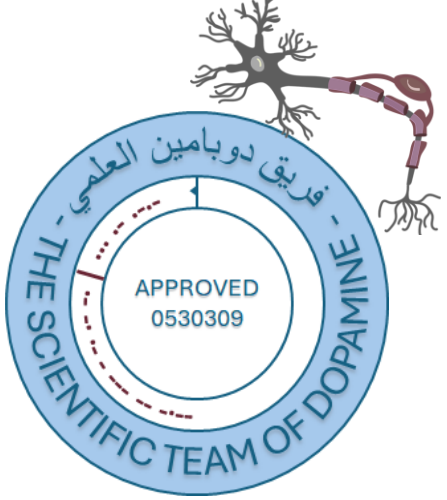


بسم الله الرحمن الرحيم

DOPAMINE SCIENTIFIC TEAM

Brain Stem (Pt.2)

MID | Lecture 7

﴿إِنِّي تَوَكَّلْتُ عَلَى اللَّهِ رَبِّي وَرَبِّكُمْ ۚ مَا مِن دَابَّةٍ إِلَّا هُوَ آخِذٌ بِنَاصِيَتِهَا ۚ إِنَّ رَبِّي عَلَىٰ صِرَاطٍ مُّسْتَقِيمٍ﴾

Written by: Mahmoud Aljunaidi
Abdulrahman Alsaadi

Reviewed by: Mahmoud Aljunaidi

ANATOMY

رحلة اليقين مع سورة يس

بِسۡمِ ٱللَّهِ ٱلرَّحۡمَٰنِ ٱلرَّحِيمِ

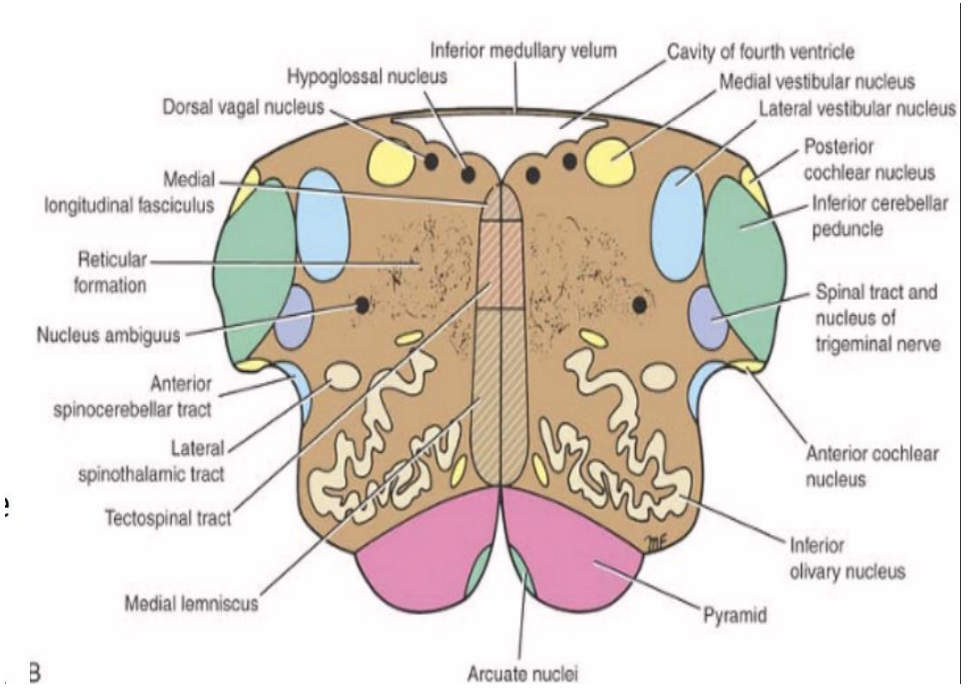
ءَأَتَّخِذُ مِن دُونِهِۦٓ ءَالِهَةً إِن يُرِدۡنِ ٱلرَّحۡمَٰنُ بِضُرّٖ لَّا تُغۡنِ عَنِّي شَفَٰعَتُهُمۡ شَيۡـٔٗا وَلَا يُنقِذُونِ ﴿٢٣﴾ إِنِّيٓ إِذٗا لَّفِي ضَلَٰلٖ مُّبِينٍ ﴿٢٤﴾

{أَأَتَّخِذُ مِنْ دُونِهِ آلِهَةً إِنْ يُرِدْنِ الرَّحْمَنُ بِضُرٍّ لَا تُغْنِ عَنِّي شَفَاعَتُهُمْ} لأنه لا أحد يشفع عند الله إلا بإذنه، فلا تغني شفاعتهم عني شيئا، وَلَا هُمْ يُنْقذون من الضر الذي أراده الله بي.

{إِنِّي إِذًا} أي: إن عبدت آلهة هذا وصفها {لَفِي ضَلَالٍ مُبِينٍ} فجمع في هذا الكلام، بين نصحهم، والشهادة للرسل بالرسالة، والاهتداء والإخبار بِتعيُّن عبادة الله وحده، وذكر الأدلة عليها، وأن عبادة غيره باطلة، وذكر البراهين عليها، والإخبار بضلال من عبدها، والإعلان بإيمانه جهرا، مع خوفه الشديد من قتلهم،

Level Just Inferior to the Pons

- No major changes.
- At the Ponto-Medullary Junction, the vestibular nuclear complex is encountered.
- As the sections progress superiorly, **Lateral vestibular nucleus** replaced the inferior vestibular nucleus, which is in the lower medulla.
- At this level, **Cochlear nuclei** are also visible on the anterior and posterior surfaces of the inferior cerebellar peduncle. Thereby, subdivided into two parts: the **ventral** (anterior) cochlear nucleus and the **dorsal** (posterior) cochlear nucleus.



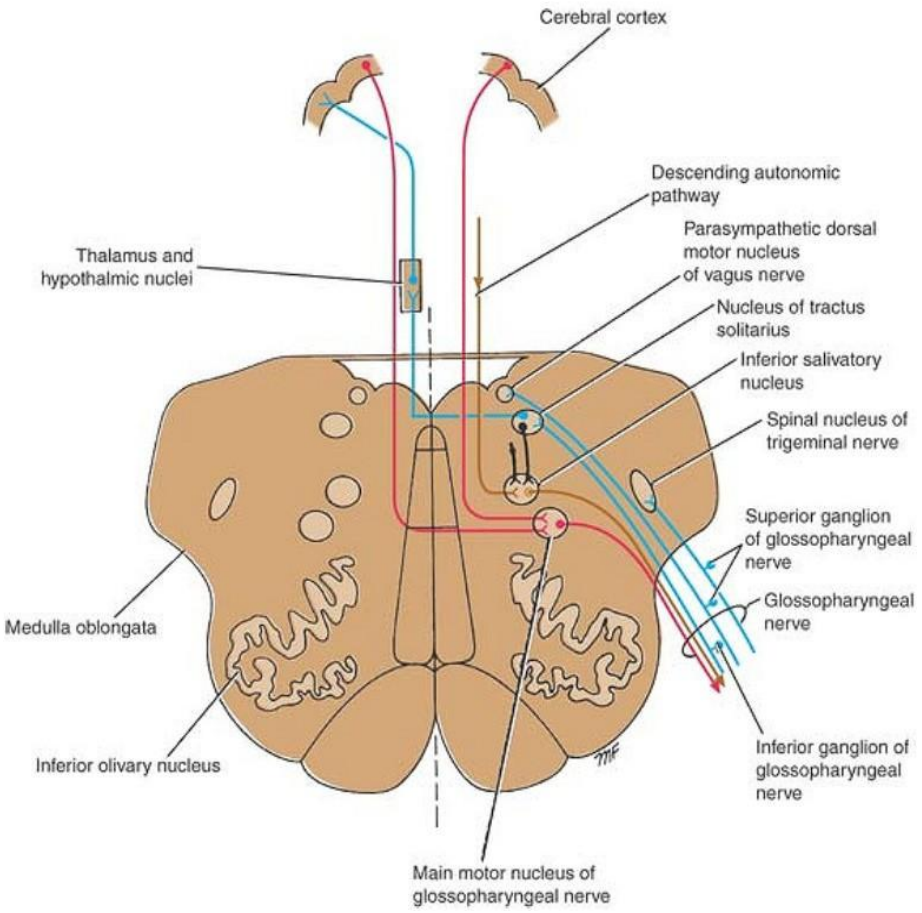
- Cochlear nuclei are components of the **vestibulocochlear nerve**, CN VIII, that play a central role in auditory hearing (processing).

The remaining slides are discussing 4 emerging Cranial nerves (9^{th} to 12^{th}):

- Glossopharyngeal Nerve (9^{th} – CN IX).
- Vagus Nerve (10^{th} – CN X).
- Accessory Nerve (11^{th} – CN XI).
- Hypoglossal Nerve (12^{th} – CN XII).

