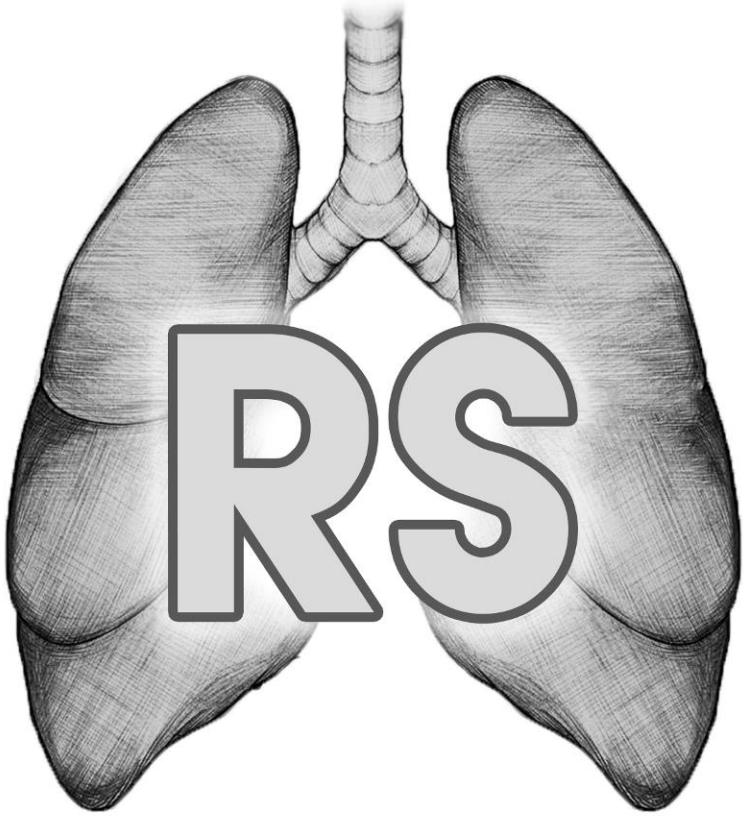

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ANATOMY / HISTOLOGY

☑ Sheet ○ Slide ○ Handout

Number

1

Subject

The Nasal Cavity

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Price:

Introduction to the Respiratory System

Over the duration of our anatomy classes, we will discuss the components of the respiratory system.

*The Nose, Nasal Cavity, and nasal sinuses, we will discuss in detail today

*We have the pharynx, which we discussed in the digestive system

-The pharynx is divided into: Nasopharynx, Oropharynx, and Laryngopharynx

*The next part is the larynx which contains the vocal cords and is responsible for phonation of the voice

*This is followed by the trachea and main bronchi

-The bronchi are either extra- or intra- pulmonary

*The bronchi are followed by bronchioles

-The difference between bronchi and bronchioles is that bronchi contain cartilage while bronchioles don't

-This is why bronchioles are more susceptible to asthma, which is contraction of the smooth muscles of the bronchioles

*The bronchioles are divided into conducting and respiratory

-Respiratory epithelium means simple squamous epithelium and covers the walls of the respiratory bronchioles

*Bronchioles are divided into bronchopulmonary segments and give off alveoli

-The lungs contain hundreds of millions of alveoli, all surrounded by a network of capillaries

-The alveoli and capillaries are involved in gas exchange (The respiratory system's most important function)

*The 2 lungs (which are formed of the intra-pulmonary bronchi and the divisions up until the alveoli) are surrounded by pleura, which is similar to the heart's pericardium. The pleura is also made up of parietal and visceral layers

What are the General Functions of the Respiratory System?

