

ANATOMY

ANATOMY

Head

HEAD

HEAD

Vessels of the HEAD

HEAD

VASCULATURE

- ARTERIAL SUPPLY
- VENOUS DRAINAGE
- LYMPHATICS

Vessels of the Head

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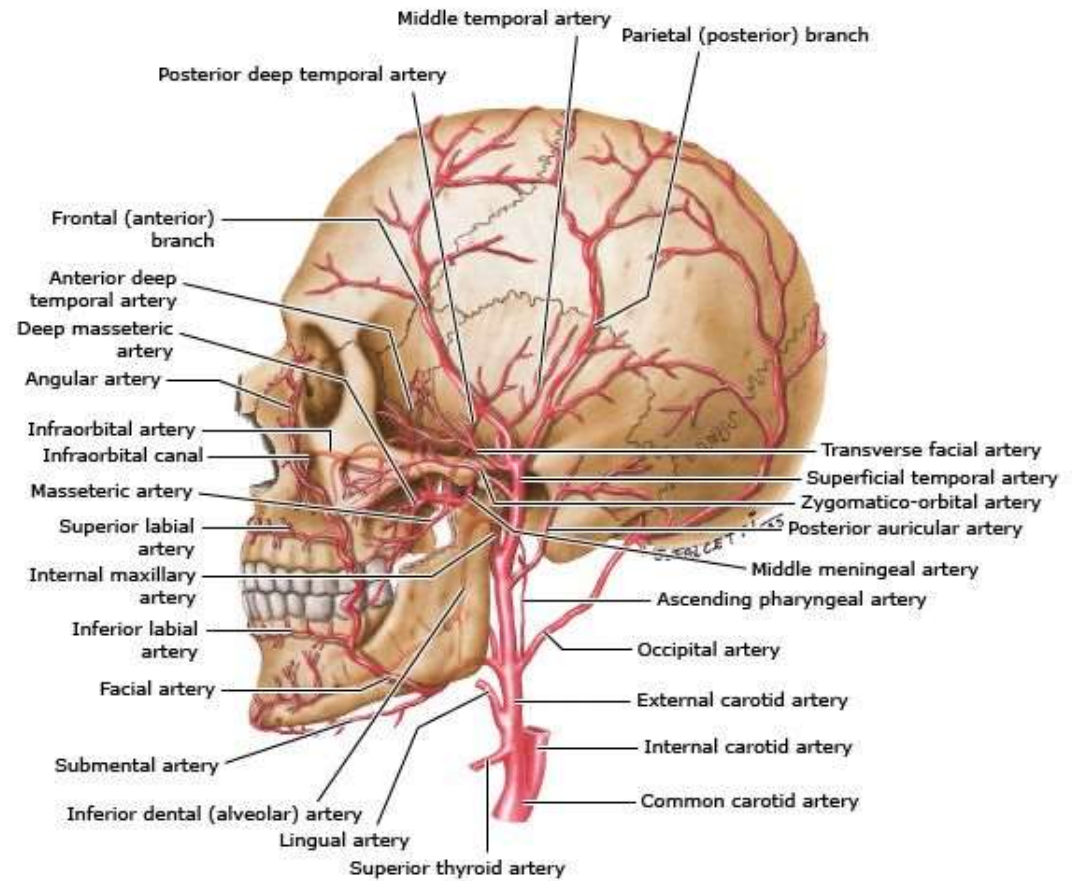
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Vessels of the Head

Carotid Arteries



Vessels of the Head

The head and neck receives the majority of its blood supply through the carotid and vertebral arteries. This article shall explore the anatomy of this arterial system – its anatomical course, branches, and clinical correlations

Vessels of the Head

- We shall start at the origin of the carotid arteries. The **right common** carotid artery arises from a **bifurcation** of the **brachiocephalic trunk** (the right subclavian artery is the other branch). This bifurcation occurs roughly at the level of the right sternoclavicular joint.
- The left common carotid artery branches directly from the **arch of aorta**. The left and right common carotid arteries ascend up the neck, **lateral** to the trachea and the [oesophagus](#). They do not give off any branches in the neck.
- At the level of the superior margin of the **thyroid cartilage (C4)**, the carotid arteries split into the **external** and **internal** carotid arteries. This bifurcation occurs in an anatomical area known as the [Carotid Triangle](#).
- The common carotid and internal carotid are slightly dilated here, this area is known as the **Carotid sinus**, and is important in detecting and regulating blood pressure

Vessels of the Head

Clinical Relevance: Carotid Sinus Hypersensitivity

- The carotid sinus is a dilated portion of the common carotid and internal carotid arteries. It contains specific sensory cells, called **baroreceptors**. The baroreceptors **detect stretch** as a measure of blood pressure. The **glossopharyngeal nerve** feeds this information to the brain, and this is used to regulate blood pressure.
- In some people, the baroreceptors are **hypersensitive** to stretch. In these patients, **external pressure** on the carotid sinus can cause slowing of the heart rate and a decrease in blood pressure. The brain becomes under perfused, and **syncope** results. In such patients, checking the pulse at the carotid triangle is not advised.
- External to the carotid sinus, there is a cluster of **nervous cells**, called the Carotid body. These act as **peripheral chemoreceptors**; detecting the **O₂** content of the blood, and relaying this information to the brain to regulate **Breathing Rate**.

Vessels of the Head

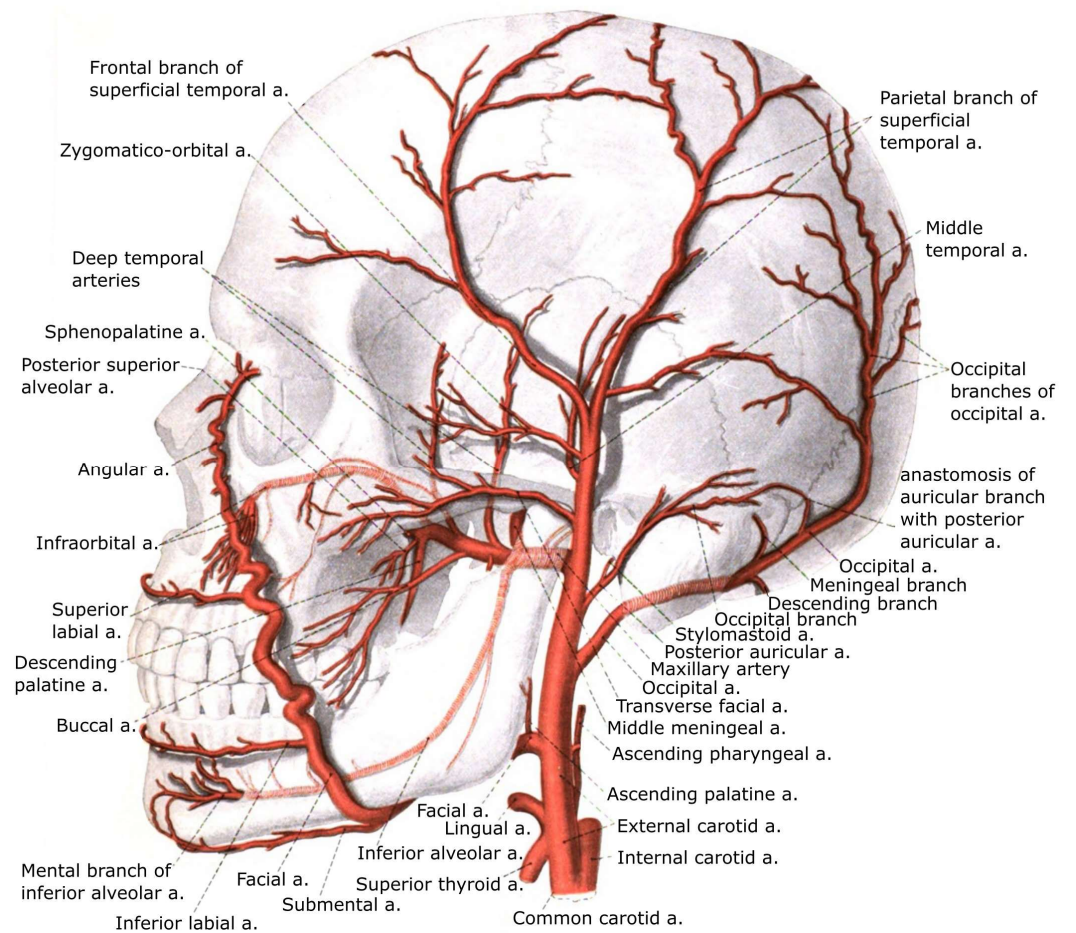
External Carotid Artery

The external carotid artery supplies the areas of the head and neck external to the cranium. After arising from the **common carotid** artery, it travels up the neck, posterior to the mandibular neck and anterior to the lobule of the ear. The artery ends within the parotid gland, by dividing into the **superficial temporal** artery and the **maxillary** artery. Before terminating, the external carotid artery gives off six branches:

- Superior Thyroid artery
- Lingual artery
- Facial artery
- Ascending pharyngeal artery
- Occipital Artery
- Posterior Auricular artery
- The facial, maxillary and superficial temporal arteries are the major branches of note. The maxillary artery supplies the **deep** structures of the face, while the facial and superficial temporal arteries generally supply superficial areas of the face.

