

OTUONYE GIFT CHARLES

17/MHS01/277

ANA 301

QUESTION 1: WRITE AN ESSAY ON THE CARVENOUS SINUS

QUESTION 2: DISCUSS THE WALLS OF THE NOSE

QUESTION 1

The cavernous sinuses are 1 cm wide cavities that extend a distance of 2 cm from the most posterior aspect of the orbit to the petrous part of the temporal bone; they are bilaterally paired collections of venous plexuses that sit on either side of the sphenoid bone. Although they are not truly trabeculated cavities like the corpora cavernosa of the penis, the numerous plexuses, however, give the cavities their characteristic sponge-like appearance. The cavernous sinus is roofed by an inner layer of dura mater that continues with the diaphragma sellae that covers the superior part of the pituitary gland. The roof of the sinus also has several other attachments. Anteriorly, it attaches to the anterior and middle clinoid processes, posteriorly it attaches to the tentorium (at its attachment to the posterior clinoid process). Part of the periosteum of the greater wing of the sphenoid bone forms the floor of the sinus. The body of the sphenoid acts as the medial wall of the sinus while the lateral wall is formed from the visceral part of the dura mater.

The cavernous sinus contains the internal carotid artery and several cranial nerves. Abducens nerve (CN VI) traverses the sinus lateral to the internal carotid artery. The remainder of the cranial nerves passes through the lateral wall of the carotid sinus, and from superior to inferior they are:

- Oculomotor nerve (CN III)
- Trochlear nerve (CN IV)
- Trigeminal nerve (CN V) - ophthalmic and maxillary divisions.

The contents of the cavernous sinus are the Oculomotor nerve (III), Internal Carotid artery, Ophthalmic nerve (V1), Abducens nerve (VI), Trochlear nerve (IV).

Internal carotid artery

In addition to the thin walled veins that traverse the cavernous sinus, a lone arterial vessel also uses the area as a conduit. The internal carotid artery (a branch of the common carotid artery) – along with its postganglionic sympathetic plexus from the superior cervical ganglion – gains access to the cavernous sinus posteriorly. As the petrous part of the internal carotid artery leaves the carotid canal, it curves vertically and superiorly above foramen lacerum to enter the cavernous sinus. Here the artery is also referred to as the cavernous part.

Within the sinus, the internal carotid artery travels anteriorly, in a horizontal manner until it reaches the anterior limit of the sinus. Here it curves vertically and superiorly to exit the sinus through its roof and

become the cerebral part of the internal carotid artery. It is noteworthy that the cavernous part of the internal carotid artery is the only arterial vessel that is completely surrounded by venous networks.

Abducent nerve

This motor nerve leaves the pons and gains access through the posterior part of the sinus after passing of the apical portion of the petrous temporal bone. It has also been known to access the cavernous sinus by way of the petrosal sinus, adjacent to the clivus. Within the cavernous sinus, it takes an inferolateral course, relative to the internal carotid artery. It exits the sinus by way of the superior orbital fissure to gain access to the orbit, where it innervates the lateral rectus muscle of the eyeball.

Oculomotor nerve

The other nerves travelling through the cavernous sinus do so between the endothelial lining and the dura mater of its lateral wall. The most superior of the four nerves in the lateral wall is the oculomotor nerve (CN III). At the posterior aspect of the roof of the cavernous sinus, the free and attached edges of tentorium cerebelli forms a space through which CN III enters the lateral wall of the sinus. It takes an anterior, inferomedial course (relative to the other nerves in the lateral wall) towards the anterior extremity of the sinus. Here it bifurcates into its superior and inferior rami that pass through the superior orbital fissure. Along with sympathetic fibers from the internal carotid plexus, CN III provides motor supply to inferior oblique, levator palpebrae superioris, and the inferior, medial and superior recti muscles.

Trochlear nerve

The smallest of the cranial nerves, the trochlear nerve (CN IV), enters the posterior aspect of the cavernous sinus after leaving the posterior part of the brainstem and decussating with the same nerve from the opposite side. It continues anteriorly in the lateral wall of the cavernous sinus, inferior to CN III and passes through the superior orbital fissure at the anterior aspect of the sinus. Once in the orbit, CN IV has the responsibility of innervating the muscles of the eyeball that are responsible for inferolateral motions.

Trigeminal nerve

Two of the three branches of the trigeminal nerve (CN V) pass through the cavernous sinus. Prior to entering the cavernous sinus, the proximal portion of the nerve lies in Meckel's cave, where it forms the trigeminal ganglion. After leaving the cave, the mandibular division (CN V3) courses inferiorly to pass through foramen ovale (without entering the cavernous sinus). The other two branches, the ophthalmic and the maxillary (CN V1 and CN V2, respectively), travel through the lateral wall of the sinus. Both take courses inferior to CN III and CN IV, however, CN V2 is the most inferior of them all. Both CN V branches in the sinus travel horizontally. CN V2 leaves the sinus via foramen rotundum, while the three branches of CN V1 exit the cranial fossa via the superior orbital fissure. CN V1 and CN V2 are purely sensory and supply specific regions of the face.

The cavernous sinus is an unconventional venous system in the sense that it does not have a unidirectional flow of blood. 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:

- Superior ophthalmic vein
- Inferior ophthalmic vein
- Superficial middle cerebral vein
- Middle meningeal vein
- Hypophyseal veins

Superior ophthalmic vein

The cavernous sinus generally has five venous tributaries. The superior ophthalmic vein receives blood from the ethmoidal, nasofrontal, vorticose (drains the ocular choroid), and central retinal veins. It drains into the anterior part of the sinus via the superior orbital fissure.

