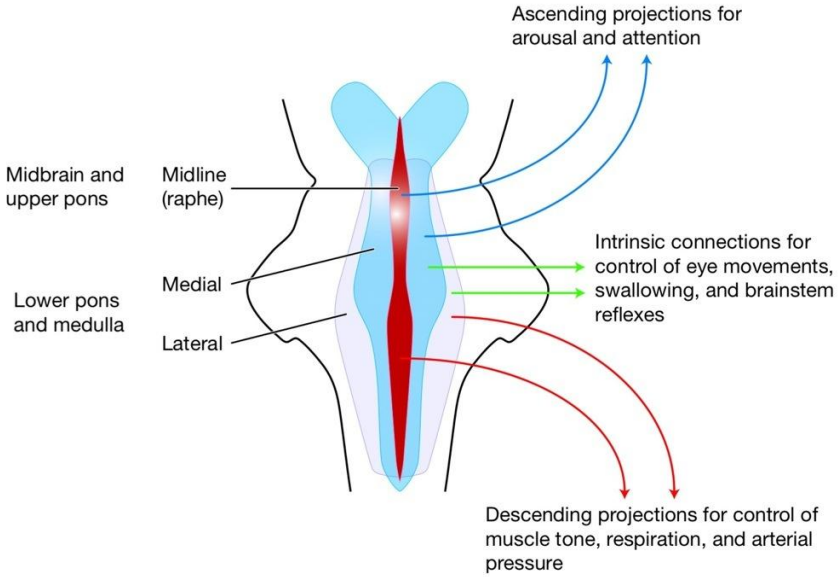
Four cranial nerve arise from the Medulla:

The cranial Nerve	Functions
CN IX (glossopharyngeal)	• Tastes (inferior 1/3 of the tongue) • Salivation (Parotid gland) • Swallowing (stylopharyngeus muscle) • Monitors carotid body and sinus
CN X (vagus)	• Tastes • Swallowing (the muscle of the pharynx) • Talking (muscle of the larynx) • communication to and from thoraco-abdominal viscera
CN XI (accessory)	• Turning the head • Elevation of the shoulder (trapezius and Sternocleidomastoid)
CN XII (hypoglossal):	• Moves tongue

Reticular Formation

A large area that is involved in various important functions of the midbrain:

- ✧ It contains LMN .
- ✧ It is involved in the pain desensitization pathway.
- ✧ It is involved in the arousal and consciousness systems.
- ✧ It contains the locus ceruleus, which is involved in intensive alertness modulation and in autonomic reflexes



Functions of the brain stem

1.Conduct functions.

All information related from the body to the cerebrum and cerebellum and vice versa, must traverse the brain stem. Including:

a. The ascending sensory pathways

b. Descending tracts

2.Provides the origin of the cranial nerves (CN III-XII).

We covered it last slides

3.Conjugate eye movement.

4. Integrative functions

Dr.najeeb's video about conjugation of the eye movement

Integrative Functions

- It controls consciousness & sleep cycle (alertness and arousal) through reticular formation.
  (SEE the physiology of sleep lecture)
- Centers for cardiovascular, respiratory & autonomic nervous system.
- It has centers for cough, gag, swallow, and vomit.
- Sense of body balance (Vestibular functions)
  CN VIII
- Pain sensitivity control: Periaqueductal grey matter of mesencephalon is an area which is rich in endogenous opioid and is important in modulation of painful stimuli.

Brainstem lesions and the clinical presentation

✧In mid brain :

1. **What are the cranial nerve affected?**

3rd and 4th

2. **What are the symptoms associated with the eye?**

a. Ipsilateral ptosis

"disfunction of levator palpebrae superioris which innervated by the 3rd cranial nerve"

a. Size of pupils is midposition to dilated and reactivity is partially sluggish to fixed.

"NO parasympathetic innervation to the circular muscles which is normally coming from the 3rd."

3. **What are the other symptoms?**

a. Abnormal extensor

b. Hyperventilation and sometimes loss of consciousness (Reticular formation)

✧In Pons:

1. **What are the cranial nerve affected?**

5^{th} , 6^{th} , 7^{th} , 8^{th}

2. **What are the symptoms associated with the eye?**

a. Pinpoint pupil size

"lesion in the pons may lead to Horner syndrome"

3. **What are the other symptoms?**

a. Abnormal extensor

b. Sustained inhalation.

c. Hyperventilation and and semi coma

✧In medulla oblongata:

1. **What are the cranial nerve affected?**

9^{th},10^{th} ,11^{th} , 12^{th}

What are the symptoms associated with the eye?

a. Size of pupils is dilated and reactivity is fixed

3. **What are the other symptoms?**

a. Abnormal Respiration

b. Absent gag reflex and cough (defect with 9^{th} nerve)

c. comatose

Brain stem function test

To Test each part of the brain stem:

1. Reticular formation → YOU HAVE to check for : Alertness, Consciousness & Sleep.

2.Corticospinal tract → YOU HAVE to check for : Motor power, reflexes

3.Pain response → Facial grimacing (يكشر) on firm pressure over the supraorbital ridge.

