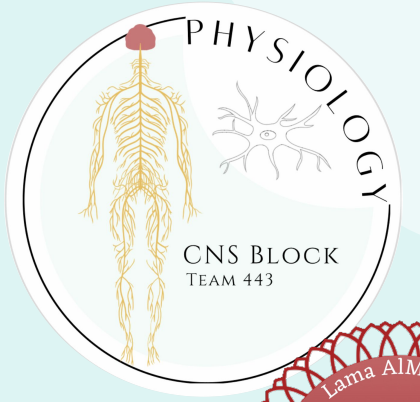
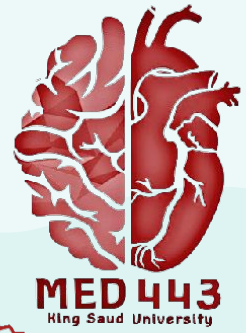
6

Physiology of the brainstem





Color Index:

- Main text
- **Important**
- Girls Slides
- Boys Slides
- Notes
- Extra

Editing File

Objectives:

1. -Enumerate components of Brainstem, as ‘meridians of longitude‘ and the various cranial nerves as ‘parallels of latitude‘.
2. -List important structures in Brainstem.
3. -Describe functions of the Brainstem.
4. -Describe functional grouping of cranial nerve sensory and motor nuclei.
5. -Describe signs & symptoms of the Brainstem lesion in different parts of brain stem in relation to site of lesion.
6. -Understand Brainstem function test.

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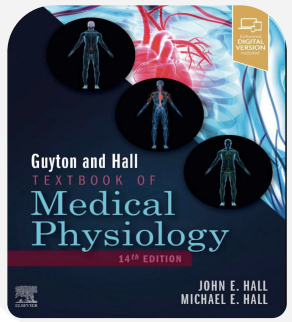

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Ninja nerd goes over the anatomy and physiology of the brainstem (In detail) over 3 videos. They can be really helpful!

Medulla **Pons** **Midbrain**

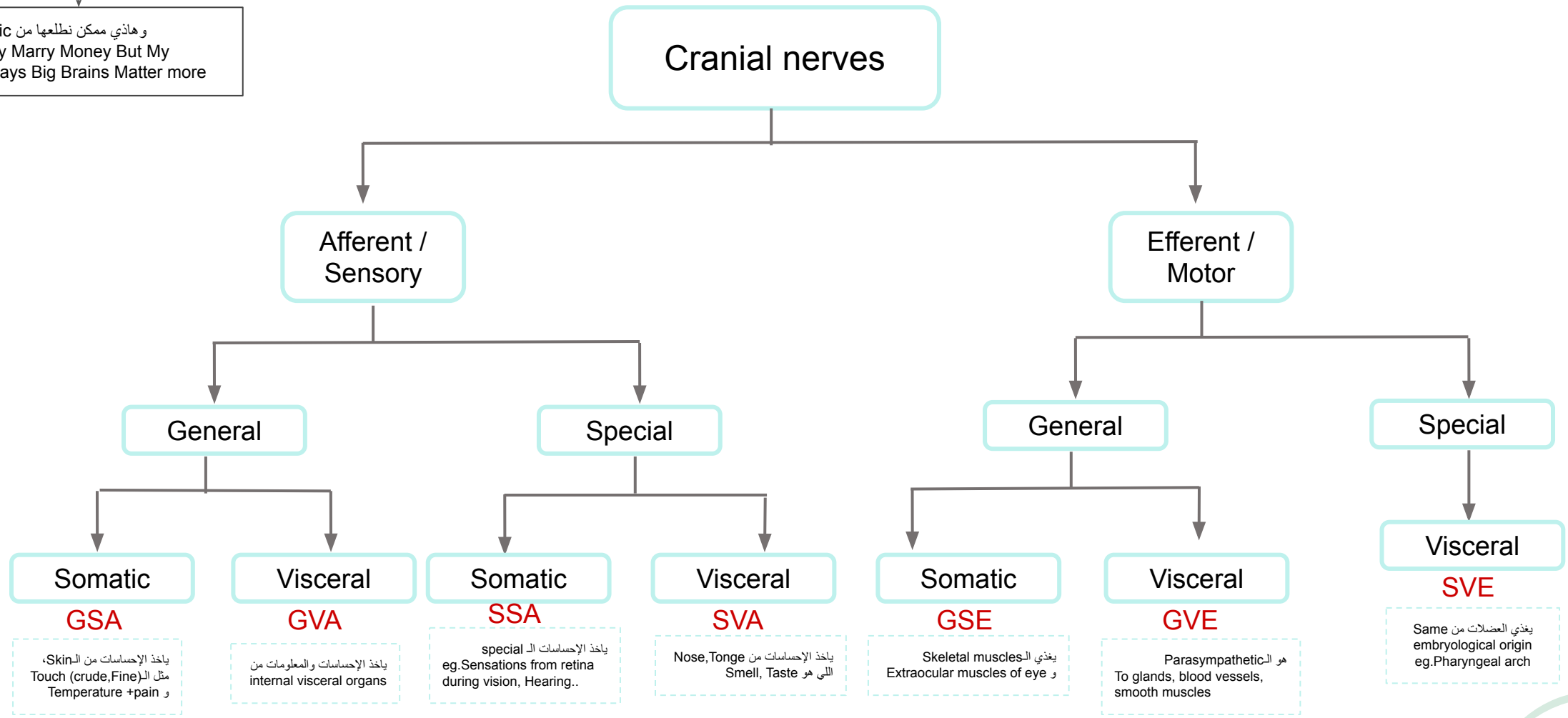
عَنْ أَبِي الدَّرْدَاءِ، ، قَالَ: سمِعْتُ رَسُول اللَّهِ ﷺ، يقولُ: (منْ سَلَكَ طَرِيقًا يَبْتَغِي فِيهِ علْمًا سهَّل اللَّه لَه طَرِيقًا إِلَى الجنةِ، وَإِنَّ الملائِكَةَ لَتَضَعُ أَجْنِحَتَهَا لِطالب الْعِلْم رِضًا بِما يَصْنَعُ)

Introductory slide..

This slide is extra Explanation from the Leader it's important to read it to understand the upcoming slides!

الأعصاب الدماغية أو الـ Cranial nerves هي 12 عصب، وقسموها مثل ما نعرف إلى Sensory , Motor, **Mixed** (Both)
فيه تقسيمة أدق توضح تفاصيل أكثر وتسمى Cranial nerve modalities وللتوضيح، قد يكون العصب الواحد يحمل أكثر من نوع مثل ما فوق عندنا **Mixed** ..