Vessels of the HEAD

External Carotid



Vessels of The Head

Carotid Bodies

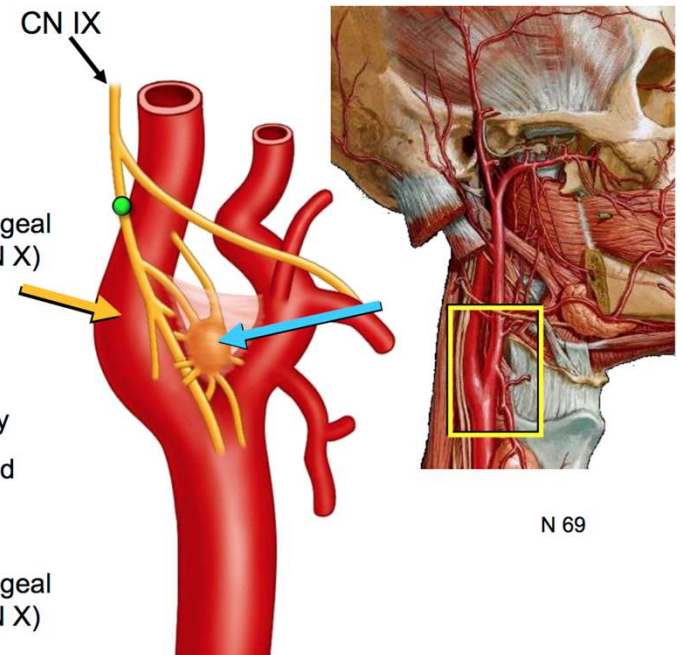
Arteries of Neck

Carotid body

- At bifurcation
- Chemoreceptor for O₂ levels
- Visceral sensory (VA): carotid sinus branch ● of glossopharyngeal n. (CN IX); some via vagus (CN X)

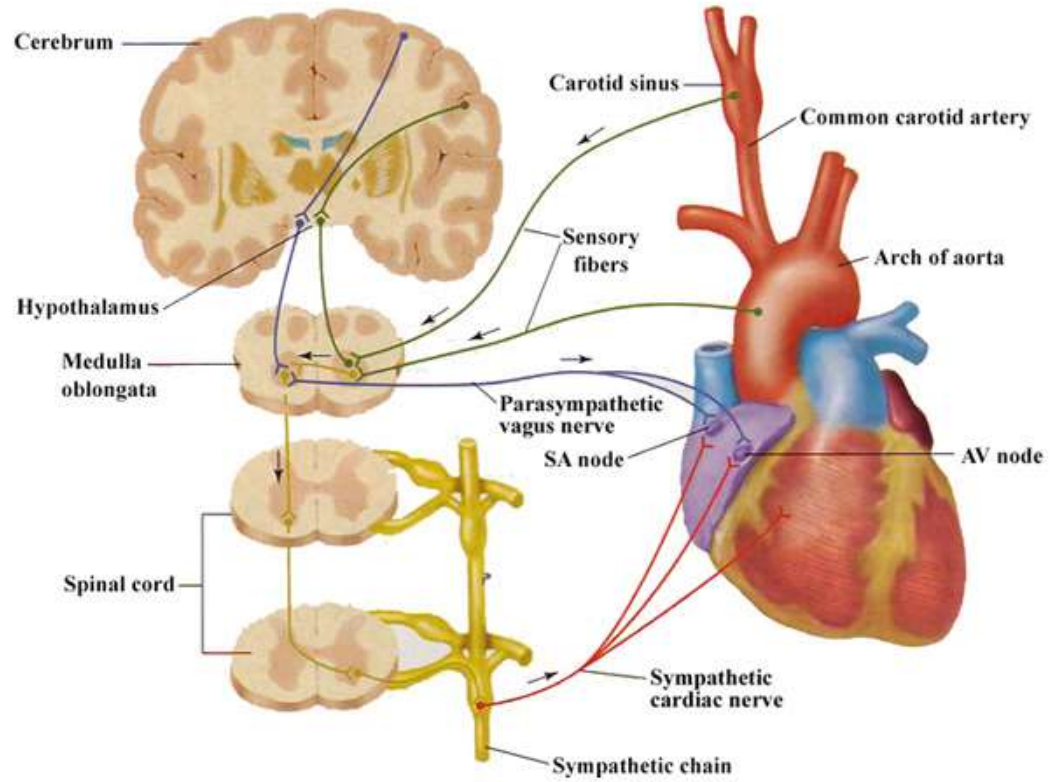
Carotid sinus

- Proximal internal carotid artery
- Baroreceptor sensitive to blood pressure
- Visceral sensory (VA): carotid sinus branch ● of glossopharyngeal n. (CN IX); some via vagus (CN X)



Vessels of Head

Carotid Artery Sinus



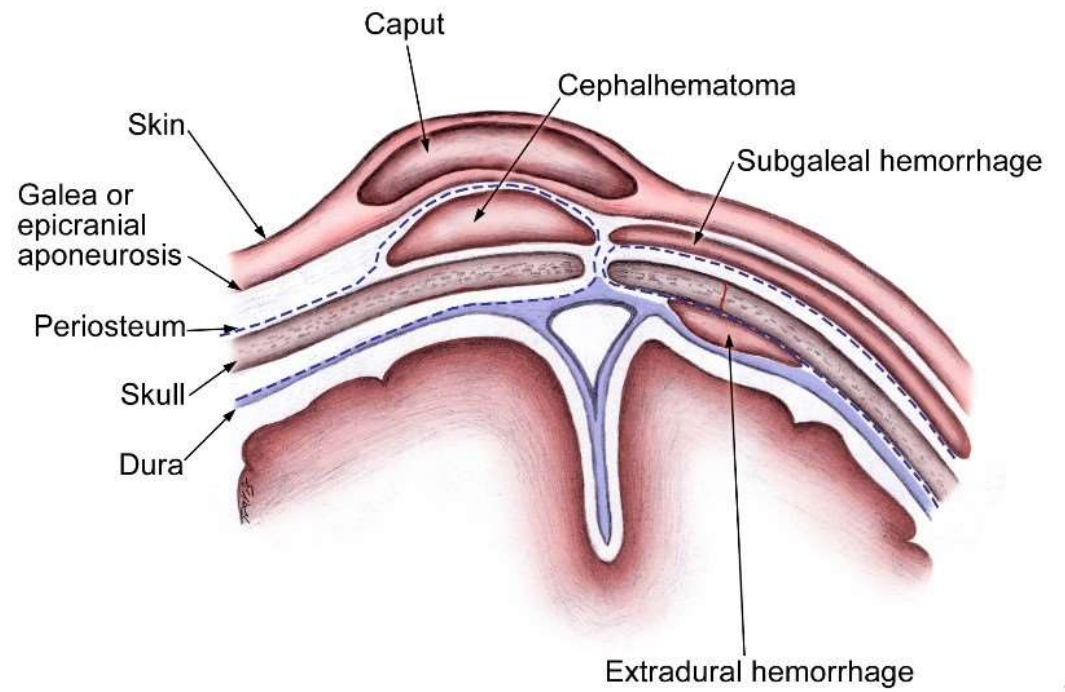
Vessels of the Head

Clinical Relevance: Blood Supply to the Scalp

- The **Posterior Auricular, Occipital and Superficial temporal arteries** (along with two branches of the internal carotid artery; **supra-orbital and supratrochlear**) combine to provide a dense blood supply to the scalp. Injuries to the scalp can cause excessive bleeding for various reasons:
- The walls of the arteries are tightly and closely bound to the underlying **connective tissue** of the scalp. This prevents them from constricting to limit blood loss following injury or laceration.
- The **numerous anastomoses** formed by the arteries produce a very densely vascularised area.
- Deep lacerations can involve the **Epicranial Aponeurosis**, which is worsened by the opposing pulls of the occipital and frontalis muscles.
- Despite the possible heavy bleeding, it is important to note that the bony skull gets its blood from an alternative source (**Middle Meningeal Artery**), and so will not undergo avascular necrosis.

Vessels of the Head

Clinical Anatomy



Vessels of the Head

Clinical Relevance: Extradural Haematoma

- The **Middle meningeal** artery is a branch of the maxillary artery. It is unique as it supplies some intracranial structures (remember, the external carotid artery and its branches usually supply **extra-cranial** structures).
- The middle meningeal artery supplies the **skull** and the **dura mater** (the outer membranous layer covering the brain). A fracture of the skull at its weakest point, the **pterion**, can injure or completely lacerate the MMA. Blood will then collect in between the dura mater and the skull, causing a dangerous increase in intra-cranial pressure. This is known as an **extradural haematoma**.
- The increase in **intra-cranial** pressure causes a variety of symptoms; nausea, vomiting, seizures, bradycardia and limb weakness. It is treated by **diuretics** in minor cases, and drilling **Burr Holes** into the skull the more extreme haemorrhages.

Vessels of the Head

Internal Carotid Artery

The internal carotid arteries do not supply any structures in the neck, entering the cranial cavity via the **carotid canal** in the petrous part of the [temporal bone](#). Within the cranial cavity, the internal carotid artery supplies:

- The brain
- Eyes
- Forehead

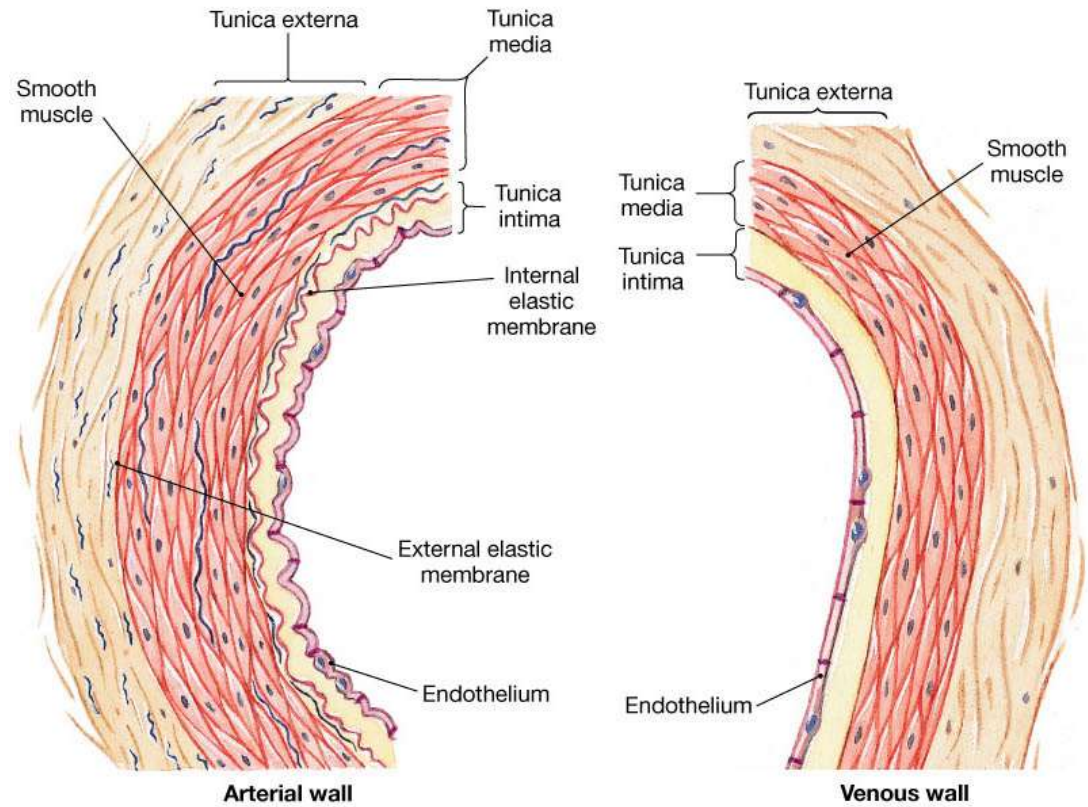
Vessels of the Head

Clinical Relevance: Atherosclerosis of the Carotid Arteries

- The swelling at the bifurcation of the common carotid arteries, the carotid sinus, produces **turbulent** blood flow. This increases the risk of atheroma formation in this area, with the internal carotid more susceptible than the others.
- Atherosclerotic thickening of the **Tunica Intima** of these arteries will reduce blood flow to the **brain**, resulting in the variety of **neurological** symptoms; headache, dizziness, muscular weakness. If blood flow is completely occluded, a cerebral ischaemia (stroke) results.
- If atherosclerosis of the carotid arteries is suspected, a **Doppler** study can be used to assess the severity of any thickening. In severe cases, the artery can be opened, and the atheromatous tunica intima removed. This procedure is called a **carotid endarterectomy**.

Vessels of the Head

Tunica Intima



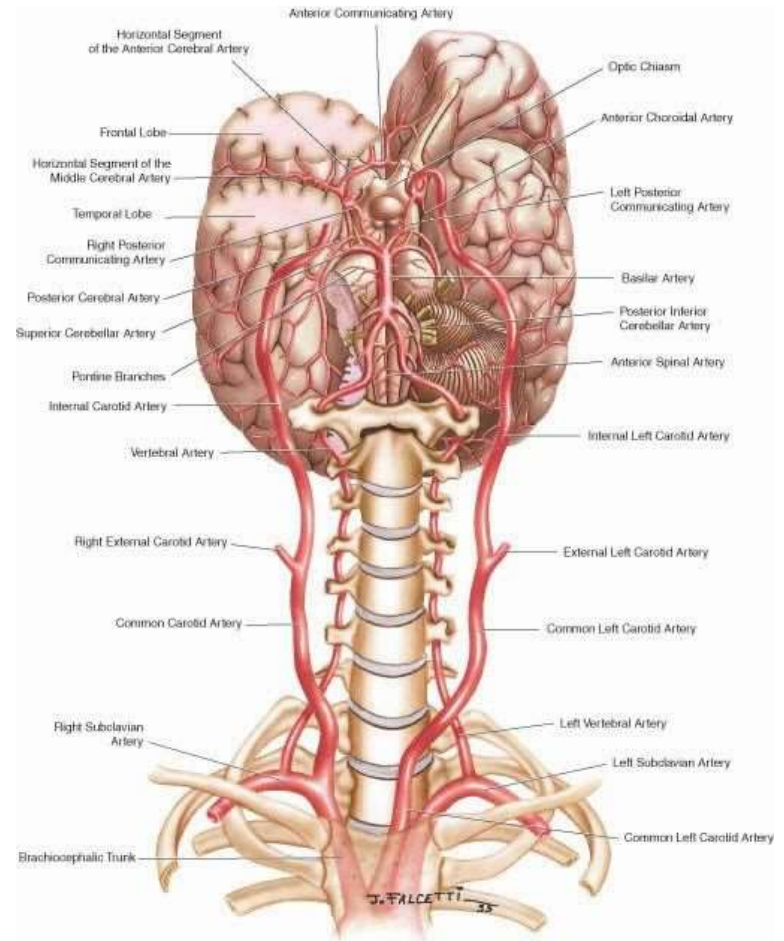
Vessels of the Head

Vertebral artery

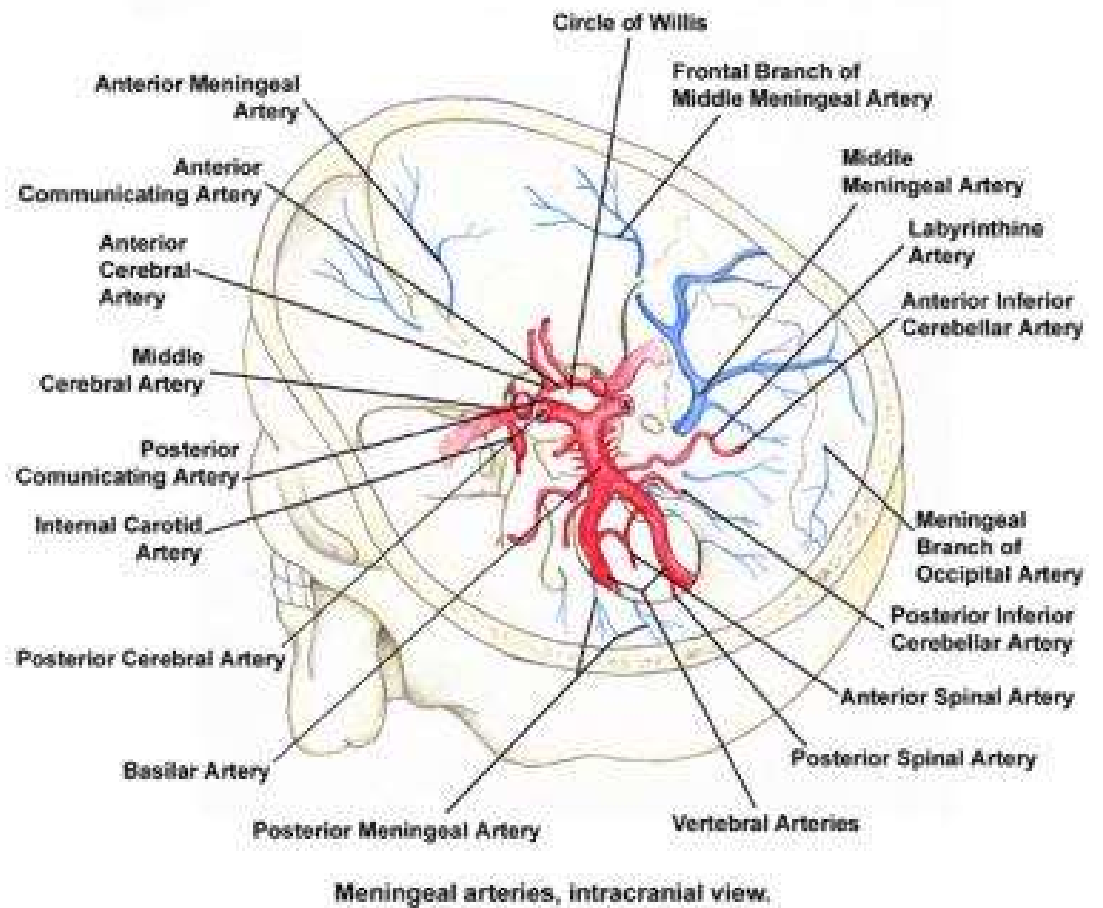
- The right and left vertebral arteries arise from the **subclavian** arteries, medial to the anterior scalene muscle. They then ascend up the posterior side of the neck, through holes in the **transverse processes** of the cervical vertebrae, known as foramen transversarium.
- The vertebral arteries enter the cranial cavity via the **foramen magnum**, and converge. They then give rise to the **basilar arteries**, which supply the brain. The vertebral arteries supply no branches to the neck, or extra-cranial structures.



