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Vessels of head and neck

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Vessels of head and neck.

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AORTA (Fig.1) is the largest arterial vessel of systemic circulation. It subdivides on ascending part of aorta, aortic arch and descending part of aorta, which has thoracic and abdominal portions of aorta.

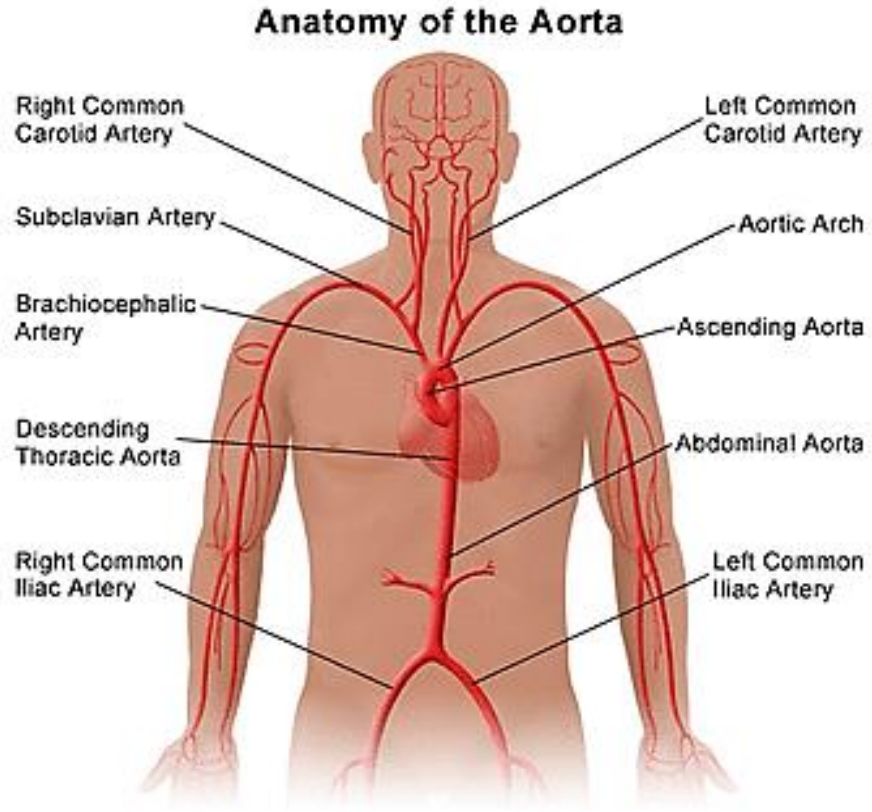

Figure.1. Aorta. Parts of aorta.

Ascending part of **aorta** (Fig.1) leave the left ventricle behind left margin of sternum on level III intercostal space. In initial department it has expansion is aorta bulb, in which three aortic sinuses are contained. Ascending part of aorta lies behind and a little to the right from pulmonary trunk, rises up and to level of second right costal cartilage passes into arc.

The **Arch of the Aorta** (Fig.1) turns posteriorly to the left from second costal cartilage to left side of fourth thoracic vertebral body, where passes into descending aorta. Between concave aortic arch surface and pulmonary trunk on beginning of left pulmonary artery is situated obliterated arterial Botali duct. From convex aortic arch surface starts to from the right to the left: brachiocephalic trunk, left common carotid and left subclavian artery.

Descending aorta (Fig.1) has thoracic part of aorta, which passes in posterior mediastinum and lies to the left from bodies of thoracic vertebrae and abdominal part of aorta, which starts on level of XII thoracic vertebra, passes through aortic hiatus of diaphragm, and extends to level of IV lumbar vertebra. Abdominal part of aorta is disposed front of anterior surface of lumbar vertebrae to the left from midiane line. Here abdominal aorta gives off the pair parietal branches, pair and odd visceral branches and finishes in bifurcation, dividing into two common iliac arteries.

The **aortic arch is the** continuation of the ascending aorta at the level of the sternomanubrial joint

- **course**: an arch from right to left and front to back anterior and to the left of the trachea
- **main branches**: subclavian and common carotid arteries
- **supply**: head, neck and upper limbs

termination: adjacent to the lower border of T4 where it continues as the descending aorta.

The aortic arch represents the continuation of the ascending aorta and is nominally defined as starting at the level of the sternomanubrial joint (which is the same level as the second sternocostal articulation).

It courses in a narrow arch from ventral to dorsal and from right to left such that at the end of the arch is sits to the left of midline, adjacent to the thoracic vertebral column.

Branches

Three main branches originate from the upward convexity of the arch in the majority of patients (proximal to distal):

1. **Brachiocephalic artery** (Fig.2) which goes on to divided into the right subclavian and right common carotid arteries The **brachiocephalic trunk** (**BCT**) is a major vessel that supplies the head, neck and right arm. BCT has previously been known as the **innominate artery**. The **brachiocephalic trunk** is the first of the three main branches of the aortic arch, which originates from the upward convexity. It measures 4-5 cm in length with a diameter of 12.1 ± 1.6 mm. After arising in the midline it courses upwards to the right, crossing the trachea, to bifurcates posteriorly to the right sternoclavicular joint into the right subclavian and right common carotid arteries. It has no other branches.

2. **Left common carotid artery** (Fig.2). The **common carotid artery** is a paired structure that supplies blood to the head and neck. The **common carotid artery** is the branch of the aorta (left) and brachiocephalic trunk (right).

3. **Left subclavian artery** (Fig.2). The **subclavian arteries** are asymmetric paired arteries that supply blood to the posterior cerebral circulation, cerebellum, posterior neck, upper limbs and the superior and anterior chest wall.

