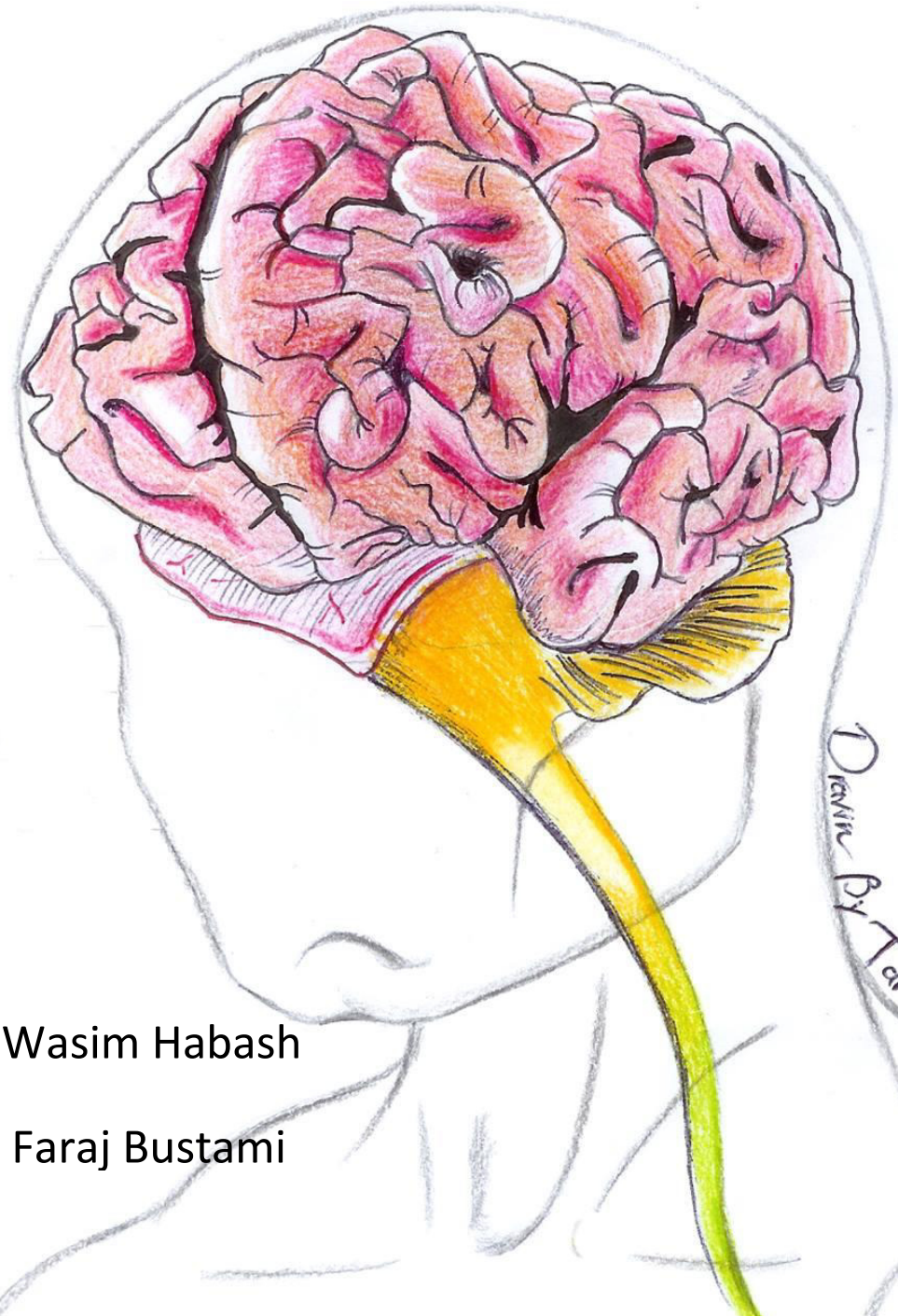
CENTRAL NERVOUS SYSTEM

- ○ Handout
- ● Sheet
- ○ Slide

- ● Anatomy
- ○ Physiology
- ○ Pathology
- ○ Biochemistry
- ○ Microbiology
- ○ Pharmacology
- ○ PBL



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Lec #: 17

Functional components of spinal & cranial nerves

1). Spinal Nerves:

Every spinal nerve has a motor, sensory and a sympathetic component. These components are found mixed together (anatomically) in the anterior and posterior rami and in the trunk of the spinal nerve. The sensory part enters the dorsal root; the motor part enters the ventral root; the sympathetic part synapses in the intermediolateral horn by passing through the ventral horn.

#functional components of a spinal nerve:

-in the dorsal (sensory) root:

**general afferent fibers:

1).**GSA**(general **S**omatic **A**fferents): receive sensations (pain, temperature, touch and proprioception) from the body wall, tendons and joints.

2).**GVA**(general **V**isceral **A**fferents): receive sensations from the viscera.