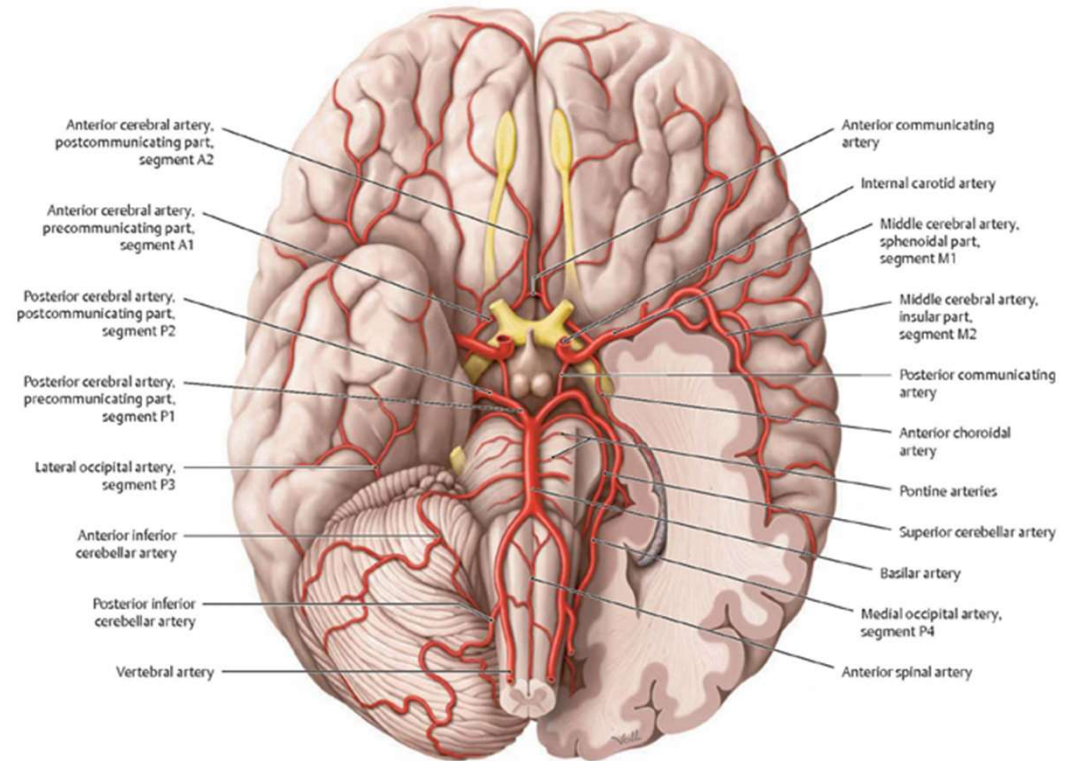
Vertebral Artery



Circle OF Willis

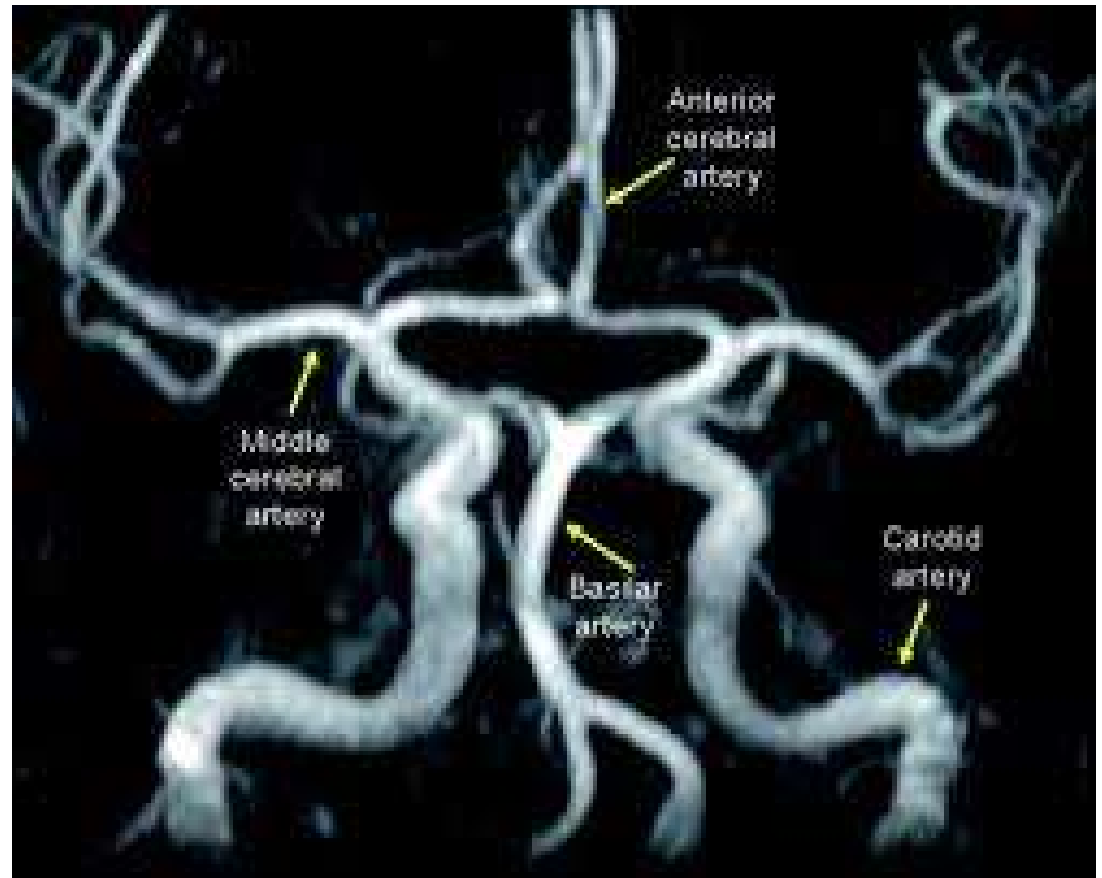


Vertebral Artery



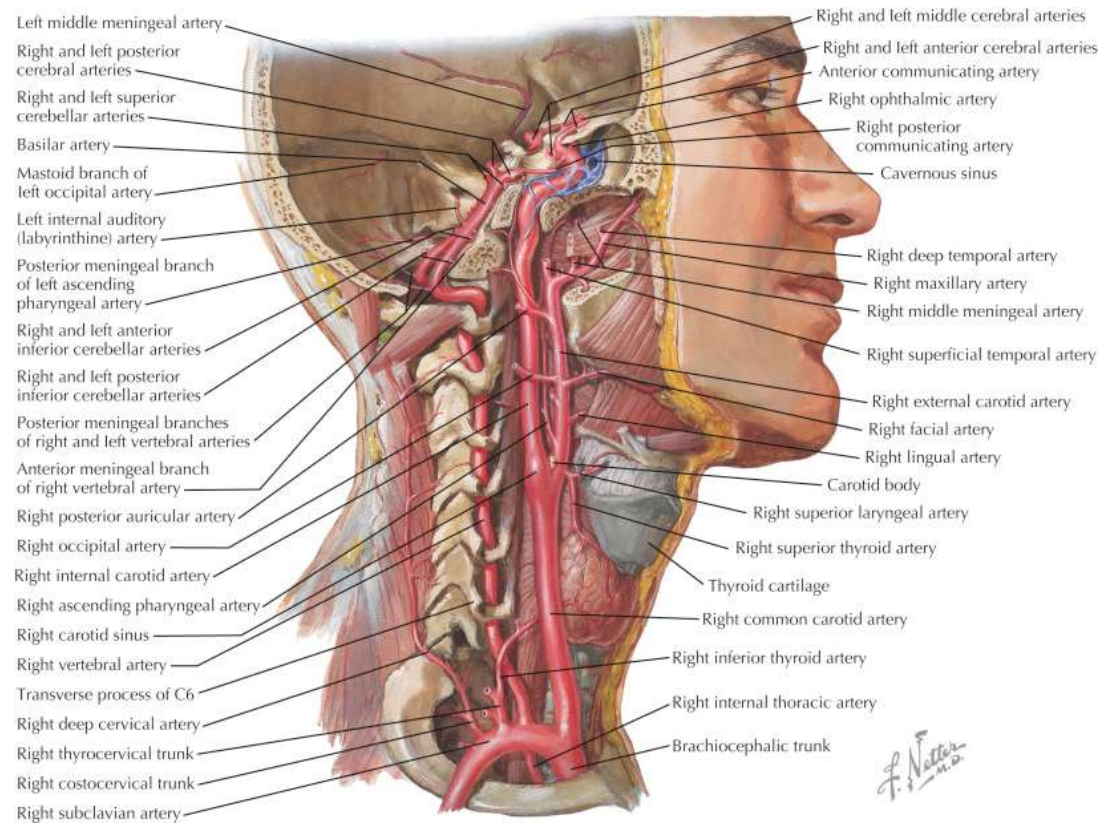


Circle Of willis



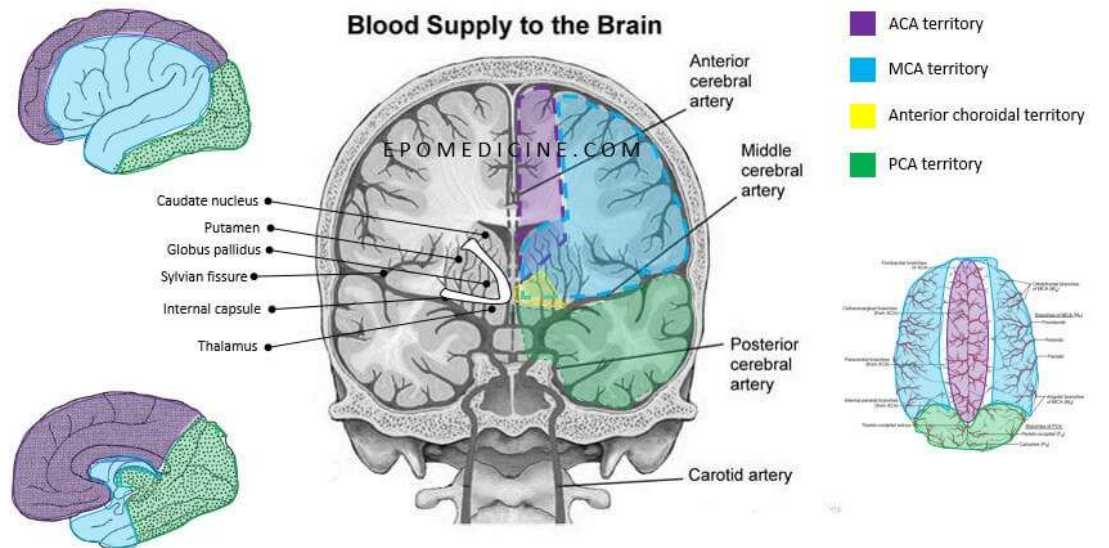


Vertebral and Internal Carotid Artery