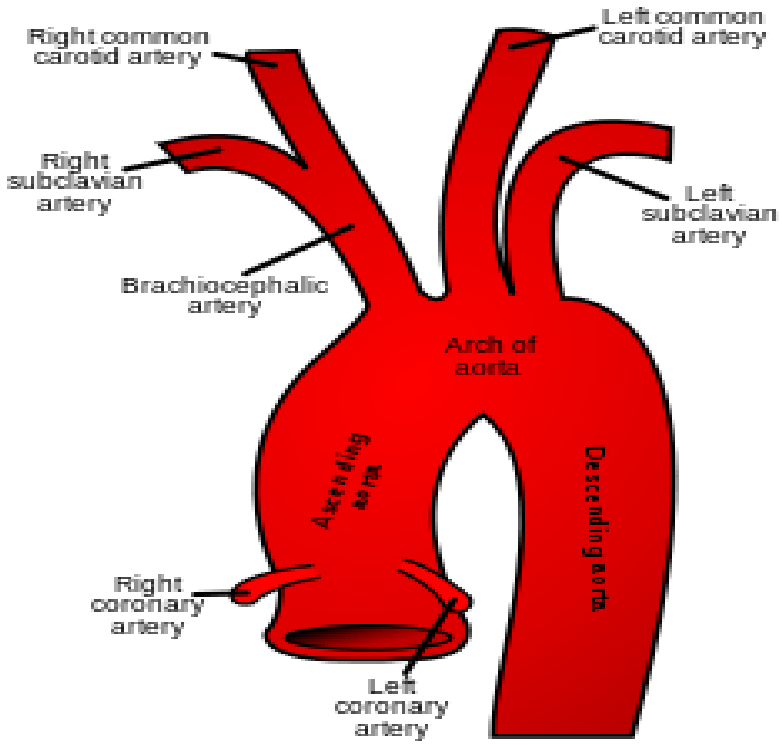

Figure.2. Aorta. Branches.

The **external carotid artery** (Fig.3) begins opposite the upper border of the thyroid cartilage, and, taking a slightly curved course, passes upward and forward, and then inclines backward to the space behind the neck of the mandible, where it divides into the superficial temporal and internal maxillary arteries. It rapidly diminishes in size in its course up the neck, owing to the number and large size of the branches given off from it. In the child, it is somewhat smaller than the internal carotid; but in the adult, the two vessels are of nearly equal size. At its origin, this artery is more superficial, and placed nearer the middle line than the internal carotid, and is contained within the carotid triangle.

The external carotid artery is covered by the skin, superficial fascia, Platysma, deep fascia, and anterior margin of the Sternocleidomastoideus; it is crossed by the hypoglossal nerve, by the lingual, ranine, common facial, and superior thyroid veins; and by the Digastricus and Stylohyoideus; higher up it passes deeply into the substance of the parotid gland, where it lies deep to the facial nerve and the junction of the temporal and internal maxillary veins. Medial to it are the hyoid bone, the wall of the pharynx, the superior laryngeal nerve, and a portion of the parotid gland. Lateral to it, in the lower part of its course, is the internal carotid artery. Posterior to it, near its origin, is the superior laryngeal nerve; and higher up, it is separated from the internal carotid by the Styloglossus and Stylopharyngeus, the glossopharyngeal nerve, the pharyngeal branch of the vagus, and part of the parotid gland.

