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MEDICINE AND SURGERY

300LV

GROSS ANATOMY OF THE HEAD AND NECK

ANA301

QUESTION 1. Discuss the anatomy of the tongue and comment on its applied anatomy.

The tongue is a mass of striated muscle covered with mucous membrane. The muscles attach the tongue to the styloid process and the soft palate above and to the mandible and the hyoid bone below. The tongue is divided into right and left halves by a median fibrous septum.

**PARTS AND SURFACES OF TONGUE**

The tongue has a root, body, and apex. The root of the tongue is the attached posterior portion, extending between the mandible, hyoid, and the nearly vertical posterior surface of the tongue. The body of the tongue is the anterior, approximately two thirds of the tongue between root and apex. The apex (tip) of the tongue is the anterior end of the body, which rests against the incisor teeth. The body and apex of the tongue are extremely mobile.

The tongue features two surfaces. The more extensive, superior and posterior surface is the dorsum of the tongue (commonly referred to as the “top” of the tongue). The inferior surface of the tongue (commonly referred to as its “underside”) usually rests against the ﬂ oor of the mouth. The margin of the tongue separating the two surfaces is related on each side to the lingual gingivae and lateral teeth. The dorsum of the tongue is characterized by a V-shaped groove, the terminal sulcus of the tongue, the angle of which points posteriorly to the foramen cecum. This small pit, frequently absent, is the non-functional remnant of the proximal part of the embryonic thyroglossal duct from which the thyroid gland developed. The terminal sulcus divides the dorsum of the tongue transversely into a presulcal anterior part in the oral cavity proper and a postsulcal posterior part in the oropharynx. A midline groove divides the anterior part of the tongue into right and left parts. The mucosa of the anterior part of the tongue is relatively thin and closely attached to the underlying muscle. It has a rough texture because of numerous small lingual papillae.

• Vallate papillae: large and ﬂat topped, lie directly anterior to the terminal sulcus and are arranged in a V-shaped row. They are surrounded by deep circular trenches, the walls of which are studded with taste buds. The ducts of the serous glands of the tongue open into the trenches. • Foliate papillae: small lateral folds of the lingual mucosa. They are poorly developed in humans.

• Filiform papillae: long and numerous, contain afferent nerve endings that are sensitive to touch. These scaly, conical projections are pinkish gray and are arranged in V-shaped rows that are parallel to the terminal sulcus, except at the apex, where they tend to be arranged transversely. • Fungiform papillae: mushroom shaped pink or red spots scattered among the ﬁliform papillae but most numerous at the apex and margins of the tongue. The vallate, foliate, and most of the fungiform papillae contain taste receptors in the taste buds. The mucosa of the posterior part of the tongue is thick and freely movable. It has no lingual papillae, but the underlying lymphoid nodules give this part of the tongue an irregular, cobblestone appearance. The lymphoid nodules are known collectively as the lingual tonsil. The pharyngeal part of the tongue constitutes the anterior wall of the oropharynx and can be inspected only with a mirror or downward pressure on the tongue with a tongue depressor. The inferior surface of the tongue is covered with a thin, transparent mucous membrane. This surface is connected to the ﬂoor of the mouth by a midline fold called the frenulum of the tongue. The frenulum allows the anterior part of the tongue to move freely. On each side of the frenulum, a deep lingual vein is visible through the thin mucous membrane. A sublingual caruncle (papilla) is present on each side of the base of the lingual frenulum that includes the opening of the submandibular duct from the submandibular salivary gland.

**MUSCLES OF THE TONGUE**

The bulk of the tongue is composed of muscle. The tongue is completely divided into left and right halves by a median sagittal septum composed of connective tissue. This means that all muscles of the tongue are paired. There are intrinsic and extrinsic lingual muscles. Except for the palatoglossus, which is innervated by the vagus nerve [X], all muscles of the tongue are innervated by the hypoglossal nerve [XII].

**INTRINSIC MUSCLES**

The intrinsic muscles of the tongue originate and insert within the substance of the tongue. They are divided into superior longitudinal, inferior longitudinal, transverse, and vertical muscles, and they alter the shape of the tongue by: • lengthening and shortening it, • curling and uncurling its apex and edges, and • flattening and rounding its surface. Working in pairs or one side at a time the intrinsic muscles of the tongue contribute to precision movements of the tongue required for speech, eating, and swallowing.