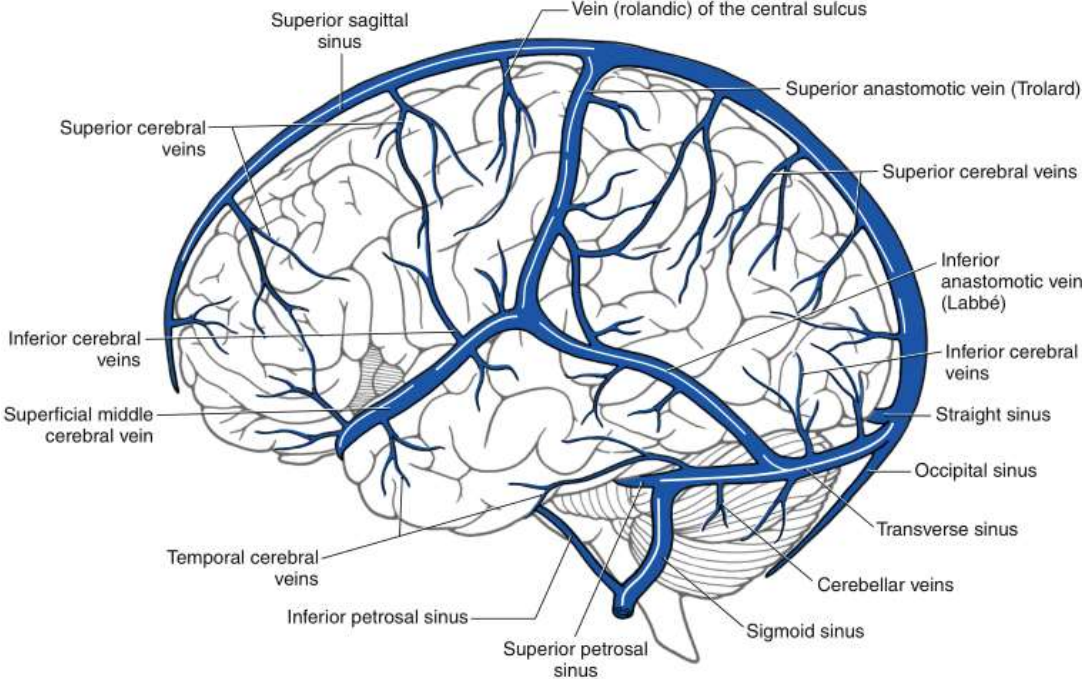




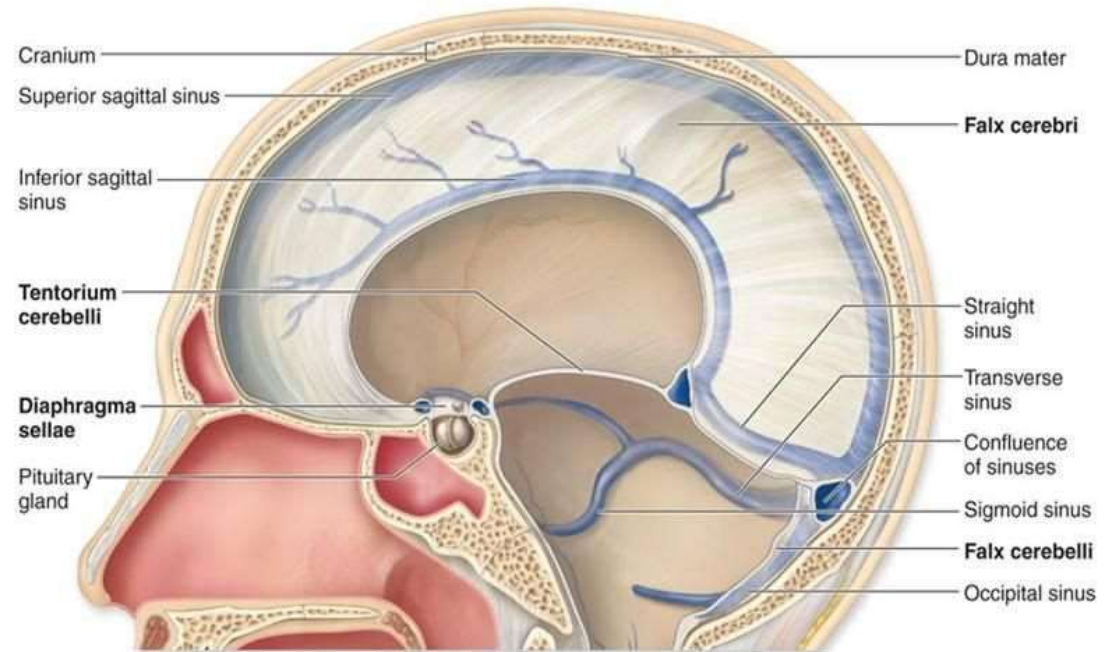
Blood Supply of the Brain



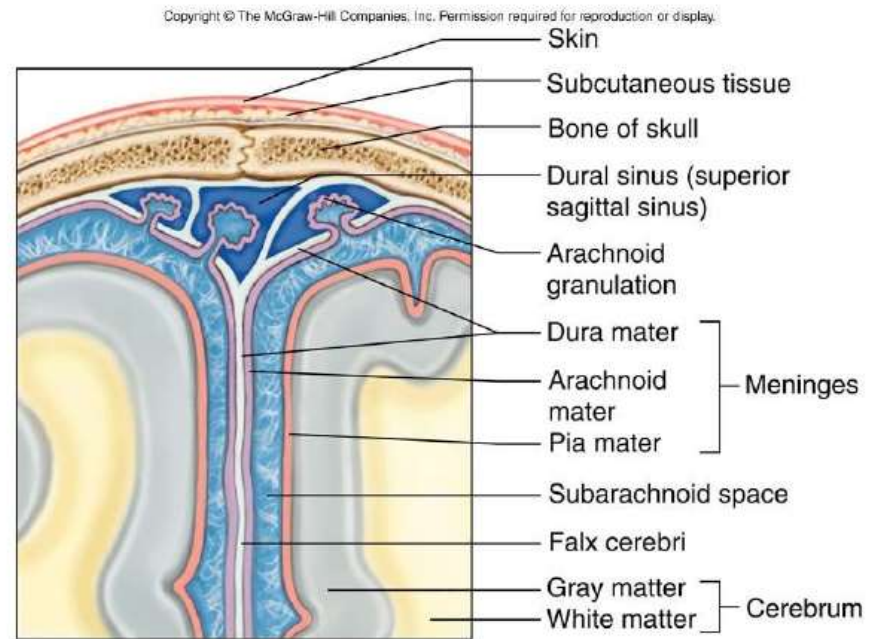
Venous Drainage



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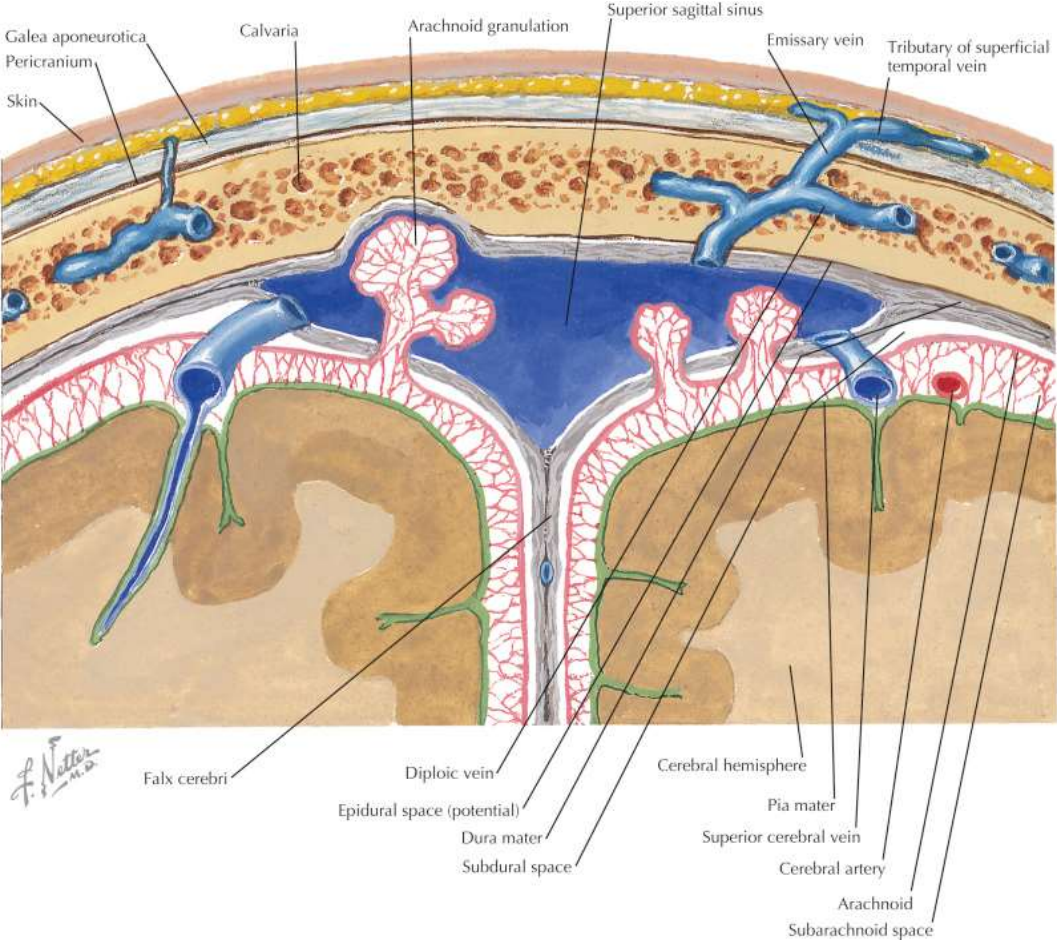


Arachnoid Granulation



(b)