Glossopharyngeal Nerve Nuclei

- The glossopharyngeal nerve (CN IX) has multiple functions and therefore possesses multiple nuclei in the brainstem.
- **Main Motor Nucleus:**
  - Location: Deep in the reticular formation of the medulla oblongata.
  - Superior end of the nucleus ambiguus.
  - Receives corticonuclear fibers from **both** cerebral hemispheres, unlike spinal nerves which undergo decussation; contralaterally.
  - Supply the **stylopharyngeus muscle.**



Glossopharyngeal Nerve Nuclei

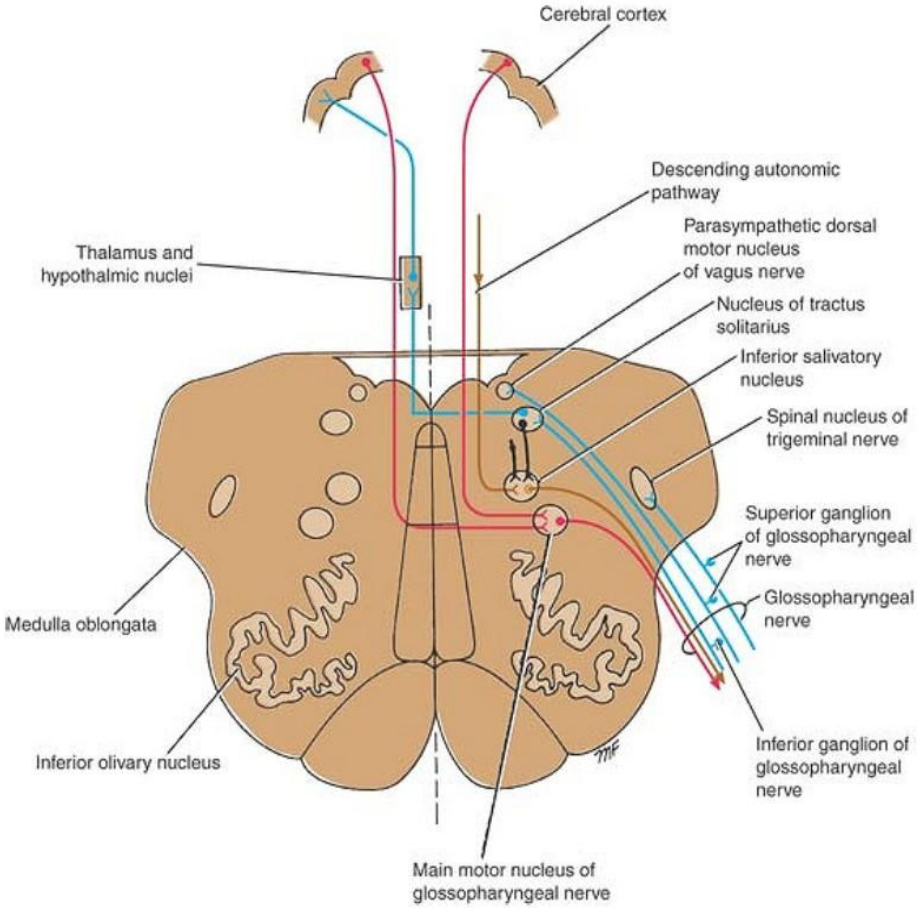
Main Motor Nucleus:

- The **nucleus ambiguus** is located deep within the reticular formation, away from the central gray matter, which lies just beneath the floor of the fourth ventricle.
- The **superior part** of the nucleus ambiguus specifically **supplies** the glossopharyngeal nerve.
- The **somatic motor** component of the glossopharyngeal nerve supplies only one skeletal muscle: the **stylopharyngeus muscle,** one of the pharyngeal muscles.
- The nucleus **receives bilateral cortical** input via **corticonuclear** (corticobulbar) fibers, similar to how corticospinal fibers descend to the spinal cord.

Glossopharyngeal Nerve Nuclei

Parasympathetic Nuclei (Visceral Motor):

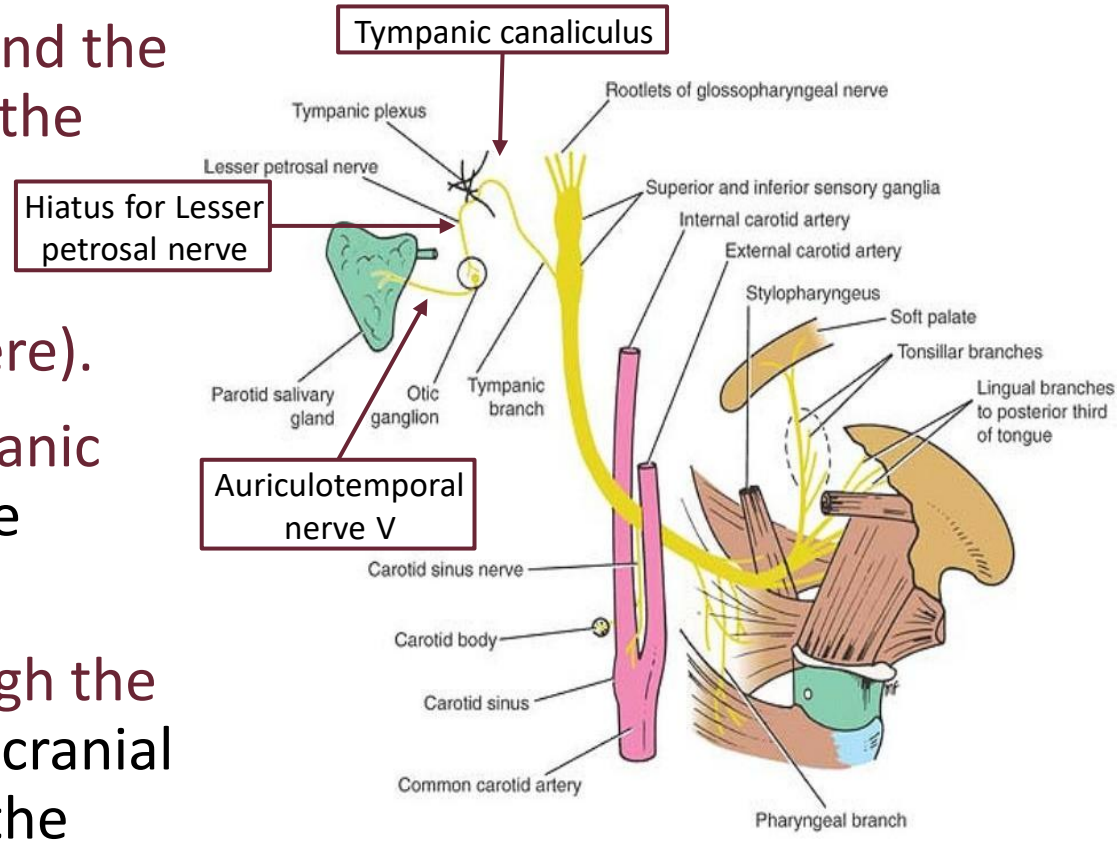
- **Inferior salivatory nucleus**
  - Posterior to the main motor nucleus lies the inferior salivatory nucleus.
  - Receives **afferents** from the hypothalamus.
  - **Efferent** preganglionic parasympathetic fibers reach the **otic ganglion** through the tympanic branch the glossopharyngeal nerve.
  - The inferior salivatory nucleus supplies the **parotid gland**. Interestingly, while the facial nerve (CN VII) passes through the parotid, it does not supply it. **The parasympathetic supply comes from CN IX.**



Glossopharyngeal parasympathetic component

Nerve supply to the parotid gland

- The nerve exits from the groove between the **olive** and the **inferior cerebellar peduncle** and leaves the skull via the **jugular foramen.**
- It has two sensory ganglia **(superior and inferior)** containing **sensory** cell bodies (no synapses occur here).
- A branch called the **tympanic nerve** enters the tympanic cavity, joins the **tympanic plexus**, and emerges as the **lesser petrosal nerve.**
- The lesser petrosal nerve (**preganglionic**) exits through the hiatus in the petrous temporal bone into the middle cranial fossa, then descends through the **foramen ovale** to the infratemporal fossa.

