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DEPARTMENT: MEDICINE & SURGERY

COURSE TITLE: GROSS ANATOMY OF HEAD AND NECK

- 1.) Write an essay on the cavernous sinus.
- 2.) Discuss the walls of the nose.

Answers

- 1.) The cavernous sinus within the human head is one of the *dural venous sinuses* creating a cavity called the lateral sellar compartment bordered by the temporal bone of the skull and the sphenoid bone, lateral to the sella turcica.

Structure

The cavernous sinus is one of the dural venous sinuses of the head. It is a network of veins that sit in a cavity, approximately 1 x 2 cm in size in an adult. The carotid siphon of the internal carotid artery, and cranial nerves III, IV, V (branches V1 and V2) and VI all pass through this blood filled space.

Nearby structures

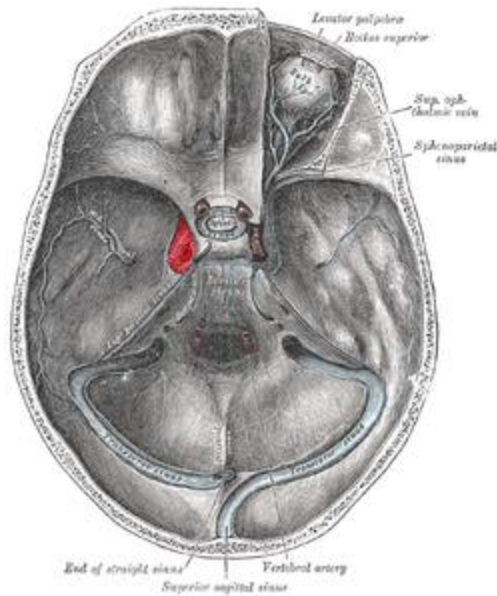
- Above: optic tract, optic chiasma, internal carotid artery.
- Inferiorly: Foramen lacerum and the junction of the body and greater wing of sphenoid bone.
- Medially: Hypophysis cerebri or (pituitary gland) and sphenoidal air sinus.
- Laterally: temporal lobe with uncus.
- Anteriorly: superior orbital fissure and the apex of the orbit.
- Posteriorly: apex of petrous temporal bone.

Venous connections

The cavernous sinus receives blood from:

- ✓ Superior and inferior ophthalmic veins
- ✓ Sphenoparietal sinus
- ✓ Superficial middle cerebral veins
- ✓ Inferior cerebral veins

Blood leaves the sinus via superior and inferior petrosal sinuses as well as via the emissary veins through the foramina of the skull (mostly through foramen ovale). There are also connections with the pterygoid plexus of veins via inferior ophthalmic vein, deep facial vein and emissary veins.



Cavernous sinus in red

Contents

Apart from the blood which passes through a venous sinus, several anatomical structures, including some cranial nerves and their branches, also pass through the sinus.

Structures within the outer (lateral) wall of the compartment from superior to inferior:

- Oculomotor nerve
- Trochlear nerve
- Ophthalmic and maxillary branches of the trigeminal nerve

Structures passing through the midline (medial) wall:

- Abducens nerve
- Internal carotid artery accompanied by the Internal carotid plexus

These nerves, with the exception of CN V2, pass through the cavernous sinus to enter the orbital apex through the superior orbital fissure. The maxillary nerve, division V2 of the trigeminal nerve travels through the lower portion of the sinus and exits via the foramen rotundum. The maxillary branch passes external to, but immediately adjacent to, the lateral wall of the sinus).

The optic nerve lies just above and outside the cavernous sinus, superior and lateral to the pituitary gland on each side, and enters the orbital apex via the optic canal.

Venous drainage

As a venous sinus, the cavernous sinus receives blood from the superior and inferior ophthalmic veins and from superficial cortical veins, and is connected to the basilar plexus of veins posteriorly. The cavernous sinus drains by two larger channels, the superior and inferior petrosal sinuses, ultimately into the internal jugular vein via the sigmoid sinus, also draining with emissary vein to pterygoid plexus.

