Digestive System

University of Jordan

Faculty of Medicine

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Medical Committee
The University of Jordan

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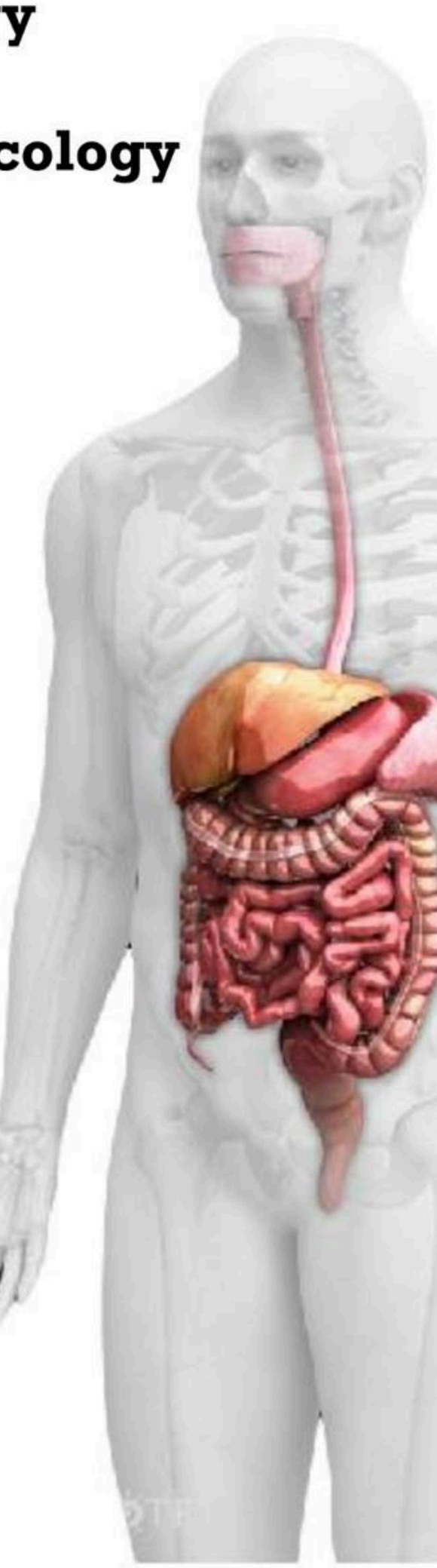

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The Pharynx

In the previous lecture we talked about the oral cavity, tongue, palate and the salivary glands (parotid, submandibular and sublingual). Here you have to pay attention to their parasympathetic innervation and anatomical relations; they are a rich material for exam questions.

* The pharynx:

The pharynx starts from the base of the skull, and terminates at the level of the lower border of the 6th cervical vertebra where it continues as the **esophagus**.

It's divided into 3 parts:

1) Nasopharynx: lies behind the nasal cavity.

2) Oropharynx: lies behind the oral cavity.

3) Laryngopharynx "hypopharynx": lies posterior to the larynx.

The pharynx is funnel shaped; it's wide at the base of the skull and becomes narrower till it reaches the esophagus.

It's a muscular tube; the muscles are present on the right, left and posterior sides only, they're absent on the anterior side, because anteriorly we have the nasal cavity, oral cavity and the laryngeal opening.

* **Choanae**: is the opening between the nasal cavity and the nasopharynx.

* **Oropharyngeal isthmus**: is the opening between the oral cavity and oropharynx.

* **Inlet of the larynx**: behind it we find the laryngopharynx.

On the lateral and posterior sides we have three *constrictor muscles of the pharynx:* superior, middle and inferior constrictor muscles of the pharynx. The lower part of each muscle enters the upper part of the next muscle (the superior enters the middle, and the middle enters the inferior).

The pharynx posteriorly receives the insertion of all constrictor muscles of the pharynx; where they are inserted into a raphe known as the **pharyngeal raphe** which starts from the pharyngeal tubercle (at the base of the skull, in front of foramen magnum).

There is an opening on the lateral wall of the nasopharynx known as the **Eustachian (auditory) tube opening** and above it we find the tubal elevation. The Eustachian tube connects the nasopharynx with the middle ear in order to regulate the equilibrium of the pressure of the ear on the ear drum (the tympanic membrane of the ear).

* Advantage of the Eustachian tube:

When you're on the plane you're advised to chew gum; the action of swallowing provides an exit to the air from your ear to the nasopharynx through the Eustachian tube resulting in *equilibrium* on both sides of the tympanic membrane.