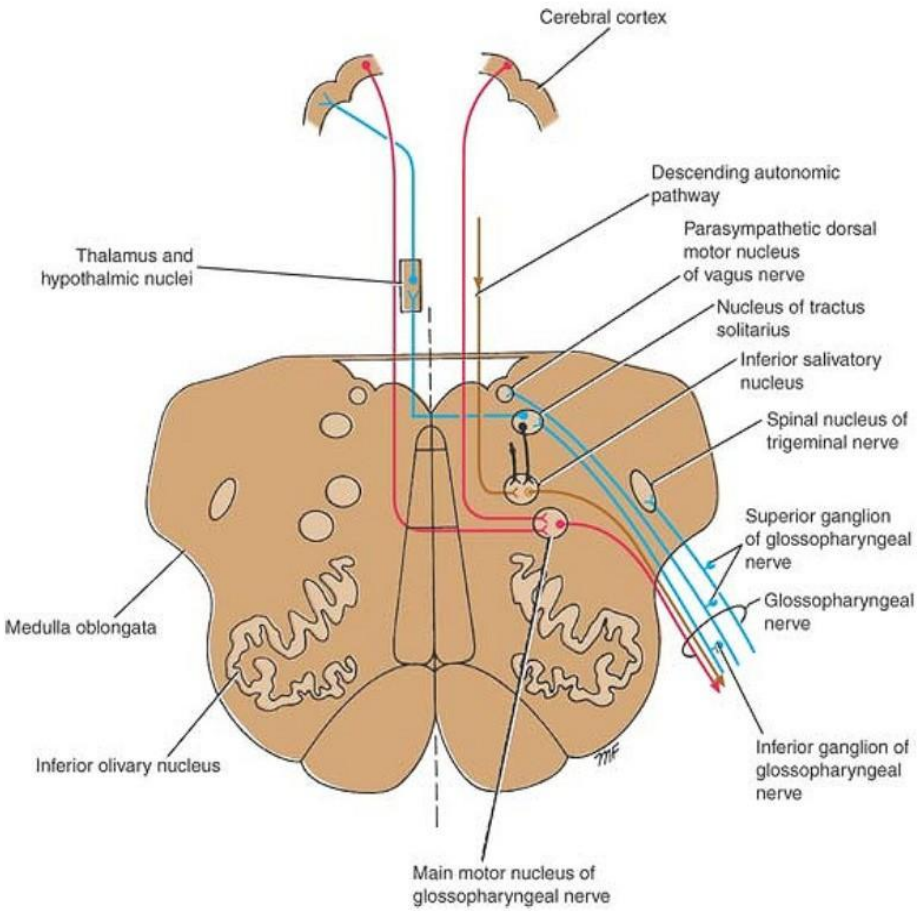


- It synapses in the **otic ganglion** (autonomic). **Postganglionic** fibers then travel with the **auriculotemporal nerve** (a branch of the mandibular nerve V3) to reach the **parotid salivary gland.**

Glossopharyngeal Nerve Nuclei

- There are two main types of sensory input:
  1. **Special** Sensory.
  2. **General** Sensory.
- **Sensory Nucleus** part of the nucleus of the tractus solitarius.

1. **Taste** from posterior 1/3 of tongue:
   - Cell bodies are in **inferior** glossopharyngeal ganglion.
   - Fibers synapse in the **Sensory nucleus** (nucleus tractus solitarius (NTS)). Then ascend to the **ventral-postero-medial** (**VPM) nucleus of the thalamus.**
   - Then project to the **primary gustatory** (taste) **cortex, posterior** to the general sensory cortex, deep to the lateral sulcus, adjacent to the lower part of the postcentral gyrus.

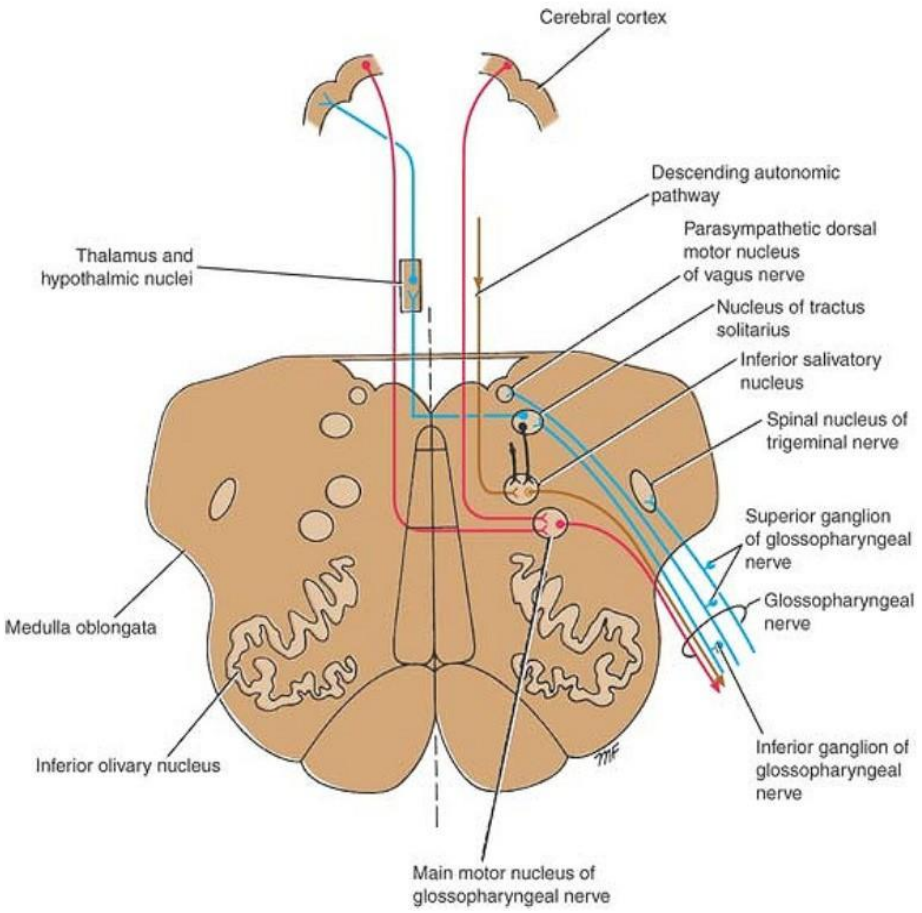


Glossopharyngeal Nerve Nuclei

- **Sensory Nucleus** part of the nucleus of the tractus solitarius.

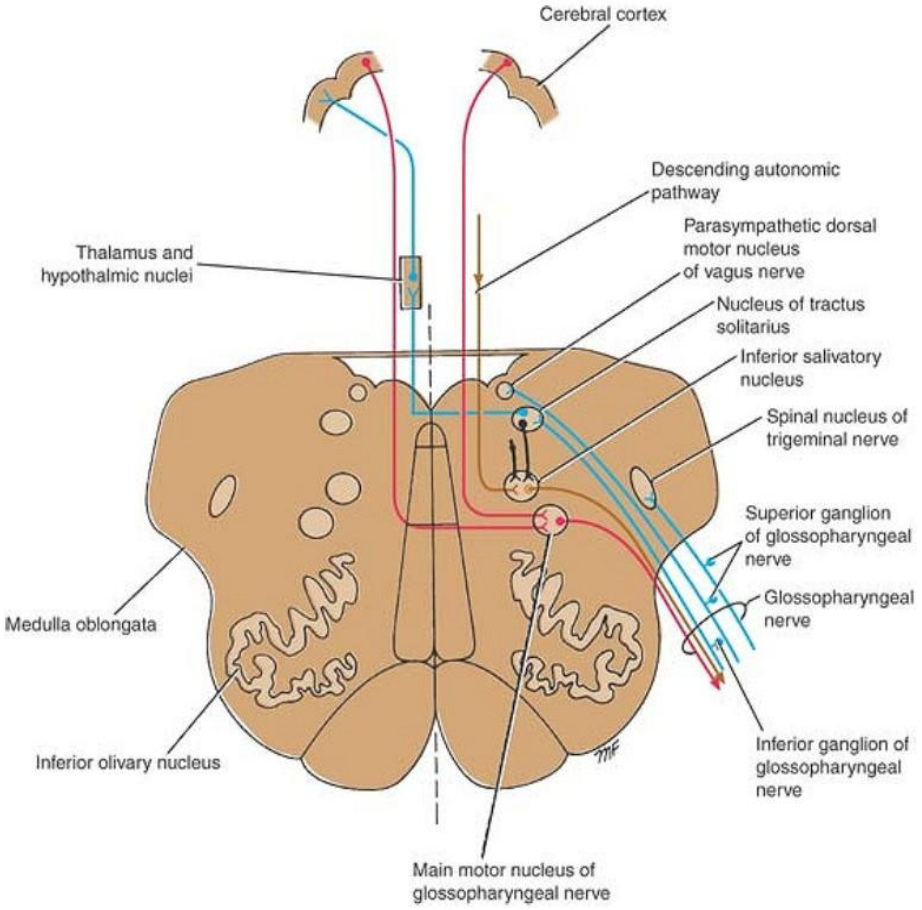
2. **Visceral Sensory** (Carotid Sinus):
   - Cell body in **inferior glossopharyngeal ganglion.**
   - Monitors blood pressure via **baroreceptors**.
   - ➢ **Increased pressure** triggers a reflex:

     Afferent impulses from the **carotid sinus** (baroreceptor) travel via CN IX to the Sensory nucleus (**NTS**), connected to **dorsal nucleus of the vagus nerve** → carotid sinus reflex activation → vasodilation to decrease blood pressure.