-in the ventral (motor) root:

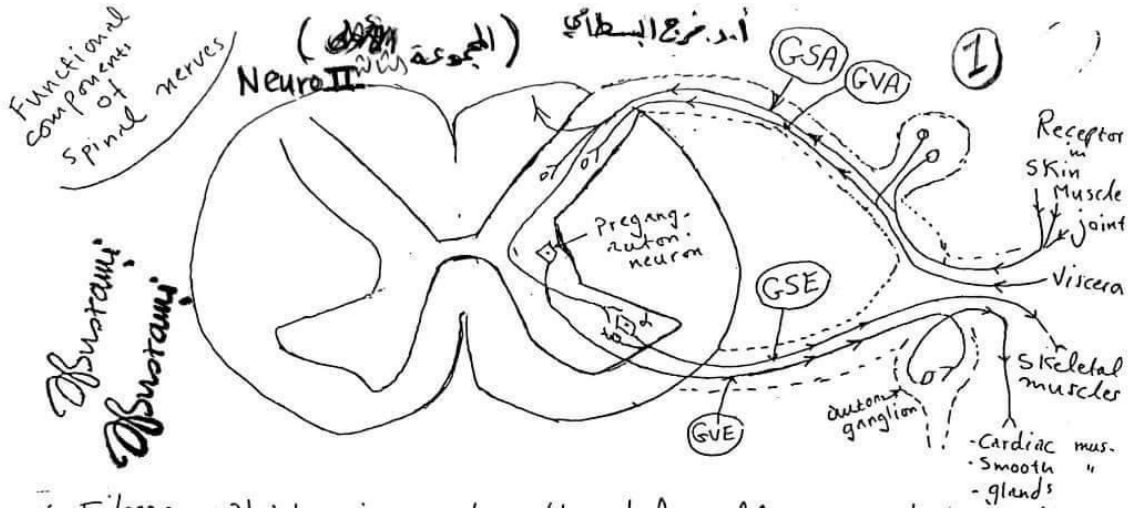
**general efferent fibers:

1).**GSE**(general **S**omatic **E**fferents): gives motor output to general muscles. Their (GSE) cell bodies are the alpha & gamma motor neurons of lamina 9 in the gray matter of the spinal cord.

2).**GVE**(general **V**isceral **E**fferents): AUTONOMIC fibers either sympathetic (cell bodies in the lateral horn of segments T1-L2) or parasympathetic (cell bodies in the lateral horn of segments S2-S4).

Autonomic fibers innervate: 1-smooth muscles anywhere in the body (in the

walls of blood vessels and in the walls of the gut) 2-Glands anywhere in the body (lacrimal, gastric, salivary, etc) 3-cardiac muscles.



***IMPORTANT: embryologically skeletal muscles in our body are of two types :

1)general muscles; derived from embryonic somites (myotomes): biceps, triceps, **extraocular muscles** and **muscles of the tongue**. NOTE: although extraocular muscles and muscles of the tongue are in the face, they're NOT special muscles, they are general muscles that receive motor output from **GSE** fibers.

2) special muscles; derived from pharyngyeal arches:

-muscles of mastication (derived from the 1st pharyngeal arch, supplied by the motor part of the trigeminal nerve [the mandibular nerve]).

-muscles of facial expression (derived from the 2nd pharyngeal arch, supplied by the motor part of the facial nerve) .

-muscles of the pharynx,larynx and palate (derived from the 4th,5th&6th pharyngyal arches, supplied by the nucleus ambiguous that gives the 9th, 10th cranial nerves in addition to the cranial accessory nerve {11th cranial nerve}).

-In spinal nerves the **GSE** fibers give motor output to **general muscles.**

-**Each** spinal nerve has **all** of these **4** components **;GSA,GVA,GSE** and **GVE.**

-Important: Remember that any nerve(cranial or spinal) containing sensory fibers must carry a ganglion or more containing mother cells of the sensory fibers.

2).Cranial nerves:

In addition to the 4 components of a spinal nerve (GSA,GVA,GSE,GVE) a cranial nerve may contain some special components that are **not** found in spinal nerves. These special components are:

1).**SSA** (special somatic afferents): nerve fibers that carry vision,hearing or equilibrium.

-why do we call these receptors "**special somatic**" ?

"Special"; hence it's a special sensation. -"Somatic"; hence the the retina, ear and equilibrium system is close to the body wall (soma = body).

2).**SVA**(special visceral afferents): olfaction & taste.

special visceral: for taste and olfaction. The tongue & nose are at the beginning of the GI & Respiratory systems so they're considered part of the viscera.

3).**SVE**(special visceral efferents): motor output to special muscles. (it is NOT a part of autonomic nervous system).

-Any of the cranial nerves may contain **one** or **more** of the above **7 components** (GSA, GVA, GSE, GVE, SSA, SVA, SVE).

-Any of the spinal nerves contain **4 components** (GSA, GSE, GVA, GVE).

-For example:

-the occulomotor nerve (3rd cranial nerve) contains only 2 components: 1- GSE: Motor fibers to all extraocular muscles except lateral rectus muscle and superior oblique muscle. 2- GVE: parasympathetic fibers to smooth intraocular muscles (constrictor pupillae and cilliary muscles).

-the hypoglossal nerve (12th cranial nerve) has only one component: GSE.

-The abducent nerve (6th cranial nerve) that supplies the lateral rectus muscle has one component: GSE.

-The trochlear nerve (4th cranial nerve) that supplies the superior oblique muscle has one component: GSE.

-The vagus nerve (10th cranial nerve) has 5 components: 1-GSA 2-GVA

3-SVA 4-GVE 5-SVE. We'll discuss them in detail later on in this sheet.