**EXTRINSIC MUSCLES**

Extrinsic muscles of the tongue originate from structures outside the tongue and insert into the tongue. There are four major extrinsic muscles on each side, the genioglossus, hyoglossus, styloglossus, and palatoglossus. These muscles protrude, retract, depress, and elevate the tongue.

**GENIOGLOSSUS**

The thick fan-shaped genioglossus muscles make a substantial contribution to the structure of the tongue. They occur on either side of the midline septum that separates left and right halves of the tongue. The genioglossus muscles originate from the superior mental spines on the posterior surface of the mandibular symphysis immediately superior to the origin of the geniohyoid muscles from the inferior mental spines. From this small site of origin, each muscle expands posteriorly and superiorly. The most inferior fibers attach to the hyoid bone. The remaining fibers spread out superiorly to blend with the intrinsic muscles along virtually the entire length of the tongue. The genioglossus muscles: • depress the central part of the tongue, and • protrude the anterior part of the tongue out of the oral fissure (i.e., stick the tongue out).

Like most muscles of the tongue, the genioglossus muscles are innervated by the hypoglossal nerves [XII].

**HYOGLOSSUS MUSCLE**

The hyoglossus muscles are thin quadrangular muscles lateral to the genioglossus muscles. Each hyoglossus muscle originates from the entire length of the greater horn and the adjacent part of the body of the hyoid bone. At its origin from the hyoid bone, the hyoglossus muscle is lateral to the attachment of the middle constrictor muscle of the pharynx. The muscle passes superiorly and anteriorly through the gap (oropharyngeal triangle) between the superior constrictor, middle constrictor, and mylohyoid to insert into the tongue lateral to the genioglossus and medial to the styloglossus. The hyoglossus muscle depresses the tongue and is innervated by the hypoglossal nerve [XII].

**An important landmark**. The hyoglossus muscle is an important landmark in the floor of the oral cavity: • The lingual artery from the external carotid artery in the neck enters the tongue deep to the hyoglossus, between the hyoglossus and genioglossus. • The hypoglossal nerve [XII] and lingual nerve (branch of the mandibular nerve [V 3]), from the neck and infratemporal fossa of the head, respectively, enter the tongue on the external surface of the hyoglossus.

**STYLOGLOSSUS MUSCLE**

The Styloglossus muscles originate from the anterior surface of the styloid processes of the temporal bones. From here, each muscle passes inferiorly and medially through the gap (oropharyngeal triangle) between the middle constrictor, superior constrictor, and mylohyoid muscles to enter the lateral surface of the tongue where they blend with the superior margin of the hyoglossus and with the intrinsic muscles.

The styloglossus muscles retract the tongue and pull the back of the tongue superiorly. They are innervated by the hypoglossal nerves [XII].

**PALATOGLOSSUS MUSCLE**

The palatoglossus muscles are muscles of the soft palate and the tongue. Each originates from the undersurface of the palatine aponeurosis and passes anteroinferiorly to the lateral side of the tongue. The palatoglossus muscles: • elevate the back of the tongue, • move the palatoglossal arches of mucosa toward the midline, and • depress the soft palate. These movements facilitate closing of the oropharyngeal isthmus and as a result separate the oral cavity from the oropharynx. Unlike other muscles of the tongue, but similar to most other muscles of the soft palate, the palatoglossus muscles are innervated by the vagus nerves [X].

**INNERVATION OF TONGUE**

All muscles of the tongue, except the palatoglossus, receive motor innervation from CN XII, the hypoglossal nerve

Palatoglossus is a palatine muscle supplied by the pharyngeal plexus. For general sensation (touch and temperature), the mucosa of the anterior two thirds of the tongue is supplied by the lingual nerve, a branch of CN V3. For special sensation (taste), this part of the tongue, except for the vallate papillae, is supplied the chorda tympani nerve, a branch of CN VII. The chorda tympani joins the lingual nerve in the infratemporal fossa and runs anteriorly in its sheath. The mucosa of the posterior third of the tongue and the vallate papillae are supplied by the lingual branch of the glossopharyngeal nerve (CN IX) for both general and special sensation. Twigs of the internal laryngeal nerve, a branch of the vagus nerve (CN X), supply mostly general but some special sensation to a small area of the tongue just anterior to the epiglottis. These mostly sensory nerves also carry parasympathetic secretomotor ﬁbers to serous glands in the tongue.