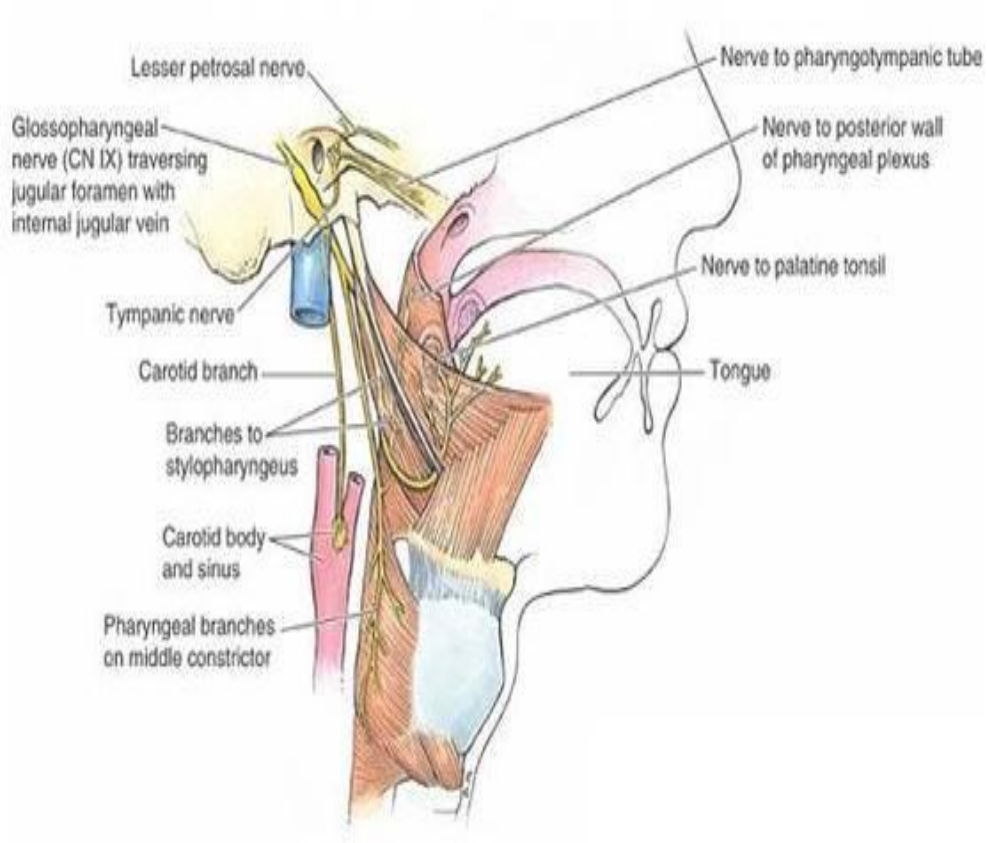
Glossopharyngeal Nerve Nuclei

- **Common sensation** (General Sensation):
  - Sensation of Pain, temperature, and crude touch from the **posterior 1/3 of the tongue**, **pharynx**, except the nasopharynx, **middle ear,** and **auditory tube.**
  - Cell body in **Superior** glossopharyngeal ganglion.
  - Fibers synapse in the **spinal nucleus of the trigeminal nerve.**
  - Thalamus.
  - postcentral gyrus.



Course of IX
(Glossopharyngeal Nerve)

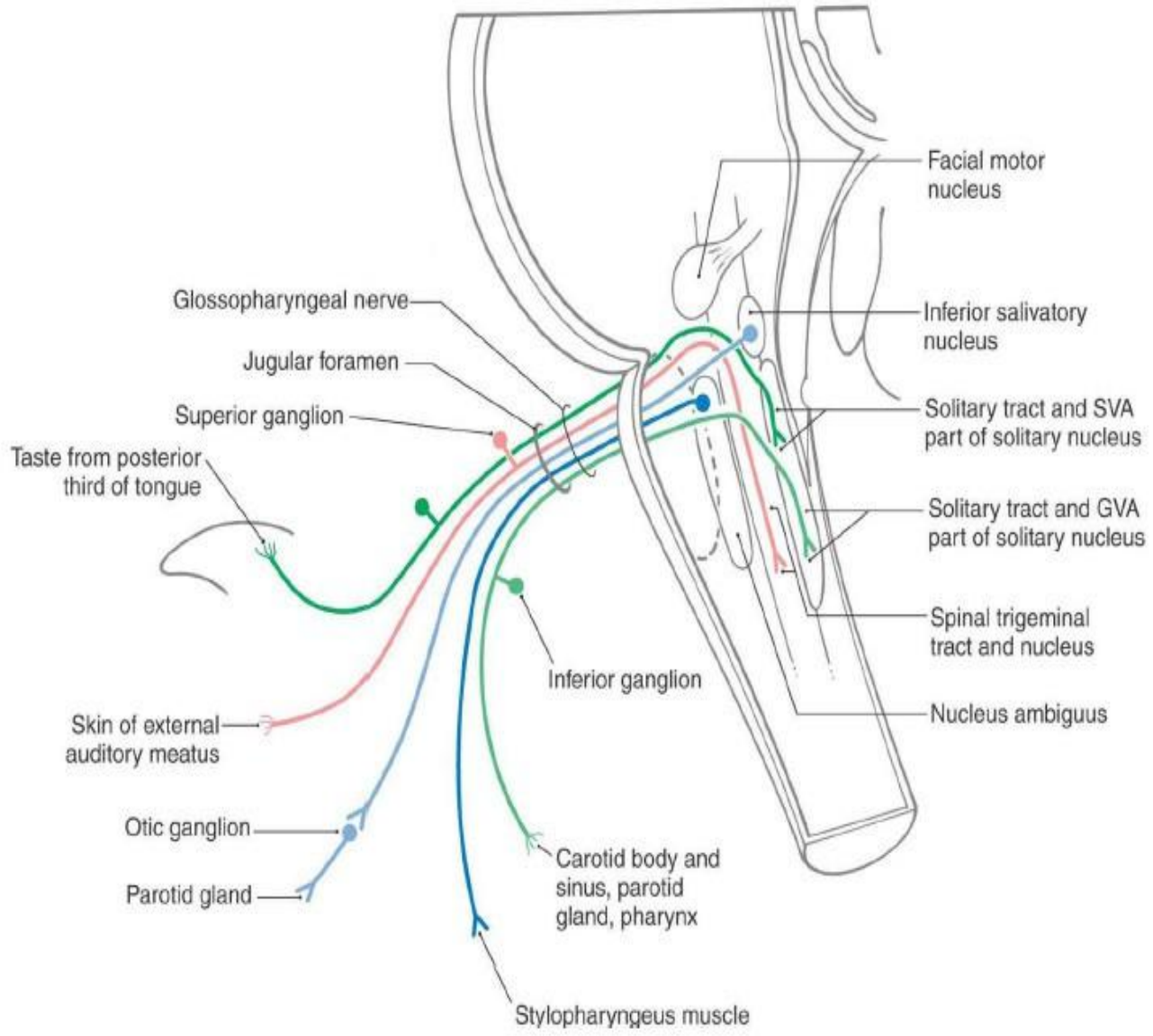
- **Anterolateral surface** of the upper part of the medulla oblongata.
- Groove between the **olive** and the **inferior cerebellar peduncle.**
- Leaves the skull through the **jugular foramen**, and forms 2 ganglia.
- **Posterior border** of the **stylopharyngeus** muscle, passing on in the anterior triangle.
- Between the **superior, middle** constrictor muscles of the pharynx, and the mylohyoid (triangular aperture).
- Sensory to the oropharynx laryngopharynx and the posterior 1/3 of the tongue



