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Course: Gross Anatomy of the Head and Neck

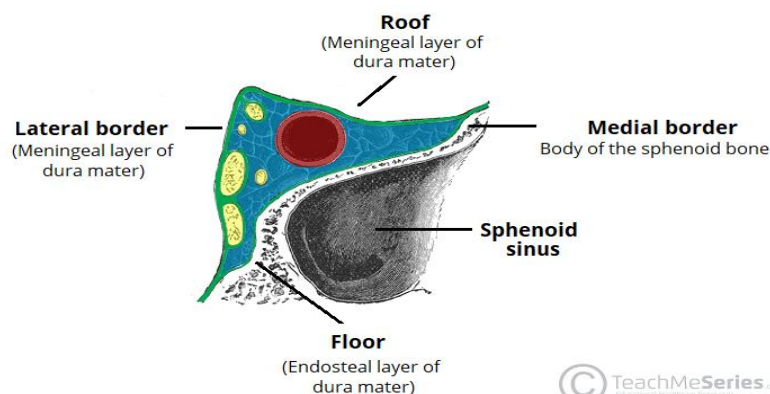
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Cavernous Sinus

The cavernous sinus is a paired dural venous sinus located within the middle cranial cavity. It lies on both sides of the sella turcicant and body of the sphenoid bone. They are about 1 cm wide. Unlike other dural venous sinuses, it is divided by septa into small cavities. They are enclosed by the endosteal and meningeal layers of the dura mater.

The borders of the cavernous sinus are as follows:

- **Anterior** – superior orbital fissure.
- **Posterior** – petrous part of the temporal bone.
- **Medial** – body of the sphenoid bone.
- **Lateral** – meningeal layer of the dura mater running from the roof to the floor of the middle cranial fossa.
- **Roof** – meningeal layer of the dura mater that attaches to the anterior and middle clinoid processes of the sphenoid bone.
- **Floor** – endosteal layer of dura mater that overlies the base of the greater wing of the sphenoid bone.



Content

Several important structures pass through the cavernous sinus to enter the orbit. They can be sub-classified by whether they travel through the sinus itself, or through its lateral wall:

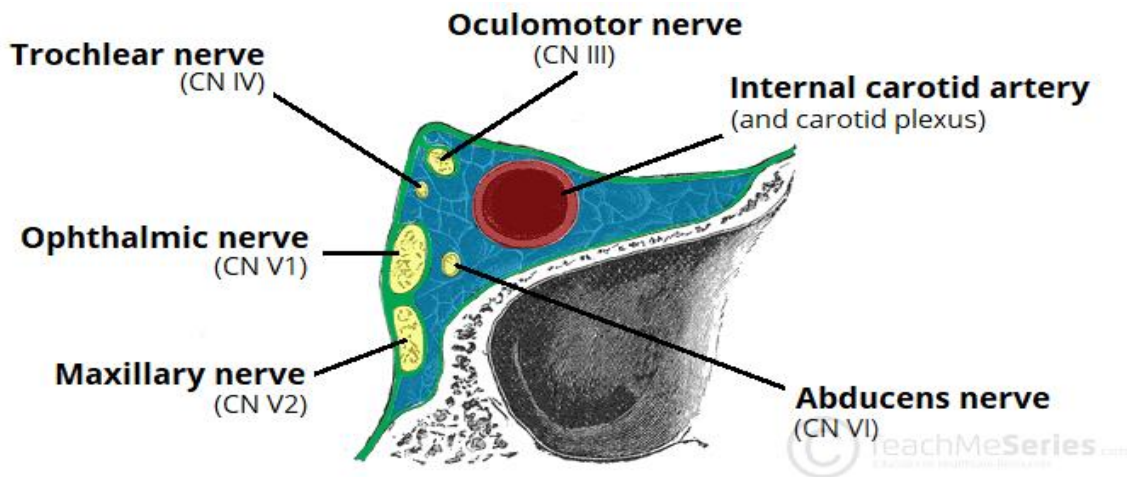
Travels through cavernous sinus:

- Abducens nerve (CN VI)
- Carotid plexus (post-ganglionic sympathetic nerve fibers)
- Internal carotid artery (cavernous portion)

Travels through lateral wall of cavernous sinus:

- Oculomotor nerve (CN III)
- Trochlear nerve (CN IV)
- Ophthalmic (V1) and maxillary (V2) branches of the trigeminal nerve

The cavernous sinus is the only site in the body where an artery (internal carotid) passes completely through a venous structure. This is thought to allow for heat exchange between the warm arterial blood and cooler venous circulation.