وهاذي ممكن نطلعها من mnemonic:
Some Say Marry Money But My
Brother Says Big Brains Matter more



The brainstem:

Female slides

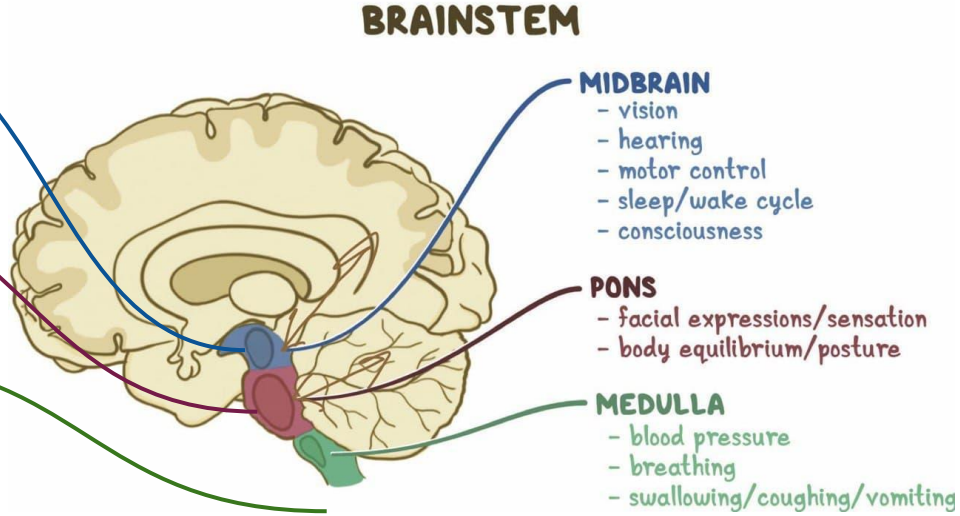
- The area at the base of the brain that lies between the deep structures of the cerebral hemispheres and the cervical spinal cord.
- It serves a critical role in regulating certain involuntary actions of the body.

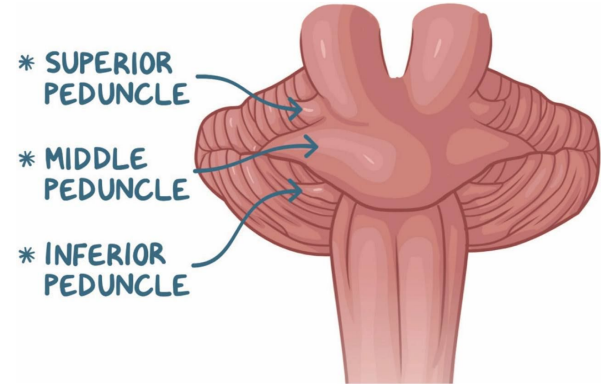
Brainstem components and their connections to the cerebellum:

Midbrain (mesencephalon)
Connects to the cerebellum via superior peduncle.

Pons (metencephalon)
Connects to the cerebellum via middle peduncle.

Medulla (myelencephalon)
Connects to the cerebellum via inferior peduncle.



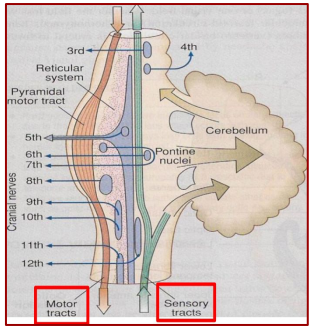


Functional organization of the brainstem:

Male slides

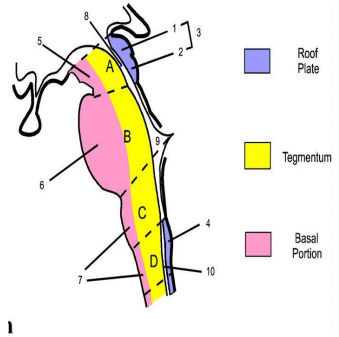
Ventral layer:
Motor in function.

Middle layer:
Sensory in function & contains medial lemniscus which conveys sensory info from dorsal column.



Basic Structure of Brain Stem:

1. Roof Plate
2. Tegmentum
3. Basal Portion



Origin and function of the cranial nerves:

Midbrain

- CN III (oculomotor)
- CN IV (trochlear)

Both moves eyes;

- CN III constricts the pupils, accommodates.

Pons

- CN V (trigeminal): Chews and feels front of the head.
- CN VI (abducens): Moves eyes.
- CN VII (facial): Moves the face, tastes, salivates.
- CN VIII (acoustic): Hears, regulates balance.

Medulla

- CN IX (glossopharyngeal): Tastes, salivates, swallows, monitors carotid body and sinus.
- CN X (vagus): Tastes, swallows, lifts palate, talks, communication to and from thoraco-abdominal viscera.
- CN XI (accessory): Turns head, lifts shoulder.
- CN XII (hypoglossal): Moves tongue.

Letter Symbol	Component	Function
	Afferent (to CNS)	**Sensory**
GSA	General somatic afferent	General sensation
GVA	General visceral afferent	Visceral sensation
SSA	Special somatic afferent	Vision, balance, hearing
SVA	Special visceral afferent	Smell, taste
	Efferent (from CNS)	**Motor**
GSE	General somatic efferent	Somatic striated muscle
GVE	General visceral efferent	Glands and smooth muscle (parasympathetic innervation)
SVE	Special visceral efferent	Branchial arch striated muscle

Nerves of the autonomic system:

- Parasympathetic:
CN-3,7,9 & 10

- Sympathetic
TI and Sup Cerv Ganglion

Classification of the Cranial Nerves According to Functions:

SENSORY: CN I, II, VIII.
MOTOR: CN III, IV, VI, XI, XII.
MIXED: CN V, VII, IX, X.

mnemonic for CN Sensory, Motor or both(Mixed):
Some Say Marry Money But My Brother Says Big Brains Matter More.

Origin and function of the cranial nerves:

General senses:
pain, temperature, touch, pressure, vibration, proprioception

Special senses:
vision, hearing, taste, and smell, equilibrium

Visceral motor fibres are divided into:

- special visceral efferents (SVE), which innervate striped muscles of branchial origin.
- general visceral efferents (GVE), which innervate involuntary muscles and secreting glands.

(This table is showing which cranial nerves are SVE, SSA...)