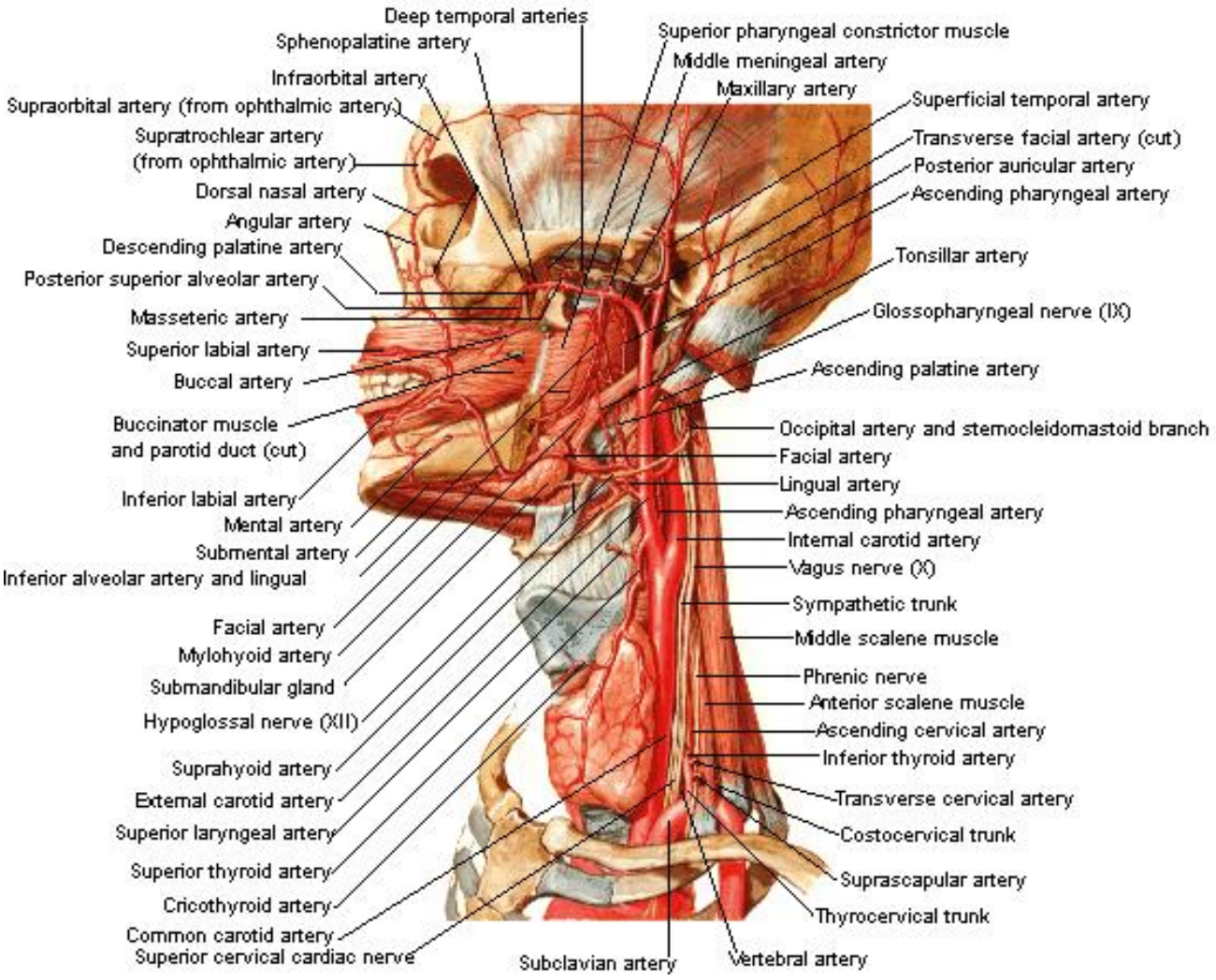

Figure.3. The external carotid artery.

Branches. The branches of the external carotid artery may be divided into four sets:

Anterior:

1. Superior Thyroid.
2. Lingual.
3. External Maxillary.

Posterior:

1. Occipital.
2. Posterior Auricular.

Ascending:

1. Ascending Pharyngeal.

Terminal:

1. Superficial Temporal.
2. Internal Maxillary.

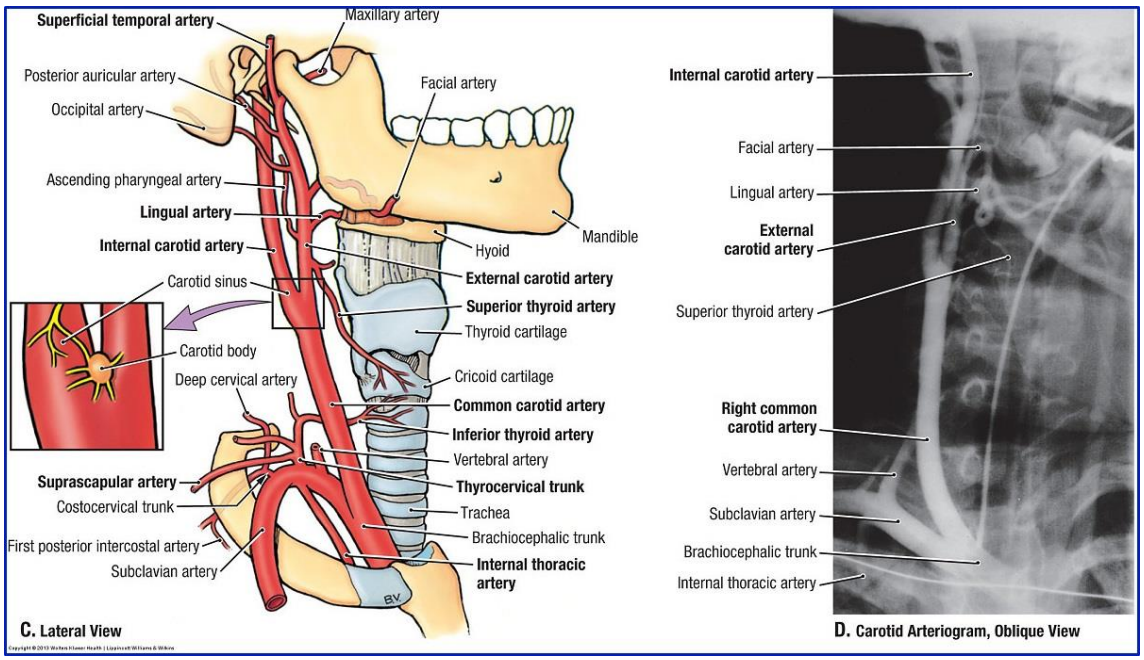

Figure.4. The external carotid artery.

The **superior thyroid artery** (*a. thyreoidea superior*) (Fig. 3) arises from the external carotid artery just below the level of the greater cornu of the hyoid bone and ends in the thyroid gland.

Relations. From its origin under the anterior border of the Sternocleidomastoideus it runs upward and forward for a short distance in the carotid triangle, where it is covered by the skin, Platysma, and fascia; it then arches downward beneath the Omohyoideus, Sternohyoideus, and Sternothyreoideus. To its medial side are the Constrictor pharyngis inferior and the external branch of the superior laryngeal nerve.

Branches. It distributes twigs to the adjacent muscles, and numerous branches to the thyroid gland, anastomosing with its fellow of the opposite side, and with the inferior thyroid arteries. The branches to the gland are generally two in number; one, the larger, supplies principally the anterior surface; on the isthmus of the gland it anastomoses with the corresponding artery of the opposite side: a second branch descends on the posterior surface of the gland and anastomoses with the inferior thyroid artery.

Besides the arteries distributed to the muscles and to the thyroid gland, the **branches** of the superior thyroid are:

1. Hyoid.
2. Sternocleidomastoid.
3. Superior Laryngeal.
4. Cricothyroid.

The **Hyoid Branch** (*ramus hyoideus; infrahyoid branch*) is small and runs along the lower border of the hyoid bone beneath the Thyreohyoideus and anastomoses

with the vessel of the opposite side

The **Sternocleidomastoid Branch** (*ramus sternocleidomastoideus; sternomastoid branch*) runs downward and lateralward across the sheath of the common carotid artery, and supplies the Sternocleidomastoideus and neighboring muscles and integument; it frequently *arises* as a separate branch from the external carotid.