Clinical significance

- 1.) It is the only anatomic location in the body in which an artery travels completely through a venous structure. If the internal carotid artery ruptures within the cavernous sinus, an arteriovenous fistula is created (more specifically, a carotid-cavernous fistula). Lesions affecting the cavernous sinus may affect isolated nerves or all the nerves traversing through it.
- 2.) The pituitary gland lies between the two paired cavernous sinuses. An abnormally growing pituitary adenoma, sitting on the bony sella turcica, will expand in the direction of least resistance and eventually compress the cavernous sinus. Cavernous sinus syndrome may result from mass effect of these tumors and cause ophthalmoplegia (from compression of the oculomotor nerve, trochlear nerve, and abducens nerve), ophthalmic sensory loss (from compression of the ophthalmic nerve), and maxillary sensory loss (from compression of the maxillary nerve). A complete lesion of the cavernous sinus disrupts CN III, IV, and VI, causing total ophthalmoplegia, usually accompanied by a fixed, dilated pupil. Involvement of CN V (V1 and variable involvement of V2) causes sensory loss in these divisions of the trigeminal nerve. Horner's syndrome can also occur due to involvement of the carotid ocular sympathetics, but may be difficult to appreciate in the setting of a complete third nerve injury.
- 3.) Because of its connections with the facial vein via the superior ophthalmic vein, it is possible to get infections in the cavernous sinus from an external facial injury within the danger area of the face. In patients with thrombophlebitis of the facial vein, pieces of the clot may break off and enter the cavernous sinus, forming a cavernous sinus thrombosis. From there the infection may spread to the dural venous sinuses. Infections may also be introduced by facial lacerations and by bursting pimples in the areas drained by the facial vein.
- 4.) Potential causes of cavernous sinus syndrome include metastatic tumors, direct extension of nasopharyngeal tumours, meningioma, pituitary tumors or pituitary apoplexy, aneurysms of the intracavernous carotid artery, carotid-cavernous fistula, bacterial infection causing cavernous sinus thrombosis, aseptic cavernous sinus thrombosis, idiopathic granulomatous disease (Tolosa–Hunt syndrome), and fungal

infections. Cavernous sinus syndrome is a medical emergency, requiring prompt medical attention, diagnosis, and treatment.

2.) The nose & its walls

The nose's exterior anatomy includes the nasal cavity, paranasal sinuses, nerves, blood supply, and lymphatics. The external part of the nose includes the root (between the eyes), the dorsum that runs down the middle, and the apex at the tip of the nose. Two openings called nostrils (nares) allow air in. They're divided by the nasal septum (dividing wall of cartilage and bone), and the parts that surround the nostrils are called the alae (ala singular).

The nose has a bony part that's formed by the bony nasal septum, the nasal bones, and parts of the maxillae, palatine, and frontal bones. The cartilaginous part of the nose is formed by two lateral cartilages, two alar cartilages, and a septal cartilage.

The nasal cavity

The nares serve as the entryway to the nasal cavities, which open posteriorly into the nasopharynx via the choanae. The walls of the nasal cavity include the following features:

- **Roof:** The roof is divided into three parts: frontonasal, ethmoidal, and sphenoidal. Each part corresponds to the underlying bone of the same name.
- **Floor:** The floor consists of the palatine process of the maxilla and the horizontal plate of the palatine bone.
- **Medial wall:** This wall is the nasal septum, which is formed by the perpendicular plate of the ethmoid bone, the vomer, cartilage, and the nasal crests of the maxillary and palatine bones.
- **Lateral wall:** This wall is hallmarked by three nasal conchae (superior, middle, and inferior) that project inferiorly from the wall. They divide the nasal cavity into four passages that have openings to the paranasal sinuses:
 - a) The sphenoethmoid recess lies posterior to the superior concha and has the opening for the sphenoidal sinus.
 - b) The superior nasal meatus lies between the superior and middle conchae and has openings to the posterior ethmoidal sinuses.
 - c) The middle nasal meatus is longer and deeper than the superior nasal meatus. The frontal sinus communicates with the middle nasal meatus via the infundibulum, a passageway that opens into the semilunar hiatus (groove in the ethmoid bone). The maxillary sinus opens into the semilunar hiatus. An ethmoidal bulla (a round swelling formed by the middle ethmoidal cells, or air-filled cavities) is formed just above the

semilunar hiatus. The middle and anterior ethmoidal sinuses drain into the middle nasal meatus.

- d) The inferior nasal meatus is found below the inferior nasal concha. The nasolacrimal duct opens into this meatus.

The nasal cavity is lined with nasal mucosa, except for the nasal vestibule, which is lined with skin. The mucosa over the superior one-third of the nasal cavity is the olfactory area. Air is drawn past the specialized mucosal cells called the olfactory epithelium as air is sniffed through the nose. The olfactory epithelium contains receptors of olfactory neurons that detect smells. Olfactory neurons (from CN I) join together to form nerve bundles that run up through the cribriform plate of the ethmoid bone to the olfactory bulb.

Bones of the nose and septal cartilage

Roof of the mouth showing position of palatine bones making up the floor of the nose, and forming the posterior nasal spine for the attachment of the musculus uvulae. The bony structure of the nose is provided by the maxilla, frontal bone, and a number of smaller bones.

The topmost bony part of the nose is formed by the nasal part of the frontal bone, which lies between the brow ridges, and ends in a serrated nasal notch. A left and a right nasal bone join with the nasal part of the frontal bone at either side; and these at the side with the small lacrimal bones and the frontal process of each maxilla. The internal roof of the nasal cavity is composed of the horizontal, perforated cribriform plate of the ethmoid bone through which pass sensory fibres of the olfactory nerve. Below and behind the cribriform plate, sloping down at an angle, is the face of the sphenoid bone.