3 SPECIAL			4 GENERAL				Male slides
SSA	SVE	SVA	GSA	GVE	GVA	GSE	SAVE VA SAVE VASE
2	5	7	5	3		3	251-5303
8	7	7	7	7		4	7,4 9,5 10,5
	9	9	9	9	9	6	SSA 2,8
	10	10	10	10	10	IIs	SVE 5, 7, 9, 10, IIc
	IIc					12	GSE 3, 4, 6, IIs, 12

SVE (special visceral efferent), SVA (special visceral afferent), GVE(general visceral efferent) ,
GVA (general visceral afferent), IIs (accessory nerve spinal part), IIc (accessory nerve cranial part)

It's (SVA)

Cranial nerve	Functional components	Nuclei	Distribution	Functions
I	SSA	–	Olfactory epithelium	Smell
II	SSA	–	Retina of eyeball	Sight (vision)
III	SE	Oculomotor nucleus	All extrinsic muscles of eyeball except lateral rectus and superior oblique	Movements of eyeball
	GVE	Edinger-Westphal n.	Sphincter pupillae and ciliary muscle	Constriction of pupil and accommodation
IV	SE	Trochlear nucleus	Superior oblique muscle of eyeball	Movement of eyeball
V	SVE	Motor nucleus	Muscles of mastication	Movements of mandible
	GSA	(a) Chief sensory n.	Skin of face and mucous membrane of mouth and nose	Touch
		(b) Spinal nucleus	Skin of face and mucous membrane of mouth and nose	Pain and temperature
		(c) Mesencephalic nucleus	Muscles of mastication	Proprioceptive sensations
VI	SE	Abducent nucleus	Lateral rectus of eyeball	Abduction of eyeball
VII	GVE	Superior salivatory nucleus	Submandibular and sublingual salivary glands	Secretomotor
	SVE	Motor nucleus	Muscles of facial expression stylohyoid, posterior belly of digastric, platysma and stapedius	Facial expressions, elevation of hyoid, etc.
	SVA	Nucleus of tractus solitarius	Taste buds in the anterior 2/3rd of tongue except vallate papillae	Taste sensations from anterior 2/3rd of tongue except vallate papillae
	GSA	Spinal nucleus of Vth nerve	Part of skin of external ear	Exteroceptive sensations
VIII	SSA	Cochlear nuclei	Organ of corti in the cochlea of internal ear	Hearing
		Vestibular nuclei	Vestibular receptors in the semicircular ducts, utricle and saccule of internal ear	Equilibrium and balance
IX	SVE	Nucleus ambiguus	Stylopharyngeus muscle	Elevation of larynx
	GVE	Inferior salivatory nucleus	Parotid gland	Secretomotor
	GVA	Nucleus tractus solitarius (lower part)	Pharynx, posterior 1/3rd of tongue	Touch, pain and temperature from pharynx and posterior 1/3rd of tongue
	SVA	Nucleus tractus solitarius (upper part)	Taste buds in posterior 1/3rd of tongue and vallate papillae	Taste sensations from posterior 1/3rd of tongue and vallate papillae
X	SVE	Nucleus ambiguus	Muscles of palate, pharynx and larynx	Movements of palate, pharynx and larynx
	GVE	Dorsal nucleus of vagus	Smooth muscles and glands of thoracic and abdominal viscera	Motor and secretomotor to bronchial tree and gut; inhibitory to heart
	GVA	Nucleus tractus solitarius	Thoracic and abdominal viscera	General sensations from thoracic and abdominal viscera
	SVA	Nucleus tractus solitarius	Taste buds in posteriormost part of tongue and epiglottis	Taste sensations from posteriormost part of tongue and epiglottis
	GSA	Spinal nucleus of Vth nerve	Part of skin of external ear	General sensations from skin of external ear
XI	SVE	Nucleus ambiguus	Muscles of palate, pharynx and larynx	Movements of palate, pharynx and larynx
	GSE	Spinal nucleus of accessory nerve (anterior grey column of upper 5 cervical spinal	Trapezius and sternocleidomastoid muscles	Movements of head and shoulder

Midbrain:

components of the midbrain:

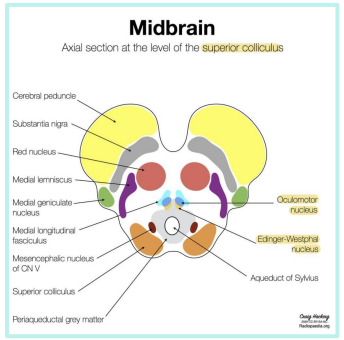
to memorize them remember this:
your eyes are **above** your ears, and the Superior colliculus(visual) are **above** the Inferior colliculus (auditory)

1 The Tectum (roof)

- It is the dorsal part of the Brainstem, it include:

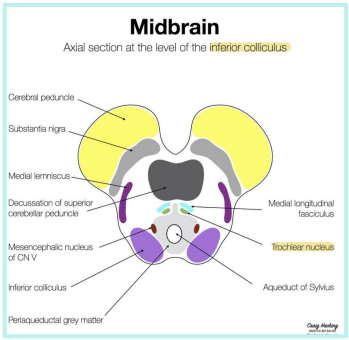
1 Superior colliculus

-It constitutes <u>center</u> for **visual reflexes**.
-It sends its superior brachium to the **lateral geniculate body** of the thalamus.



2 Inferior colliculus

-It constitutes center for **auditory pathway**.
- It sends its inferior brachium to the **medial geniculate body** of the thalamus.



N.B: The <u>cerebral aqueduct</u> runs through the <u>midbrain</u>, <u>beneath</u> the <u>colliculi</u>.

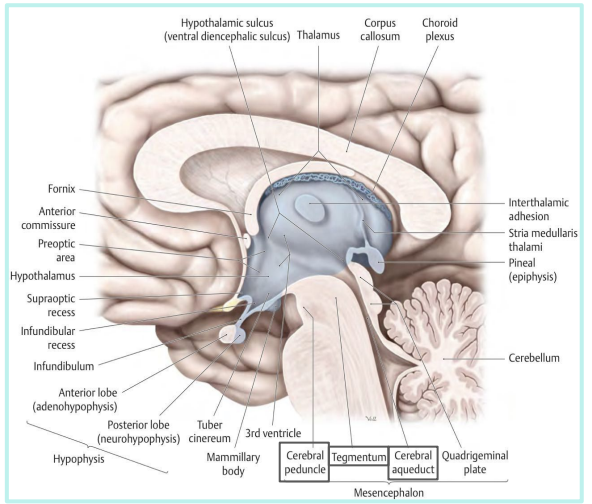
2 The Tegmentum (covering)

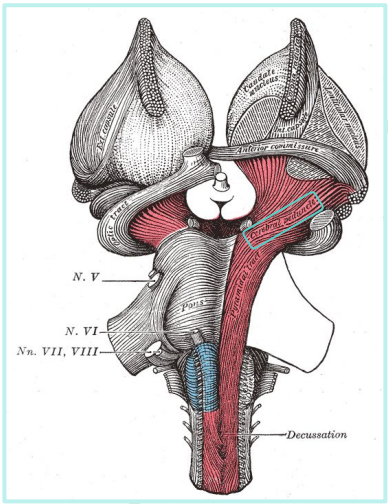
- Is the **ventral** part of the midbrain , ventral to the **cerebral aqueduct**.
- Several nuclei, tracts and the **reticular formation** is contained here.

