NNANNA NANCY CHINEMEREM

17/MHS01/203

MEDICINE & SURGERY

1. **CAVERNOUS SINUS:**



The **cavernous sinus** is a paired dural venous sinus located within the cranial cavity. It is divided by septa into small ‘caves’ – from which it gets its name.

Each cavernous sinus has a close anatomical relationship with several**key structures** in the head, and is arguably the most clinically important venous sinus.

*The dural venous sinuses are channels between the two layers of dura mater which are responsible for the venous drainage of the brain, skull, orbit and internal ear.*

**Anatomical Location and Borders**

The cavernous sinuses are located within the middle cranial fossa, on either side of the **sella turcica**of the sphenoid bone (which contains the pituitary gland). 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.

**Contents**

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

|  |  |
| --- | --- |
| **Travels through cavernous sinus:** | **Travels through lateral wall of cavernous sinus:** |
| * Abducens nerve (CN VI)
* Carotid plexus (post-ganglionic sympathetic nerve fibres)
* Internal carotid artery (cavernous portion)
 | * 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.

*inferior, and CAT (internal carotid artery, abducens nerve, trochlear nerve) refers to the horizontal contents, from medial to lateral.*

**Dural Venous Sinus System**

Each cavernous sinus receives venous drainage from:

* **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.

It is important to note that the 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**. They travel through the sella turcica of the sphenoid bone.

**Function**

* + Facilitate heat exchange from the between arterial and venous blood as they transverse each other.

**Clinical Application**

* + ***Cavernous Sinus Thrombosis*:**
		- The veins of the face drain blood into the cavernous sinus via the superior ophthalmic vein.  As such, infections of the face (particularly those involving the "danger triangle" (orbits, nasal sinuses, and superior part of the face) can cause a cavernous sinus thrombosis.
			* Staphylococcus aureus is seen in up to 70% of patients with this complication
			* Other bacteria include: Streptococcus, H. influenza
		- Patients presenting with cavernous sinus thrombosis will usually complain of a headache, a cranial nerve deficit involving CN III, IV, V1, V2, and/or VI, and unilateral eye swelling that progresses to bilateral eye swelling
		- ***Complications*:**
			* Septic thrombosis of this area can also cause acute meningitis.
			* Fairly rapid changes in mental status (confusion and fatigue)
			* Death
		- ***Work-Up*:**
			* Labs: CBC, +/- D-dimer (possibly helpful), +/- CSF
			* Imaging: Noncontrast CT head or MRI with MR venogram (MRV)
		- ***Treatment*:**
			* Empiric antibiotics to include:
				+ Vancomycin 15 mg/kg IV every 12 hours + ceftriaxone 2 g IV every 12 hours
				+ If source is dental, add on metronidazole
				+ Treatment duration is influenced by underlying cause and organism
			* Heparin or low-molecular weight heparin at full doses (note: limited data but may be helpful).
1. Discuss the walls of the nose

**WALLS OF THE NOSE**

 **The Nose**, the prominent structure between the eyes that serves as the entrance to the [respiratory tract](https://www.britannica.com/science/respiratory-system) and contains the olfactory organ. It provides air for [respiration](https://www.britannica.com/science/human-respiratory-system), serves the sense of [smell](https://www.britannica.com/science/smell), conditions the air by filtering, warming, and moistening it, and Scleans itself of foreign debris extracted from inhalations.

The nose has two cavities, separated from one another by a wall of [cartilage](https://www.britannica.com/science/cartilage) called the septum. The external openings are known as nares or nostrils. The roof of the [mouth](https://www.britannica.com/science/mouth-anatomy) and the floor of the nose are formed by the palatine [bone](https://www.britannica.com/science/bone-anatomy), the mouth part of which is commonly called the hard [palate](https://www.britannica.com/science/palate); a flap of [tissue](https://www.britannica.com/science/tissue), the [soft palate](https://www.britannica.com/science/soft-palate), extends back into the [nasopharynx](https://www.britannica.com/science/nasopharynx), the nasal portion of the [throat](https://www.britannica.com/science/pharynx), and during swallowing is pressed upward, thus closing off the nasopharynx so that food is not lodged in the back of the nose.