-So remember that every **spinal nerve** has **all** of the **4** components (GSA,GVA,GSE,GVE) only, whereas cranial nerves may contain one or more of the 7 components (GSA,GVA,GSE,GVE,SSA,SVA,SVE). And that SSA,SVA,SVE fibers are found only in the cranial nerves.

-Anatomical position of the cranial nerves' nuclei:

''A cranial nerve nucleus is a collection of neurons (gray matter) in the brain stem that is associated with one or more cranial nerves.''-wiki

**In the figure below the motor nuclei are showed at one side and the sensory nuclei on the other side just to make it simpler than it should be :P but of course each half of the brain stem has both motor & sensory nuclei.

-These nuclei have ascending or descending nerve fibers, these fibers are present in the form of columns in the brain stem.

lets start with the **sensory nuclei** and their fibers:

1).GSA

which cranial nerve passes in this column? the trigeminal nerve.

-the trigeminal nerve has 3 sensory nuclei:

1).The chief (major) sensory nucleus in the pons: brings touch sensation from the

face

2).The spinal trigeminal nucleus (descends from the pons to the medulla to the upper 2/ 3 of the spinal cord): it's formed of more than one part; collectively receives pain,temperature and touch sensations from wide areas of the face.

3).The mesencephalic nucleus (ascends to the mesencephalon; the midbrain); receives proprioception from muscles and joints of the face.

-These 3 sensory, trigeminal nuclei form a column in the brainstem as part of the GSA.

2).SSA

**medial to the GSA's nuclei.

(vestibulocochlear).

the cochlear part presented by the 2 cochlear nuclei: dorsal (posterior) and ventral (anterior) cochlear nuclei.

the vestibular part presented by the 4 vestibular nuclei: lateral and superior vestibular nuclei present in the pons; while medial and inferior vestibular nuclei are present in the medulla.

3).SVA: taste & olfaction. **4).GVA**: sensation from the viscera.

both SVA & GVA have the same nucleus: the nucleus solitarius (tractus solitarius). The rostral part of the nucleus carries SVA (taste&olfaction) while the caudal part of the nucleus carries GVA (visceral sensations).

Now lets move to the **motor columns** and their nuclei:

1).GSE

which nuclei belong to this column?

-in the medulla: the hypoglossal nucleus.

-in the pons: the abducent nucleus.

-in the midbrain: the trochlear nucleus and a part (majority) of the occulomotor nucleus .(the remaining part of oculomotor nucleus belongs to the parasympathetic GVE column).

2).GVE

-parasympathetic fibers.

which nuclei belong to this column?

-in the medulla: dorsal motor nucleus of vagus (giving rise to the parasympathetic fibers in the vagus).

-in the pons: inferior salivatory nucleus (parasympathetic innervation along with the glossopharyngeal - 9th cranial - to the parotid gland). And superior salivatory nucleus (giving rise to the parasympathetic fibers of the facial nerve-7th cranial- that supply **all** glands of the face **except** the parotid. **[**Glands of the face: lacrimal, nasal, submandibular salivary gland, sublingual salivary gland, intralingual salivary gland**]**.

-in the midbran: Edinger-Westphal nucleus (EWN) (gives rise to the parasympathetic fibers of the occulomotor that supply the 2 smooth intraoccular muscles: constrictor pupillae and cilliary muscles).

3)SVE

motor to special muscles.

which nuclei belong to this column?

- in the medulla: nucleus ambigious (gives rise to the 9th and 10th cranial nerves and to the cranial part of the 11th-accessory- ,supplies muscles of the pharynx,larynx and palate).

-in the pons: facial motor nucleus (supplies muscles of facial expression). And the motor part of the trigeminal nucleus (supplies muscles of mastication).

So those were the sensory and motor functional components (sensory and motor columns) of cranial nerves, located in the brain stem. And as we mentioned before a cranial nerve may contain one or more of those components but not all of them.

-Any nerve (spinal or cranial) that contains sensory fibers (a sensory component) should have a ganglion or more.

-Inside the ganglion of spinal nerves are pseudounipolar neurons which divide into a peripheral process (synapsing on the receptors) and a central process(enters the spinal cord and synapses on the 2nd order neurons).

-In cranial nerves, for example the trigeminal nerve (which the majority of its components are sensory fibers) its sensory neurons' peripheral processes synapse on receptors in the face, its central process enters the sensory nucleus and synapses there (the sensory nucleus here mimics the 2nd order neurons in spinal nerves that are either in the spinal cord or medulla), and the cell bodies of these sensory neurons are in the trigeminal ganglia (also called semilunar ganglia).

''An important characteristic of 2nd order neurons is their DECUSSATION, the spinothalamic tract decussates in the spinal cord and the dorsal column system decussates in the medulla. Then the fibers ascend and synapse on the 3rd order neurons''.

The motor part of the trigeminal (minority) arise from alpha and gamma motor neurons in the brain stem (as like motor parts of spinal nerves arise from alpha and gamma motor neurons in the spinal cord).