3 Cerebral peduncles

The ventral side of midbrain is comprised of cerebral peduncles which transmits to the UMN.

Note: do not confuse cerebral peduncles with cerebellar peduncles



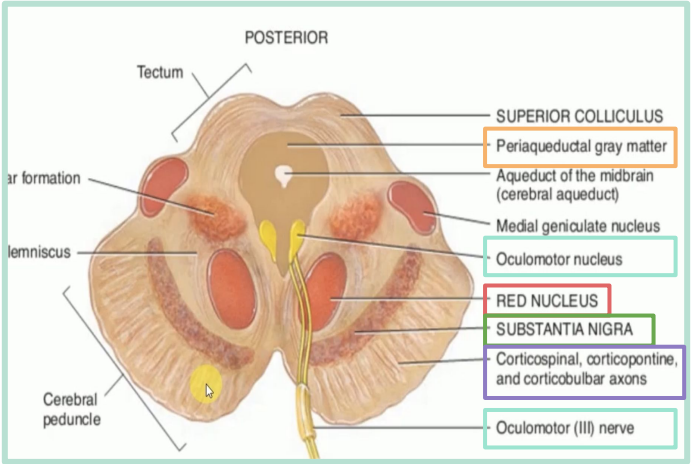


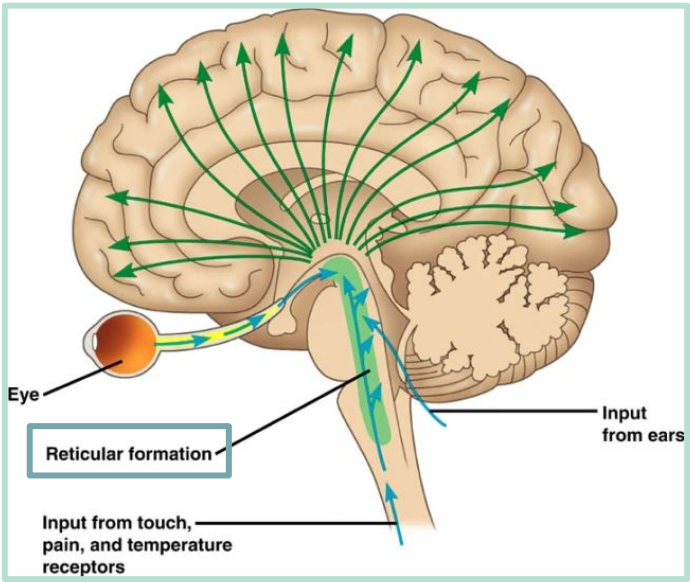
Midbrain:

components of the midbrain:

4 other internal structures:

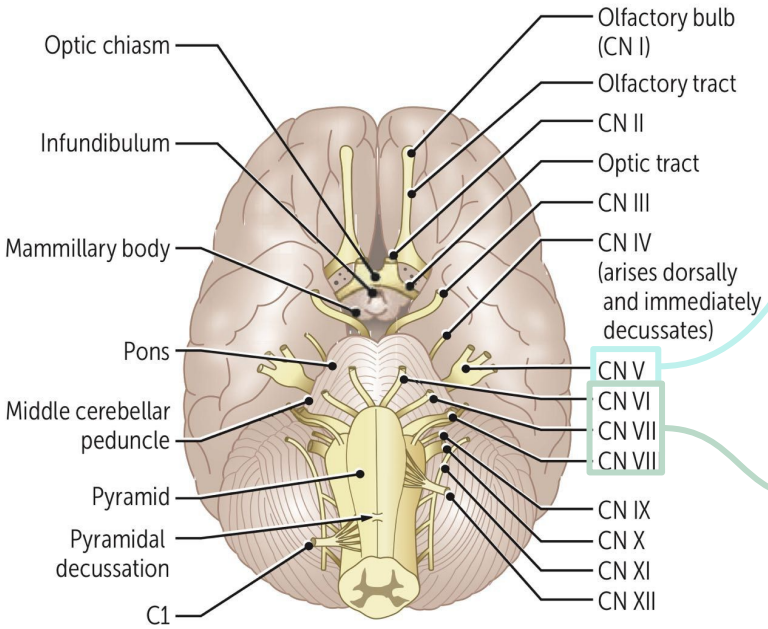
Periaqueductal Gray	- Area of grey matter in the midbrain around the cerebral aqueduct. - It is the primary control center for descending pain modulation- - plays a role in autonomic function, motivated with behavior and behavioural responses to threatening stimuli.
Nerves	- Oculomotor Nerve (CN III) nucleus. - Trochlear Nerve (CN IV) nucleus. - Red Nucleus This is a motor nucleus that sends a descending tract to the LMN (lower motor neurons)
Substantia Nigra	- A concentration of neutrons in the ventral portion of midbrain - It is involved in motor function.
Central Tegmental Tract	- Directly anterior to the floor of the 4th ventricle. - It is a pathway for tracts to project between the cortex and the spinal cord.
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 coeruleus, which is involved in intensive alertness modulation and in autonomic reflexes.





