

ANATOMY OF THE PHARYNX: HEAD AND NECK REGION

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Introduction

The pharynx, a central structure located in the midline of the neck, serves as a shared pathway for the gastrointestinal tract (GIT) and the respiratory system, in addition to the oral cavity. It is a funnel-shaped organ, wider at the upper end beneath the base of the skull and narrower at its lower end at the level of the sixth cervical vertebra (C6), where it transitions into the esophagus posteriorly and the larynx anteriorly. Its muscular and membranous composition enables it to perform vital functions such as food swallowing, air conduction, and voice production. Understanding its anatomy, embryology, neurovascular supply, musculature, surgical implications, and clinical relevance is essential to appreciating its significance.

Structure and Function

The pharynx is divided into three regions from top to bottom:

1. **Nasopharynx:** Located behind the posterior nasal apertures (choanae), it is exclusively part of the respiratory system, channeling air from the nasal cavities. The lateral walls of the nasopharynx feature the auditory (Eustachian) tubes, surrounded by mucous membrane elevations called tubal elevations. These tubes connect to the middle ears, facilitating pressure equalization and drainage.
2. **Oropharynx:** Positioned behind the oral cavity, this section directs the bolus toward the laryngopharynx. During swallowing, the soft palate muscles close the choanae to prevent food from entering the nasal cavity, while the epiglottis seals the laryngeal inlet, ensuring food does not enter the airway.
3. **Laryngopharynx:** Located behind the laryngeal inlet, it receives the bolus from the oropharynx and transfers it into the esophagus for digestion. Air passes through the nasopharynx and oropharynx before entering the laryngopharynx, ultimately reaching the larynx and trachea for respiratory conduction.

Embryology

The pharynx originates during the fourth and fifth weeks of gestation from the pharyngeal (branchial) apparatus, which comprises arches, pouches, clefts, and membranes essential for head and neck development. The third, fourth, and sixth pharyngeal arches contribute to the musculature of the pharynx. The third arch forms the stylopharyngeus muscle, while the fourth and sixth arches give rise to the constrictor and longitudinal muscle groups. Neurovascular bundles passing through these arches provide corresponding nerve and blood supply.

Blood Supply and Lymphatics

The pharynx receives oxygenated blood from four branches of the external carotid artery: the ascending pharyngeal, tonsillar (a branch of the facial artery), maxillary, and lingual arteries. Venous blood drains through pharyngeal veins into the internal jugular vein.

Lymphatic drainage is primarily directed to the deep cervical lymph nodes (DCLNs) either directly or indirectly via retropharyngeal or paratracheal nodes.

The Waldeyer ring, a lymphoid structure, surrounds the entrance to the GIT and respiratory tract. It includes:

- **Pharyngeal tonsils** (adenoids) at the roof of the nasopharynx.
- **Palatine and tubal tonsils** along the lateral walls.
- **Lingual tonsils** at the tongue's posterior surface.

Nerves

The pharynx receives sensory (afferent) and motor (efferent) innervation:

- **Sensory supply:**
 - **Nasopharynx:** Maxillary division of the trigeminal nerve (CN V2).
 - **Oropharynx:** Glossopharyngeal nerve (CN IX).
 - **Laryngopharynx:** Internal laryngeal nerve, a branch of the superior laryngeal nerve (CN X).
- **Motor supply:**
 - All pharyngeal muscles, except the stylopharyngeus, are innervated by the vagus nerve (CN X).
 - The stylopharyngeus is innervated by the glossopharyngeal nerve (CN IX).

This comprehensive anatomical, embryological, and functional overview underscores the pharynx's critical role in integrating the GIT and respiratory systems.

Muscles of the Pharynx

The pharyngeal musculature plays a vital role in enabling the pharynx to perform essential functions, including swallowing and airway management. The muscles are categorized into two groups:

1. Constrictor Muscles:

- **Superior Constrictor:** Originates from the medial pterygoid plate, pterygoid hamulus, pterygomandibular ligament, and mylohyoid line of the mandible. It inserts at the pharyngeal tubercle of the occipital bone and the pharyngeal raphe. It assists in soft palate closure during swallowing and propels the bolus downward.
- **Middle Constrictor:** Originates from the stylohyoid ligament and the lesser and greater cornua of the hyoid bone. It inserts at the pharyngeal raphe, aiding in downward propulsion of the bolus.
- **Inferior Constrictor:** Originates from the lamina of the thyroid cartilage and the cricoid cartilage. It inserts into the pharyngeal raphe and facilitates bolus movement into the esophagus.
- **Cricopharyngeus Muscle:** Derived from the inferior constrictor, it functions as a sphincter at the lower end of the pharynx, preventing esophageal reflux into the pharynx.