-Now we'll discuss in detail the functional components of some cranial nerves:

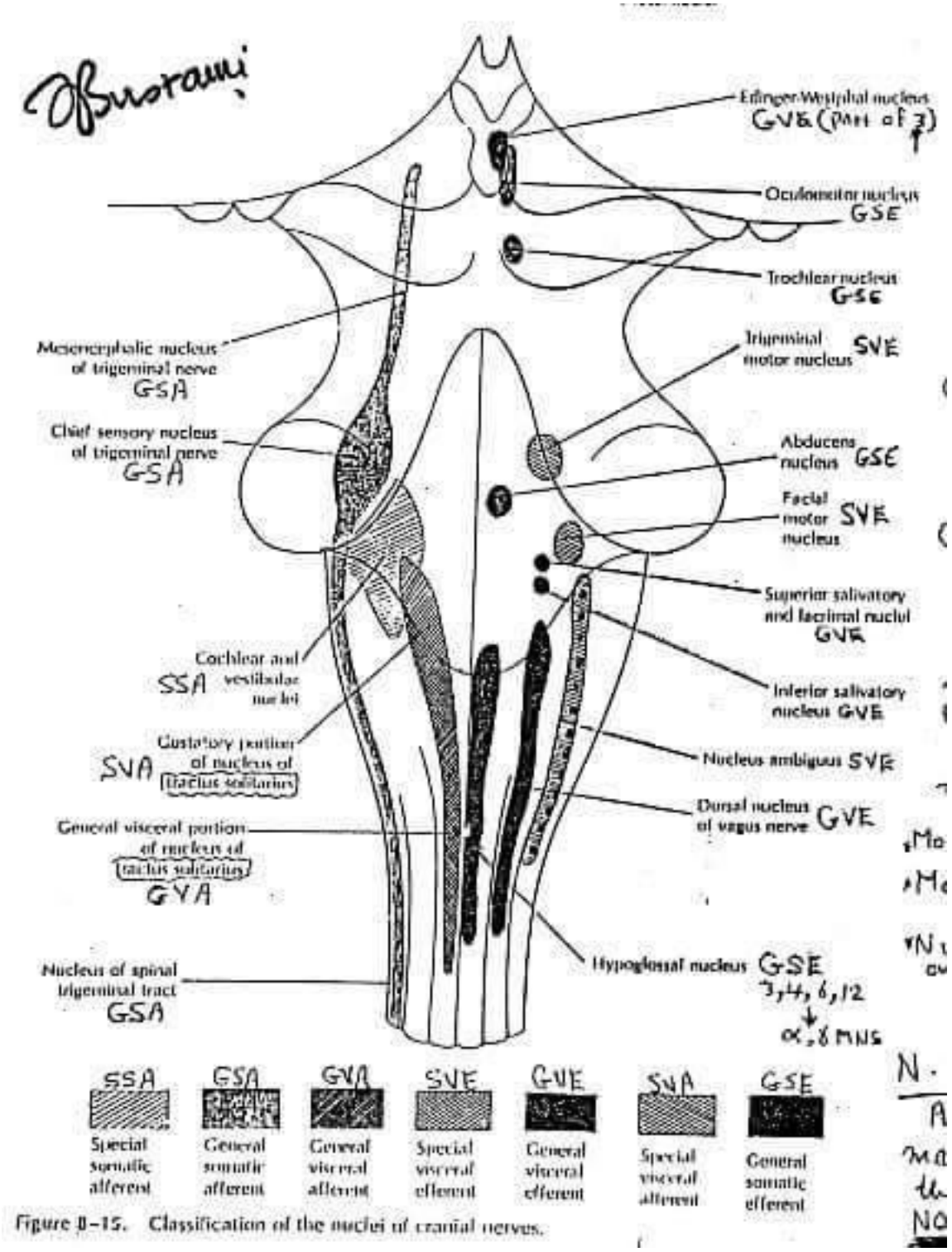


Figure 8–15. Classification of the nuclei of cranial nerves.

1).Vagus nerve.

It has both sensory and motor components. As a general rule, any nerve that

contains sensory fibers should have a ganglion or more. For the vagus nerve, it has 2 ganglia under the jugular foramen (at the base of the skull): superior ganglion (jugular ganglion) and inferior ganglion (nodose ganglion).

Cell bodies of sensory fibers (pseudounipolar neurons) are in the ganglion and have central and peripheral processes synapsing on sensory nuclei and receptors respectively.

*sensory components of vagus:

1).**GSA**: carries sensations of pain, temperature and touch from the external ear.

Centrally passes through the **Spinal trigeminal nucleus**

2nd order neurons send signals to the thalamus

If any part of this pathway gets stimulated, then it will cause severe inhibition of the heart (severe bradycardia) and marked drop of Cardiac output to the degree of shock. So you must be cautious when cleaning someone's ear because you may stimulate the vagus. Hitting someone on his/her ear could be dangerous due to the same reasons.

2).**SVA**: carries sensation of taste from the epiglottis (epiglottis has taste buds).

Centrally it passes through the upper (rostral) part of **nucleus solitarius**

3).**GVA**: carries general sensations from the abdominal and thoracic viscera.

Centrally passes through the **Solitary nucleus.**

*Motor components of vagus:

Motor fibers in the vagus just pass through the ganglion

1).GVE; sends parasympathetic fibers to the viscera

Mother cells are found either in the nucleus ambiguous or dorsal nucleus of vagus.