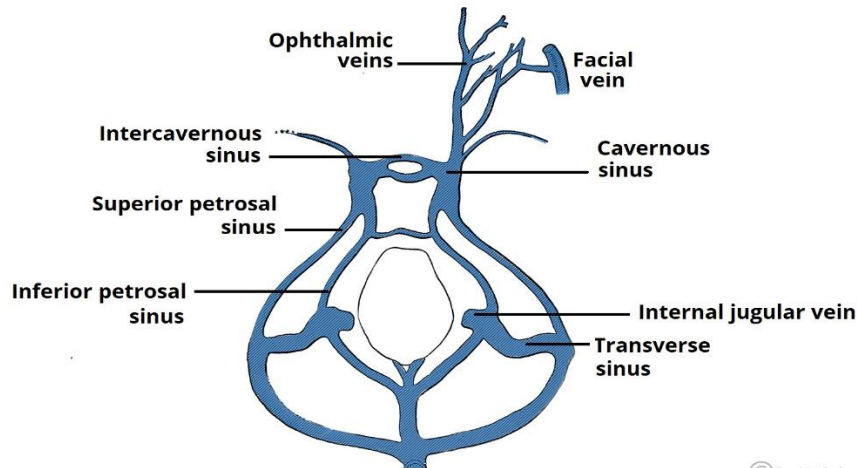
Communications of the Cavernous Sinus

The cavernous sinus is an unconventional venous system in the sense that it does not have a unidirectional flow of blood as seen in other veins. Owing to the fact that there are no valves in the sinus and its connected veins, the direction of blood flow is dependent on venous pressure. The veins that communicate with the cavernous sinus are:

- **Ophthalmic veins** (superior and inferior) – these enter the cavernous sinus via the superior orbital fissure.
- **Central vein of the retina** – drains into the superior ophthalmic vein, or directly into the cavernous sinus.
- **Sphenoparietal sinus** – empties into the anterior aspect of the cavernous sinus.
- **Superficial middle cerebral vein** – contributes to the venous drainage of the cerebrum

- **Pterygoid plexus** – located within the infratemporal fossa.

Superior ophthalmic vein forms an anastomosis with the facial vein. Therefore, the ophthalmic veins represent a potential route by which infection can spread from an extracranial to an intracranial site. The cavernous sinuses empty into the superior and inferior petrosal sinuses, and ultimately, into the internal jugular vein. The left and right cavernous sinuses are connected in the midline by the anterior and posterior intercavernous sinuses.



Clinical Anatomy

1. **Cavernous Sinus Thrombosis (CST)**: cavernous sinus thrombosis refers to the formation of a clot within the cavernous sinus. The most common cause of CST is infection. Infection usually spread from extracranial locations such as the orbit, paranasal sinuses to the cavernous sinus. This is possible because the superior ophthalmic vein anastomoses with the facial vein. Common clinical features include headache, cranial nerve palsies, and proptosis (eye bulging). Treatment is typically with antibiotic therapy. When the cause is infection, CST can rapidly progress to meningitis.
2. **Carotid-cavernous fistula**: Head trauma resulting in rupture of the cavernous part of the internal carotid artery can produce carotid-cavernous fistula. Protrusion and pulsation of the eyeball (pulsating exophthalmos) can result as the venous pressure in the sinus would increase and reverse the flow of blood in the ophthalmic veins.