1) Gas exchange, which occurs in the alveolar-capillary membrane

2) Regulation of blood pH by controlling CO2 and O2 concentrations

3) Filtration of air from dust, foreign bodies, viruses, and bacteria

-That's why the type of epithelium on structures responsible for filtration is Pseudostratified squamous epithelium, with cilia which move unwanted particles to the outside of the body (The cilia are unidirectional –inside to outside-)

-The part of the nose responsible for filtration is the vestibule

-The vestibule contains short, thick hair called vibrissae and is present on the anterior part of the nose

4) Olfaction/smell

-Bipolar cells in the roof of the nasal cavity are responsible for your sense of smell and give rise to the first cranial nerve (the olfactory nerve)

5) Phonation/Sound production

-This occurs due to the vibration of the true vocal cords of the larynx

6) Mucous secretion

-This contributes to filtration and moisturizing the air entering the respiratory tract

Layers of the Wall of the Respiratory Tract:

1) Mucosa

-Lining epithelium

-Lamina Propria→ contains glands which secrete mucus

-Muscularis mucosa

2) Submucosa

3) Supporting layer, which contains cartilage to maintain the shape of the respiratory openings

4) Adventitia

*In the GIT wall, the layers are the same, except for a muscular layer instead of the supporting layer of cartilage

The Nose, Nasal Cavity, and Paranasal Sinuses (الجيوب الهوائية)

*The Nose is mainly divided into the:

1) External Nose

2) Nasal Cavity

*The nose can very generally be described as two cavities separated by a septum

-The Septum is considered the medial wall of the nasal cavity

1) External Nose

Anterior part: Movable cartilage

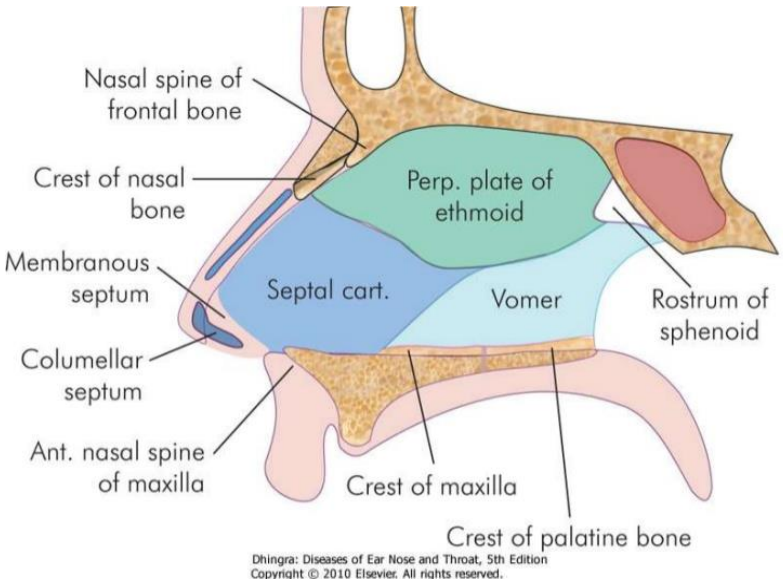
Posterior part: Bone

A) Nasal Septum/ Medial wall of the Nasal Cavity

*If we look at this picture of the septum of the nose, we see that

1) The anterior part is cartilage (Septal cartilage)

2) The upper posterior part is the vertical/perpendicular plate of the ethmoid bone



3) The lower posterior part is made up of the vomer

B) Lateral Wall of the External Nose

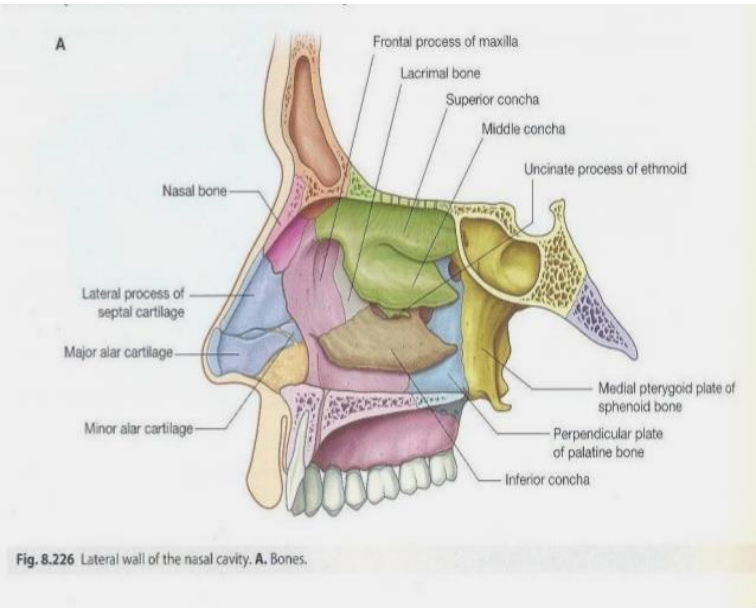


Fig. 8.226 Lateral wall of the nasal cavity. **A.** Bones.