❖ **Lesion of the glossopharyngeal nerve:**

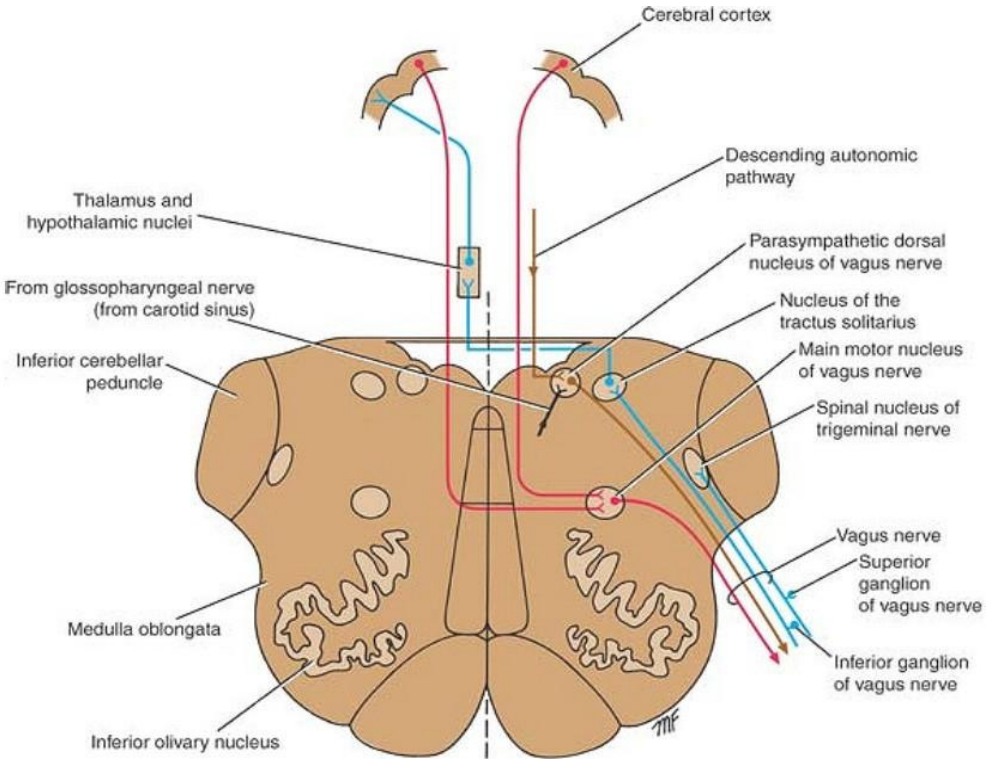
- ➢ **Loss** of pharyngeal reflex (**gag reflex**), a reflex that normally induces vomiting.
- ➢ **Loss of carotid sinus reflex**.
- ➢ **Loss of taste in the posterior third of tongue** (Vallate papillae).

Course of IX
(Glossopharyngeal Nerve)



Vagus Nerve Nuclei

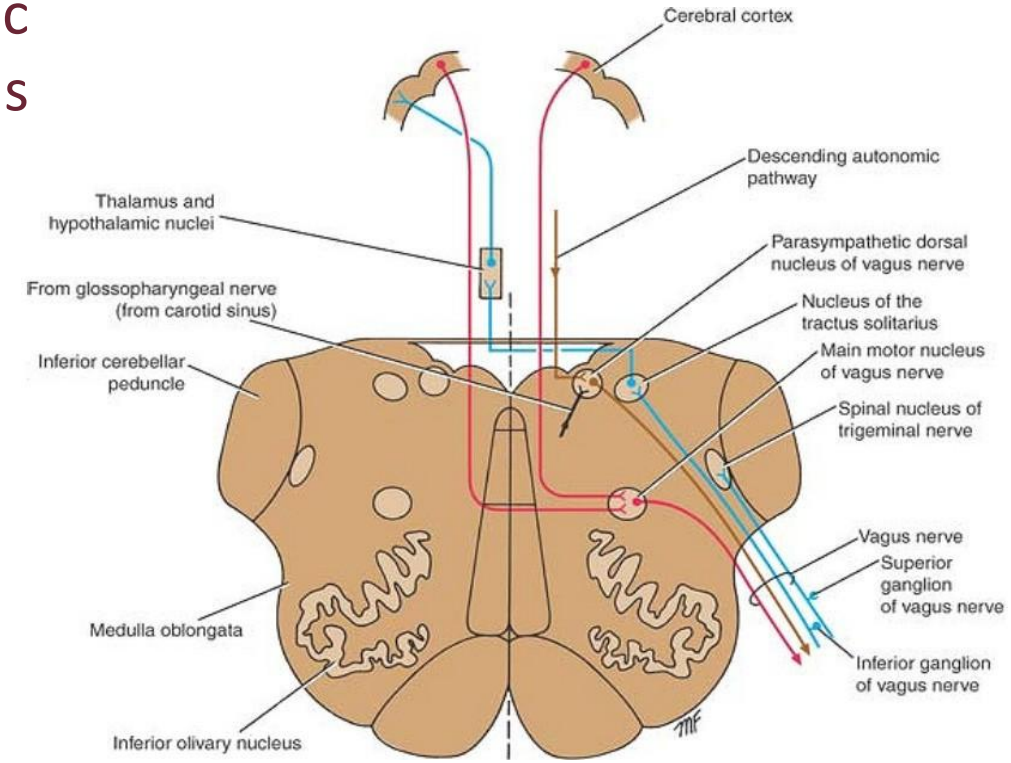
- The vagus also has motor, parasympathetic, and sensory components.
- **Main Motor Nucleus**
  - Location: Deep in the reticular formation of the medulla oblongata.
  - Lower part (level) of nucleus ambiguus than CN IX.
  - Receives corticonuclear fibers from **both** cerebral hemispheres; bilateral cortical input.
  - Supply the constrictor **muscles of the pharynx** (all muscles except stylopharyngeus) and the **intrinsic muscles of the larynx**. It also supplies the soft palate (except tensor veli palatini).



Vagus Nerve Nuclei

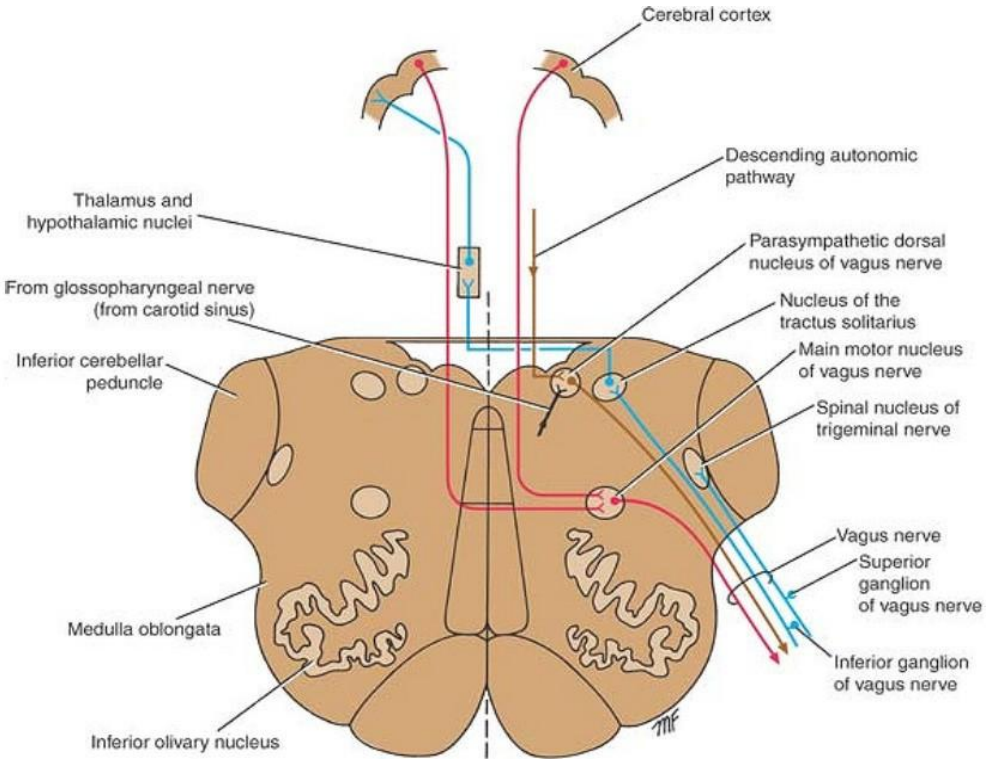
Parasympathetic Nuclei:

- Dorsal nucleus of the vagus, has preganglionic fibers that follow the distribution of the vagus nerve.
- **Floor of the lower part** of the fourth ventricle.
- Receives **afferents** from:
  - Hypothalamus
  - glossopharyngeal nerve (carotid sinus reflex).
- **Efferent** to involuntary muscle of the bronchi, heart, esophagus, stomach, small intestine, and large intestine as far as the distal one-third of the transverse colon.