The **Superior Laryngeal Artery** (*a. laryngea superior*), larger than either of the preceding, accompanies the internal laryngeal branch of the superior laryngeal nerve, beneath the Thyreohyoideus; it pierces the hyothyroid membrane, and supplies the muscles, mucous membrane, and glands of the larynx, anastomosing with the branch from the opposite side.

The **Cricothyroid Branch** (*ramus cricothyreoideus*) is small and runs transversely across the cricothyroid membrane, communicating with the artery of the opposite side.

2. The **lingual artery** (*a. lingualis*) (Fig. 5) arises from the external carotid between the superior thyroid and external maxillary; it first runs obliquely upward and medialward to the greater cornu of the hyoid bone; it then curves downward and forward, forming a loop which is crossed by the hypoglossal nerve, and passing beneath the Digastricus and Stylohyoideus it runs horizontally forward, beneath the Hyoglossus, and finally, ascending almost perpendicularly to the tongue, turns forward on its lower surface as far as the tip, under the name of the **profunda linguæ.**

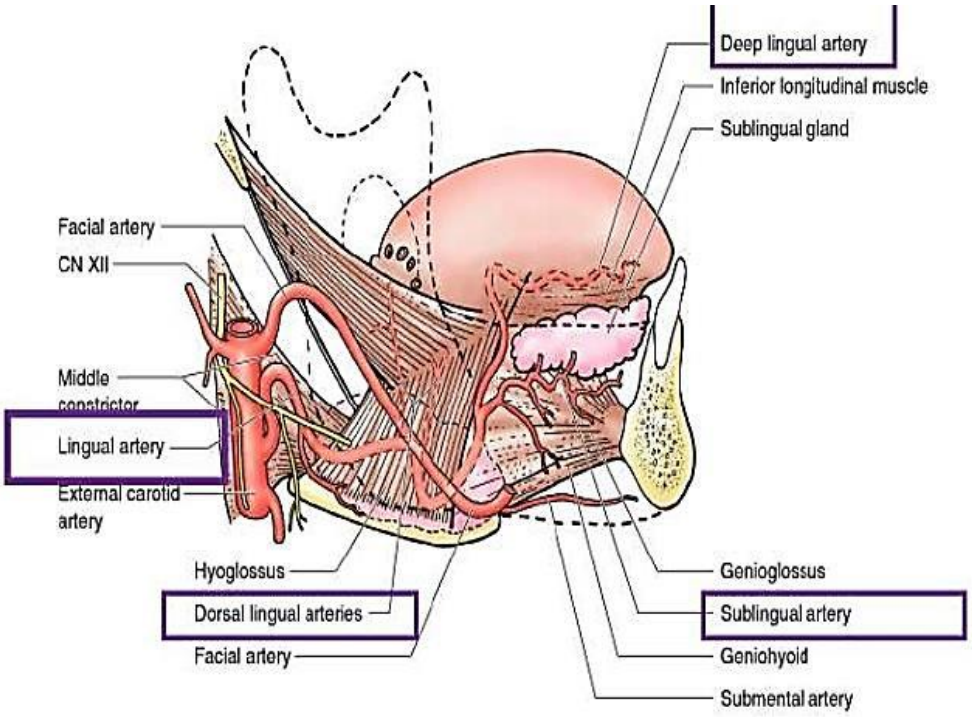

Figure.5. The lingual artery

Relations. Its first, or oblique, portion is superficial, and is contained within the carotid triangle; it rests upon the Constrictor pharyngis medius, and is covered by the Platysma and the fascia of the neck. Its second, or curved, portion also lies upon the Constrictor pharyngis medius, being covered at first by the tendon of the Digastricus and by the Stylohyoideus, and afterward by the Hyoglossus. Its third, or horizontal, portion lies between the Hyoglossus and Genioglossus. The fourth, or terminal part, under the name of the **profunda linguæ**(*ranine artery*) runs along the under surface of the tongue to its tip; here it is superficial, being covered only by the mucous membrane; above it is the Longitudinalis inferior, and on the medial side the Genioglossus. The hypoglossal nerve crosses the first part of the lingual artery, but is separated from the second part by the Hyoglossus.

Branches.—The branches of the lingual artery are:

1. Hyoid.
2. Dorsales linguæ.
3. Sublingual.
4. Profunda linguæ.

The **Hyoid Branch** (*ramus hyoideus; suprahyoid branch*) runs along the upper border of the hyoid bone, supplying the muscles attached to it and anastomosing with its fellow of the opposite side.

The **Arteriæ Dorsales Linguæ** (Fig. 5) (*rami dorsales linguæ*) consist usually of two or three small branches which *arise* beneath the Hyoglossus; they ascend to the back part of the dorsum of the tongue, and supply the mucous membrane in this situation, the glossopalatine arch, the tonsil, soft palate, and epiglottis; anastomosing with the vessels of the opposite side.

The **Sublingual Artery** (Fig. 5) (*a. sublingualis*) *arises* at the anterior margin of the Hyoglossus, and runs forward between the Genioglossus and Mylohyoideus to the sublingual gland. It supplies the gland and gives branches to the Mylohyoideus and neighboring muscles, and to the mucous membrane of the mouth and gums. One branch runs behind the alveolar process of the mandible in the substance of the gum to anastomose with a similar artery from the other side; another pierces the Mylohyoideus and anastomoses with the submental branch of the external maxillary artery.

The **Arteria Profunda Linguæ** (Fig. 5) (*ranine artery; deep lingual artery*) is the terminal portion of the lingual artery; it pursues a tortuous course and runs along the under surface of the tongue, below the Longitudinalis inferior, and above the mucous membrane; it lies on the lateral side of the Genioglossus, accompanied by the lingual nerve. At the tip of the tongue, it is said to anastomose with the artery of the opposite side, but this is denied by Hyrtl. In the mouth, these vessels are placed one on either side of the frenulum linguæ.