*The lateral wall is made up of cartilage, bones, and mucosa

*Anteriorly, it's formed of the upper and lower lateral nasal cartilages, plus the alar cartilage

*The ala contains two muscles important for the nose; The dilator and the compressor nasalis

-These muscles move the ala of the nose to either 'flare'/open your nostrils or compress them

*The nose does contains a fatty layer under the skin which separates the muscles from the frame of the nose

-This fat is located in the lateral ala

C) Nasal Bones

*There are two nasal bones which go up into the skull and are separated by a suture

*Lateral to the nasal bone on either side is the joining of the maxillary/nasal process of the frontal bone to the frontal processes of the maxilla

D) Blood Supply of the External Nose

*Most blood supply to the external nose is from the Ophthalmic and Maxillary arteries

*The ophthalmic artery is a branch of the internal carotid

-The ophthalmic artery enters the orbital cavity through the optic canal, while accompanying the optic nerve

-When the ophthalmic artery enters the nasal canal, it gives the anterior and posterior ethmoidal arteries

-The anterior ethmoidal artery is the one which goes to the external nose and becomes the external nasal artery

*The maxillary artery is a branch of the external carotid

*The maxillary artery gives blood supply to the upper jaw and then enters the inferior orbital foramen to become the infraorbital artery

-The infraorbital artery gives three branches: the nasal, labial, and the palpebral

*The facial artery also participates in the blood supply to the external nose

*Like the maxillary artery, the facial artery is also a branch of the external carotid artery

*The facial artery gives rise to the superior labial artery and the angular artery

-The angular artery terminates at the medial angle of the eye, which explains its name

E) Nerve Supply of the External Nose

*The External nose is supplied by the infratrochlear and external nasal branches of the ophthalmic nerve

-The ophthalmic nerve, like the artery, gives rise to anterior and posterior ethmoidal branches

-The external nasal branch is a direct branch of the anterior ethmoidal nerve

*The maxillary nerve, like the maxillary artery, gives an infraorbital branch on entering the inferior orbital foramen

-The infraorbital nerve gives three branches: the nasal, labial, and the palpebral

*The maxillary and the ophthalmic nerve are both branches of the trigeminal nerve (Cranial Nerve V)

2) The Nasal Cavity

A) Functions of the Nasal Cavity:

1) Respiration

2) Olfaction

3) Resonance of the voice

-The part of the nasal cavity responsible for this function is the paranasal sinuses

-The paranasal sinuses are the frontal, ethmoidal, maxillary, and sphenoid air sinuses

-They are small cavities filled with air and covered by mucosa

-This is why sinusitis leads to change in voice

4) Draining of lacrimal fluid

-The lacrimal sac in the medial angle of the eye is filled with tears and secretions and connects to the nasolacrimal duct

-The nasolacrimal duct is drained into the inferior meatus of the lateral wall of the nasal cavity

-This is why excessive production of tears, like in crying, can lead to leakage from the nose

5) Protective

-These protective functions include sneezing to excrete unwanted substances, filtration to prevent foreign body entrance, proteolytic enzymes to kill bacteria, and warming and moistening of the air

*The mucous membrane in the nasal cavity is very thick. This is because it contains a large plexus of veins

-This plexus of veins serves to warm blood

B) Borders of the Nasal Cavity

Medial wall

*The septum, composed of the septal cartilage, vertical plate of ethmoid, and the vomer