4. Respiratory center "Check if the pattern of respiration is normal of abnormal"

5. Cardiovascular center "Look for normal circulatory function"
6. Bain stem reflexes:

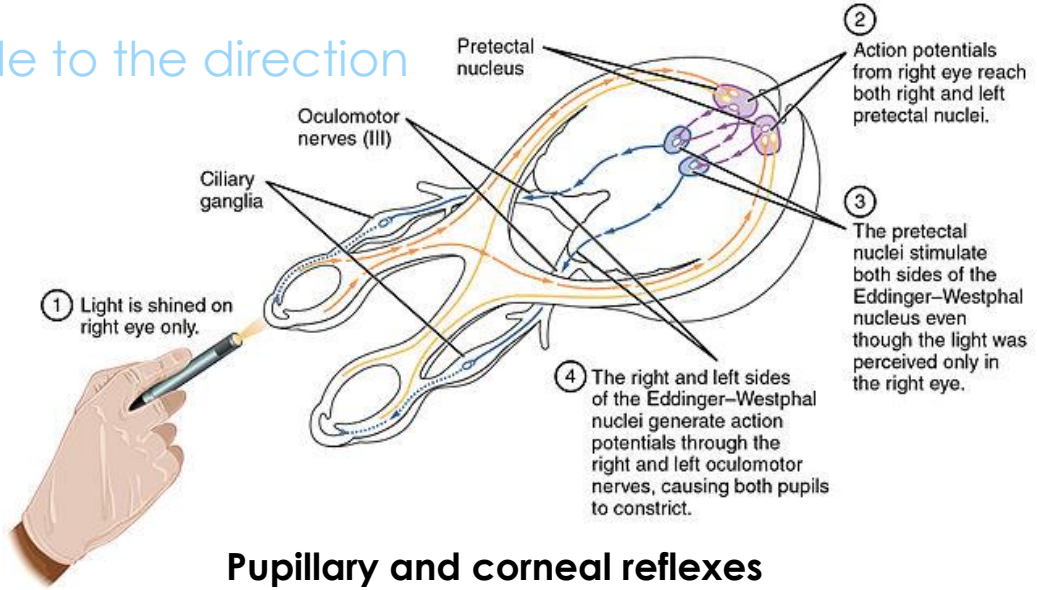
- Pupillary and corneal reflexes.
- Vestibulo-ocular reflex by

"by injection of iced water into the ear and that normally will produce eye movements"

- Oculo-cephalic reflex

"Eyes rotate to the opposite side to the direction of head rotation"

- Gag reflex
- Cough reflex



Pupillary and corneal reflexes

#	Name	Nerve type	Function
I	Olfactory	Sensory	Smell
II	Optic	Sensory	Vision
III	Oculomotor	Motor	Most eye movement
IV	Trochlear	Motor	Moves eye
V	Trigeminal	Both	Face sensation, mastication
VI	Abducens	Motor	Abducts the eye
VII	Facial	Both	Facial expression, taste
VII	Vestibulocochlear	Sensory	Hearing, balance
IX	Glossopharyngeal	Both	Taste, gag reflex
X	Vagus	Both	Gag reflex, parasympathetic innervation
XI	Accessory	Motor	Shoulder shrug
XII	Hypoglossal	Motor	Swallowing, speech

MNEMONIC

Some say marry money but my brother says big brains matter more

S = pure sensory

M = pure motor

B = both (motor and sensory)

Summary

1- Regarding the mid brain
A. Tegmentum is most posterior
B. Tectum is in the middle
C. Cerebral peduncles is posterior to tectum
D. Tegmentum is in the middle

2-A patient with a lesion in Trochlear nerve , which muscle nerve supply is effected?
A. Superior oblique
B. Inferior oblique
C. Lateral rectus
D. Superior rectus

3-Parkinson's disease result from the death of
A. Periaqueductal grey
B. Substantia gelatinosa
C. Substania nigra
D. Reticular formation

4- A structure in mid brain that collect the auditory senses
A. Inferior colliculus
B. Superior colliculus
C. Tegmentum
D. Substania nigra

5- Reticular formation is located in
A. Pons
B. Tectum
C. Tegmentum
D. Medullary pyramids

6- Facial nerve carries the taste sensation from the ..
A. Anterior 1/3 of tongue
B. Posterior 2/3 of tongue
C. Anterior 2/3 of tongue
D. The whole tongue

7-Hypoglossal nerve emerge just lateral to olives
A. True
B. False

8-Pinpoint pupil size , hyperventilation and sustained inhalation is a characteristic of
A. Lesion in medulla oblongata
B. Lesion in cerebral peduncles
C. Lesion in mid brain
D. Lesion in pons

1.D
2. A
3.C
4. A
5.C
6.C
7.B
8.D

MCQs

1- Give TWO functions of the hypoglossal nerve ?

- Tastes
- Salivation

2- Where in the brain stem does the Periaqueductal Gray found? And What its function?

-Midbrain , pain desensitization pathway

3- A lesion of with which area will lead to dilated pupil ?

- Midbrain , medulla oblongata

4- A lesion of the right abducens nerve, Which muscle is defected?

- Right lateral rectus muscle

5- What is the symptoms that is always associated with facial nerve injury?

- Loss of facial expression

6- A lesion of with which area will lead to absent gag reflex ?

- Medulla oblongata

THANK YOU FOR CHECKING OUR WORK!

BEST OF LUCK

Done By:

- Abdularahman alharbi
- Moath aleisa