3. The **external maxillary artery** (*a. maxillaris externa; facial artery*) (Figs. 3, 6), *arises* in the carotid triangle a little above the lingual artery and, sheltered by the ramus of the mandible, passes obliquely up beneath the Digastricus and

Stylohyoideus, over which it arches to enter a groove on the posterior surface of the submaxillary gland. It then curves upward over the body of the mandible at the antero-inferior angle of the Masseter; passes forward and upward across the cheek to the angle of the mouth, then ascends along the side of the nose, and ends at the medial commissure of the eye, under the name of the **angular artery.** This vessel, both in the neck and on the face, is remarkably tortuous: in the former situation, to accommodate itself to the movements of the pharynx in deglutition; and in the latter, to the movements of the mandible, lips, and cheeks.

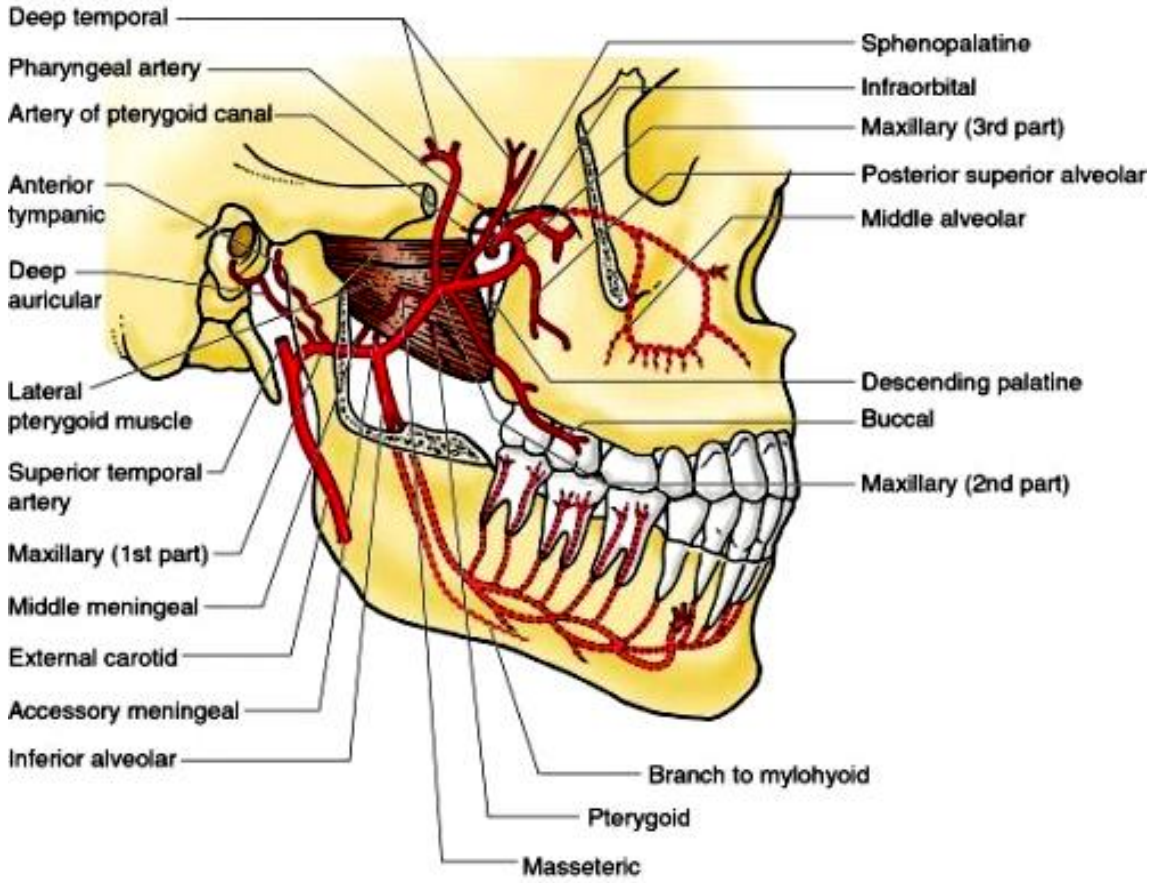

Figure.6. The external maxillary artery

Relations. In the neck, its origin is superficial, being covered by the integument, Platysma, and fascia; it then passes beneath the Digastricus and Stylohyoideus muscles and part of the submaxillary gland, and frequently beneath the hypoglossal nerve. It lies upon the Constrictores pharyngis medius and superior, the latter of which separates it, at the summit of its arch, from the lower and back part of the tonsil. *On the face,* where it passes over the body of the mandible, it is comparatively superficial, lying immediately beneath the Platysma. In its course over the face, it is covered by the integument, the fat of the cheek, and, near the angle of the mouth, by the Platysma, Risorius, and Zygomaticus. It rests on the Buccinator and Caninus, and passes either over or under the infraorbital head of the Quadratus labii superioris. The anterior facial vein lies lateral to the artery, and takes a more direct course across the face, where it is separated from the artery by a considerable

interval. In the neck it lies superficial to the artery. The branches of the facial nerve cross the artery from behind forward.

Branches. The branches of the artery may be divided into two sets: those given off in the neck (*cervical*), and those on the face (*facial*).

Cervical Branches.

1. Ascending Palatine.
2. Tonsillar.
3. Glandular.
4. Submental.
5. Muscular.

Facial Branches.