Walls of the Nose

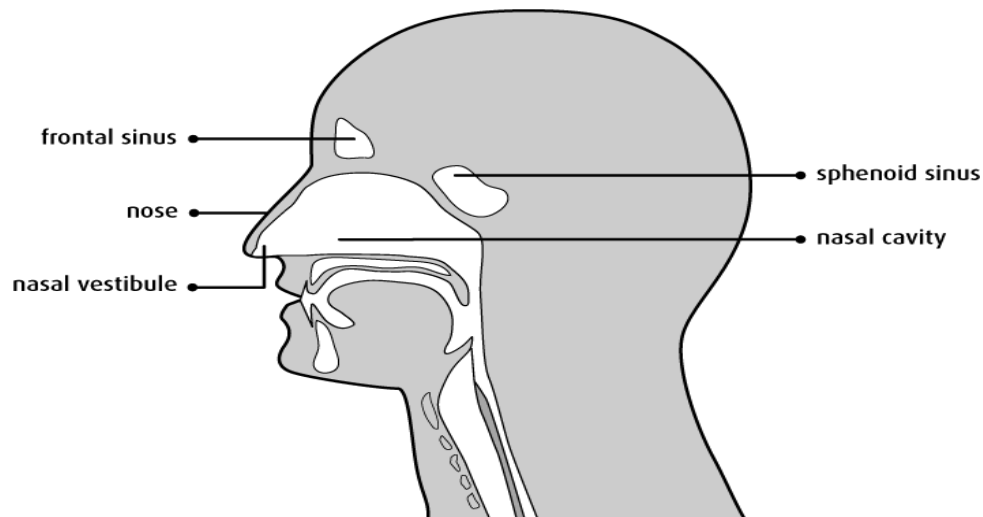
The nose is the most protruding part of the face. It bears the nostrils and is the first organ of the respiratory system. It also contains the peripheral organ of smell. The nose is divided into two;

- External nose (visible portion that protrude from the face)
- Nasal cavity

Nasal Cavity

The nasal cavity is a large air-filled space above and behind the external nose. The nasal septum divides this cavity into two cavities. Each cavity is a continuation of one of the two nostrils. Posteriorly, these cavities communicate with the nasopharynx through two apertures called choanae.

The Nose and Nasal Cavity



Boundaries of the Nasal Cavities

Each cavity has

1. Roof
2. Floor
3. Medial wall
4. Lateral wall

Roof: The roof of the nasal cavity is formed by nasal cartilages and several bones chiefly the nasal and frontal bones, cribriform plate of the ethmoid bone and the body of the sphenoid bone.

Floor: The floor is wider than the roof and it is formed by the palatine process of the maxilla and the lateral plates of the palatine bone.

Medial wall: This is formed by the nasal septum. The nasal septum is formed by cartilage, vomer bone and the perpendicular plate of the ethmoid bone.

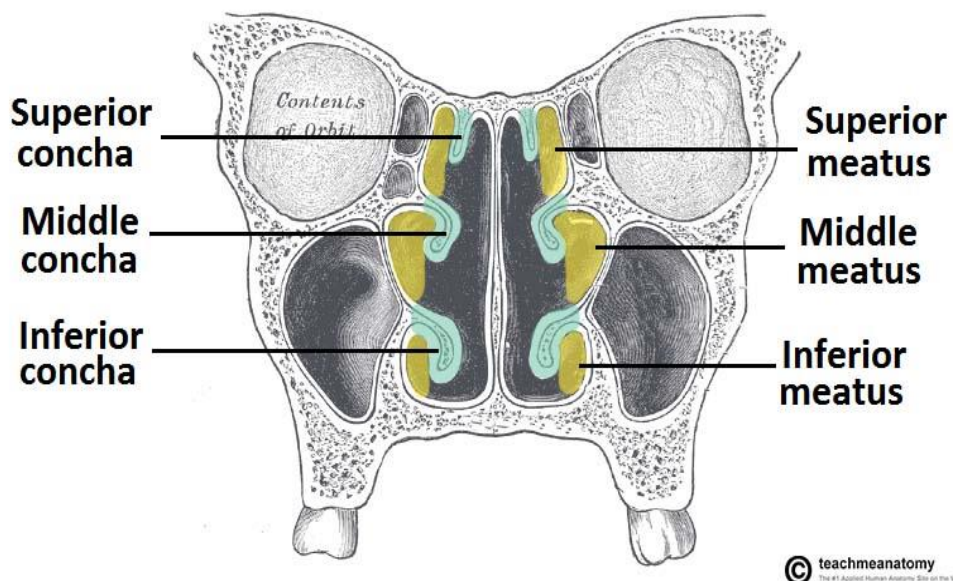
Lateral Wall

The lateral wall of the nasal cavity is characterized by ridges known as nasal conchae (turbinate). It is the region of the nasal cavity that is essential for humidifying and filtering the air that breath in. There are three nasal conchae

- Superior nasal conchae
- Middle nasal conchae
- Inferior nasal conchae

The Superior and Middle nasal conchae arise from the perpendicular plate of the ethmoid bone. The mucosa around the superior nasal conchae forms the olfactory epithelium. While the inferior nasal conchae are formed as independent bones. It is the longest and hardest. These conchae project into the nasal cavity creating four pathways for air to flow. These pathways are called meatus. They include

- **Inferior meatus** – between the inferior concha and floor of the nasal cavity.
- **Middle meatus** – between the inferior and middle concha.
- **Superior meatus** – between the middle and superior concha.
- **Spheno-ethmoidal recess** – superiorly and posteriorly to the superior concha.

