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ANA 301 Assignment; - Carvanous Sinus and Walls of the Nose.

Course Title: - Gross Anatomy of Head and Neck.

1) Essay on the carvanous 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. The cavernous sinuses are one of several drainage pathways for the brain that sits in the middle. In addition to receiving venous drainage from the brain, it also receives tributaries from parts of the face.

The left and right cavernous sinuses communicate by through the anterior and posterior intercavernous sinuses. The cavernous sinus drains to the superior and inferior petrosal sinuses, which then join the sigmoid sinus.

Structure

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 pass through the lateral wall of the carotid sinus, and from superior to inferior they are:

i) 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.

There are also other non-vascular structures that utilize the cavernous sinus as a pathway to their points of supply. Five cranial nerves (CN) use this pathway to gain access to their points of innervation. The first to be discussed is the abducent nerve (CN VI). 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.

ii) 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.

iii) 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.

iv) Trigeminal nerve

Finally, 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 travels 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.

Relations

There are numerous structures surrounding the cavernous sinus that are noteworthy. Medially, the sinus is adjacent to the lateral walls of the pituitary fossa with the pituitary gland, the sphenoid bone and its air sinus. The cerebral part of the internal carotid artery courses superiorly. Laterally, the medial aspect of the temporal lobe of each hemisphere lies adjacent to the sinus. And

posteriosuperiorly, the uncus of the temporal lobe has a relation to the sinus.

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

a) 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.

b) 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.

c) 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.

d) Middle meningeal vein

Finally, 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.

e) Hypophyseal veins

Additionally, 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.

2) Walls of the nose.

The walls of the nose include the lateral and medial wall.

a) Lateral wall: -

The lateral wall of the nasal cavity is a region of the nasopharynx essential for humidifying and filtering the air we breathe in nasally.

Here we can find a structure called agger nasi. The agger nasi is also referred to as the 'nasoturbinial concha' or 'nasal ridge.' It can be described as a small mound or ridge found in

the lateral side of the nasal cavity. The structure is located midway along the anterior aspect of the middle nasal concha. An abnormally enlarged form may restrict the drainage of the frontal sinus by obstructing the frontal recess area.

The lateral walls of the nose are irregular owing to three bony plates, the nasal conchae, which project inferiorly, somewhat like louvers.

Features on the lateral wall of the nasal cavity

There is the presence of nasal conchae and they curve inferomedially

The nasal conchae include;

- Superior nasal concha
- Middle nasal concha
- Inferior nasal concha

The conchae or turbinates of many mammals (especially running mammals and those existing in extreme environments) are highly convoluted, scroll-like structures that offer a vast surface area for heat exchange

Underneath each concha in both humans with simple nasal conchae and animals with complex turbinates is a recess or meatus in the nasal cavity.

- Inferior nasal concha:-

It is the longest and broadest of the conchae and is formed by an independent bone (of the same name, inferior concha). The concha is covered by a mucous membrane that contains large vascular spaces and is one of the three that work to both humidify and clear the air that passes into the nasopharynx.

- Superior and Middle nasal conchae:-

Arise from the perpendicular plate of the ethmoid bone. The middle nasal concha is found in between the superior and inferior nasal concha and plays a role in humidifying and clearing inspired air of micro-particles such as dirt. The superior nasal concha is a bony shelf located above the middle nasal concha and below the sphenoidal recess. Similar to the middle nasal concha the superior concha is itself part of the ethmoid bone.

b) Medial wall: -

The medial wall of the nasal cavity comprises the nasal septum, the septal cartilage and various bones of the skull which are the ethmoid, maxillary, vomer and palatine bones.

- Ethmoid bone: -

Posteriorly the perpendicular plate of the ethmoid bone forms the superoposterior part of the bony nasal septum and articulates superiorly with the cribriform plate. The posterior border articulates superiorly with the sphenoidal crest and with the vomer by its inferior border.

The cribriform plate is found in the midline on the anterior floor of the anterior cranial fossa. It can be described as a thin bony plate of perforated bone through which the fibres of the olfactory nerve ascend and reach the entorhinal cortex. The plate is divided by the crista galae in the midline.

- Maxillary bone: -

Further posteriorly than the ethmoid bone, the crest of both the maxilla and palatine bone complete the posterior septum. The anterior septum is formed entirely of the quadrangular cartilage which divides the cavity in the midline. The nasal septum can be deviated in some and is a sign of nasal trauma or abnormal growth.

- Vomer: -

The vomer is an unpaired bone of the skull forms the inferior part of the septum. It is located in the mid sagittal plane and articulates with the ethmoid, both palatine bones and both maxillary bones.

- Palatine bone: -

The horizontal plate of the palatine bone is a rectangular shaped bone that projects medially and forms a right angle with the perpendicular plate of the ethmoid. The nasal surface of the bone forms part of the inferior meatus of the nose, while the serrated anterior maxillary surface articulates with the maxilla. Laterally the bone articulates with the perpendicular plate, and superior portion of the plate forms the posterior part of the nasal cavity. The inferior surface of the plate is rough and provides attachment to the oral mucosa of the hard palate.

Nasal cartilage and associated structures.

The septal cartilage is approximately 3-4mm thick. It divides the nasal cavity into two halves. The anteroinferior part of the cartilage has an expansion known as the 'footplate' which is 4-8mm wide. This foot plate lies in free contact with the membranous septum. The cartilage is expanded in other regions, namely the

junction with the lateral nasal cartilage termed the posterior process. The cartilage is firmly adhered to the nasal bone by taut collagen fibres.

The cartilage of the septum is also termed the 'quadrangular cartilage' due to its shape. The posterior nasal spine is a sharp pointed projection of the posterior border of the palatine bone. The musculus uvula gains its attachment here.

The Pharyngeal Tonsil: -

The pharyngeal tonsil is also known as the adenoid. It is a mass of lymphatic tissue located in the roof of the nasopharynx. The structure degrades with age and is almost entirely absent at puberty. The torus tubarius is also known as the tubar tonsil. It resides at the base of the cartilaginous section of the Eustachian tube.

The Choana: -

The choana is an opening at the back of the nasal passage that empties into the nasopharynx, close to where the adenoids are. The passage way forms an outflow from the nasopharynx into the mouth and throat.