Before the parasympathetic fibers reach the stomach and heart (the viscera in general) they should enter and synapse in a ganglion, that's why we have preganglionic and postganglionic parasympathetic fibers.

2).SVE

Gives Motor innervation to special muscles.

Centrally passes through the **nucleus ambigious**

Parts of the 9th and 10th cranial nerves , (the part of the 10th cranial nerve that runs here is actually the cranial part of the accessory nerve! , yes the cranial part of the accessory nerve is part of the vagus!)

-so actually when we say 'pharyngeal part of vagus ' or 'superior laryngeal part of vagus we're referring to the crainial part of the accessory nerve.

-To be more accurate the motor part of vagus nerve supplys:

1-All muscles of the pharynx except the styloopharyngeus muscle.

2-All muscles of the larynx.

3-All muscles of the palate except the tensor palatine muscle.

-If there is a lesion in the vagus nerve (if the nerve is cut) we call the lesion infranuclear lesion 'lower motor neuron lesion' and it has the same effect of lesion in the nucleus.

When the vagus is cut we'll lose its functions;

Loss of the motor function will lead to:

1- Paralysis of the pharynx which results in dysphagia (difficulty in swallowing).

2- Paralysis of the palate which results in nasal regurgitation of fluid during swallowing (nervous type of dysphagia)"الأنف من السوائل ارتداد"

3- Position of the uvula will be affected (the uvula is part of the palate and is maintained in its position by the muscles on the right and left sides), so if there was a lesion in the nerve that supplies the muscles of one side the muscles of this side will get paralyzed and the uvula will deviate to the other side 'the normal side' as an effect of the action of the intact muscles of the pharynx. (notice that this is a LMNL so the effect is ipsilateral).

4- Paralysis of the larynx which results in hoarseness of the voice.

Note: hoarseness of the voice is not always an indication of vagus nerve injury, it could be a result of simple meningitis or a common cold due to an influenza infection.

Loss of the parasympathetic function will lead to:

1- Arrhythmias, as a result of the loss of inhibition to the heart.

2- Disturbance in functions of the stomach.

The most important effects of vagus nerve injury that we will most commonly see in clinic are the dysphagia, the nasal regurgitation and hoarseness of the voice.

2).Accessory nerve

**It has 2 parts: Spinal and cranial.

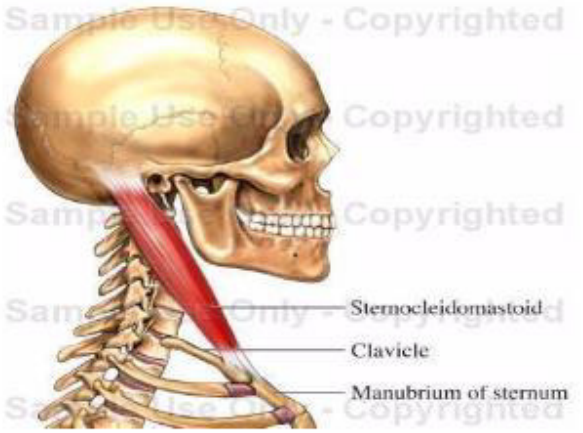
-The cranial part runs along with the vagus to supply the muscles of the pharynx , larynx and palate (special muscles).Its mother cells are in the nucleus ambiguous. (We never find a cranial accessory nerve running alone; its always accompanied by the vagus nerve)

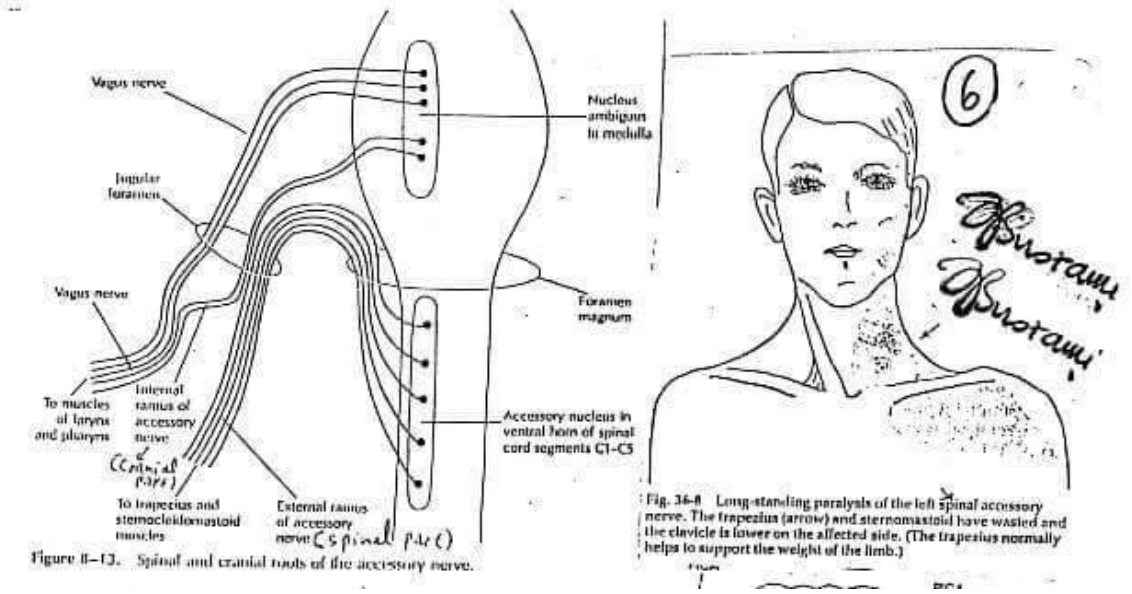
-The Spinal part of the accessory nerve has its mother cells in the upper 5 cervical segments of the spinal cord, but these cells are not located in the ventral horn nor in the dorsal horn as expected. These are **special** alpha and gamma cells (have a special position) that are located between the dorsal and ventral horns. These neurons **don't** exit through the ventral root of the spinal cord, instead they exit the spinal cord between the dorsal and ventral horns and form the spinal