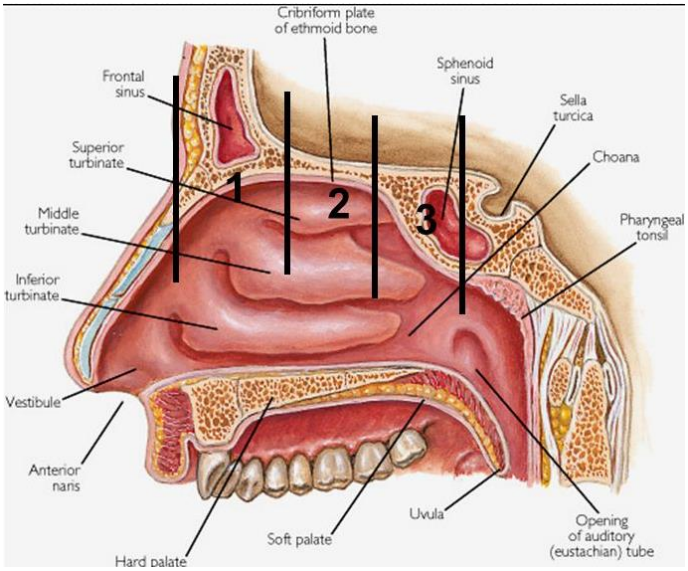
Roof

*The sloping, anterior part of the roof is made up of the nasal spine of the frontal bone and the nasal bones

*The horizontal, middle part of the roof is made up of the cribriform plate of the ethmoid bone

-It's called cribriform because it contains perforations (ثقوب) to allow passage of the filaments of the olfactory nerve (Cranial nerve I). You can note bipolar cells around the cribriform plate which reach to the olfactory nerve.

-The olfactory nerve is responsible for smell sensations



*The sloping, posterior part is the anterior surface of the sphenoid bone, the ala of the vomer, and the vaginal process of the palatine bone.

Floor

*Hard Palate

-The hard plate is made up of the maxilla anteriorly, and the palatine bone posteriorly

-The part of the maxilla making up the hard palate is called the palatine process of the maxilla

-The part of the palatine bone making up the hard palate is called the horizontal plate of palatine bone

Lateral Wall

*The part of the nasal cavity right after the anterior opening is the vestibule

-The vestibule contains short and thick hair which is responsible for filtration of air which enter the nose

-The type of epithelium in vestibules is stratified squamous keratinized epithelium with hair follicles. This epithelium can also be simply called modified skin.

Note: The vestibule and the area above the superior conchae are important to note, because they are not covered by respiratory epithelium.

*After the vestibule, we have the atrium or antrum

*Finally the lateral wall of the nasal cavity is made up of three conchae, 3 meatuses, and 1 recess.

-This recess is called the sphenoethmoidal recess

*Conchae are projections of bone covered by mucosa.

-Conchae provide bony support to the lateral wall of the nasal cavity

*Meatuses are grooves directly below the conchae. Their function is drainage of the paranasal sinuses.

*Below the lateral surface of the uncinate process of the ethmoid and in the anterior part of the middle meatus is the infundibulum

*The middle meatus contains 2 structures: The bulla ethmoidalis and the hiatus semilunaris

-Under the bulla ethmoidalis is a groove called the hiatus semilunaris

*There are 3 ethmoidal paranasal sinuses (Anterior, middle, and posterior), 1 maxillary, 1 frontal, and 1 sphenoid air sinus on each side of the skull.

*The infundibulum is the site of drainage of the frontal air sinus

*The sphenoethmoidal recess is the site of drainage of the sphenoid air sinuses

*The superior meatus is the site of drainage of the posterior ethmoidal sinuses

*The inferior meatus is the site of drainage of the nasolacrimal duct

*The rest drain into the middle meatus (The anterior and middle ethmoidal and the maxillary air sinuses)

-The middle ethmoidal air sinus drains into the bulla ethmoidalis

-The maxillary air sinus drains into the posterior of the hiatus semilunaris

-The anterior ethmoidal air sinus drains into the anterior of the hiatus semilunaris
(It is written in the infundibulum in the slides by mistake)

What bones participate in the formation of the lateral wall of the nasal cavity?