* Disadvantage of the Eustachian tube:

Otitis media results from food or bacteria reaching the middle ear which is done through the Eustachian tube. When infants vomit, their vomit might reach the middle ear through the Eustachian tube leading to *otitis media*.

* Pharyngeal tonsil (Adenoid):

It's a lymphoid tissue found on the roof of the nasopharynx. Sometimes it enlarges and blocks the nasopharynx, so children in this case will breathe from

their oral cavity rather than from their nose. This enlargement will also cause some changes in the face of children (characteristic face of adenoid); where the ala of the nose will be dilated because air is trying to enter from the nasal cavity, but the block (enlarged pharyngeal tonsil) prevents the entry causing high pressure.

* Treatment:

Surgical treatment and removal of the pharyngeal tonsil from the roof of the pharynx.

* Muscles of the pharynx:

A- Three constrictor muscles:

1) Superior constrictor muscle: you find it posterior to the buccinator muscle; it is separated from the buccinator muscle by a raphe (a ligament-like structure).

- Origin: medial pterygoid plate, pterygoid hamulus and mylohyoid line of mandible.

- Insertion: raphe in midline posteriorly (pharyngeal raphe); which starts from the pharyngeal tubercle of occipital bone and extends in the midline posteriorly.

- Innervation: pharyngeal plexus of nerves, which is formed mainly by the Vagus nerve.

- Functions: 1. As all constrictor muscles; it propels the bolus downwards (peristaltic movement).

2. Upon contraction it moves forward which helps in the closure of the nasopharyngeal isthmus (the opening above

the oropharyngeal isthmus) to prevent passage of food upwards to the nasal cavity.

- Movement of the soft palate backwards and upwards together with the movement of the posterior wall of the pharynx forward by the superior constrictor muscle → causes complete closure of the nasopharyngeal isthmus.

2) Middle constrictor muscle:

- Origin: Lower part of stylohyoid ligament, lesser and greater cornu of hyoid bone.
- Insertion: pharyngeal raphe.
- Innervation: pharyngeal plexus.
- Action: propels bolus downwards.

3) Inferior constrictor muscle: has two parts (2 different actions);

- Origin: thyroid and cricoid cartilages.

I. Upper part is attached to the thyroid cartilage (above the cricoid).
II. Lower part: **Cricopharyngeus muscle** (horizontal fibers) it is attached to the cricoid cartilage of the larynx. It's always contracted thereby closes the esophagus to prevent the passage of air to the esophagus and stomach. It's stimulated to relax when the bolus reaches its inner surface on its way to reach the esophagus.

- So this muscle works as the <u>sphincter of the esophagus</u> "special function". While the function of other muscles is peristaltic movement which results in pushing and propelling the bolus from the pharynx downward toward the esophagus.

- Killian's dehiscence:
  It's the area between the lower end of the inferior constrictor muscle and the cricopharyngeus muscle.

If you're confused, check what's written in the slides:

Killian's dehiscence is the area on the posterior pharyngeal wall between the upper propulsive part of the inferior constrictor and the lower sphincteric part, the cricopharyngeus.

B- Stylopharyngeus muscle: its fibers descend obliquely (not circular as the constrictors). It's the only muscle that's innervated by the glossopharyngeal nerve, while ALL remaining muscles of the pharynx are innervated by the **pharyngeal plexus of the Vagus nerve**.

C- Palatopharyngeus muscle: found in the lateral wall of the nasopharynx (with the Eustachian tube).

- Innervation: pharengeal plexus.
- Action: elevates the pharynx.

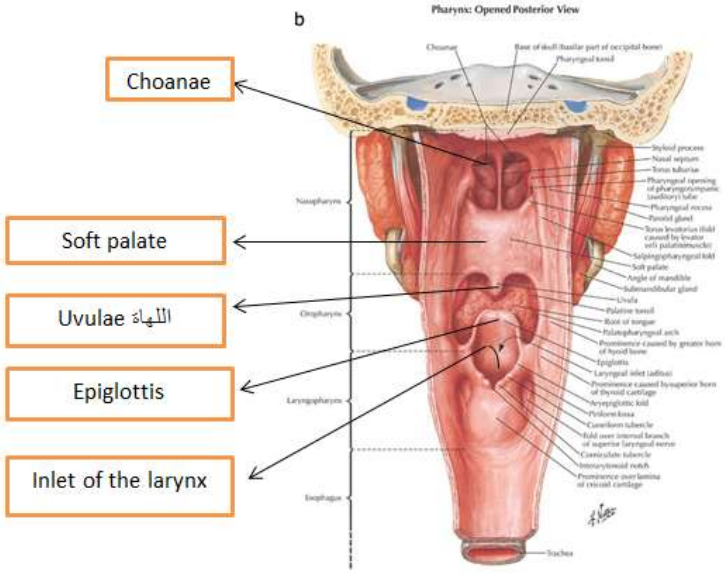
- Recall that around the palatine tonsil we have 2 muscles surrounding it: Palatoglossal (anteriorly) and palatopharengeal (posteriorly).

