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**Matric No: 17/MHS01/135**

**Level: MBBS 300**

**Essay on the cavernous sinus**

**INTRODUCTION**

The cavernous sinus is part of the brain’s dural venous sinus and contains multiple neuro-vasculatures. It is situated bilaterally to the sella turcica and extends from the superior orbital fissure anteriorly to the petrous part of the temporal bone posteriorly, and is about 1 cm wide and 2 cm long. The venous blood that flows to the cavernous sinus is from the superior and anterior ophthalmic veins, superficial middle cerebral vein, and spheno-parietal sinus. The communication between the left and right cavernous sinuses is made by the inter-cavernous sinuses anterior and posterior to the infundibulum of the pituitary gland.

**STRUCTURE AND FUNCTION**

The cavernous sinus works as a conduit. Cranial nerves leaving the brainstem travel through the cavernous sinus before entering the orbit to innervate extraocular and intrinsic eye muscles. Also, different venous tributaries drain into the cavernous sinus. The superior ophthalmic vein collects venous blood from the ethmoidal, vorticose, central retinal, and nasofrontal veins before draining into the anterior part of the cavernous sinus through the superior orbital fissure. The inferior ophthalmic vein, on the other hand, receives blood from the lacrimal sac, eyelids, the inferior rectus and inferior oblique muscles, the vorticose vein, and from the anterior and medial wall of the orbit. It then runs posteriorly toward the lower part of the orbit and divides into two branches. One of these branches joins the cavernous sinus, while the other one drains into the pterygoid plexus. The superficial middle cerebral originates on the lateral surface of the hemisphere, runs in the lateral sulcus, and drains most of the temporal lobe into the cavernous sinus. The sphenoparietal sinus receives blood from some branches of the middle meningeal vein before draining into the cavernous sinus. It is noteworthy to mention that efferent hypophyseal veins also drain into the cavernous sinus. After collecting venous blood from these different veins, the cavernous sinus drains to the superior and inferior petrosal sinuses, which then join the sigmoid sinus to form the internal jugular vein. The internal jugular vein exits the brain through the jugular foramen and connects with the subclavian vein to become the right or left brachiocephalic vein.

**BLOOD SUPPLY AND LYMPHATICS**

The common carotid artery bifurcates in the cervical region and gives rise to the external and internal carotid artery. The internal carotid artery travels superiorly and enters the skull via the carotid canal. After entering the carotid canal, the internal carotid makes a 90-degree turn and travels horizontally in the petrous part of the temporal bone - this is the petrous part of the internal carotid artery. The petrous part of the internal carotid then enters the cavernous sinus via the foramen lacerum. In the cavernous sinus, the internal carotid artery is also referred to as the cavernous part. The cavernous part travels horizontally and anteriorly until it reaches the anterior limit of the sinus, where it curves vertically, exits the sinus superiorly, and becomes the cerebral part of the internal carotid artery. It is important to mention that the cavernous part of the internal carotid artery is the only artery in the body that is surrounded completely by venous blood.

**NERVES OF THE CAVERNOUS SINUS**

The nerves of the cavernous sinus are the occulomotor nerve (CN III), trochlear nerve (CN IV), ophthalmic nerve (V1), maxillary nerve (V2), abducens nerve (CN VI), and the sympathetic plexus around the internal carotid artery.The sympathetic plexus around the internal carotid artery originates from the superior cervical ganglion, travels with the internal carotid artery, enters the skull through the carotid canal, and enters the cavernous sinus through the jugular foramen. Within the cavernous sinus, it gives sympathetic fibers to the CN III and V1.

**SURGICAL CONSIDERATIONS**

Performing surgery in the cavernous sinus is challenging given the fact that it contains vital neuronal structures and elevated risk of hemorrhage. Direct exposure of the cavernous sinus is possible, but it is considered to be a morbid procedure, even for experienced neurosurgeons. However, other approaches such as a transorbital pathway may provide found to be less morbid. The transorbital pathway provides less-invasive access to the cavernous sinus. This approach provides the entire lateral wall of the cavernous sinus to be exposed, without entering its neurovascular compartment, while also providing a favorable angle for performing procedures.