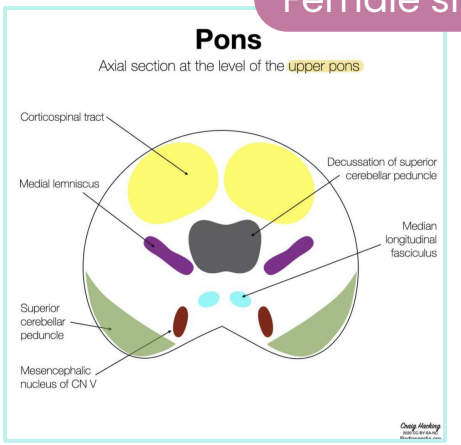
Pons:

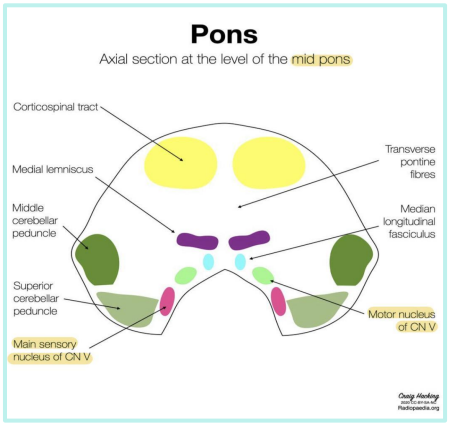
- **Largest** part of the brainstem located above the medulla and below the midbrain.
- It is a group of nerves that function as a connection **between the cerebrum and cerebellum.**
- It is very important in regulation of vital functions.
- Contains nuclei of some important cranial nerves:
  CN V, CN VI, CN VII, CN VIII (Cranial nerves from 5 to 8)

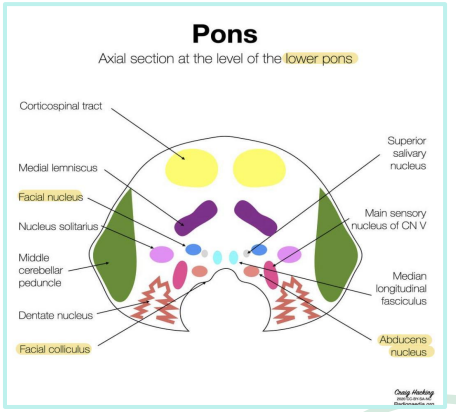


At the level of the **mid pons, trigeminal nerve (CN V)** also called "pontine" emerges

Between the **basal pons**, those cranial nerves emerge: (medial to lateral):
-VI (abducens)
-VII (facial)
-VIII (vestibulocochlear)





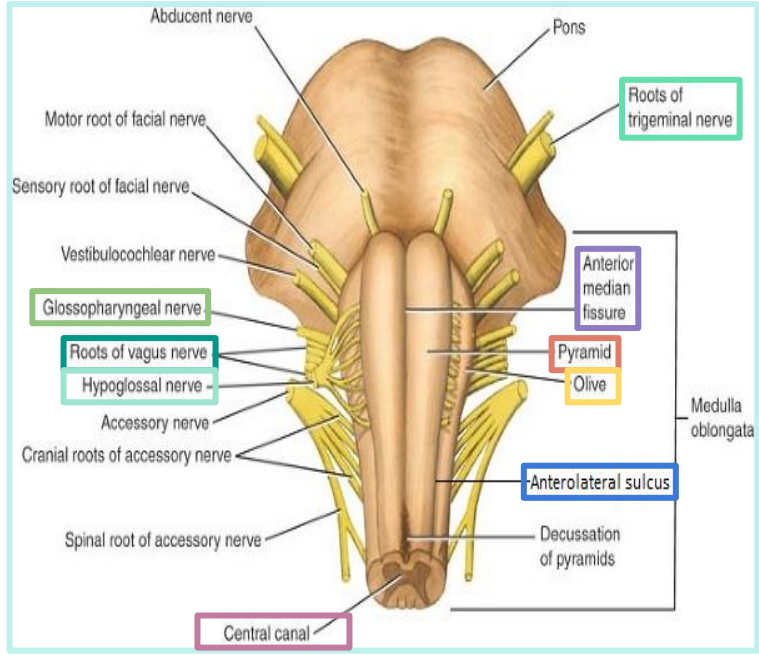


- **Important:**
  CN never cross (except, the 4th CN) and clinical findings are always on the same side as the cranial nerve involved.

Female slides

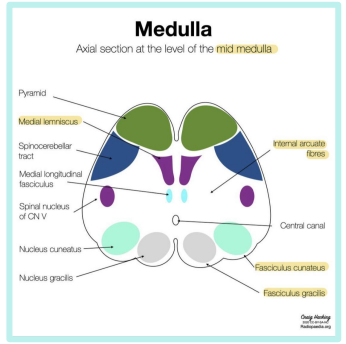
Medulla Oblongata:

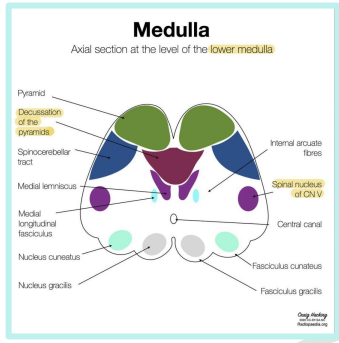
- It is the lowest part of the brain and the lowest portion of the brain stem.
- It plays a critical role in transmitting signals between the spinal cord and the higher parts of the brain and in controlling autonomic activities, such as heart beats and respiration.

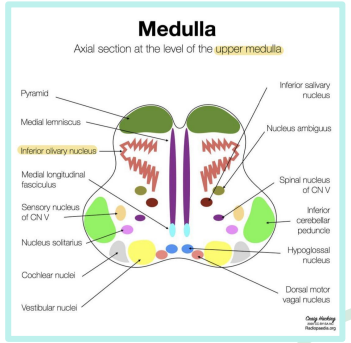


Ventral and dorsal view of medulla

Ventral view	Dorsal view
The most medial part of the medulla is the anterior median fissure.	The most medial part of the medulla is the **posterior median fissure.**
The next lateral object are the pyramids which contains the fibers of corticospinal tract as they head inferiorly to synapse on lower motor neuronal cell bodies within the ventral horn of the spinal cord.	Moving laterally on each side is the fasciculus gracilis. Lateral to fasciculus gracilis is the fasciculus cuneatus. tip: gracilis are the medial one and cuneatus are the lateral one, to save them remember that the "gracilis are responsible for legs which is near the the grass", the dorsal column begin with gracilis which in common sense will be medial, cuneatus are responsible for the upper body will be lateral
The anterolateral sulcus is lateral to the pyramids. Emerging from the anterolateral sulci are the hypoglossal nerve (CN XII) rootlets.	
Lateral to the anterolateral sulci are the olives containing underlying inferior olivary nuclei and afferent fibers).	Superior to each of these, are the gracile and cuneate tubercles, respectively. Underlying these are their respective nuclei.
Lateral (and dorsal) to the olives are the rootlets for glossopharyngeal (IX) & vagus (X) cranial nerves	In the midline is the vagal trigone and superior to that is the hypoglossal trigone. Underlying each of these are motor nuclei for the respective cranial nerves.