D- Salpingopharyngeus muscle: also found in the lateral wall of the nasopharynx.

* Interior of the pharynx:

(contents inside the pharynx)

By taking a coronal section of the pharynx, and looking at the anterior part; you should see the pointed structures.



Boundaries of the oropharyngeal isthmus: above: soft palate and uvulae, below: the posterior third of the tongue, both sides: palatine tonsils.

* Nasopharyngeal isthmus:

It's closed when the uvulae and the soft palate move backwards. In cases of vomiting, the vomit exits from the oral cavity, it doesn't exit from the nasal cavity due to the closure of the nasopharyngeal isthmus by the soft palate and by the contraction of the superior constrictor muscle (moving forward).

When infants vomit while they're lying on their back, vomit will go to the nasopharynx because there isn't complete closure. Vomits can then reach the middle ear through the Eustachian tube and cause otitis media.

* Inlet of the larynx:

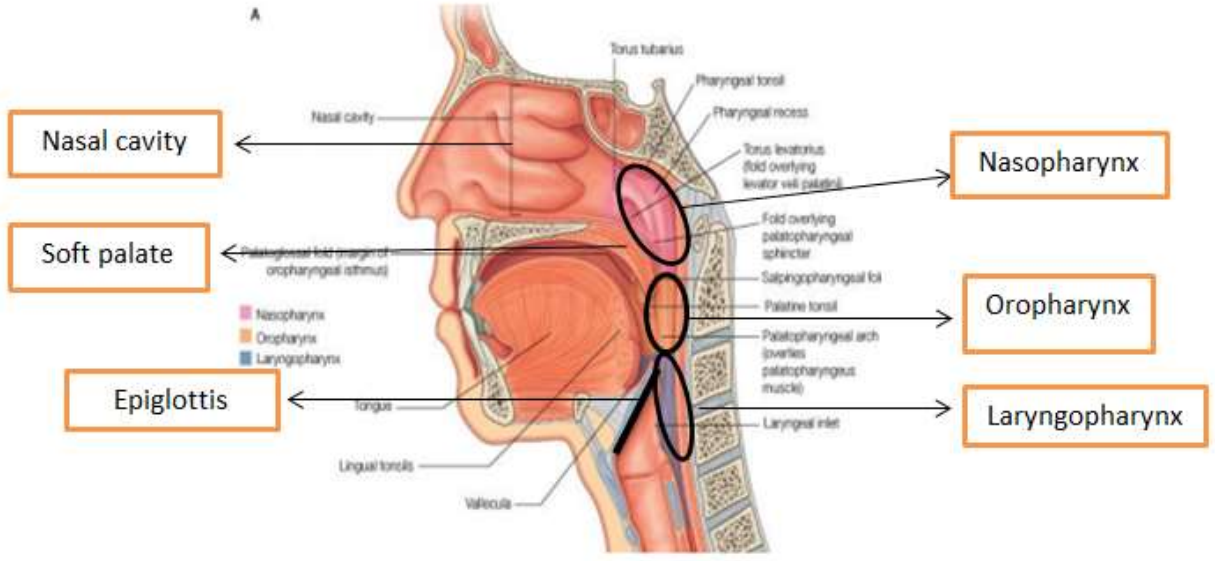
The epiglottis is above it and we have aryepiglottic fold and aryepiglotticus muscle, together they cause the closure of the inlet of the larynx. Other muscles also cause elevation of the larynx.

So when the bolus reaches the dorsum of the tongue (deglutition). Along with the deglutition there will be closure and rising of the larynx upwards against the posterior third of the tongue, this rising aids the bolus in going directly into the esophagus so nothing will enter the inlet of the larynx, because nothing should enter the inlet of the larynx except for air! If by chance a small particle of food or water entered the inlet, the patient will keep coughing until the particle goes out and enters the pharynx.

* Piriform fossa:

It's a depression found on the lateral side of the posterior surface of the larynx (on the lateral side of the anterior part of laryngopharynx). It's important clinically because sometimes foreign bodies (e.g. small bones of fish) will be lodged in this region.