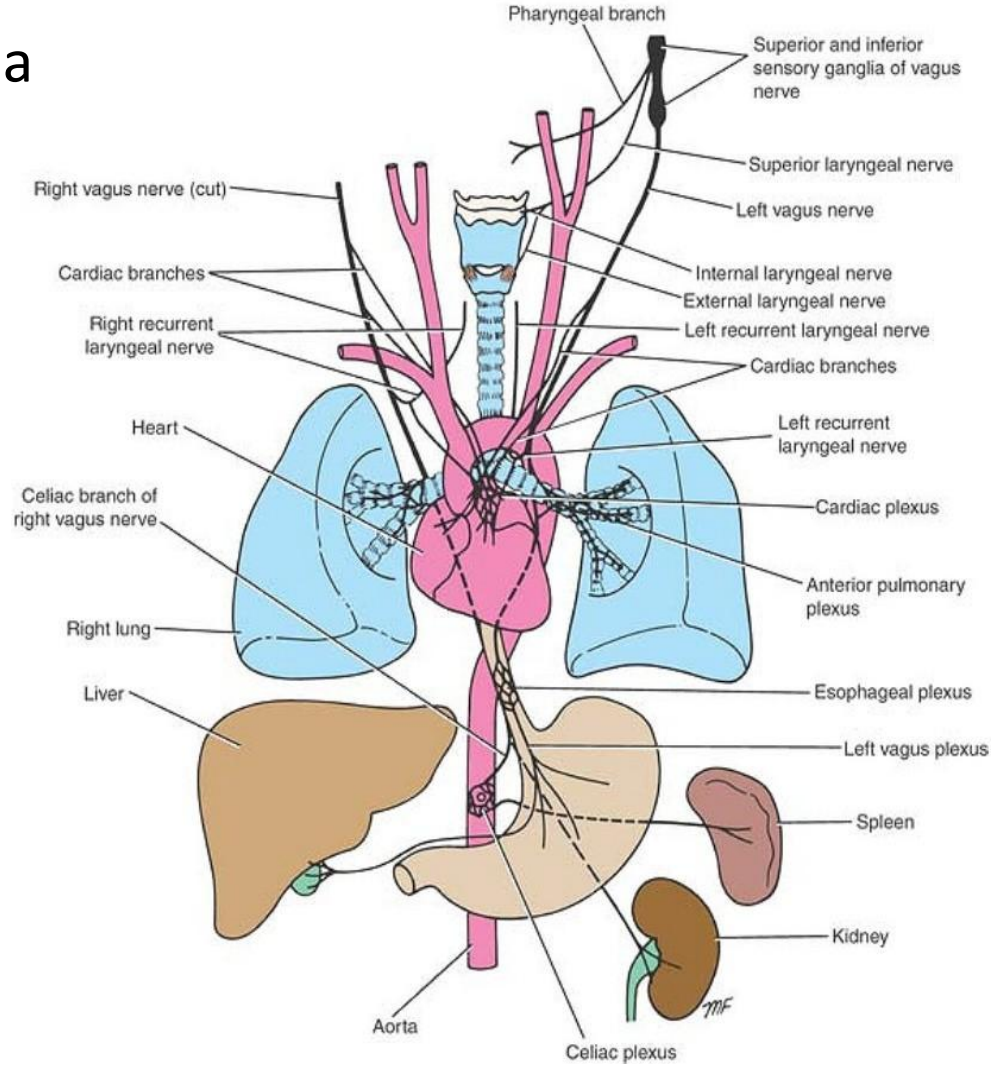
Vagus Nerve Nuclei

- **Sensory Nucleus** Lower part of the nucleus of the tractus solitarius.
- Like CN IX, it has a **superior ganglion** (general sensation) and an **inferior ganglion** (taste from the epiglottis and visceral sensation).
  1. **Taste** from epiglottis.
     - Cell body in **inferior** ganglion of vagus.
     - **Goes to the Sensory nucleus (NTS).**
     - Thalamus
     - Postcentral gyrus
  2. **Common sensation**
     - Cell body in **superior** ganglion of vagus.
     - **Goes to Spinal nucleus of the trigeminal nerve.**
     - Sensation from the **outer ear**, **mucosa of the larynx**, and **dura of posterior cranial fossa.**



Course of X
(Vagus Nerve)

- **Anterolateral surface** of the upper part of the medulla oblongata
- Groove between the olive and the inferior cerebellar peduncle
- Leaves the skull through the jugular foramen
- descends **vertically** in the neck within the carotid sheath.
- It's the only CN that leaves the head and neck area.



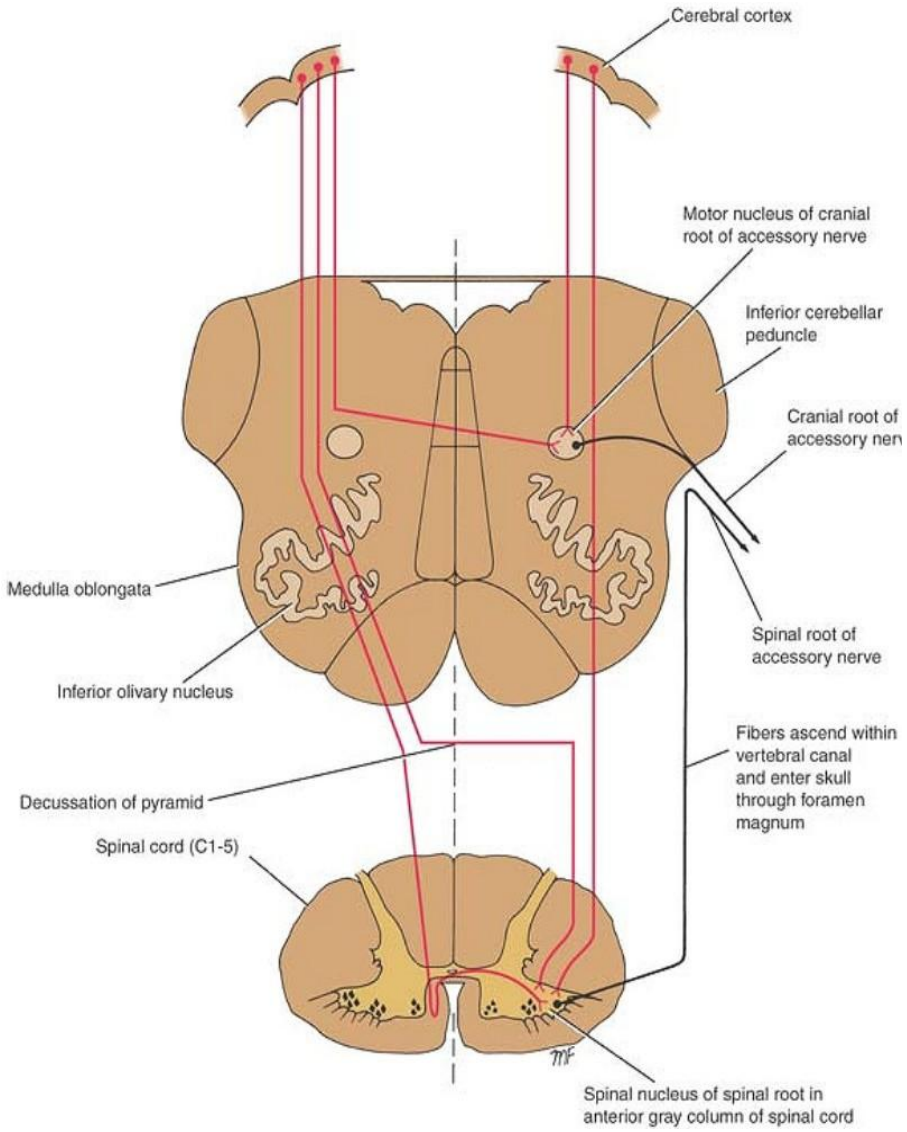
❖ **Lesion of Vagus:**

- ➢ Uvular deviation: Uvula deviates to the healthy side.
- ➢ Hoarseness of voice: Due to paralysis of the **laryngeal** muscles.
- ➢ Dysphagia (difficulty swallowing), due to **pharyngeal** muscle weakness and nasal regurgitation.
- ➢ Arrhythmia in heart and irregularity in GI tract because of parasympathetic loss.

Accessory Nerve

This nerve has two distinct roots:

1. **cranial root**
   - Originates from the nucleus ambigus, joins the spinal root briefly, but then separates to **join the vagus nerve** to supply the soft palate and pharynx.
   - Receives corticonuclear fibers from **both** cerebral hemispheres.
   - **Anterior surface** of the medulla oblongata between the **olive** and the **inferior cerebellar peduncle.**