accessory nerve that enters through the foramen magnum. Once it enters the foramen, it will run close to the cranial part of the accessory then when it gets farther, it will leave the cranial cavity via the jugular foramen as the spinal accessory nerve that will supply the sternocleidomastoid and trapezius muscles in the neck.

-An injury to the spinal accessory nerve by a stab wound or during surgical removal of a lymph node in a cancer patient will affect the posterior triangle of the neck and lead to paralysis of the sternocledomastoid muscle. [NOTE: the right sternocledomastoid muscle turns the face to the left and the left one turns the face to the right]. So to diagnose a lesion in the spinal accessory nerve, we ask the patient to turn his face/head to one side. If there is difficulty in moving the head to one side, then the injured spinal accessory nerve is on the opposite side. Example: The patient was asked to turn his head to the right. The patient could not perform this task. What and where is the site of the injured nerve? Left spinal accessory nerve.

NOTE: (V.IMPORTANT) the cranial part of the accessory nerve is accompanied by the vagus nerve WHILE the spinal part of accessory runs alone.





3).Glossopharyngeal nerve

It has both motor and sensory components. (almost the same components of the vagus).

Again the sensory efferents from the sensory component has 2 ganglia: superior and inferior ganglia.

Mother cells of the sensory fibers are in the ganglia whereas motor fibers just pass in the ganglia

*sensory components of glossopharyngeal:

1-**GSA**: carries sensations of pain, temperature and touch from the external ear. The central processes will synapse at the spinal trigeminal nucleus. This component is not of importance in our discussion.

2-**SVA**: carries sensation of taste from the border between the posterior third and the anterior two thirds of the tongue. To be more specific, it carries taste from the sulcus terminalis. The sulcus terminalis has circumvallate papillae that contain taste buds.

Very important: There are absolutely **NO** taste buds in the posterior third of the tongue. Lymphatic nodules are found in the posterior third of the tongue. Some geniuses will point at the lymphatic nodules and say these are taste buds :p try not to be one :p

-This component of the glossopharyngeal synapses centrally in the nucleus of taste: the nucleus solitarius.

3-**GVA:**

Which is The most important component of the glossopharyngeal nerve.

It Carries sensation from the viscera:

- the upper part of the oropharynx and from its lateral wall (Palatine tonsils)

- the eustachian tube (auditory tube).

- the posterior third of the tongue.

An example of referred pain involving the posterior third of the tongue:

A patient with carcinoma in the posterior third of his tongue will also complain about pain in his ear; as the glossopharyngeal nerve supplies both the middle ear and the posterior third of the tongue*]*.

- the middle ear

An example of referred pain involving the middle ear:

A child with acute tonsillitis commonly complains about pain in his ear, we can explain this by knowing that the nerve that supplies the tonsils (glossopharyngeal) also supplies the middle ear.**

-Carotid body (chemoreceptors).

-the Carotid sinus (a main site for baroreceptors; involved in blood pressure regulation). As we took in the CVS these receptors are sensitive to stretch - characterized by an increase in blood pressure - so they're important in the

pathway of lowering blood pressure.(massaging the carotid sinus has the same effect as an increased blood pressure. As a result of that, the chemoreceptors of the carotid sinus will be stimulated to decrease blood pressure back to normal).

Afferents of the carotid sinus reflex are fibers of the glossopharyngeal, whereas the efferent part is fibers of the vagus.

-In cases of supraventricular tachycardia (200-250 beat/min), we massage the carotid sinus on **one side** to reduce the blood pressure. Don't ever massage the carotid sinus on both sides because it will result in severe bradycardia. You may kill the patient!

-Carotid sinus syndrome :

Presented as hypersensitive carotid sinus. A mild stimulation to the baroreceptors will result in severe bradycardia. (The collar of the shirt can stimulate the carotid sinus)

"The carotid sinus contains numerous baroreceptors which function as a "sampling area" for many homeostatic mechanisms for maintaining blood pressure. The carotid sinus baroreceptors are innervated by the sinus nerve of Hering, which is a branch of cranial nerve IX (glossopharyngeal nerve). The glossopharyngeal nerve synapses in the nucleus tractus solitarii (NTS) located in the medulla oblongata of the brainstem. The NTS indirectly modulates the activity of sympathetic and parasympathetic (vagal) neurons in the medulla and pons through the hypothalamus. These neurons then regulate the autonomic control of the heart and blood vessels"-wiki

-A lesion in the glossopharyngeal nerve will result in:

1- loss of carotid sinus reflex.

2-loss of gag reflex (pharyngeal reflex).

But first what is the gag reflex?