* Midsagittal section of the pharynx:



- The soft palate separates the nasopharynx from the oropharynx.

- On the lateral wall of nasopharynx we'll find the Eustachian tube, tubal elevation, salpingopharyngeus fold and muscle and there's a recess behind it.

- On the lateral side of the oropharyngeal isthmus there're palatine tonsils.

- Is there a connection between the epiglottis and the tongue? YES, through the glossoepiglottic folds (lateral and median) and between them there is a depression known as vallecula.

- Piriform fossa which is a depression in the mucous membrane found on the sides of the laryngeal inlet or on the anteriolateral part of laryngopharynx.

* Nerve supply to the pharynx:

- Motor:
  All muscles are innervated by the **pharyngeal plexus of nerves**, except for the stylopharyngeus muscle which is innervated by glossopharyngeal nerve.
- Sensory:
  It's divided according to parts of the pharynx:
  1) Nasopharynx:
     From the maxillary nerve.
  2) Oropharynx:
     From the glossopharyngeal nerve.
  3) Laryngopharynx:
     From internal laryngeal nerve which is a branch from the vagus nerve.

➢ The vagus nerve gives the superior laryngeal nerve which furtherly divides into internal and external laryngeal nerves.

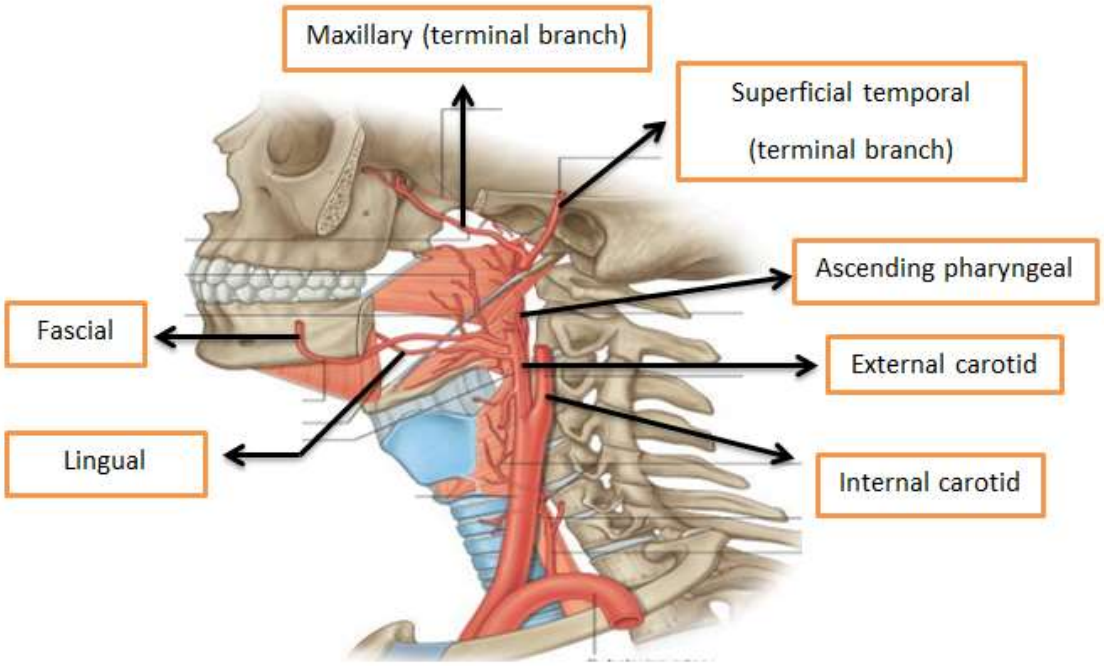
* Blood supply of the pharynx:

1- Ascending pharyngeal artery; which is a branch from the external carotid artery.

2- Tonsillar branch of fascial artery.

3- Branches of the maxillary artery; one of the terminal branches of the external carotid.

4- Branches of the lingual artery; a branch of the external carotid.



*Lymphatic drainage of the pharynx:

The lymph goes directly to the **deep cervical lymph nodes**, or indirectly through the retropharyngeal and paratracheal lymph nodes which will eventually lead to the deep cervical nodes.

* Venous drainage of the pharynx:

The veins are usually the exact opposite of arteries. The veins terminate at the pharyngeal plexus of veins → internal jugular vein.

* The process of swallowing: (deglutition)

This is physiology, but here -in anatomy- we're only concerned about the muscles responsible for this process.

- Step 1:

The bolus is formed at the dorsum of the tongue. During mastication the oropharyngeal isthmus is closed in order to increase the intra-oral pressure which helps in mastication and formation of the bolus.