**CLINICAL CORRELATE**

**Cavernous Sinus Syndrome**

Cavernous sinus syndrome is a medical emergency and life-threatening disorder that presents with different symptoms depending on what structure is affected. A severe lesion involving the entire sinus will present with total ophthalmoplegia, due to CN III, IV, and VI injury, accompanied with fixed and dilated pupils due to compression of the superficial parasympathetic fibers of the CN III. Cavernous sinus syndrome can lead to Horner’s syndrome. Horner’s syndrome occurs when the sympathetic plexus around the internal carotid is damaged. When CN V1 and CN V2 are involved, sensory loss in the face, scalp, maxilla, nasal cavity, sinuses, and palate occurs. There are several causes of cavernous sinus syndrome, including metastatic tumor, meningioma, pituitary tumor, extension of nasopharyngeal tumors, granulomatous diseases, cavernous sinus thrombosis, and aneurysms of the cavernous part of the internal carotid artery. In case of rupture of a cavernous aneurysm, a carotid-cavernous fistula is created, leading to a pulsating exophthalmos on physical examination.

**Facial veins and implication to cavernous sinus infection**

Blood from the medial angle of the eye, lips, and nose usually drain via the facial vein. However, blood from these parts may also drain superiorly through the facial vein, to the superior ophthalmic, to the cavernous sinus. By doing so, it provides a pathway for infections from the face to spread to the cavernous sinus and from the sinus to the brain.

Another way for infections to spread from the face to the brain is via the inferior ophthalmic vein. In fact, the inferior ophthalmic vein communicates with the pterygoid plexus of veins, and the pterygoid plexus communicates with the cavernous sinus via the emissary's vein. Gravity dictates the blood flow from the cavernous sinus to the pterygoid plexus; however, in the case of inflammation or obstruction, the pressure gradient can be reversed. Because there are no valves in the brain’s venous sinus, blood will flow from the pterygoid plexus to the cavernous sinus carrying bacteria with it.

**DISCUSS THE WALLS OF THE NOSE**

The nasal cavity is made up of a floor, a roof, a medial wall and a lateral wall.

1. **The floor.**

This is composed of:

* The palatine process of the maxilla making up the anterior 3/4th.
* The horizontal process of the palatine bone making up the posterior 1/4th.
1. **The roof.**

This is composed of:

* An anterior slope made up of the nasal bone.
* A posterior slope made up of the body of sphenoid.
* A middle horizontal bone made up of cribiform plate of the ethmoid bone through which the olfactory nerve pass through.
1. **The medial wall**

The medial wall is made up cartilage and the septum proper.

The septum proper is made up of:

* Septal cartilage
* The perpendicular plate of the ethmoidpostero-superiorly
* The vomer posterior-inferiorly

These articulate with the following bones to complete the septum.

* Superiorly: the nasal bone, frontal bone and rostum of the sphenoid.
* Inferiorly: with the nasal crest of the maxilla, the anterior nasal spine of the maxilla and the palatine bone.
1. **The lateral wall.**

It is made up of:

* Medial part of maxilla.
* Ethmoid bone.
* Nasal bone.
* Ascending part of the maxilla.
* Inferior nasal conchae.
* Medial pterygoid plate.
* Perpendicular plate of the palatine bone.

The lateral wall has projections called concha: they are long and narrow curled protections that protrudes into the breathing passage of the nose to interrupt air flow in order to increase its contact with the blood vessels that line the nasal cavity.

The conchae;

* The superior conchae: part of the ethmoid.
* The middle conchae: part of the ethmoid.
* The inferior conchae: a separate bone.
* And sometimes the presence of a fourth conchae called the concha suprema.

Below and lateral to each conchae Is a corresponding meatus;

* The inferior meatus: the nasolacrimal duct opens into its anterior part.
* The middle meatus: the frontal, maxillary and anterior ethmoidal sinus open into it. It makes up the bulla ethmoidalis, the hiatus semilunaris and the infundibulum.
* The superior meatus: the posterior ethmoidal sinus opens into it.
* The sphenoethmoidal recess: this is a triangular fossa that lies above the superior meatus. The Sphenoidal sinus opens into it.