1. Inferior Labial.
2. Superior Labial
3. Lateral Nasal.
4. Angular.
5. Muscular.

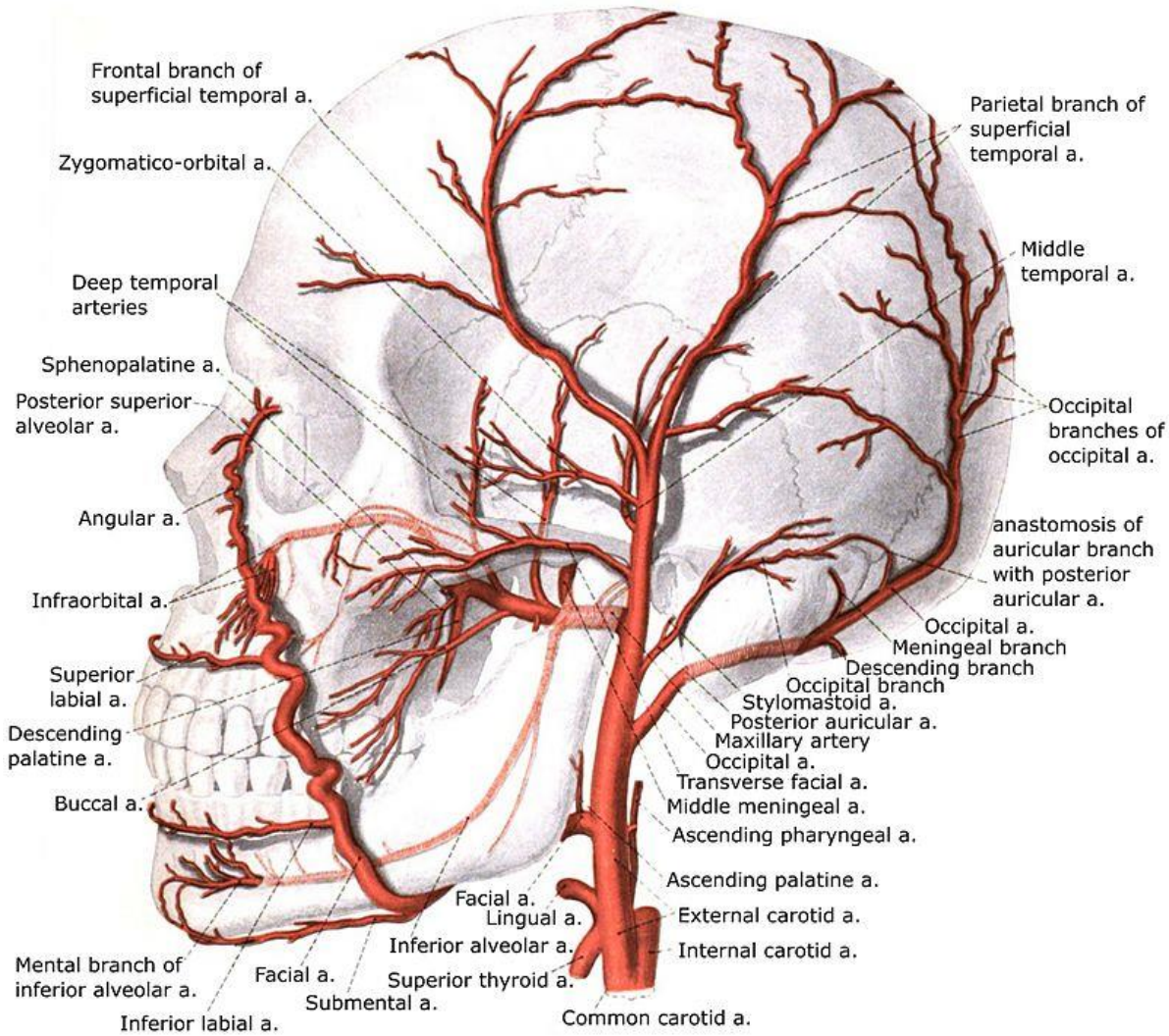

Figure.7. The external maxillary artery

The **Ascending Palatine Artery** (*a. palatina ascendens*) (Figs. 6, 7) *arises* close to the origin of the external maxillary artery and passes up between the Styloglossus and Stylopharyngeus to the side of the pharynx, along which it is continued between the Constrictor pharyngis superior and the Pterygoideus internus to near the base of the skull. It divides near the Levator veli palatini into two branches: one follows the course of this muscle, and, winding over the upper border of the Constrictor pharyngis superior, supplies the soft palate and the palatine glands, anastomosing with its fellow of the opposite side and with the descending palatine branch of the internal maxillary artery; the other pierces the Constrictor pharyngis superior and supplies the palatine tonsil and auditory tube, anastomosing with the tonsillar and ascending pharyngeal arteries.

The **Tonsillar Branch** (*ramus tonsillaris*) (Figs.6,7) ascends between the Pterygoideus internus and Styloglossus, and then along the side of the pharynx, perforating the Constrictor pharyngis superior, to ramify in the substance of the palatine tonsil and root of the tongue.

The **Glandular Branches** (*rami glandulares; submaxillary branches*) consist of three or four large vessels, which supply the submaxillary gland, some being prolonged to the neighboring muscles, lymph glands, and integument.

The **Submental Artery** (*a. submentalis*) (Figs.6,7) the largest of the cervical branches, is given off from the facial artery just as that vessel quits the submaxillary gland: it runs forward upon the Mylohyoideus, just below the body of the mandible, and beneath the Digastricus. It supplies the surrounding muscles, and anastomoses with the sublingual artery and with the mylohyoid branch of the inferior alveolar; at the symphysis menti it turns upward over the border of the mandible and divides into a superficial and a deep branch. The superficial branch passes between the integument and Quadratus labii inferioris, and anastomoses with the inferior labial artery; the deep branch runs between the muscle and the bone, supplies the lip, and anastomoses with the inferior labial and mental arteries.