The wall separating the two cavities of the nose, the nasal septum, is made up of bone inside and cartilage closer to the tip of the nose. The bony part is formed by the perpendicular plate of the ethmoid bone at the top, and the vomer bone below. The floor of the nose is made up of the incisive bone and the horizontal plates of the palatine bones, and this makes up the hard palate of the roof of the mouth. The two horizontal plates join together at the midline and form the posterior nasal spine that gives attachment to the musculus uvulae in the uvula.

The two maxilla bones join at the base of the nose at the lower nasal midline between the nostrils, and at the top of the philtrum to form the anterior nasal spine. This thin projection of bone holds the cartilaginous center of the nose. [5][6] It is also an important cephalometric landmark.

Cartilages

Nasal cartilages

The nasal cartilages are the septal, lateral, major alar, and minor alar cartilages. The major and minor cartilages are also known as the greater and lesser alar cartilages. There is a narrow strip of cartilage called the vomeronasal cartilage that lies between the vomer and the septal cartilage.

The septal nasal cartilage, extends from the nasal bones in the midline, to the bony part of the septum in the midline, posteriorly. It then passes along the floor of the nasal cavity. The septum is quadrangular—the upper half is attached to the two lateral nasal cartilages which are fused to the dorsal septum in the midline. The septum is laterally attached, with loose ligaments, to the bony margin of the anterior nasal aperture, while the inferior ends of the lateral cartilages are free (unattached). The three or four minor alar cartilages are adjacent to the lateral cartilages, held in the connective tissue membrane, that connects the lateral cartilages to the frontal process of the maxilla.

The nasal bones in the upper part of the nose are joined together by the midline internasal suture. They join with the septal cartilage at a junction known as the rhinion. The rhinion is the midpoint of the internasal suture at the join with the cartilage, and from the rhinion to the apex, or tip, the framework is of cartilage.

The major alar cartilages are thin, U-shaped plates of cartilage on each side of the nose that form the lateral and medial walls of the vestibule, known as the medial and lateral crura. The medial crura are attached to the septal cartilage, forming fleshy parts at the front of the nostrils on each side of the septum, called the medial crural footpods. The medial crura meet at the midline below the end of the septum to form the columella and lobule. The lobule contains the tip of the nose and its base contains the nostrils. At the peaks of the folds of the medial crura, they form the alar domes the tip-defining points of the nose, separated by a notch. They then fold outwards, above and to the side of the nostrils forming the lateral crura. The major alar cartilages are freely moveable and can respond to muscles to either open or constrict the nostrils.

There is a reinforcing structure known as the nasal scroll that resists internal collapse from airflow pressure generated by normal breathing. This structure is formed by the junction between the lateral and major cartilages. Their edges interlock by one scrolling upwards and one scrolling inwards.

Muscles

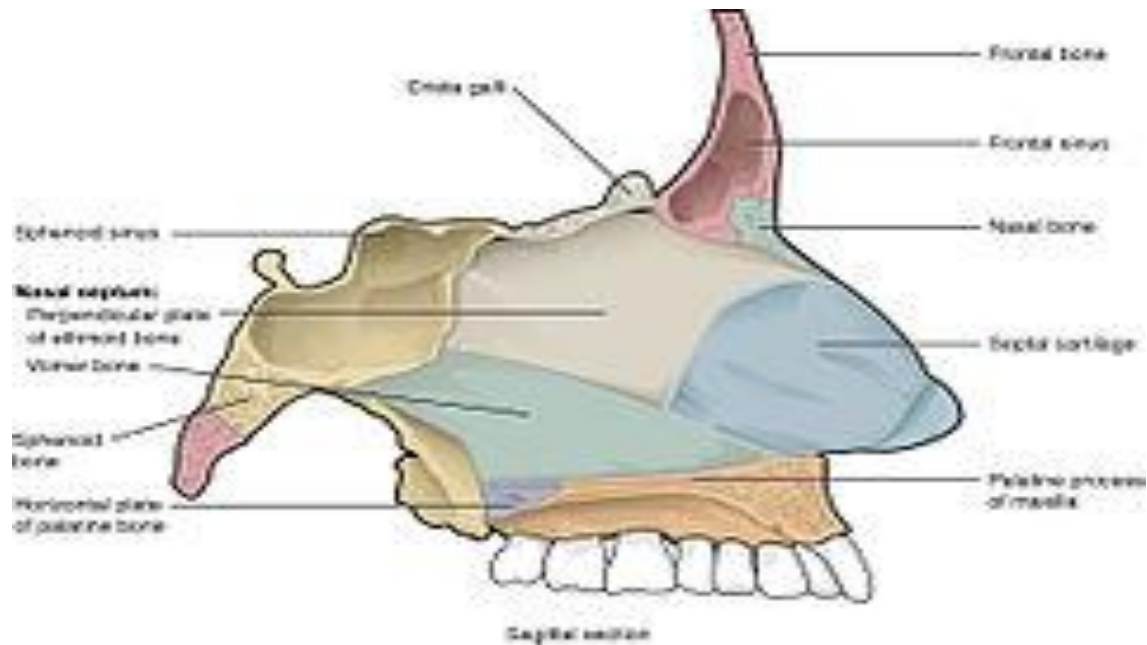
The muscles of the nose are a subgroup of the muscles of facial expression. They are involved in respiration and facial expression. The muscles of the nose include the procerus, nasalis, depressor septi nasalis, levator labii superioris alaeque nasalis, and the orbicularis oris of the mouth. As are all of the facial muscles, the muscles of the nose are innervated by the facial nerve and its branches. Although each muscle is independent, the muscles of the nose form a continuous layer with connections between all the components of the muscles and ligaments, in the nasal part of a superficial muscular aponeurotic system (SMAS). The SMAS is continuous from the nasofrontal process to the nasal tip. It divides at level of the nasal valve into superficial and deep layers, each layer having medial and lateral components.