There are four basic taste sensations: sweet, salty, sour, and bitter. Sweetness is detected at the apex, saltiness at the lateral margins, and sourness and bitterness at the posterior part of the tongue. All other “tastes” expressed by gourmets are olfactory (smell and aroma).

**VASCULATURE OF TONGUE**

The arteries of the tongue are derived from the lingual artery, which arises from the external carotid artery. On entering the tongue, the lingual artery passes deep to the hyoglossus muscle. The dorsal lingual arteries supply the root of the tongue; the deep lingual arteries supply the lingual body. The deep lingual arteries communicate with each other near the apex of the tongue. The dorsal lingual arteries are prevented from communicating by the lingual septum. The veins of the tongue are the dorsal lingual veins, which accompany the lingual artery; the deep lingual veins, which begin at the apex of the tongue, run posteriorly beside the lingual frenulum to join the sublingual vein.

The sublingual veins in elderly people are often varicose (enlarged and tortuous). Some or all of them may drain into the IJV, or they may do so indirectly, joining ﬁrst to form a lingual vein that accompanies the initial part of the lingual artery.

The lymphatic drainage of the tongue is exceptional. Most of the lymphatic drainage converges toward and follows the venous drainage; however, lymph from the tip of the tongue, frenulum, and central lower lip runs an independent course. Lymph from the tongue takes four routes:

1. Lymph from the root drains bilaterally into the superior deep cervical lymph nodes.

2. Lymph from the medial part of the body drains bilaterally and directly to the inferior deep cervical lymph nodes.

3. Lymph from the right and left lateral parts of body drains to the submandibular lymph nodes on the ipsilateral side

4. The apex and frenulum drain to the submental lymph nodes, the medial portion draining bilaterally. All lymph from the tongue ultimately drains to the deep cervical nodes, and passes via the jugular venous trunks into the venous system at the right and left venous angles.

**SALIVARY GLANDS**

Salivary glands are glands that open or secrete into the oral cavity. Most are small glands in the submucosa or mucosa of the oral epithelium lining the tongue, palate, cheeks, and lips, and open into the oral cavity directly or via small ducts. In addition to these small glands are much larger glands, which include the paired parotid, submandibular, and sublingual glands.

**PAROTID GLAND**

The parotid gland on each side is entirely outside the boundaries of the oral cavity in a shallow triangular-shaped trench formed by: • the sternocleidomastoid muscle behind, • the ramus of the mandible in front, and • superiorly, the base of the trench is formed by the external acoustic meatus and the posterior aspect of the zygomatic arch.

The gland normally extends anteriorly over the masseter muscle, and inferiorly over the posterior belly of the digastric muscle. The parotid duct passes anteriorly across the external surface of the masseter muscle and then turns medially to penetrate the buccinator muscle of the cheek and open into the oral cavity adjacent to the crown of the second upper molar tooth. The parotid gland encloses the external carotid artery, the retromandibular vein, and the origin of the extracranial part of the facial nerve [VII].

**SUBMANDIBULAR GLANDS**

The elongate submandibular glands are smaller than the parotid glands but larger than the sublingual glands. Each is hook shaped:

• The larger arm of the hook is directed forward in the horizontal plane below the mylohyoid muscle and is therefore outside the boundaries of the oral cavity-this larger superficial part of the gland is directly against a shallow impression on the medial side of the mandible (submandibular fossa) inferior to the mylohyoid line. • The smaller arm of the hook (or deep part) of the gland loops around the posterior margin of the mylohyoid muscle to enter and lie within the floor of the oral cavity where it is lateral to the root of the tongue on the lateral surface of the hyoglossus muscle.

The submandibular duct emerges from the medial side of the deep part of the gland in the oral cavity and passes forward to open on the summit of a small sublingual caruncle (papilla) beside the base of the frenulum of the tongue.

The lingual nerve loops under the submandibular duct, crossing first the lateral side and then the medial side of the duct, as the nerve descends anteromedially through the floor of the oral cavity and then ascends into the tongue.

**SUBLINGUAL GLANDS**

The sublingual glands are the smallest of the three major paired salivary glands. Each is almond shaped and is immediately lateral to the submandibular duct and associated lingual nerve in the floor of the oral cavity.

Each sublingual gland lies directly against the medial surface of the mandible where it forms a shallow groove (sublingual fossa) superior to the anterior one-third of the mylohyoid line.