2. Longitudinal Muscles:

- **Stylopharyngeus:** Originates from the styloid process of the temporal bone and inserts on the posterior surface of the thyroid cartilage. It elevates the pharynx during swallowing.
- **Palatopharyngeus:** Arises from the palatine aponeurosis and inserts into the thyroid cartilage. It aids in pharyngeal elevation and bolus propulsion, pulling the palatopharyngeal arches medially during contraction.

- **Salpingopharyngeus:** Originates from the auditory tube and merges with the palatopharyngeus. It assists in elevating the pharynx during swallowing.

Physiological Variants

The pharynx is normally positioned in the midline of the neck, allowing it to efficiently convey air and food. However, minor anatomical and physiological variations are observed, particularly in the musculature:

- Additional attachments of the longitudinal muscle group may extend to the palatine tonsils, epiglottis, arytenoid, and thyroid cartilages.
- The **salpingopharyngeus muscle** is absent in approximately 37% of individuals, with its absence more commonly observed in thinner individuals.

Surgical Considerations

Surgical procedures involving the pharynx require precision due to its complex anatomy and the proximity of vital neurovascular bundles. Key considerations include:

1. Airway and Swallowing Assessment:

- Breathing difficulties, dysphagia, and malignancies in the pharyngeal region often necessitate surgical intervention. Postoperative assessments are critical for ensuring effective airway management and swallowing function.
- Feeding tubes may be employed when oral food passage is not possible.

2. Obstructive Sleep Apnea Treatment:

- Lateral pharyngoplasty often requires the preservation of the **stylopharyngeus muscle** to optimize outcomes.

3. Airway Management:

- The pharynx may be bypassed via endotracheal intubation or controlled with other airway management devices. In emergencies where these methods fail, a **cricothyroidotomy** can be life-saving.

4. Tonsil Enlargement and Trauma:

- Enlarged tonsils or trauma causing airway obstruction require prompt intervention. Severe cases, such as airway compromise due to elevated pressure or trauma, may necessitate procedures like **thyroidectomy** or immediate airway clearance.

By understanding the structural, functional, and clinical aspects of the pharyngeal muscles, surgical interventions can be performed more effectively, ensuring patient safety and optimal outcomes.

Clinical Significance

Pharyngitis

Pharyngitis, commonly referred to as "sore throat," involves inflammation of the pharynx and is most frequently caused by viral infections. Symptoms typically include discomfort, pain, irritation, and difficulty swallowing (dysphagia). Treatment usually involves non-steroidal anti-inflammatory drugs (NSAIDs) for both adults and children, while aspirin is an option for adults. If caused by *Streptococcus pyogenes*, specific diagnostic testing and targeted treatment are required.

Dysphagia

Dysphagia, or difficulty swallowing, results from muscle weakness, nerve damage, or underlying diseases. It can lead to complications such as aspiration of food or saliva,

malnutrition, and dehydration. Dysphagia is particularly common in approximately 50% of elderly patients and those with neurological disorders.

Adenoiditis

Adenoiditis is the inflammation of the adenoid lymphatic tissue located in the upper nasopharynx, often secondary to infection. Patients typically experience symptoms resembling a cold, including rhinorrhea (runny nose), nasal obstruction, and difficulty breathing.

Sleep Apnea

During sleep, the pharyngeal muscles may become hypotonic (weak), potentially allowing the airways to collapse and cause breathing difficulties. Factors contributing to sleep apnea include obesity, generalized hypotonia, and macroglossia (an enlarged tongue).

Zenker's Diverticulum

Zenker's diverticulum occurs in the laryngopharynx at the Killian dehiscence, a triangular gap between the inferior constrictor and cricopharyngeus muscles. Weakness or hypotonia in this area can lead to herniation of the pharyngeal mucosa and submucosa, forming a pouch. Food accumulation in this false diverticulum (confined to mucosa and submucosa without muscle involvement) can cause complications such as dysphagia, regurgitation, and aspiration.

Cricopharyngeal Achalasia

Cricopharyngeal achalasia is a rare condition where the cricopharyngeus muscle fails to relax adequately during swallowing. This prevents the upper esophageal sphincter from opening properly, resulting in food leakage, discomfort, and dysphagia. This dysfunction can also contribute to the development of Zenker's diverticulum.

Understanding these clinical conditions emphasizes the importance of the pharynx in maintaining proper airway and digestive function while highlighting the need for accurate diagnosis and management of associated disorders

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