Functions of the Brainstem

Though it is small, brain stem is an extremely important part of the brain:

1 Conduct Functions:

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

The ascending sensory pathways		Descending tract	
Coming from the body to the brain includes:		**Corticospinal tract** (UMN):	**Upper motor neurons**
The **spinothalamic tract** for pain and temperature sensation + crude touch.	The **dorsal column**, fasciculus gracilis, and cuneatus for fine touch, proprioceptive and fine pressure sensation.	Runs through crus cerebri (the anterior portion of the cerebral peduncle), basal part of pons and medullary pyramids; 70-90 % of fibers cross in pyramidal decussation to form the lateral corticospinal tract, synapse on LMN in ventral horn of spinal cord. pyramidal	Originate in brain stem's vestibular, red, and reticular nuclei, which also descend and synapse in the spinal cord. Extrapyramidal

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

- The brain stem provides the main motor and sensory innervation to the face and neck via the cranial nerves (CN III-XII).
- The fibers of cranial nerve nuclei **(except for olfactory & optic nerve)** either originate from, or terminate in the cranial nerve nuclei in brainstem.

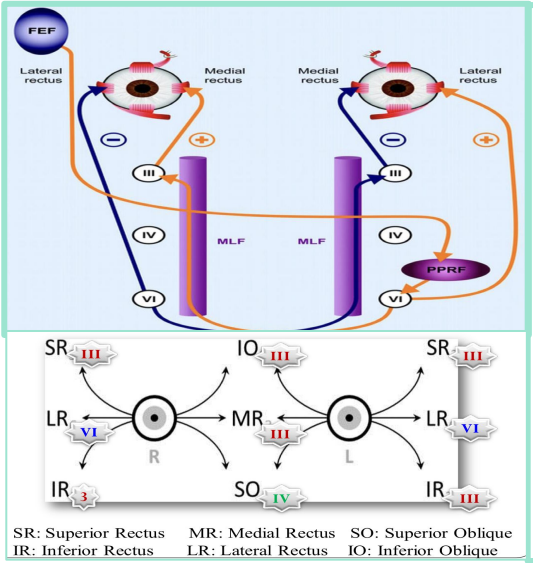
Functions of the Brainstem

Know the concept

Though it is small, brain stem is an extremely important part of the brain:

3 Conjugate Eye Movement:

It refers to motor coordination of the eyes that allows for bilateral fixation on a single object.



The frontal eye field (FEF) projects to the opposite side at the midbrain-pontine junction, and then innervates the **paramedian pontine reticular formation (PPRF).**

From there, projection directly innervate the **lateral rectus (contralateral to FEF)** and the **medial rectus muscle** (ipsilateral to FEF).

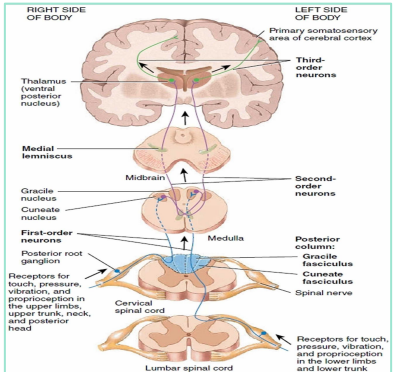
The left FEF command to trigger conjugate eye movements to the right.

Frontal eye field area → midbrain-pontine junction Cross → Paramedian Pontine Reticular formation → Innervate lateral rectus and medial rectus

- Same side
- Opposite side

If there is a lesion in the left FEF, no lateral movement of eye (the eye can't move to the right).
-This part will be discussed in detail with special sense lecture-

4 Center for Brain stem reflexes



Functions of the Brainstem,Cont..

Though it is small, brain stem is an extremely important part of the brain:

5 Many control centers and integrative functions:

It controls consciousness & sleep cycle (alertness and arousal) through reticular formation.

- It has got center for cardiovascular, respiratory & autonomic nervous system.
- It has centers for cough, gag, swallow and vomit.
- Sense of body balance (vestibular function).
- **Substantia Nigra** which is a part of the basal ganglia is present in midbrain and is involved in control of **movement**.
- Midbrain also contain **red nucleus** which regulate the motor activity through cerebellum.
- **Superior and inferior colliculi** are situated on the dorsal surface of the midbrain and is involved in visual & auditory processing required for head movements.
- 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.

Brain Stem Lesion

Female slides

- Because of the important neural structures concentrated in this small portion of the nervous system, **even very small lesions of the brain stem may have profound effects (as speech disorders, vestibular disturbance, abnormal consciousness).**
- Such disorders can be caused by **trauma, tumours, strokes, infections, and demyelination (multiple sclerosis).**
- Complete loss of brain stem function is regarded by some experts as equivalent to brain death.

Functions and Lesions

CLick me

1- Midbrain

Functions	Signs & Symptoms of lesion
❑ Nerve pathway to cerebral hemispheres. ❑ Auditory and visual reflex centres (superior and inferior collicli respectively). **Cranial Nerves:** - **CN III – Oculomotor** (Motor) (Related to **eye movement**). - **CN IV – Trochlear** (Motor) (Superior oblique muscle of the eye which rotates the eye down and out). All muscles of the eye are supplied by CN III except SO by 4, LR by 6	- **Cranial Nerve (CN) deficits:** Ipsilateral **CN III**, contralateral **CN IV** palsy and ptosis (drooping of eyelids). - **Pupils:** Size ⟶ Midposition to dilated. Reactivity ⟶ sluggish to fixed. - **Posture:** Upper midbrain lesions cause abnormal extensor response (**Decorticate**). - **Respiratory:** Hyperventilating. (Rapid and shallow) - **Level of consciousness (LOC):** Varies. (Semiconscious, confused or unconscious)

Why? Because it cross and pass posteriorly.