-When you touch the posterior wall of the pharynx by a spatula this is followed by contraction of the pharyngeal constrictors and elevation of the pharynx and larynx and they will get closer to the epiglottis. Patient will feel a sense of nausea (try putting your finger at the posterior third of your tongue, you'll feel like you're about to vomit).

How does this happen?

1- Stimulation of touch receptors in the posterior wall of oropharynx.

2- Impulses will run along the glossopharyngeal nerve (this is the afferent part of the reflex)

3- Impulses will pass to the solitary nucleus

4- Then synaptic connections are made with the Nucleus ambiguous that sends fibers of the cranial accessory nerve that runs along with the vagus (this is the efferent part of the reflex) to muscles of the pharynx.

5- Contraction of pharyngeal muscles,

-This reflex is very important, it's a protective reflex: it prevents liquids from entering to the larynx, as the larynx will elevate and its inlet will be closed by the epiglottis.

-This reflex is absent in comatose patients and in patients under anesthesia.

-Suppose you spill a liquid in the mouth of a comatose patient, this liquid will enter the respiratory passage! because the gag reflex is absent and the larynx won't be elevated and its inlet won't be closed by the epiglottis.

-In anesthetic patients where the gag reflex is absent, any liquids in the mouth will enter the larynx. This is very dangerous. Our salivary glands produce saliva continuously; this will lead to accumulations of fluid in our oral cavity that will eventually enter the respiratory passage due to the absence of the gag reflex.

How did doctors solve this? They thought of an agent that reduces secretions. They used **atropine** - an antimuscaranic agent - that works by blocking the parasympathetic system (Remember, the parasympathetic system is responsible for body secretions).

4).Hypoglossal nerve

Its Nucleus is within the medulla: the hypoglossal nucleus. It emerges between the pyramid and the inferior olive.

It has:

1).**GSE**: motor innervation to the intrinsic and extrinsic muscles of the tongue (except the palatoglossus). These muscles are derived from the occipital myotomes so they are **general** muscles not special muscles. A strong evidence for that is the way the hypoglossal nerve is oriented compared to all the other cranial nerves. All cranial nerves ascend vertically EXCEPT for the hypoglossal nerve that ascend transversally. This gives us a clue that the muscles supplied by the hypoglossal nerve originated from the occipital myotomes, then they migrated anteriorly along with their nerve.

Some books say that the tongue receives proprioception sensations from the muscle spindles in the muscles of tongue via the hypoglossal nerve but Dr.Faraj disagrees and states that it is the trigeminal nerve that carries proprioception sensations from the tongue and not the hypoglossal nerve.

-if there was an injury to the hypoglossal nerve or its nucleus (LMNL) this will result in:

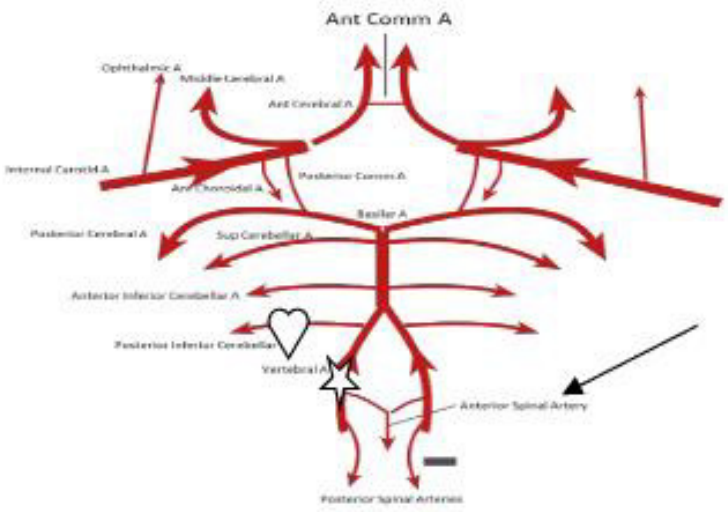
1). Paralysis and Atrophy of the muscles of the affected side of the tongue (ipsilateral effect), atrophy of the muscles will cause the tongue to have an uneven surface.

2).Deviation of the protruding tongue to the atrophic side (this is as result of loss of function of the genioglossus muscle that normally - when contracted - protrudes the tongue).

3).Fasciculation (spontaneous activity of muscle fibers at rest) as an early sign of any LMNL'' in its acute stage''. It's best seen when the tongue is only slightly protruded.

-Examination of the hypoglossal nerve is the easiest among the cranial nerves; just ask the patient to protrude his tongue. If there were any LMN injury, tongue will deviate to the affected side.

-Medial medullary syndrome:



Anterior parts of the medulla (pyramid, medial lemniscus, hypoglossal nerve) receive their blood supply from the anterior spinal artery that originates from the two vertebral on both sides (the arrow in the figure)

-If the anterior spinal artery was occluded by a thrombus or emboli, the areas supplied by this artery will suffer from ischemia:

1).If the Pyramidal tract **alone** was affected: contralateral flaccid paralysis, but if the extrapyramidal tract was also involved this will result in contralateral spastic paralysis (as we took before that the effects of extrapyramidal tract lesions

overshadow the effects of pyramidal tract lesions).