The superior margin of the sublingual gland raises an elongate fold of mucosa (sublingual fold), which extends from the posterolateral aspect of the floor of the oral cavity to the sublingual papilla beside the base of the frenulum of the tongue at the midline anteriorly.

The sublingual gland drains into the oral cavity via numerous small ducts (minor sublingual ducts), which open onto the crest of the sublingual fold. Occasionally, the more anterior part of the gland is drained by a duct (major sublingual duct) that opens together with the submandibular duct on the sublingual caruncle.

**VESSELS**

Vessels that supply the parotid gland originate from the external carotid artery and from its branches that are adjacent to the gland. The submandibular and sublingual glands are supplied by branches of the facial and lingual arteries.

Veins from the parotid gland drain into the external jugular vein, and those from the submandibular and sublingual glands drain into lingual and facial veins.

Lymphatic vessels from the parotid gland drain into nodes that are on or in the gland. These parotid nodes then drain into superficial and deep cervical nodes.

Lymphatics from the submandibular and sublingual glands drain mainly into submandibular nodes and then into deep cervical nodes, particularly the jugulaomohyoid node.

**INNERVATION**

**Parasympathetic**

Parasympathetic innervation to all salivary glands in the oral cavity is by branches of the facial nerve [VII], which join branches of the maxillary [V 2] and mandibular [V 3] nerves to reach their target destinations. The parotid gland, which is entirely outside the oral cavity, receives its parasympathetic innervation from fibers that initially traveled in the glossopharyngeal nerve [IX]. which eventually joins a branch of the mandibular nerve [V3] in the infratemporal fossa.

**Greater petrosal nerve**

All salivary glands above the level of the oral fissure, as well as all mucus glands in the nose and the lacrimal gland in the orbit, are innervated by parasympathetic fibers carried in the greater petrosal branch of the facial nerve [VII]. Preganglionic parasympathetic fibers carried in this nerve enter the pterygopalatine fossa and synapse with postganglionic parasympathetic fibers in the pterygopalatine ganglion formed around branches of the maxillary nerve [V 2]. Postganglionic parasympathetic fibers join general sensory branches of the maxillary nerve, such as the palatine nerves, destined for the roof of the oral cavity, to reach their target glands.

**Chorda tympani**

All glands below the level of the oral fissure, which include those small glands in the floor of the oral cavity, in the lower lip, and in the tongue, and the larger submandibular and sublingual glands, are innervated by parasympathetic fibers carried in the chorda tympani branch of the facial nerve [VII]. The chorda tympani join the lingual branch of the mandibular nerve [V3] in the infratemporal fossa and passes with it into the oral cavity. On the external surface of the hyoglossus muscle, preganglionic parasympathetic fibers leave the inferior aspect of the lingual nerve to synapse with postganglionic parasympathetic fibers in the submandibular ganglion, which appears to hang off the lingual nerve. Postganglionic parasympathetic fibers leave the ganglion and pass directly to the submandibular and sublingual glands while others hop back onto the lingual nerve and travel with branches of the lingual nerve to target glands.

**APPLIED ANATOMY OF THE TONGUE**

**Paralysis of Genioglossus**

When the genioglossus muscle is paralyzed, the tongue has a tendency to fall posteriorly, obstructing the airway and presenting the risk of suffocation. Total relaxation of the genioglossus muscles occurs during general anesthesia; therefore, an airway is inserted in an anesthetized person to prevent the tongue from relapsing.

**Frenectomy**

An overly large frenulum of the tongue (tongue-tie) interferes with tongue movements and may affect speech. In unusual cases, a frenectomy (cutting the frenulum) in infants may be necessary to free the tongue for normal movements and speech.

**Laceration of the Tongue**

A wound of the tongue is often caused by the patient’s teeth following a blow on the chin when the tongue is partly protruded from the mouth. It can also occur when a patient accidentally bites the tongue while eating, during recovery from an anesthetic, or during an epileptic attack. Bleeding is halted by grasping the tongue between the finger and thumb posterior to the laceration, thus occluding the branches of the lingual artery.

**Injury to Hypoglossal Nerve**

Trauma, such as a fractured mandible, may injure the hypoglossal nerve (CN XII), resulting in paralysis and eventual atrophy of one side of the tongue. The tongue deviates to the paralyzed side during protrusion because of the action of the unaffected genioglossus muscle on the other side.