- Step 2:

During deglutition the tongue moves backwards and the oropharyngeal isthmus opens. The nasopharyngeal isthmus closes by the contraction of tensor veli palatini muscle and levator veli palatini muscle → rising of the soft palate upwards and backwards. Also the posterior wall of the pharynx is pulled forward by the contraction of superior constrictor muscle resulting in complete closure of the nasopharynx.

- Step 3:

Closure of the inlet of the larynx, so that water and food particles can't enter the larynx; only air is allowed to enter there. This closure is done by movement of the tongue (downwards and backwards) and the larynx (upwards against the posterior third of the tongue) by the contraction of aryepiglottic muscle so the bolus descends to the pharynx.

- Step 4:

The cricopharyngeus muscle relaxes when the bolus reaches its inner surface; allowing the passage of the bolus to the esophagus.

* Palatine tonsils:

They're two masses of lymphoid tissue found on both sides of the oropharyngeal isthmus. They are very important in the immunity of children, since children put everything in their mouths, so the palatine tonsils work as filters of bacteria, viruses and foreign bodies. That's why they get repeatedly infected (tonsillitis) either by bacterial or viral infection. The bacterial infection is always associated with fever.

If the infection is repeated more than 3-4 times a year, it's recommended to do tonsillectomy because the infection may reach the blood and spread to the joints causing infection there, kidneys causing glomerulonephritis or infecting the heart. So tonsillitis must be treated as soon as possible before it becomes chronic and cause severe complications.

Usually adults' palatine tonsils diminish (become small), their infection becomes rare (once every 2-3 years). However if the infection is repetitive in adults, tonsillectomy is also recommended since there's lymphoid tissue all over the body that can overcome the loss of palatine tonsils.

The tonsil is covered by a mucous membrane and has two surfaces; free medial surface (related to the oropharyngeal isthmus) it's usually covered by **pits or crypts** حفر which are caused by repeated infections. Lateral surface (separated from the superior constrictor muscle of the pharynx by loose areolar tissue) it's covered by a **fibrous capsule**.

This is important in tonsillectomy, where it takes only 10-15 minutes, the trick is to go to the lateral surface of the tonsil and make an incision in the capsule, then by your index you enucleate the whole tonsil.

* Blood supply to the palatine tonsils:

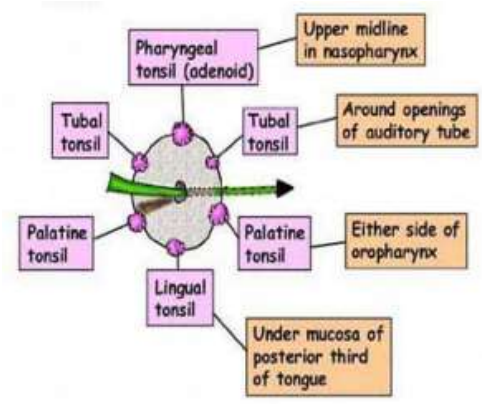
By the tonsillar branch of fascial artery, external palatine branch and the pharyngeal branch.

* Venous drainage:

By external palatine vein (paratonsillar vein) which terminates at the fascial vein → internal jugular vein. This vein pierces the superior constrictor muscle, so whenever this muscle contracts it presses on the vein.

In tonsillectomy we ligate the artery and the vein after removing the tonsil and the patient must stay in the hospital for 48 hours because there's a chance of having bleeding after tonsillectomy. Commonly the source for that bleeding is the **paratonsillar vein** because the superior constrictor muscle presses it so it may move the ligation → bleeding.

- Laterally, you can find the super constrictor muscles of the pharynx, styloglossus muscle, facial artery that gives tonsillar artery to the tonsils and external carotid artery.
- All these vessels have **lateral relation** with the tonsil through its capsule, and they're at a risk of injury during tonsillectomy while making an incision in the capsule laterally.



* Lymphatic drainage:

To the deep cervical lymph nodes, and some lymph nodes found behind the angle of the mandible.

* Waldeyer's Ring of Lymphoid Tissue:

The arrow represents the oropharyngeal opening.

- **Palatine tonsils** are found on both sides.
- The posterior third of the tongue is found inferiorly and it has **lingual tonsils** on it.
- The nasopharynx is upwards, and it has the **pharyngeal tonsil** (adenoid),
- **Tubal tonsils** are found at the opening of the Eustachian tube.

* Function:

Filtration of bacteria, viruses and foreign bodies that enter from the oral cavity to the pharynx.

The End!