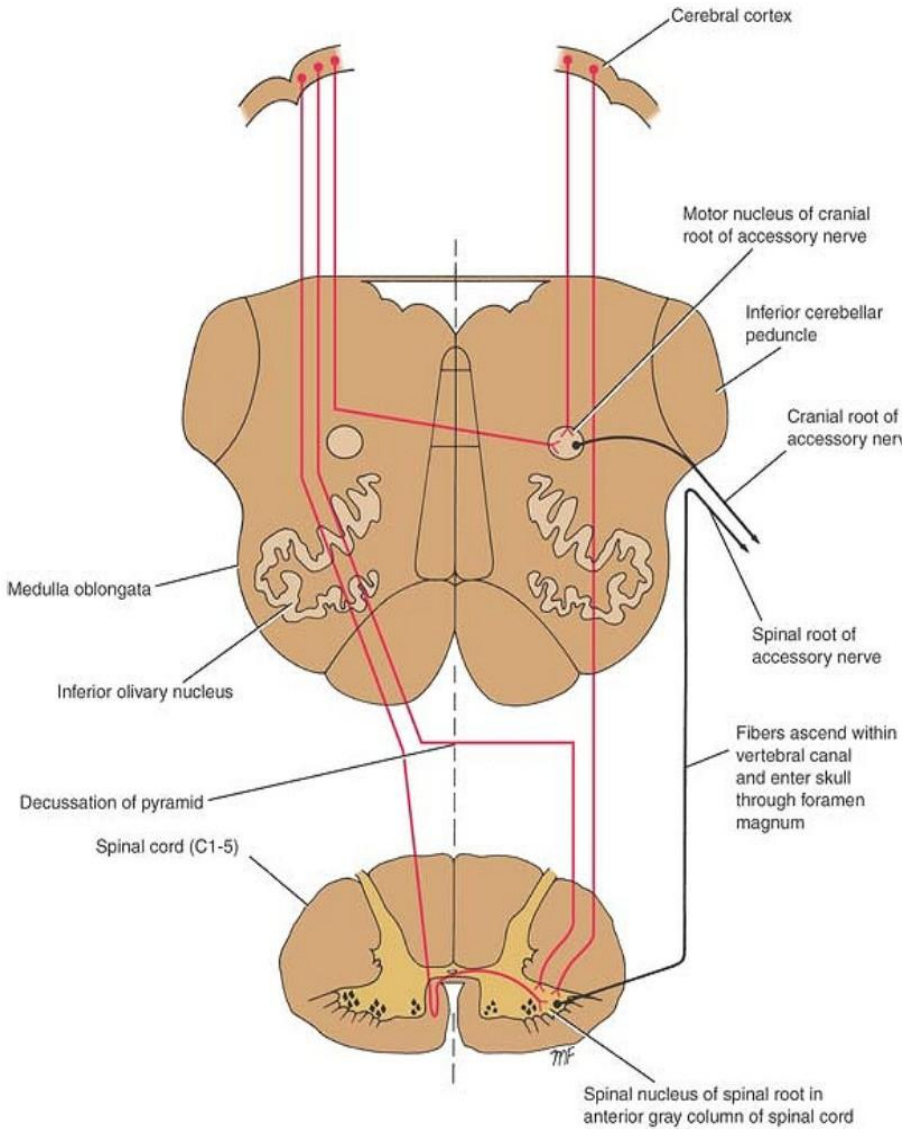


Accessory Nerve

2. Spinal root

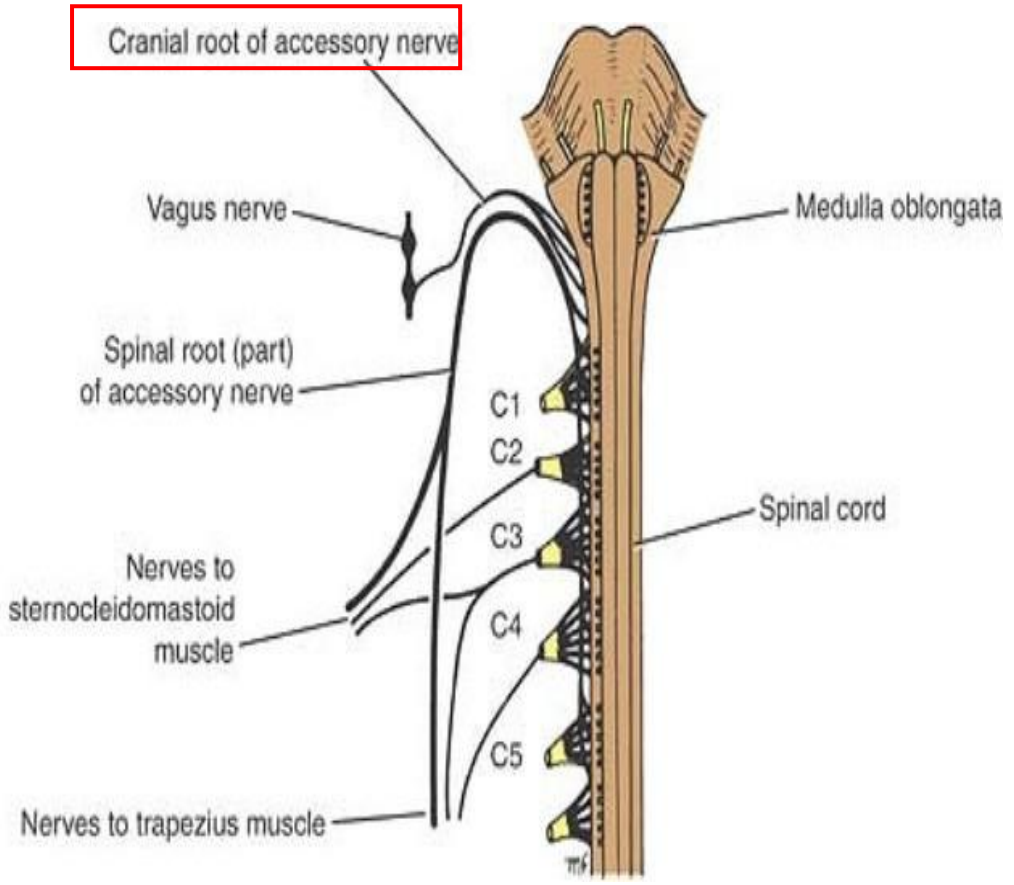
- **spinal nucleus, o**riginates from the **C1–C5** spinal segments (anterior gray column of upper five cervical segments); pure motor.
- It enters the skull through the **foramen magnum** and exits via the **jugular foramen**.
- It supplies the **sternocleidomastoid** and **trapezius** muscles.

Repeated next slide.



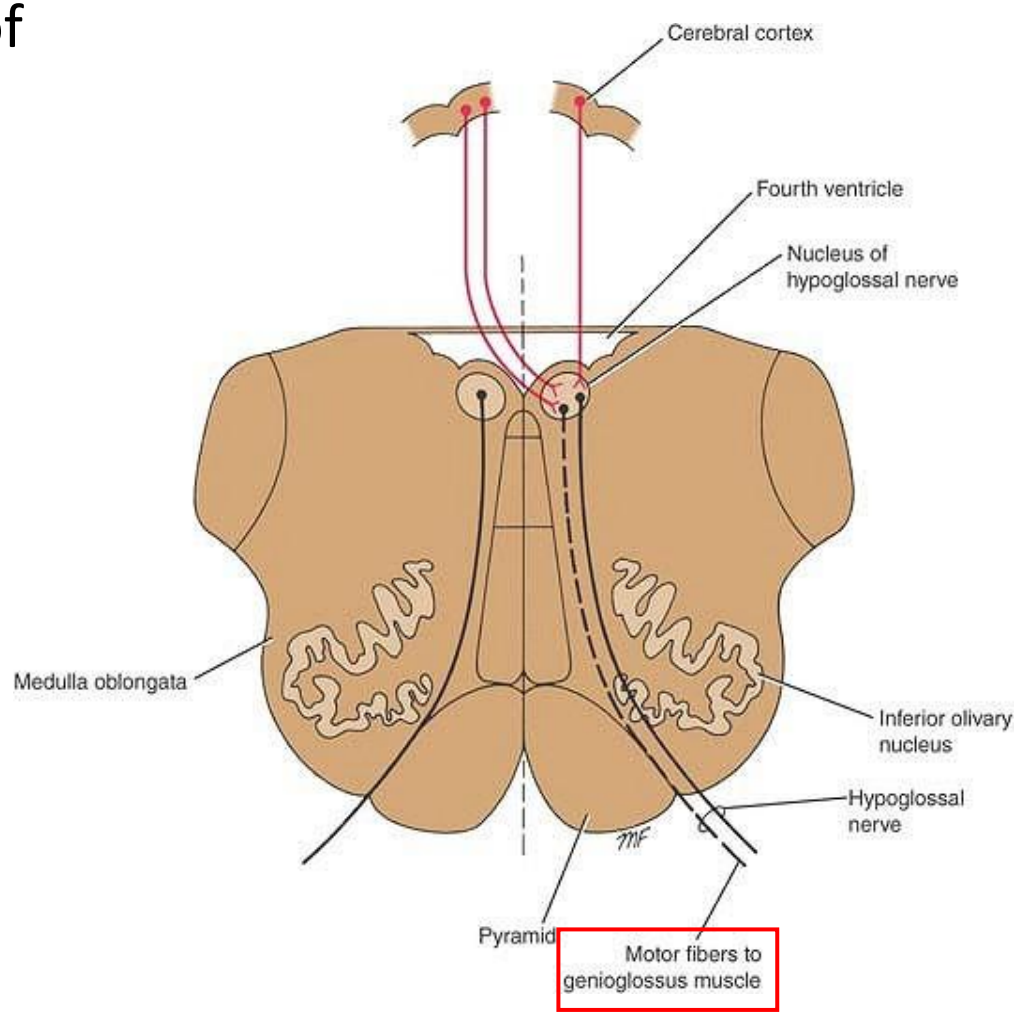
Accessory Nerve Course

- Spinal root emerge from the spinal cord **between the anterior and posterior nerve roots** of the cervical spinal nerves.
- Enters the skull through the **foramen magnum.** And joins the cranial root.
- Leaves the skull through **jugular foramen**, then **separates** into:
  - **Cranial root**: joins the vagus.
  - **Spinal root**: supplies **sternocleidomastoid** and **trapezius** muscles, the borders of the posterior triangle.