**Lingual Carcinoma**

A lingual carcinoma in the posterior part of the tongue metastasizes to the superior deep cervical lymph nodes on both sides, whereas a tumor in the anterior part usually does not metastasize to the inferior deep cervical lymph nodes until late in the disease. Because the nodes are closely related to the IJV, metastases from the tongue may be distributed through the submental and submandibular regions and along the IJVs in the neck

QUESTION 2. Write an essay on the air sinuses.

**PARANASAL SINUSES**

The paranasal sinuses are air-ﬁlled extensions of the respiratory part of the nasal cavity into the following cranial bones: frontal, ethmoid, sphenoid, and maxilla. They are named according to the bones in which they are located. The sinuses continue to invade the surrounding bone, and marked extensions are common in the crania of older individuals.

**FRONTAL SINUSES**

The right and left frontal sinuses are between the outer and inner tables of the frontal bone, posterior to the superciliary arches and the root of the nose. Frontal sinuses are usually detectable in children by 7 years of age. The right and left sinuses each drain through a frontonasal duct into the ethmoidal infundibulum, which opens into the semilunar hiatus of the middle nasal meatus. The frontal sinuses are innervated by branches of the supra-orbital nerves (CN V1).

The right and left frontal sinuses are rarely of equal size, and the septum between them is not usually situated entirely in the median plane. The frontal sinuses vary in size from approximately 5 mm to large spaces extending laterally into the greater wings of the sphenoid. Often a frontal sinus has two parts: a vertical part in the squamous part of the frontal bone, and a horizontal part in the orbital part of the frontal bone. One or both parts may be large or small. When the supra-orbital part is large, its roof forms the ﬂoor of the anterior cranial fossa and its ﬂoor forms the roof of the orbit.

**ETHMOIDAL CELLS**

The ethmoidal cells (sinuses) are small invaginations of the mucous membrane of the middle and superior nasal meatus into the ethmoid bone between the nasal cavity and the orbit. The ethmoidal cells usually are not visible in plain radiographs before 2 years of age but are recognizable in CT scans. The anterior ethmoidal cells drain directly or indirectly into the middle nasal meatus through the ethmoidal infundibulum. The middle ethmoidal cells open directly into the middle meatus and are sometimes called “bullar cells” because they form the ethmoidal bulla, a swelling on the superior border of the semilunar hiatus. The posterior ethmoidal cells open directly into the superior meatus. The ethmoidal cells are supplied by the anterior and posterior ethmoidal branches of the nasociliary nerves (CN V1).

**SPHENOIDAL SINUSES**

The sphenoidal sinuses are located in the body of the sphenoid, but they may extend into the wings of this bone. They are unevenly divided and separated by a bony septum. Because of this extensive pneumatization (formation of air cells), the body of the sphenoid is fragile. Only thin plates of bone separate the sinuses from several important structures: the optic nerves and optic chiasm, the pituitary gland, the internal carotid arteries, and the cavernous sinuses. The sphenoidal sinuses are derived from a posterior ethmoidal cell that begins to invade the sphenoid at approximately 2 years of age. In some people, several posterior ethmoidal cells invade the sphenoid, giving rise to multiple sphenoidal sinuses that open separately into the sphenoethmoidal recess. The posterior ethmoidal arteries and the posterior ethmoidal nerves that accompany the arteries supply the sphenoidal sinuses.

**MAXILLARY SINUSES**

The maxillary sinuses are the largest of the paranasal sinuses. They occupy the bodies of the maxillae and communicate with the middle nasal meatus. • The apex of the maxillary sinus extends toward and often into the zygomatic bone. • The base of the maxillary sinus forms the inferior part of the lateral wall of the nasal cavity. • The roof of the maxillary sinus is formed by the ﬂoor of the orbit. • The ﬂoor of the maxillary sinus is formed by the alveolar part of the maxilla. The roots of the maxillary teeth, particularly the ﬁrst two molars, often produce conical elevations in the ﬂoor of the sinus. Each maxillary sinus drains by one or more openings, the maxillary ostium (ostia), into the middle nasal meatus of the nasal cavity by way of the semilunar hiatus. The arterial supply of the maxillary sinus is mainly from superior alveolar branches of the maxillary artery, however, branches of the descending and greater palatine arteries supply the ﬂoor of the sinus. Innervation of the maxillary sinus is from the anterior, middle, and posterior superior alveolar nerves, which are branches of the maxillary nerve.