The procerus muscle produces wrinkling over the bridge of the nose, and is active in concentration and frowning. It is a prime target for Botox procedures in the forehead to remove the lines between the eyes.

The nasalis muscle consists of two main parts: a transverse part called the compressor naris, and an alar part termed the dilator naris. The compressor naris muscle compresses the nostrils and may completely close them. The alar part, the dilator naris mainly consists of the dilator naris posterior, and a much smaller dilator naris anterior, and this muscle flares the nostrils. The dilator naris helps to form the upper ridge of the philtrum. The anterior, and the posterior dilator naris, (the alar part of the nasalis muscle), give support to the nasal valves.

The depressor septi muscle may sometimes be absent or rudimentary. The depressor septi pulls the columella, the septum, and the tip of the nose downwards. At the start of inspiration this muscle tenses the nasal septum and with the dilator naris widens the nostrils.

The levator labii superioris alaeque nasi, divides into a medial and a lateral slip. The medial slip blends into the perichondrium of the major alar cartilage and its overlying skin. The lateral slip blends at the side of the upper lip with the levator labii superioris, and with the orbicularis oris. The lateral slip raises the upper lip and deepens and increases the curve above the nasolabial furrow. The medial slip pulls the lateral crus upwards and modifies the curve of the furrow around the alae, and dilates the nostrils.



The paranasal sinuses

The paranasal sinuses are air-filled cavities in the frontal, ethmoid, maxilla, and sphenoid bones. They're lined with a mucosal membrane and have small openings into the nasal cavity:

- **Maxillary sinus:** This sinus is located in the body of the maxilla behind the cheek just above the roots of the premolar and molar teeth. It's shaped like a pyramid. It opens into the nasal cavity via the semilunar hiatus.
- **Frontal sinuses:** Found within the frontal bone, each of these sinuses is triangular in shape and runs above the medial end of the eyebrow and backward to the orbit. They open into the nasal cavity via the semilunar hiatus.
- **Sphenoid sinuses:** These sinuses are found in the sphenoid bone. Each opens into the sphenoethmoid recess.
- **Ethmoid sinuses:** The anterior, middle, and posterior ethmoid sinuses are located in the ethmoid bone between the nose and the eye. The anterior sinus opens into the nasal cavity by the infundibulum, the middle sinus opens into the ethmoidal bulla, and the posterior sinus opens into the superior meatus.

Nerves, blood vessels, and lymphatics of the nose

Nerve supply to the external nose is provided by the *infratrochlear and external nasal branches of the ophthalmic nerve and the infraorbital branch of the maxillary nerve*, both of which are part of the trigeminal nerve (CN V). The olfactory nerves (CN I) pass through the cribriform plate of the ethmoid bone. General sensory innervation of the nasal cavity and the paranasal sinuses is from the ophthalmic nerve (CN V1) and maxillary nerve (CN V2).

Blood is supplied to the external part of the nose by ***branches of the ophthalmic and maxillary arteries***. The skin of the ala and septum are supplied by the facial artery. Blood is brought to the walls of the nasal cavity and sinuses by branches of the maxillary artery. The most important is the sphenopalatine artery, which anastomoses with a branch of the superior labial artery. Venous blood is returned from the nasal cavity by veins that accompany the arteries.

Lymph from the nasal cavity drains into the ***submandibular lymph nodes*** and vessels that drain into the upper deep cervical lymph nodes.