2).If the medial lemniscus (that is composed of axons of the cuneate, gracile and Z nuclei of the opposite side) was affected we will lose all types of sensations carried by the dorsal column; we'll lose position sense, stereognosis , vibration and two-point discrimination on the contralateral side. (recall that if the lesion was below the ML ''in the dorsal column'' we won't lose stereognosis).

3).lesion to the rootlets of the hypoglossal nerve will result in paralysis, atrophy and fasciculation of the ipsilateral half of the tongue.

''It's important to know that the tongue isn't one part; it consists of a right and a left half''.

-Remember that an injury to the pyramidal and extrapyramidal tracts and the cranial nerve nucleus in the brain stem will result in **alternating hemiplegia** (injury of pyramidal and extrapyramidal tracts will cause a contralateral effect, whereas injury to the cranial nerve's nucleus will cause an ipsilateral effect).

-Lateral medullary syndrome:

The posterolateral (dorsolateral) part of the medulla receives its blood supply from the PICA (posterior inferior cerebellar artery, heart symbol in the figure above), this artery mainly supplies the cerebellum and on its way supplies this part of the medulla. It's also called PICA syndrome or Wallenberg's syndrome.

From the handout: lateral medullary syndrome may be caused by occlusion of the vertebral artery (star symbol in the figure above).

The dorsolateral part of the medulla contains many vital structures:

1). **Spinal trigeminal nucleus**: this nucleus receives sensations of pain, temperature and touch from the ipsilateral part of the face.

Next to it:

2).**Spinothalamic tract:** receives sensations of pain, temperature and touch from

the contralateral side of the body (as the spinothalamic tract ''ALS'' decussates in the spinal cord).

So any lesion at this part of the medulla (the part containing the spinal trigeminal nucleus and the spinothalamic tract) will result in **alternating hemianesthesia:** characterized by loss of pain, temperature and touch from one side of the face and the opposite side of the body. These clinical manifestations are noted ONLY with this syndrome.

3).**Inferior cerebellar peduncle:** ischemia and damage to this part will lead to ipsilateral ataxia of upper and lower limbs.

Inside the inferior cerebellar peduncle are the dorsal spinocerebellar tract, the cuneocerebellar tract, the olivocerebellar tract, the vestibulocerebellar tract and the cerebrovestibular tract.

We divide the inferior cerebellar peduncle into two subdivisions: 1-The restiform (the largest part) 2-The juxtarestiform (the inner part)

4).**Nucleus ambiguous**: this nucleus contains the cell bodies of the 9^{th}, 10^{th} and 11^{th} cranial nerves that supply muscles of the pharynx, larynx and palate. So an injury to this nucleus will result in:

- Nervous type of dysphagia: as a result of paralysis of the pharyngeal muscles.

- Nasal regurgitation: as a result of paralysis of the palate.

5).**Vestibular nuclei**: a lesion anywhere in this nucleus will cause two major symptoms: 1-Vertigo (hallucination of turning) 2-Vomiting

-For example: travelling on a ship, plane or car for the first time (or you're just not used to traveling) will cause your head to move and turn in all directions (forward, backward, right and left). This will stimulate the vestibular receptors in the middle ear (macula, saccule and Semicircular canal) and will cause vertigo and vomiting.

6).**Descending sympathetic fibers** from the hypothalamus to the spinal cord.

Any lesion in these fibers will cause **Horner's syndrome** (loss of sympathetic innervation to the face) at the same side of lesion.

Signs of Horner's syndrome:

1) Mild ptosis (due to loss of sympathetic innervation to the levator palpebrae muscle). NOTE: it is "mild" ptosis because the other muscles are still functioning.

2) Miosis (dilation of the pupil due to loss of the sympathetic effect that normally constricts the pupil).

3) Anhidrosis (No proper sweating due to absent sympathetic innervation).

-fig 8.40 page 7 in the handout shows a patient with atrophy at one side of the tongue - uneven surface and depressions at one side of the tongue. We may also see fasciculations (twitching of the muscles) in the acute stage. These signs (atrophy and fasciculations) may be present in early stages of **motor neuron disease**; we may also find dysphagia and nasal regurgitation of fluids. Why?
Motor neuron diseases affect motor neurons of certain cranial nerves. If the hypoglossal nucleus was affected, we'll end in atrophy on one side of the tongue. If the vagus nucleus (nucleus ambiguous) was affected, we'll end in dysphagia (due to paralysis of the pharynx) and nasal regurgitation (due to paralysis of the palate).

-So not every time you see a patient with dysphagia and nasal regurgitation it will be due to cut of vagus, it could be the **nucleus** of vagus which is injured as a sign of a motor neuron disease.

-Not uncommonly in a patient with motor neuron disease we'll find signs of paralysis. The **worst** part of this disease is when it affects, both, the nucleus ambiguous and the hypoglossal nucleus. The patient can't move his tongue, he can't chew food or sallow it. So we have to supply the patient with a nasogastric tube providing fluids and nutrients; we insert it in the nose to the nasopharynx to the oropharynx to the esophagus to the stomach.

Dedications to: Asma Jisrawi , shatha khader, dania tobasy , leen yonis, Baraa danoon , Ghaydaa hawamde, hadeel samy and my love Aya naim <3

Salam alkhreisha الجداول ملكة

Esraa ode :P

And my buddieeees Rawand Ahmad and Farah jamal <3