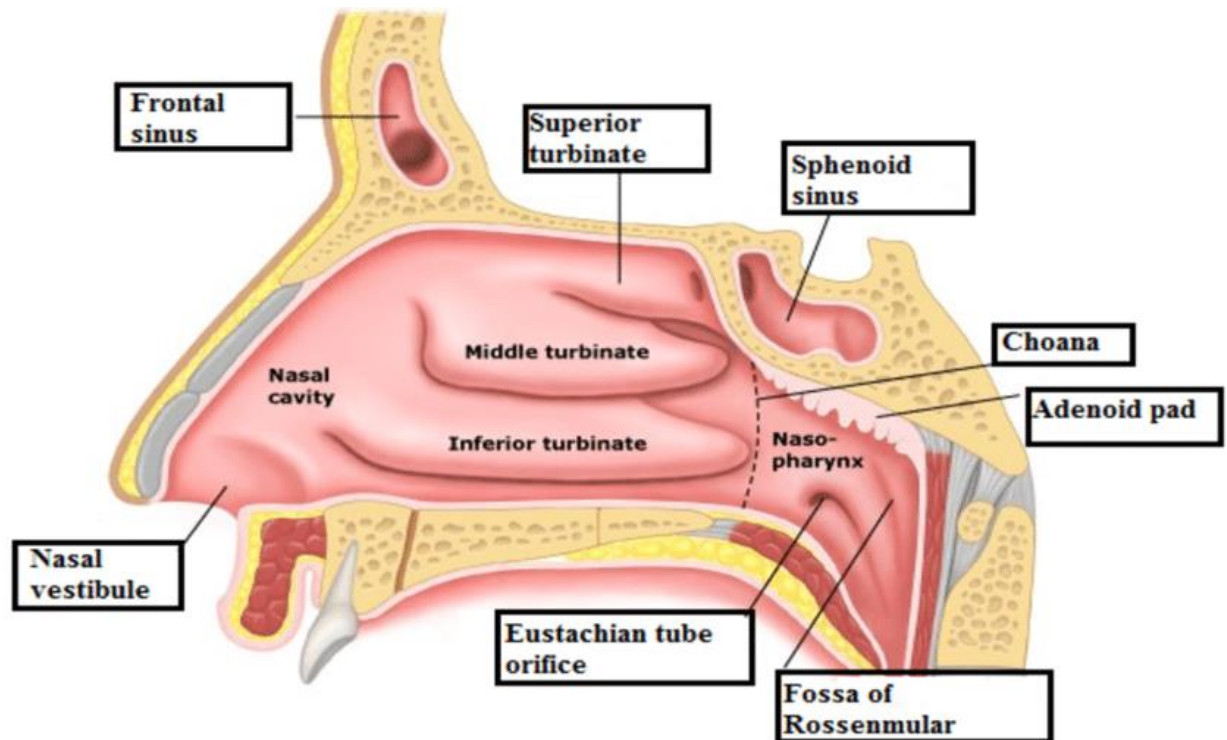


Openings on the Lateral Wall

One of the functions of the nose is to drain a variety of structures. Thus, there are many openings into the nasal cavity, by which drainage occurs. The **paranasal sinuses** drain into the nasal cavity. The frontal,

maxillary and anterior ethmoidal sinuses open into the middle meatus. The location of this opening is marked by the **hiatus semilunaris**, a crescent-shaped groove on the lateral walls of the nasal cavity. The middle ethmoidal sinuses empty out onto a structure called the **ethmoidal bulla**. This is a bulge in the lateral wall formed by the middle ethmoidal sinus itself. The posterior ethmoidal sinuses open out at the level of the superior meatus. The only sinus that does not drain into the lateral walls of the nasal cavity is the sphenoid sinus. It drains onto the posterior roof. In addition to the paranasal sinuses, other structures open into the nasal cavity:

- **Nasolacrimal duct** – acts to drain tears from the eye. It opens into the inferior meatus.
- **Auditory (Eustachian) tube** – opens into the nasopharynx at the level of the inferior meatus. It allows the middle ear to equalize with the atmospheric air pressure.