1) The inferior conchae articulates with the maxilla, pterygoid bone, and perpendicular plate of palatine bone

2) The superior and middle conchae are part of the ethmoid bone and articulate with the lacrimal bone

*So the lacrimal bone, ethmoid bone, palatine bone, pterygoid bone, and maxilla all provide support for the lateral wall

C) Openings of the Nasal Cavity

*The most anterior opening of the nasal cavity is the nares or nostrils

*The posterior openings of the nasal cavity are called choanae (plural of choana), and are what connect the nasal cavity and the nasopharynx

*The medial relation of the choanae is the vomer

*The superior medial relation is the ala of the vomer

*Inferior to the choanae is the horizontal plate of the palatine bone

*Lateral to the choanae is the medial pterygoid plate of sphenoid

D) Blood Supply of the Nasal Cavity

*When discussing the blood or nerve supply of the nose, we divide it into two major categories: Vessels which supply the septum or vessels which supply the lateral wall

*Generally, almost all of the blood supply comes from the ophthalmic artery, a branch of the internal carotid, or the maxillary artery, a branch of the external carotid.

Lateral Wall

*The lateral wall can be divided into 4 quadrants: Superior anterior, superior posterior, inferior anterior, and inferior posterior

-The posterior superior quadrant is mostly supplied by the Short sphenopalatine branch of the sphenopalatine artery (branch of the maxillary artery)

-The anterior superior quadrant is mostly supplied by the anterior and posterior ethmoidal arteries of the ophthalmic arteries

Septal Wall

*The main blood supply to the septum is a branch of the sphenopalatine artery (which is a branch of the maxillary artery).

-The Sphenopalatine divides to form the Long and Short Sphenopalatine arteries

-The Long Sphenopalatine/Nasopalatine artery is the main blood supply to the septum (The upper 2/3rd)

*The Second most important source of blood supply to the septum is a branch of the facial artery called the Superior Labial artery which gives off a septal branch (The lower 3rd)

*The Palatine artery (of the maxillary artery) gives rise to Greater and Lesser Palatine arteries.

-The Lesser Palatine artery supplies the soft palate

-The Greater palatine artery supplies the hard palate, enters the nasal cavity via the incisive foramen and supplies the posterior and antero-inferior quadrants of the nasal septum

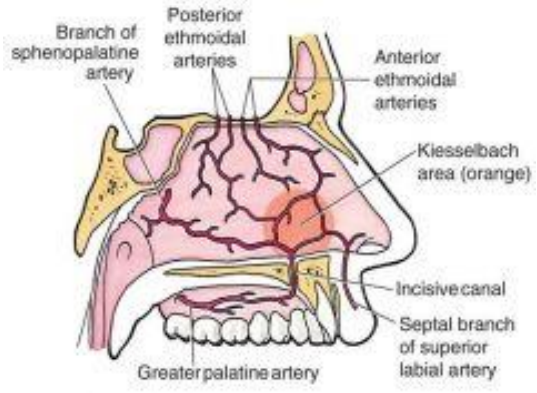
*The anterior and posterior ethmoidal arteries (branches of the ophthalmic artery) both have septal branches coming from the roof

-They entered the orbital cavity and penetrated the cranium to enter the nose

Epistaxis

*Bleeding through the nose

*The Long Sphenopalatine artery and the Septal branch of Superior Labial artery form anastomoses on the wall of the septum of the nasal cavity



-The area of anastomosis between these 2 arteries is called Keisselbach's area

-Keisselbach's area is located between the upper 2/3 of the septum and the lower 1/3

*Any trauma is Keisselbach's area could lead to bleeding

*The usual treatment should just be to avoid swallowing any blood and placing pressure on the cartilage of the anterior nares for a few minutes

-If this treatment doesn't work, cauterization should be performed or silver nitrate should be administered

Venous Drainage

*Superiorly → Opthalmic veins → Cavernous sinus

*Anteriorly → through the facial vein

*Posteriorly → maxillary vein → pterygoid plexus of veins

Lymphatics

*Mainly drain into the submandibular nodes which drain into the deep cervical lymph nodes

Innervation

*The nerves are organized the same way as the blood supply (into lateral wall and septum) and take the same names as their arteries

*Branches of the ophthalmic and maxillary nerves supply general sensation to the nose

* The main nerve supply to the septum of the nose is the Long Sphenopalatine/ Nasopalatine nerve

*The ophthalmic nerve gives rise to the anterior and posterior ethmoidal nerves, which give of branches to the lateral and septal walls of the nose

*The parasympathetic stimulation and secretomotor innervation is supplied by the greater petrosal nerve (which is a branch of the facial nerve)

*The olfactory nerve is responsible for smell sensation/olfaction

Not mentioned in the lecture, but important:

Branches of the Maxillary Nerve:

1. Posterior superior lateral nasal nerves pass forward on and supply the lateral wall of the nasal cavity;

2. Posterior inferior nasal nerves originate from the greater palatine nerve, innervate the lateral wall of the nasal cavity

3. Anterior superior alveolar branch of the infra-orbital nerve supply the lateral wall near the anterior end of the inferior concha.