(Loss of parasympathetic fibres that cause miosis)

Upper midbrain damage
Decorticate posture

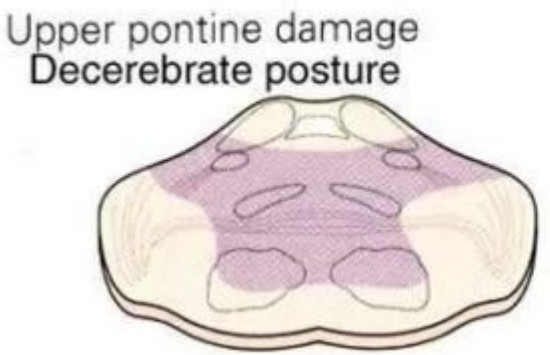
Doesn't move properly

Functions and Lesions

CLick me

2- Pons

Functions	Signs & Symptoms of lesion
❑ **Respiratory center.** **Cranial Nerves:** - **CN V -Trigeminal** (Mixed) (Skin of face, tongue, teeth; muscle of mastication). - **CN VI - Abducens** (Motor) (Lateral Rectus muscle of the eye which rotates the eye outward and laterally). - **CN VII - Facial** (Mixed) (Muscle of facial expression). - **CN VIII - Acoustic** (Sensory) (Hearing).	- **Cranial Nerve (CN) deficits:** CN V, CN VI, CN VII, CN VIII. - **Pupils:** Pinpoint (disruption of pontine sympathetic fibers carried by CN III). - **Posture:** Upper pontine lesion cause abnormal extensor response (**Decerebrate**) **(rigidity) .** - **Respiratory:** Apneustic (Abnormal respiration marked by sustained inhalation) or Hyperventilation. - **Level of consciousness (LOC):** Semi-coma.



Functions and Lesions

3- Medulla Oblongata

Functions

- ❑ Respiratory center.
- ❑ Cardiac center.
- ❑ Crossing of motor tracts.
- ❑ Centers for cough, gag, swallow, and vomit.
- ❑ Vasomotor center: nerves having vascular control of the blood vessel walls.

(The lower level, the worse prognosis)

Cranial Nerves:

- **CN IX – Glossopharyngeal** (Mixed)
  (Muscles & mucous membranes of pharynx, the constricted openings from the mouth & Oropharynx and the posterior third of the tongue).
- **CN X – Vagus** (Mixed)
  (Pharynx, Larynx, Heart, Lungs & Stomach).
- **CN XI – Accessory** (Motor)
  (Rotation of the head and shoulders).
- **CN XII – Hypoglossal** (Motor)
  (Intrinsic muscles of the tongue).

Signs & Symptoms of lesion

- **Cranial Nerve (CN) Palsies:**
  Inability to control movements.
  Absent cough & gag reflex (X and IX).
- **Pupils:**
  Size ⟶ Dilated.
  Reactivity ⟶ Fixed.
- **Movement:** Ipsilateral paralysis.
- **Respiratory:** Abnormal breathing patterns. (ataxia)
- **Level of consciousness (LOC):** Comatose.

Only in MO lesions

If the lesion before decussation (in MO), the effect will be contralateral. If after, the effect will be ipsilateral.

Brain Stem Function Tests

1. **To test reticular formation**
   Alertness, consciousness & sleep.

   Ex: What is your name? How is the weather today?

2. **Corticospinal tract**
   Motor pathway and reflexes.

3. **Pain response**
   Facial grimacing on firm pressure over the supraorbital ridge.

4. **To test respiratory center**
   Look for normal pattern of respiration.

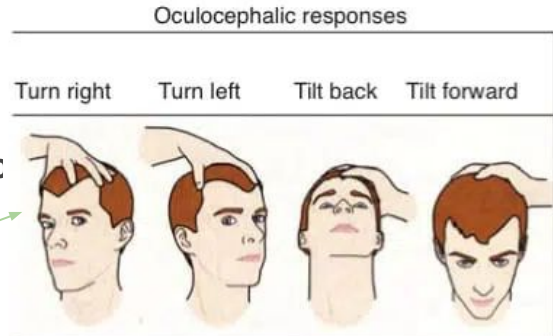
5. **To test cardiovascular center**
   - Look for normal circulatory function.

   Ex: Blood pressure and cyanosis

   -Look for normal circulatory function of heart brain interaction (e.g : Baroreceptors, HRV).

   - Trigeminocardiac reflex (TCR)→ stimulation of sensory branches of the trigeminal nerve. This produces bradycardia, hypotension, asystole, apnea (in an awake patient).

6. **To test brainstem reflexes**
   - Pupillary and corneal reflexes.
   - Vestibulo-ocular reflex: Injection c iced water into the ear will produce eyes movement.
   - Oculocephalic reflex "DOLL'S EYES REFLEX": Eyes will be fixed when head is moved in or another direction.
   - Gag & cough reflexes.



The Rule of 4 of The Brain Stem

4 structures in "midline" and begin with "M" :	-Motor pathway → lesion : **(Contralateral weakness).** -Medial lemniscus→ lesion : **(Contralateral proprioception/vibration lose).** +fine touch -Medial longitudinal fasciculus → lesion :**(Ipsilateral internuclear ophthalmoplegia).** Loss of addiction movement -Motor nucleus and nerve → lesion: **(Ipsilateral CN function loss).**
4 motor nuclei in midline and are those that divisors of 12 (3,4,6,12):	-CN Number can divide the number 12. -Nuclei of CN 3,4,6,12 are **midline.** -Nuclei of CN 5,7,9,11 are **lateral.**
4 structures of the "side" (lateral) and begin with "S":	-Spinocerebellar pathway → lesion: **(Ipsilateral ataxia).** -Spinothalamic pathway→ lesion: **(Contralateral pain/temp sensory loss).** -Sensory nucleus of CN 5 →lesion: **(Ipsilateral pain/temp loss in face).** -Sympathetic pathway→ lesion: **(Ipsilateral Horner's Syndrome).**
4 CN in medulla (9,10,11,12):	-Glossopharyngeal CN 9→ lesion: **(Ipsilateral pharyngeal loss).** -Vagus CN 10 → lesion:**(Ipsilateral palatal weakness).** -Spinal accessory CN 11 →lesion: **(Ipsilateral shoulder weakness).** -Hypoglossal CN 12 →lesion:**(Ipsilateral weakness of tongue).**
4 CN in Pons (5,6,7,8):	-Trigeminal CN 5→ lesion: **(Ipsilateral facial sensory loss).** -Abducens CN 6→ lesion: **(Ipsilateral eye abduction weakness).** -Facial CN 7 → lesion:**(Ipsilateral facial weakness).** -Auditory CN 8 → lesion: **(Ipsilateral deafness).**
4 CN in above pons "Midbrain" (3,4):	-Olfactory CN 1 **(not in the midbrain).** -Optic CN 2 **(not in the midbrain).** -Oculomotor CN 3 → lesion:**(eye turned out and down).** -Trochlear CN 4 → lesion: **(eye unable to look down when looking towards nose).**

Sample Case 1

Male slides

A sample case

A 58 y/o female patient was referred to you because of recent onset of left hemiparesis, left-sided loss of proprioception and right-sided tongue deviation.