The **Inferior Labial Artery** (*a. labialis inferior; inferior coronary artery*) (Figs.6,7) arises near the angle of the mouth; it passes upward and forward beneath the Triangularis and, penetrating the Orbicularis oris, runs in a tortuous course along the edge of the lower lip between this muscle and the mucous membrane. It supplies the labial glands, the mucous membrane, and the muscles of the lower lip; and anastomoses with the artery of the opposite side, and with the mental branch of the inferior alveolar artery.

The **Superior Labial Artery** (*a. labialis superior; superior coronary artery*) (Figs.6,7) is larger and more tortuous than the inferior. It follows a similar course along the edge of the upper lip, lying between the mucous membrane and the Orbicularis oris, and anastomoses with the artery of the opposite side. It supplies the upper lip, and gives off in its course two or three vessels which ascend to the nose; a **septal branch**ramifies on the nasal septum as far as the point of the nose, and an **alar branch** supplies the ala of the nose.

The **Lateral Nasal** branch is derived from the external maxillary as that vessel ascends along the side of the nose. It supplies the ala and dorsum of the nose,

anastomosing with its fellow, with the septal and alar branches, with the dorsal nasal branch of the ophthalmic, and with the infraorbital branch of the internal maxillary.

The **Angular Artery** (*a. angularis*) (Figs.6,7) is the terminal part of the external maxillary; it ascends to the medial angle of the orbit, imbedded in the fibers of the angular head of the Quadratus labii superioris, and accompanied by the angular vein. On the cheek it distributes branches which anastomose with the infraorbital; after supplying the lacrimal sac and Orbicularis oculi, it ends by anastomosing with the dorsal nasal branch of the ophthalmic artery.

The **Muscular Branches** (Figs.6,7) in the neck are distributed to the Pterygoideus internus and Stylohyoideus, and on the face to the Masseter and Buccinator. The anastomoses of the external maxillary artery are very numerous, not only with the vessel of the opposite side, but, *in the neck,* with the sublingual branch of the lingual, with the ascending pharyngeal, and by its ascending palatine and tonsillar branches with the palatine branch of the internal maxillary; *on the face*,with the mental branch of the inferior alveolar as it emerges from the mental foramen, with the transverse facial branch of the superficial temporal, with the infraorbital branch of the internal maxillary, and with the dorsal nasal branch of the ophthalmic.

Peculiarities. The external maxillary artery not infrequently arises in common with the lingual. It varies in its size and in the extent to which it supplies the face; it occasionally ends as the submental, and not infrequently extends only as high as the angle of the mouth or nose. The deficiency is then compensated for by enlargement of one of the neighboring arteries.

4. The **occipital artery** (*a. occipitalis*) (Fig. 8) arises from the posterior part of the external carotid, opposite the external maxillary, near the lower margin of the posterior belly of the Digastricus, and ends in the posterior part of the scalp.

Course and Relations. At its origin, it is covered by the posterior belly of the Digastricus and the Stylohyoideus, and the hypoglossal nerve winds around it from behind forward; higher up, it crosses the internal carotid artery, the internal jugular vein, and the vagus and accessory nerves. It next ascends to the interval between the transverse process of the atlas and the mastoid process of the temporal bone, and passes horizontally backward, grooving the surface of the latter bone, being covered by the Sternocleidomastoideus, Splenius capitis, Longissimus capitis, and Digastricus, and resting upon the Rectus capitis lateralis, the Obliquus superior, and Semispinalis capitis. It then changes its course and runs vertically upward, pierces the fascia connecting the cranial attachment of the Trapezius with the Sternocleidomastoideus, and ascends in a tortuous course in the superficial fascia of the scalp, where it divides into numerous branches, which reach as high as the vertex of the skull and anastomose with the posterior auricular and superficial temporal arteries. Its terminal portion is accompanied by the greater occipital nerve.