Emissary Vein



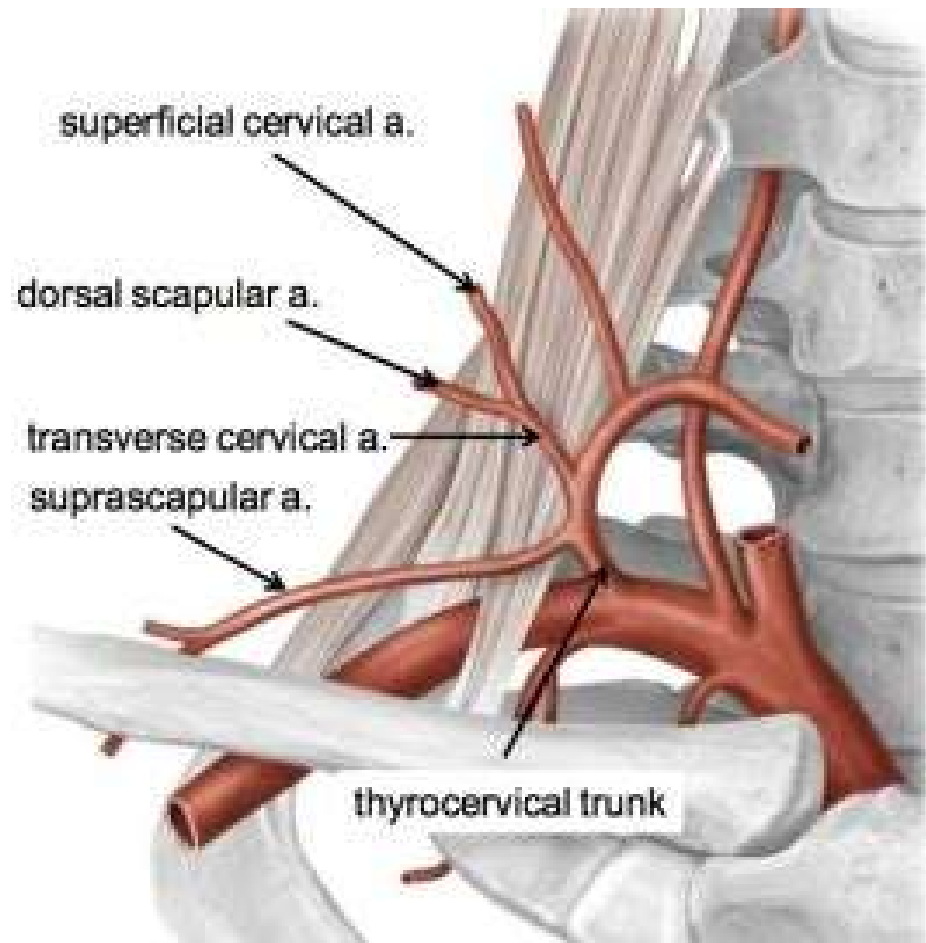
Vessels of the Head

Other Arteries of the Neck

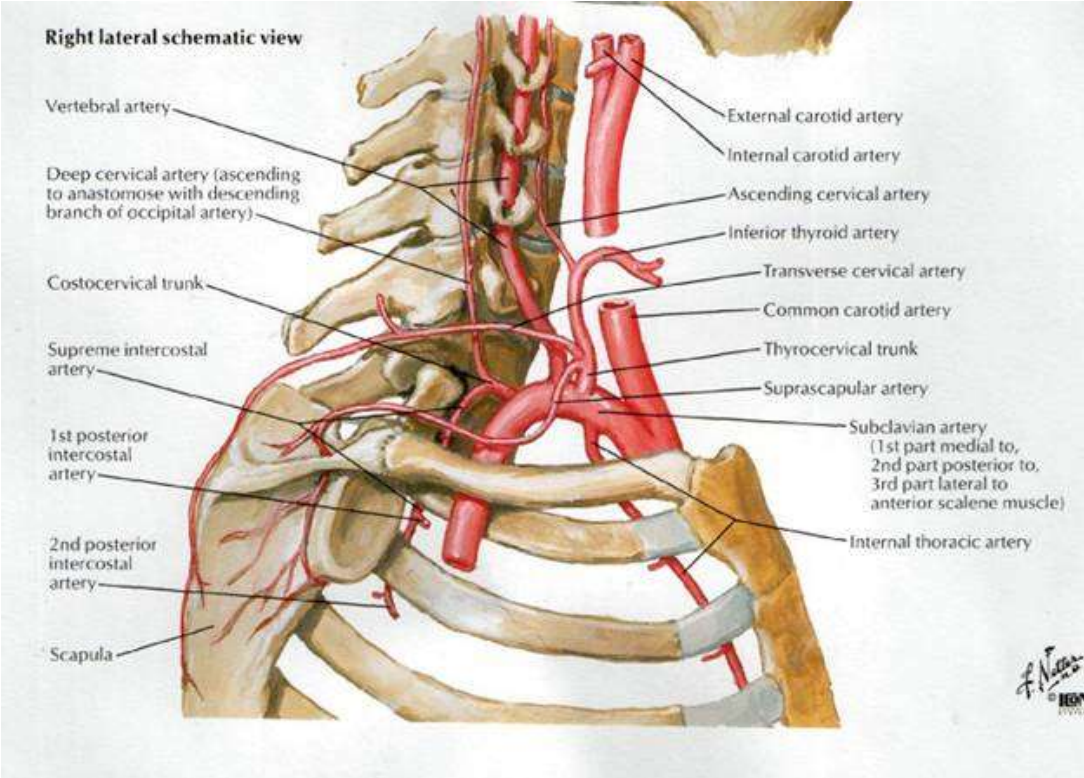
- The neck is supplied by arteries other than the carotids. The right and left subclavian arteries give rise to the **Thyrocervical trunk**. From this trunk, several vessels arise, which go on to supply the neck.
- The first branch of the thyrocervical trunk is the **Inferior thyroid artery**. It supplies the thyroid gland
- The **Ascending Cervical Artery** arises from the Inferior Thyroid Artery, as it turns medially in the neck. This vessel supplies the posterior **prevertebral** muscles.
- The **Transverse Cervical Artery** is the next branch off the thyrocervical trunk. It crosses the base of the carotid triangle, and supplies the trapezius and rhomboid muscles.
- Lastly, the **Suprascapular Artery** arises. It supplies the posterior shoulder area.