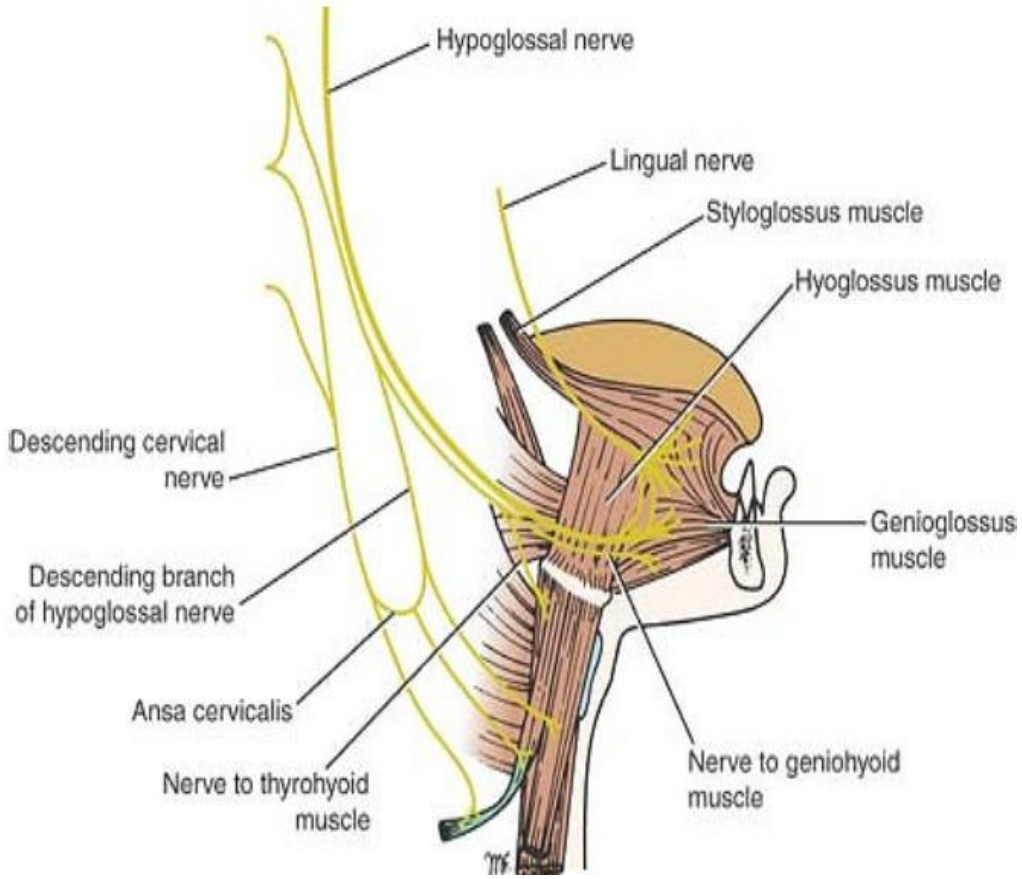
Hypoglossal nucleus

- Located near the midline, just **beneath** the floor of the lower part of the **fourth ventricle.**
- Exits from the groove between the **olive** and the **pyramid**.
- Most of the nucleus receives corticonuclear fibers from **both** cerebral hemispheres (bilateral cortical input), but the part for the **genioglossus** muscle receives only contralateral input.
- Cells responsible for supplying the **genioglossus** muscle, responsible for protraction, receives from **opposite** cerebral hemisphere
- Motor to the tongue; supplies all tongue muscles except the **palatoglossus**, which is supplied by CN X.



Hypoglossal Nerve Course

The hypoglossal nerve (CN XII) originates from the **anterior surface of the medulla oblongata** between the **pyramid** and the **olive**. It leaves the skull through the **hypoglossal canal** on either side of foramen magnum and descends into the anterior triangle the neck, traveling between the **internal carotid artery** and **internal jugular vein**. From there, it passes forward to provide motor innervation to the muscles of the tongue, except palatoglossus.



Hypoglossal Nerve injury

- Lower motor neuron lesion
  - Tongue deviation toward the paralyzed side.
  - Muscle atrophy (ipsi).
- Upper motor neuron lesion
  - No atrophy
  - On protrusion tongue will deviate to the side opposite the lesion.

Hypoglossal Nerve injury

1. **Lower Motor Neuron (LMN) Lesions** – Ipsilateral Effects:
   - A lower motor neuron lesion of the Hypoglossal nerve occurs either at its nucleus in the brainstem or along the nerve after it exits the skull.

   - If the **right hypoglossal nerve is damaged** as it travels through the hypoglossal canal, **the deficit appears on the right side**. Why?
     - Each hypoglossal nerve directly innervates the muscles of its own side of the tongue. Therefore, right-sided nerve damage leads to right-sided weakness.

   - **Muscle changes (atrophy):**
     Because the affected muscles lose their direct neural input, they undergo ipsilateral atrophy, becoming visibly thin or shrunken over time.

Hypoglossal Nerve injury

Mechanism of Tongue Deviation

- To understand tongue deviation, consider the following anatomical principles:

1. **Paired muscle structure:**
   - Although the tongue appears as a single organ, it is **divided by a median septum**, creating paired muscles on each side (e.g., right and left genioglossus, right and left styloglossus).
2. The Genioglossus muscle is primarily responsible for protruding the tongue. It acts as a forward "pushing" muscle.

➢ What happens in a right LMN lesion, when the patient protrudes the tongue:
   - **The healthy left genioglossus contracts normally and pushes forward.**
   - The paralyzed right side cannot counteract this movement.
   - As a result, the tongue deviates toward the paralyzed (right) side, **which is the same side as the lesion.**

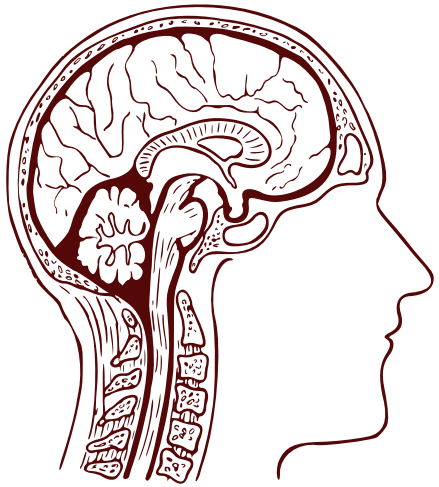
Hypoglossal Nerve injury

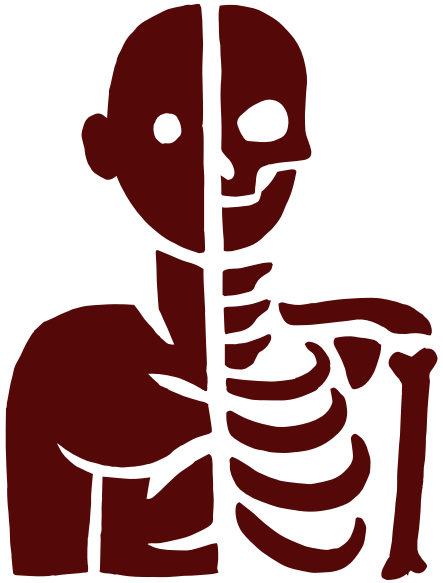
2. Upper Motor Neuron (UMN) Lesions – Contralateral Effects

- An **upper motor neuron lesion** involves damage to the corticobulbar (corticonuclear) fibers that descend from the cerebral cortex to the hypoglossal nucleus.

- If a lesion occurs in the left cerebral hemisphere, it affects motor control of the **opposite** (right) side.
  - Even though the injury is on the left, weakness appears on the **right side** of the tongue, producing deviation to the right during protrusion.
  - The primary deficit involves the genioglossus muscle, as it depends mainly on **contralateral cortical input for protrusion**.

- **Absence of atrophy:**
  A defining feature of UMN lesions is **lack of muscle atrophy**, since the lower motor neuron remains intact. Instead of wasting, reflex activity is typically increased.





ANATOMY QUIZ LECTURE 7

External Resources

رسالة من الفريق العلمي

اللهم إن عمر عطية في ذمتك وحبل جوارك، فقِه من فتنة القبر وعذاب النار،
أنت أهل الوفاء والحق، فاغفر له وارحمه إنك أنت الغفور الرحيم.

دعواتكم الطيبة يا كرام

For any feedback, scan the code or click on

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V1			
V1 → V2			