Vasculature of the Nasal Cavity

The nose has a very rich vascular supply. This allows it to effectively change humidity and temperature of inspired air. The nose receives blood from both the internal and external carotid arteries:

Internal carotid branches:

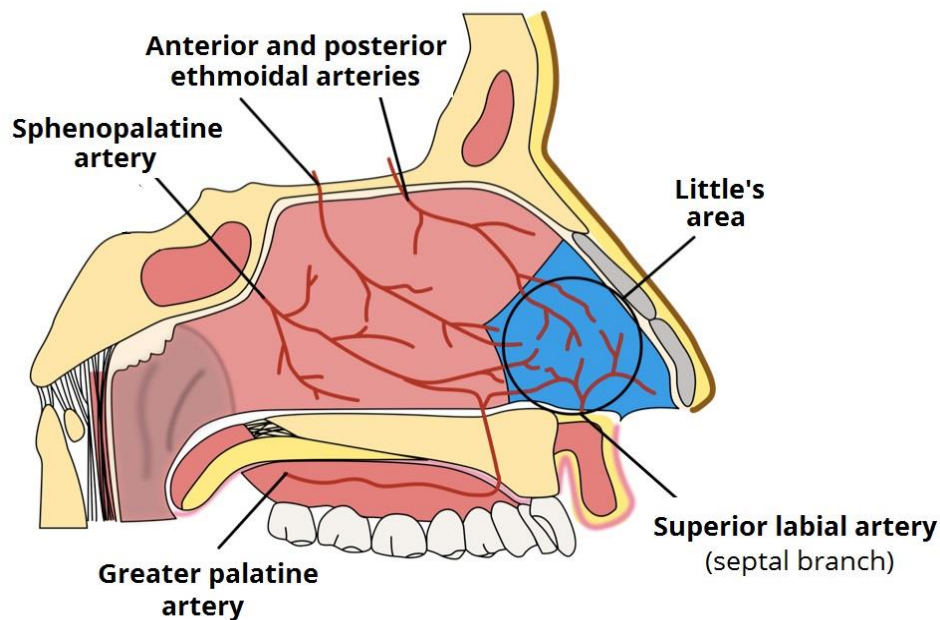
- Anterior ethmoidal artery
- Posterior ethmoidal artery

The ethmoidal arteries are branch of the **ophthalmic** artery. They descend into the nasal cavity through the cribriform plate

External carotid branches:

- Sphenopalatine artery
- Greater palatine artery
- Superior labial artery
- Lateral nasal arteries

In addition to the rich blood supply, these arteries form anastomoses with each other. This is particularly prevalent in the anterior portion of the nose. The veins of the nose tend to follow the arteries. They drain into the pterygoid plexus, facial vein or cavernous sinus. In some individuals, a few nasal veins join with the **sagittal sinus** (a dural venous sinus). This represents a potential pathway by which infection can spread from the nose into the cranial cavity.



Innervation

The innervation of the nose can be functionally divided into **special** and **general** innervation. Special sensory innervation refers to the ability of the nose to smell. This is carried out by the **olfactory nerves**. The olfactory bulb, part of the brain, lies on the superior surface of the cribriform plate, above the nasal cavity. Branches of the olfactory nerve run through the cribriform plate to provide special sensory innervation to the nose. General sensory innervation to the septum and lateral walls is delivered by the **nasopalatine nerve** (branch of maxillary nerve) and the **nasociliary nerve** (branch of the ophthalmic nerve). Innervation to the external skin of the nose is supplied by the **trigeminal nerve**.

Clinical Anatomy

1. **Epistaxis**: epistaxis is the medical term for a nosebleed. Due to the rich supply of the nose, this is a common occurrence. It can be divided into two categories; anterior and posterior nosebleed depending on the site the bleeding originates. An anterior nose bleed occurs from damage to the capillaries and small blood vessels in the front area of the nose. It is the most common type

of nose bleed. Posterior nose bleed occurs from much larger arteries deep in the nose. Damage to the sphenopalatine artery is the most common cause of a posterior nosebleed. The cause could be local or systemic.

2. Cribriform plate fracture: A fracture of the cribriform plate can occur as a result of nose trauma. It is either fractured directly by trauma or by fragments of the ethmoid bone. A fractured cribriform plate can penetrate the meningeal linings of the brain, causing leakage of cerebro-spinal fluid. Exposing the brain to the outside environment like this increases the risks of meningitis. The olfactory bulb lies on the cribriform plate and can be damaged irreversibly by the fracture. In this case the patient may present with anosmia (loss of smell).