The shape of the [nasal cavity](https://www.britannica.com/science/nasal-cavity) is complex. The forward section, within and above each nostril, is called the [vestibule](https://www.britannica.com/science/vestibule-of-the-nose). Behind the vestibule and along each outer wall are three elevations, running generally from front to rear. Each elevation, called a [nasal concha](https://www.britannica.com/science/nasal-concha) or turbinate, hangs over an air passage. Beside and above the uppermost concha is the olfactory region of the nasal cavity. The rest of the cavity is the respiratory portion. The respiratory area is lined with a moist [mucous membrane](https://www.britannica.com/science/mucous-membrane) with fine hairlike projections known as [cilia](https://www.britannica.com/science/cilium), which serve to collect debris. [Mucus](https://www.britannica.com/science/mucus) from cells in the membrane wall also helps to trap particles of dust, carbon, soot, and bacteria. [Sinus](https://www.britannica.com/science/sinus) cavities are located in the bony [skull](https://www.britannica.com/science/skull) on both sides of the nose.

In the olfactory (smelling) portion of the nose, most of the lining is mucous membrane. A small segment of the lining contains the [nerve](https://www.britannica.com/science/nerve-anatomy) cells that are the actual sensory organs. Fibres, called [dendrites](https://www.britannica.com/science/dendrite-neuron), which project from the nerve cells into the nasal cavity, are covered only by a thin layer of moisture. The moisture dissolves microscopic particles that the air has carried into the nose from odour-emitting substances, and the particles dissolved in the [fluid](https://www.britannica.com/science/fluid-biology) stimulate the olfactory nerve cells chemically.

**Divisions:**

The nasal cavity is the most superior part of the **respiratory tract**. It extends from the vestibule of the nose to the nasopharynx, and has three divisions:

* **Vestibule** – the area surrounding the anterior external opening to the nasal cavity.
* **Respiratory** **region** – lined by a ciliated psudeostratified epithelium, interspersed with mucus-secreting goblet cells.
* **Olfactory region** – located at the apex of the nasal cavity. It is lined by olfactory cells with olfactory receptors.

**Nasal Conchae**

Projecting out of the lateral walls of the nasal cavity are curved shelves of bone. They are called **conchae** (or turbinates). The are three conchae – inferior, middle and superior.

They **project** into the nasal cavity, creating four pathways for the air to flow. These pathways are called meatuses:

* **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.

The function of the conchae is to increase the **surface area** of the nasal cavity – this increases the amount of inspired air that can come into contact with the cavity walls. They also disrupt the fast, laminar flow of the air, making it slow and turbulent. The air spends longer in the nasal cavity, so that it can be humidified.

**Openings into the Nasal Cavity**

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 semilunar hiatus, 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 structure not to empty out onto 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 equalise with the atmospheric air pressure.

**Gateways to the Nasal Cavity**

As well as openings for the drainage of structures, nerves, vasculature and lymphatics need to be able to access the nasal cavity.

The **cribriform plate** is part of the ethmoid bone. It forms a portion of the roof of the nasal cavity. It contains very small perforations, allowing fibres of the olfactory nerve to enter and exit,

At the level of the superior meatus, the **sphenopalatine foramen** is located. This hole allows communication between the nasal cavity and the **pterygopalatine fossa**. The sphenopalatine artery, nasopalatine and superior nasal nerves pass through here.

The**incisive canal** is a pathway between the nasal cavity and the incisive fossa of the oral cavity. It transmits the nasopalatine nerve and greater palatine artery.

**Vasculature**

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 revelance:**

**cribiform plate fracture:**  A fracture of the cribiform 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 cribiform plate can penetrate the mesangial lining of the brain, occurring leakage of cerebrospinal fluid. Exposing the brain to theoutside environment like this increases the risks of meningitis encephalitis and cerebral abscesses. The olfactory bulb lies on the cribiform plate and can be damaged irreversibly by the fracture. In this case , the patient may be present with anosmia ( loss of smell).

**Epistaxis:**

Epistaxis is the medical term for nose bleed. Due to the rich blood supply of the nose, this a common occurrence. It is most likely to occur in the anterior third of the nasal cavity- this area is known as kiessselbarch area.

This cause can be local (such as trauma ) or systemic (such as hypertension.)

**Clinical Relevance: Epistaxis**

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