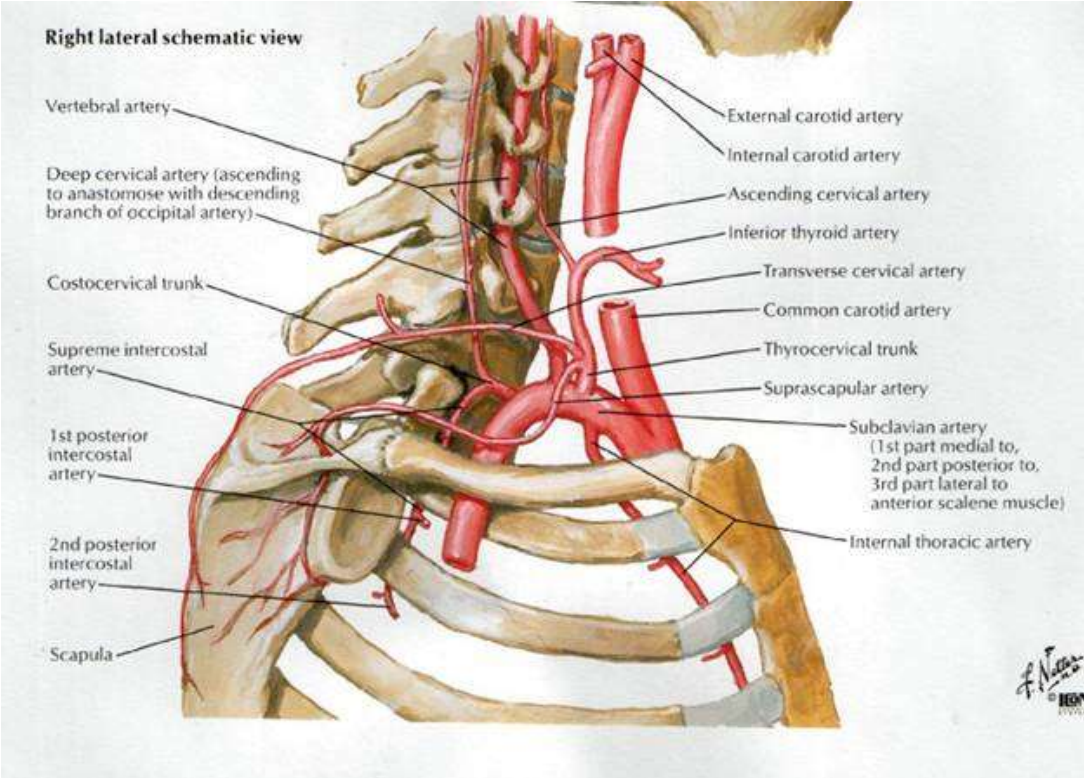
Thyrocervical Trunk

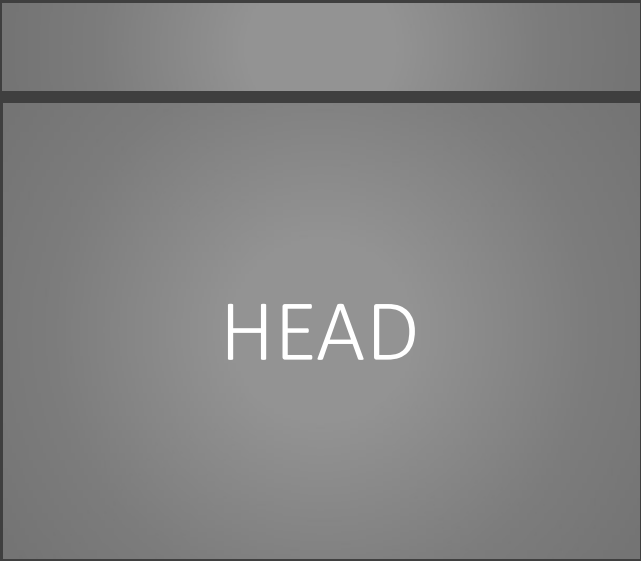


Subclavian Artery



Thyrocervical Trunk





VESSELS OF HEAD

Venous Drainage of the Neck

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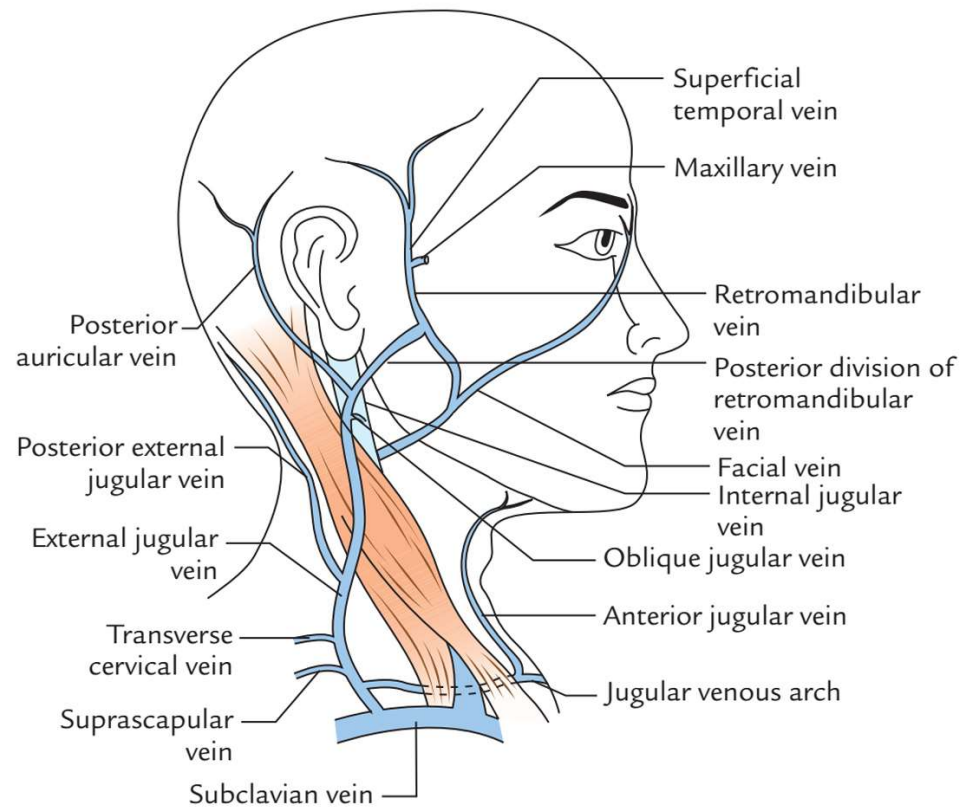
1.3.1 Clinical Relevance: Jugular Venous Pressure

2 Dural Venous Sinuses

2.1 Clinical Relevance: Cavernous Sinus



External Juglar Vein



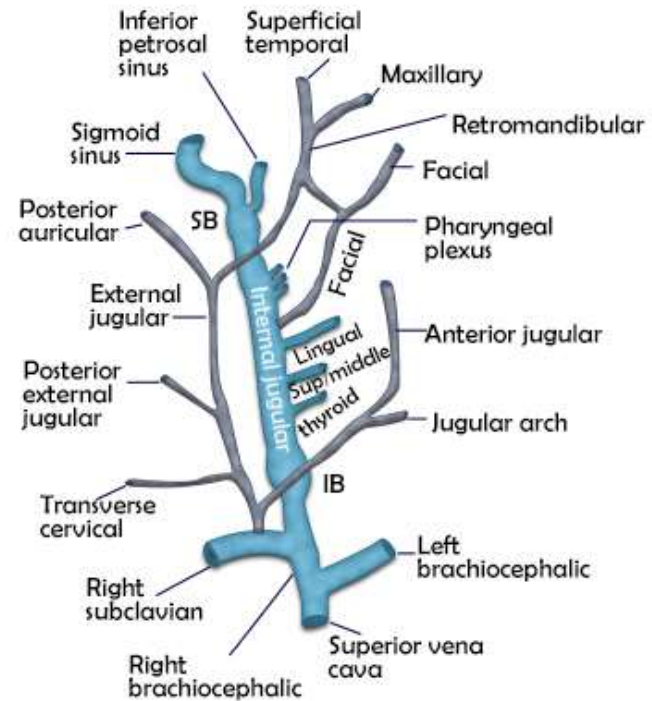
Venous Drainage of Head

The veins of the head and neck collect deoxygenated blood and return it to the heart. Anatomically, the venous drainage can be divided into three parts:

- **Venous drainage of the brain and meninges:** Supplied by the dural venous sinuses.
- **Venous drainage of the scalp and face:** Drained by veins synonymous with the [arteries of the face](#) and scalp. These empty into the internal and external jugular veins.
- **Venous drainage of the neck:** Carried out by the anterior jugular veins.
- In this article, we shall look at the veins mentioned above, their anatomical course, and any clinical correlations.

External juglar Vein

INTERNAL JUGULAR VEIN



Right internal and external jugular veins

SB = Superior bulb

IB = Inferior bulb

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Venous Drainage of HEAD

Jugular Veins

- There are three main jugular veins – External, Internal and Anterior. They are ultimately responsible for the venous drainage of the whole head and neck.

Venous Drainage of Head

External Jugular Vein

- The external jugular vein and its tributaries supply the majority of the **external face**. It is formed by the union of two veins:
- **Posterior auricular vein** – drains the area of scalp superior and posterior to the outer ear.
- **Retromandibular vein** (posterior branch) – itself formed by the **maxillary and superficial temporal veins**, which drain the face.
- These two veins combine immediately posterior to the angle of mandible, and inferior to the outer ear, forming the external jugular vein.
- After formation, the external jugular vein descends down the neck within the superficial fascia. It runs anteriorly to the **sternocleidomastoid** muscle, crossing it in an oblique, posterior and inferior direction.
- In the root of the neck, the vein passes underneath the **clavicle**, and terminates by draining into the **subclavian** vein. Along its route down the neck, the EJV receives tributary veins – posterior external jugular, transverse cervical and suprascapular veins.

Venous Drainage of HEAD

Clinical Relevance: Severance of the External Jugular Vein

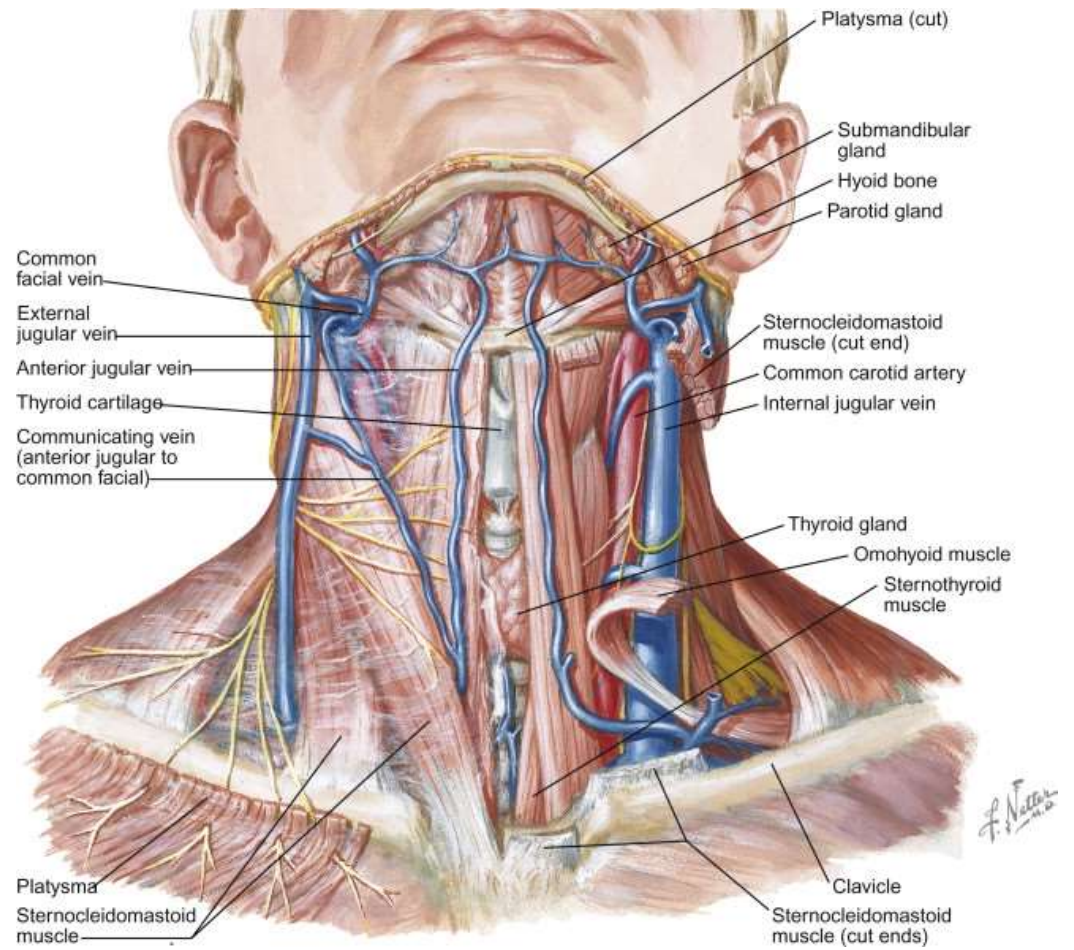
- The external jugular vein has a relatively **superficial** course down the neck, leaving it vulnerable to damage.
- If it is severed, in an injury such as a knife slash, its **lumen** is held open – this is due to the thick layer of **investing** fascia (for more information see [Fascial Layers of the Neck](#)). Air will be drawn into the vein, producing **cyanosis**, and can stop blood flow through the **right atrium**. This is a medical emergency, managed by the application of **pressure** to the wound – stopping the bleeding, and the entry of air.