- What CNS structures are affected?
- Explain the symptoms regarding structure affected.
- **Where is the lesion?**

Answers:

Click here for an illustration of the answer from the male doctor

-Medial medullary syndrome (R).
-Vertebral artery, medullary branch (R).

History	Fiber	Location
Left hemiparesis	Motor (corticospinal tract), Right.	Medial
Left-sided loss of proprioception	Medial lemniscus, Right.	Medial
Right-sided tongue deviation	Hypoglossal nerve CN XII, Right.	Medulla Medial

Sample Case 2

Male slides

A sample case

A 60 y/o male patient was referred to you because of recent onset of left-sided miosis, anhydrosis, ptosis, left-sided ataxia and Uvula deviated to right.

- What CNS structures are affected?
- Explain the symptoms regarding structure affected.
- **Where is the lesion?**

Answers:

-lateral medullary syndrome (L).
-posterior inferior cerebellar artey (L).

History	Fiber	Location
left-sided miosis, anhydrosis, ptosis	Sympathetic tract, Left	Side, Left
left-sided ataxia	Spinocerebellar	Side, Left
Uvula deviated to right	Vagus nerve, CN X, Left	Medulla

Sample Case 3

Male slides

A sample case

A 10 y/o girl with symptoms of Left-sided weakness, Right eye deviates medially, and Right-sided facial weakness.

- What CNS structures are affected?
- Explain the symptoms regarding structure affected.
- **Where is the lesion?**

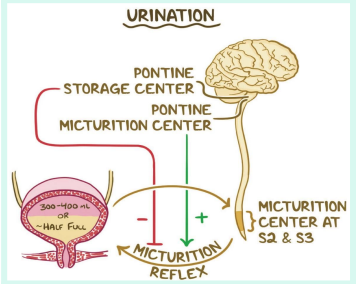
Answers:

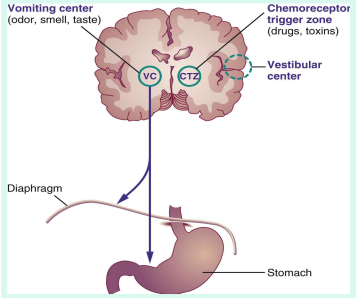
- MillarPdo-Gnusb tleur syndrome.
- pons tumor (medial pons).

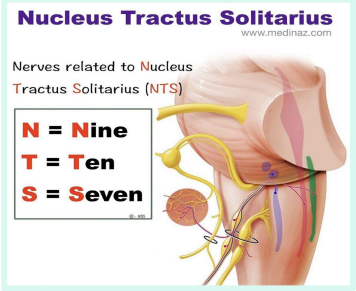
History	Fiber	Location
Left-sided weakness.	Motor (corticospinal tract), Right.	Medial structure
Right eye deviates medially	LR weakness, CN VI, Right.	Pons
Right-sided facial weakness	Vagus nerve CN X, Right.	Pons

Functions of the brainstem: (summary)

- The Autonomic nervous system is activated mainly by centers located in the spinal cord, brain stem, and hypothalamus (Cardiovascular, Gastrointestinal, Autonomic Reflexes).
- Functions of Brain Stem Nuclei in Controlling Subconscious, Stereotyped Movements (crying, yawn, suckling, stretch) (anencephaly).
- Motor branch of the fifth cranial nerve, and the chewing process is controlled by nuclei in the brain stem and also swallowing & salivary secretion, vomiting (chemoreceptor trigger zone).
- The actual mechanics of feeding are controlled by centers in the brain stem.
- Vasomotor center for CV control (Baroreceptors) in medulla and Respiratory Nuclei for resp control.
- Brain stem Neurohormonal Systems in the human brain for activating four neurohormonal systems.
- Many of the Behavioral functions elicited from the hypothalamus and other limbic structures are also mediated through the reticular nuclei in the brainstem and their associated nuclei.
- Although the Micturition reflex/Defecation reflex is an autonomic spinal cord reflex, it can also be inhibited or facilitated by centers in the cerebral cortex & brain stem in Pontine micturition center (PMC)ldefecation c.
- Accommodation Is Controlled by Parasympathetic Nerves by 3rd CN.
- Neural Pathways for Control of Eye Movements. also shows brain stem nuclei for the third, fourth, and sixth cranial nerves by medial longitudinal fasciculus.
- Auditory Nervous Pathways → superior olivary nucleus.
- Nucleus of tractus solitarious → Taste pathway→ Sup & Inf Salivatory Nuclei.
- Bulboreticular facilitatory area of brain stem for Gamma efferent system (stabilizes joints).
- Control of Cerebral Activity by Continuous Excitatory Signals from the Brain Stem (Reticular Excitatory Area of the Brain Stem → bulboreticular facilitory area→it is the same brain stem reticular area that transmits facilitatory signals to maintain tone in the antigravity muscles and spinal cord reflexes.







TEST YOURSELF !

1- A patient went to an ENT doctor due to loss of hearing on the right side, MRI showed a lesion in the brain stem. Which one of the following is most likely associated?

A) Lateral geniculate body

B) Inferior colliculus

C) Internal capsule

D) Solitary nucleus

2- A semi-comatose patient with history of road traffic accident has a pinpoint pupil, hyperventilation and sustained inhalation. Which part of the CNS is affected?

A) Cerebral peduncles

B) Medulla oblongata

C) Pons

D) Midbrain

3- A56 years old male with movement defects in the right eye, ptosis and dilated pupil that becomes sluggish to light which region is affected ?

A) Pons

B) Crus cerebri

C) Midbrain

D) Medulla oblongate

4- Which one of the following helps to test brainstem function?

A) Pupillary reflex

B) Knee jerk

C) High cerebral functional test

D) Superficial reflex

Answers : B, C, C, A.

SAQ

What is the reticular formation and what is its function?

It is 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 coeruleus, which is involved in intensive alertness modulation and in autonomic reflexes.

Mention at least 3 control centers in the brain stem

- Center of cardiovascular
- Center of respiratory
- Center of cough

What are the signs and symptoms of Medulla oblongata lesions?

- **Cranial Nerve (CN) Palsies:**
  Inability to control movements.
  Absent cough & gag reflex (X and IX).
- **Pupils:**
  Size ⟶ Dilated.
  Reactivity ⟶ Fixed.
- **Movement:** Ipsilateral paralysis.
- **Respiratory:** Abnormal breathing patterns.
- **Level of consciousness (LOC):** Comatose.

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