Inferior ophthalmic vein

The inferior ophthalmic vein collects blood from the eyelids, lacrimal sac, and some vorticose contributions, as well as the anterior floor and medial wall of the orbit. In addition to draining to the cavernous sinus, it also drains to the pterygoid plexus.

Superficial middle cerebral vein

At the point where the internal carotid artery emerges, the superficial middle cerebral vein pierces the roof of the sinus. Here, it drains blood from the cortices that are adjacent to it as it courses through the lateral sulcus.

Middle meningeal vein

Branches of the middle meningeal vein may join the sphenoparietal sinus on its way to the cavernous sinus. Before piercing the roof of the sinus, it travels along the edge of the lesser wing of the sphenoid between the layers of dura mater.

Hypophyseal veins

Efferent hypophyseal veins of both the adenohypophysis and neurohypophysis drain to the cavernous sinus.

Intercavernous sinuses and drainage

The left and right cavernous sinuses communicate by way of the anterior and posterior intercavernous sinuses. These vessels travel anteriorly and posteriorly (respectively) around the infundibulum of the pituitary gland, deep to the diaphragma sellae, between the layers of dura mater. The cavernous sinus in

turn drains to the superior and inferior petrosal sinuses. Both sinuses join the sigmoid sinus, which then becomes the internal jugular vein. The internal jugular vein meets with the subclavian vein to become the left (or right) brachiocephalic vein.

Clinical Significance

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.

Carotid-cavernous fistula

Head trauma resulting in rupture of the cavernous part of the internal carotid artery can produce what is known as a carotid-cavernous fistula. A pulsating exophthalmos can result as the venous pressure in the sinus would increase and reverse the flow of blood in the ophthalmic veins.

QUESTION 2

The nasal cavity is the most cephalic part of the respiratory tract. It communicates with the external environment via the anterior apertures, nares, and the nasopharynx via the posterior apertures, choanae. This cavity is divided into two separate cavities by the septum and kept patent by a bone and cartilaginous framework. Each cavity consists of a roof, floor, medial wall, and lateral wall. Within each cavity are three regions; nasal vestibule, respiratory region, and olfactory region.

Medial wall (nasal septum)

The nasal septum partitions the nasal cavity into two equal but separate compartments. Cartilage and bone comprise the nasal septum. It is covered by squamous epithelium, which differs from the lateral walls of the nasal cavity. A portion of the anterior septum is covered in erectile tissue. It also contributes to lateral projections called the upper lateral cartilages, which makes up the middle third of the nose. The bony segment of the septum is pneumatized, and when it over expands, it has the potential to obstruct airflow. Below are the components of the septum.

Quadrangular (septal) cartilage: This is the most anterior portion of the septum. It contains the Kiesselbach plexus

Attachments:

- Superior: nasal bone
- Inferior: anterior nasal spine of the maxilla
- Posterior-Superior: perpendicular plate of the ethmoid
- Posterior-Inferior: vomer and maxillary crest

Perpendicular Plate of the Ethmoid: This is a vertical projection from the cribriform plate of the ethmoid inferiorly to the septal cartilage.

Vomer: Located inferior and slightly posterior to the perpendicular plate of the ethmoid. It is attached inferiorly to the nasal crest of the maxilla and palatine bone.

Nasal Crest of the Maxilla and Palatine Bone: Together these bones form the inferior support for the septal cartilage.

Anterior Nasal Spine of the Maxilla: This is a bony projection formed by the paired maxillary bones. It is located anterior to the piriform aperture and is palpable at the superior portion of the philtrum of the upper lip.

Lateral Wall of the Nasal Cavity

The nasal cavity's lateral wall has three medially projecting inferiorly curved bones called conchae. The middle and superior conchae are part of the ethmoid bone, whereas the inferior concha is a separate bone altogether. There is a normal variant called the supreme concha. These conchae, when covered by mucosa, are termed turbinates. The turbinates augment the surface area of the nasal cavity to aid in its functions of humidifying, warming, and humidifying the air. The turbinates create four channels. Three of these channels are termed meatuses, and the fourth is the sphenoethmoidal recess.

Bones of the lateral wall:

- Ethmoid bone
- Perpendicular plate of the palatine bone
- The medial plate of the pterygoid process of the sphenoid bone
- Medial surface of the lacrimal and maxillary bones
- Inferior concha

The lateral wall contains the following openings:

Sphenoethmoidal recess: The space between the superior nasal concha and the sphenoid bone, with openings from the sphenoid sinus.

Superior meatus: The space inferior to the superior nasal concha, with openings from the posterior ethmoidal air cells.

Middle meatus: The space inferior to the middle nasal concha, with openings for the frontal sinus via the nasofrontal duct, the middle ethmoidal air cells on the ethmoidal bulla, and the anterior ethmoidal air cells and maxillary sinus in the hiatus semilunaris.

Inferior meatus: The space inferior to the inferior nasal concha, with an opening for the nasolacrimal duct, which drains tears from the eye into the nasal cavity.

Sphenopalatine foramen: An opening posterior to the middle nasal concha receives the nasopalatine nerve and the sphenopalatine artery from the pterygopalatine fossa into the nasal cavity.