Venous Drainage of HEAD

Anterior Jugular Veins

- The anterior jugular veins vary from person to person. They are **paired** veins, which drain the anterior aspect of the neck. Often they will communicate via a jugular venous **arch**. The anterior jugular veins descend down the midline of the neck, emptying into the subclavian vein.

Juglar Vein



Venous Drainage of HEAD

Internal Jugular Vein

- The **internal jugular vein (IJV)** begins in the cranial cavity as a continuation of the sigmoid sinus. The initial part of the internal jugular vein is dilated and is known as the superior bulb. It exits the skull via the jugular foramen.
- In the neck, the internal jugular vein descends within the **carotid sheath**, deep to the sternocleidomastoid muscle and lateral to the common carotid artery. At the base of the neck, posteriorly to the sternal end of the clavicle, the IJV combines with the **subclavian vein** to form the brachiocephalic vein. Immediately prior to this, the inferior end of internal jugular vein dilates to form the inferior bulb. It has a valve that stops back-flow of blood.
- During its descent down the neck, the internal jugular vein receives blood from the **facial, lingual, occipital, superior** and **middle** thyroid veins. These veins drain blood from the anterior face, trachea, [thyroid](#), [oesophagus](#), larynx, and [muscles of the neck](#).

Venous Drainage of HEAD

Clinical Relevance: Jugular Venous Pressure

- In clinical practice, the internal jugular vein can be observed for **pulsations** – the nature of which provide an estimation of right atrial **pressure**.
- When the heart contracts, a pressure wave passes upwards, which can be observed. There are no **valves** in the brachiocephalic or subclavian veins – so the pulsations are a fairly accurate indication of right atrial pressure

Venous Drainage of HEAD

Dural Venous Sinuses

- The dural venous sinuses are spaces between the **Periosteal** and **Meningeal** layers of dura mater, which are lined by **endothelial** cells. They collect venous blood from the veins that drain the brain and bony skull, and ultimately drain into the internal jugular vein.

Venous Drainage of HEAD

Clinical Relevance: Cavernous Sinus

- The **cavernous sinuses** are a clinically important pair of dural sinuses. They are located next to the lateral aspect of the body of the **sphenoid** bone. This sinus receives blood from the superior and inferior **ophthalmic** veins, the middle superficial **cerebral** veins, and from another dural venous sinus; the **sphenoparietal** sinus.
- Located within the cavernous sinus is the **internal carotid** artery, which crosses the sinus. This allows for **cooling** of the arterial blood before it reaches the brain. Along with the internal carotid artery, the **abducens (VI) nerve** crosses the sinus. Several nerves are located within the lateral wall of each sinus; **oculomotor (III)**, **trochlear (IV)**, **ophthalmic (V1)** and **maxillary (V2) nerves**.
- If the cavernous sinus becomes infected, these nerves are at risk of damage. The **facial** vein is connected to cavernous sinus via the superior ophthalmic vein. The facial vein is **valveless** – blood can reverse direction and flow from the facial vein to the cavernous sinus. This provides a potential pathway by which infection of the face can spread to the venous sinuses.

Lymphatics of HEAD and NECK

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Lymphatics of HEAD and NECK

- The lymphatic system functions to drain tissue fluid, plasma proteins and other cellular debris back into the blood stream, and is also involved in immune defence. Once this collection of substances enters the lymphatic vessels, it is known as **lymph**. Lymph is subsequently filtered by lymph nodes and directed into the venous system.
- This article will explore the anatomy of lymphatic drainage throughout the head and neck, and how this is relevant clinically. We will also look at **Waldeyer's ring**, the collection of lymphatic tissue surrounding the superior pharynx.

Lymphatics of HEAD and NECK

Lymphatic Vessels

- The lymphatic vessels of the head and neck can be divided into two major groups; superficial vessels and deep vessels.

Lymphatics of HEAD and NECK

Superficial Vessels

- The superficial vessels drain lymph from the scalp, face and neck into the **superficial ring** of lymph nodes at the junction of the neck and head

Lymphatics of HEAD and NECK

Deep Vessels

- The deep lymphatic vessels arise from the **deep cervical lymph nodes**. They converge to form the left and right **jugular lymphatic trunks**:
- **Left jugular lymphatic trunk** – joins the thoracic duct at the root of the neck.
- **Right jugular lymphatic trunk** empties into the right lymphatic duct at the root of the neck

Lymphatics of HEAD and NECK

Superficial Lymph Nodes

- The superficial lymph nodes of the head and neck receive lymph from the scalp, face and neck. They are arranged in a **ring shape**; extending from underneath the chin, to the posterior aspect of the head. They ultimately drain into the deep lymph nodes.
- **Occipital:** There are usually between 1-3 occipital lymph nodes. They are located in the back of the head at the lateral border of the trapezius muscle and collect lymph from the occipital area of the scalp.
- **Mastoid:** There are usually 2 mastoid lymph nodes, which are also called the post-auricular lymph nodes. They are located posterior to the ear and lie on the insertion of the sternocleidomastoid muscle into the mastoid process. They collect lymph from the posterior neck, upper ear and the back of the external auditory meatus (the ear canal).
- **Pre-auricular:** There are usually between 1-3 pre-auricular lymph nodes. They are located anterior to the auricle of the ear, and collect lymph from the superficial areas of the face and temporal region.

Lymphatics of HEAD and NECK

- **Parotid:** The parotid lymph nodes are a small group of nodes located superficially to the [parotid gland](#). They collect lymph from the nose, the nasal cavity, the external acoustic meatus, the tympanic cavity and the lateral borders of the orbit. There are also parotid lymph nodes deep to the parotid gland that drain the nasal cavities and the nasopharynx.
- **Submental:** These lymph nodes are located superficially to the mylohyoid muscle. They collect lymph from the central lower lip, the floor of the mouth and the apex of the tongue.
- **Submandibular:** There are usually between 3-6 submandibular nodes. They are located below the mandible in the submandibular triangle and collect lymph from the cheeks, the lateral aspects of the nose, upper lip, lateral parts of the lower lip, gums and the anterior tongue. They also receive lymph from the submental and facial lymph nodes.
- **Facial:** This group comprises the maxillary/infraorbital, buccinator and supramandibular lymph nodes. They collect lymph from the mucous membranes of the nose and cheek, eyelids and conjunctiva.

Lymphatics of HEAD and NECK

Superficial Cervical: The superficial cervical lymph nodes can be divided into the superficial anterior cervical nodes and the posterior lateral superficial cervical lymph nodes. The anterior nodes lie close to the anterior jugular vein and collect lymph from the superficial surfaces of the anterior neck. The posterior lateral nodes lie close to the external jugular vein and collect lymph from superficial surfaces of the neck.

Lymphatics of HEAD and NECK

Deep Lymph Nodes

- The deep (cervical) lymph nodes receive all of the lymph from the head and neck – either directly or indirectly via the superficial lymph nodes. They are organised into a vertical chain, located within close proximity to the **internal jugular vein** within the carotid sheath. The efferent vessels from the deep cervical lymph nodes converge to form the **jugular lymphatic trunks**.
- The nodes can be divided into **superior** and **inferior** deep cervical lymph nodes. They are numerous in number, but include the prelaryngeal, pretracheal, paratracheal, retropharyngeal, infrahyoid, jugulodigastric (tonsilar), jugulo-omohyoid and supraclavicular nodes.

Lymphatics of HEAD and NECK

Clinical Relevance: Virchow's Node

- Virchow's node is a **supraclavicular node**, located in the left supraclavicular fossa (located immediately superior to the clavicle). It receives lymph drainage from the abdominal cavity.
- The finding of an enlarged Virchow's node is referred to as **Troisier's Sign** – and indicates of the presence of cancer in the abdomen, specifically gastric cancer, that has spread through the lymph vessels.

Lymphatic Drainage of THE HEAD

Waldeyer's Ring

Waldeyer's tonsillar ring refers to the collection of lymphatic tissue surrounding the superior pharynx. This lymphatic tissue responds to pathogens that may be ingested or inhaled. The tonsils that make up the ring are as follows:

- **Lingual tonsil** – located on the posterior base of the tongue to form the antero-inferior part of the ring.
- **Palatine tonsils** – located on each side between the palatoglossal and palatopharyngeal arches. These are the common 'tonsils' that can be seen within the oral cavity. They form the lateral part of the ring.
- **Tubal tonsils** – these are located where each Eustachian tube opens into the nasopharynx and form the lateral part of the ring.
- **Pharyngeal tonsil** – also called the nasopharyngeal/adenoid tonsil, located in the roof of the nasopharynx, behind the uvula and forms the postero-superior part of the ring.

Lymphatics of HEAD and NECK

Clinical Relevance: Inflamed Palatine Tonsils (Tonsillitis)

- The palatine tonsils can become **inflamed** due to a viral or bacterial infection. In such a case, they appear red and enlarged, and are accompanied by enlarged **jugulo-digastric** lymph nodes.
- Chronic infection of the palatine tonsils can be treated with their removal, a **tonsillectomy**. When performing a tonsillectomy, there may be bleeding primarily from the **external palatine vein** and secondarily from the **tonsilar branch** of the facial artery.
- If an infection spreads to the **peritonsillar tissue**, it can cause abscess formation. This can cause deviation of the uvula, known as **quinsy**. A quinsy is a medical emergency, as it can potentially cause obstruction of the pharynx. It is treated with draining of the abscess and antibiotics.

Lymphatics of HEAD and NECK

Lymphatics of the Brain

- It was thought that lymphatics were absent from the brain until in 2015, scientists located lymphatic vessels in the brains of mice and subsequently humans. Work is underway to determine and describe the lymphatic vessels involved.