4. Largest of these nerves is the **nasopalatine nerve**, pass through the incisive canal onto the roof of the oral cavity, and terminates by supplying the oral mucosa posterior to the incisor teeth

5. Posterior superior medial nasal nerves cross the roof to the nasal septum and supply both these regions

Summary for blood supply and innervations:

1. Postero-superior quadrant: Posterior-superior lateral nerve and vessels (short spheno palatine)

2. Postero-inferior quadrant: Greater palatine nerve and vessels

3. Antero-superior quadrant: Anterior Ethmoidal nerve (internal and external nerve) and artery

4. Antero-inferior quadrant: Ant. Superior alveolar nerve and branches from the facial and greater palatine artery

5. Nasal septum:

-Lower posterior part by the long sphenopalatine nerve

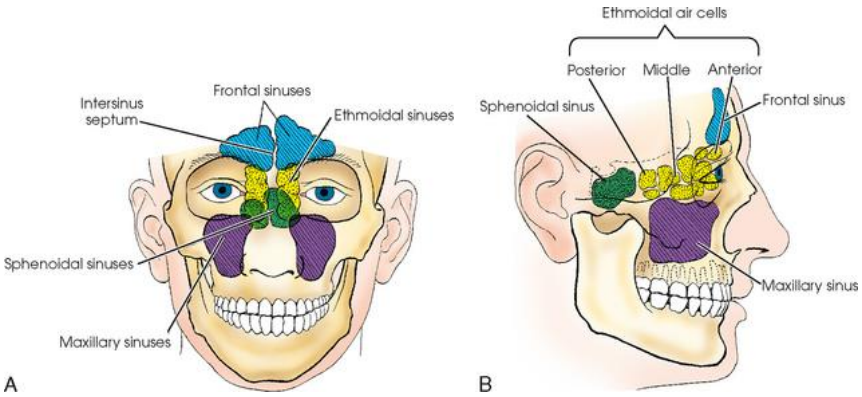
-Upper anterior part by the septal branch of the anterior ethmoidal nerve.

-Blood supply by the long sphenopalatine artery.

Paranasal Sinuses

*As we mentioned before, there are 6 paranasal sinuses on each side of the nasal cavity

-There are 3 ethmoidal sinuses, 1 sphenoid, 1 maxillary, and 1 frontal air sinus



*These sinuses function in resonance of the voice, decreased weight of the skull, and protection (by reducing the intracranial pressure and preventing damage or compression to the brain).

*These sinuses start off rudimentary and enlarge with growth of the bones of the face

*These air sinuses are innervated by branches of the maxillary and ophthalmic nerve

-The Frontal air sinus is innervated by the supra-orbital nerve of the ophthalmic nerve

-The Ethmoidal air sinuses are innervated by the anterior and posterior ethmoidal branches of the ophthalmic nerve

-The Maxillary sinus is innervated by the infraorbital branch of the maxillary nerve

-The sphenoid sinus is innervated by the posterior ethmoidal nerve of the ophthalmic nerve AND the orbital branches of the maxillary nerve

*A pituitary gland tumor can lead to block of the sphenoid air sinuses

*The maxillary sinus is pyramidal in shape. It has very bad drainage

-This is because the opening of the maxillary sinus is directed upwards against gravity

-You can drain the maxillary sinus surgically by removing one of the upper molar teeth

*Infection of the maxillary sinus can complicate to fistula formation (opening to the oral cavity)

Relations of the Maxillary Sinus (not mentioned, but we need to know them):

*Related above to the orbit

*Related below to the roots of the upper molar and premolar teeth

*Related behind to the infratemporal fossa

*Related medially to the lower part of the nasal cavity