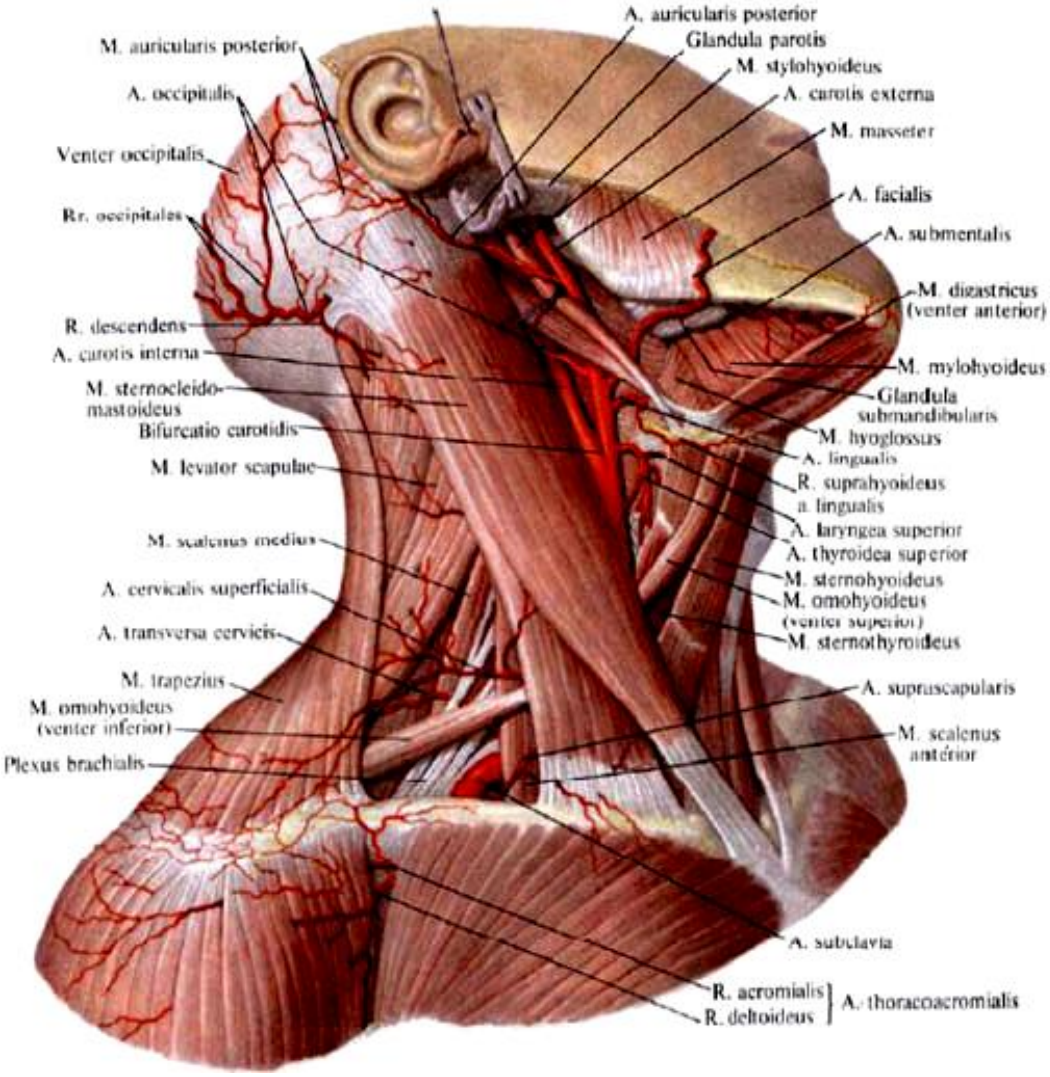

Figure.8. The occipital artery.

Branches. The branches of the occipital artery are:

1. Muscular.
2. Meningeal.
3. Sternocleidomastoid.
4. Descending.
5. Auricular.

The **Muscular Branches** (*rami musculares*) supply the Digastricus, Stylohyoideus, Splenius, and Longissimus capitis.

The **Sternocleidomastoid Artery** (*a. sternocleidomastoidea; sternomastoid artery*) (Fig. 8) generally arises from the occipital close to its commencement, but sometimes springs directly from the external carotid. It passes downward and backward over the hypoglossal nerve, and enters the substance of the muscle, in company with the accessory nerve.

The **Auricular Branch** (*ramus auricularis*) supplies the back of the concha and frequently gives off a branch, which enters the skull through the mastoid foramen and supplies the dura mater, the diploë, and the mastoid cells; this latter branch sometimes arises from the occipital artery, and is then known as the **mastoid branch.**

The **Meningeal Branch** (*ramus meningeus; dural branch*) ascends with the internal jugular vein, and enters the skull through the jugular foramen and condyloid canal, to supply the dura mater in the posterior fossa.

The **Descending Branch** (*ramus descendens; arteria princeps cervicis*) (Fig. 8), the largest branch of the occipital, descends on the back of the neck, and divides into a superficial and deep portion. The superficial portion runs beneath the Splenius, giving off branches which pierce that muscle to supply the Trapezius and anastomose with the ascending branch of the transverse cervical: the deep portion runs down between the Semispinales capitis and colli, and anastomoses with the vertebral and with the a. profunda cervicalis, a branch of the costocervical trunk. The anastomosis between these vessels assists in establishing the collateral circulation after ligature of the common carotid or subclavian artery.

The terminal branches of the occipital artery are distributed to the back of the head: they are very tortuous, and lie between the integument and Occipitalis, anastomosing with the artery of the opposite side and with the posterior auricular and temporal arteries, and supplying the Occipitalis, the integument, and pericranium. One of the terminal branches may give off a meningeal twig which passes through the parietal foramen.

5. The **posterior auricular artery** (*a. auricularis posterior*) (Fig. 9) is small and arises from the external carotid, above the Digastricus and Stylohyoideus, opposite the apex of the styloid process. It ascends, under cover of the parotid gland, on the styloid process of the temporal bone, to the groove between the cartilage of the ear and the mastoid process, immediately above which it divides into its auricular and occipital branches.

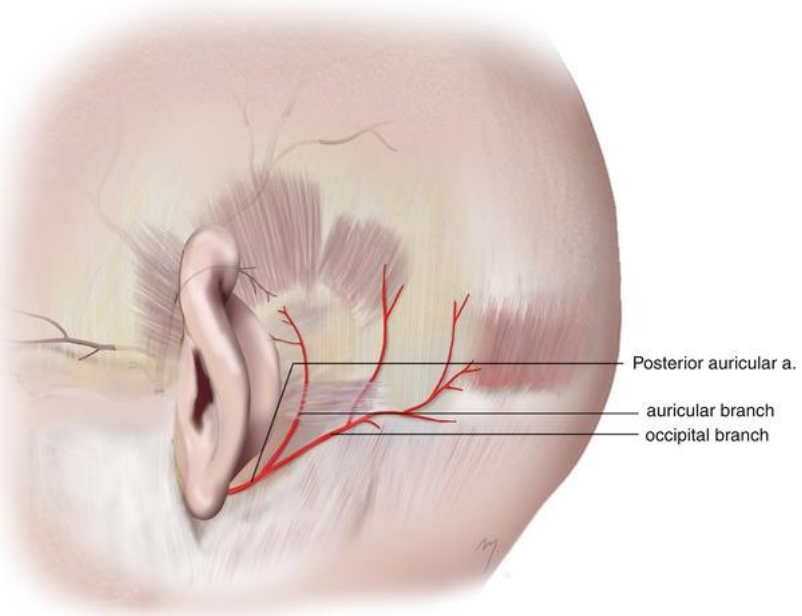

Figure.9. The posterior auricular artery

Branches. Besides several small branches to the Digastricus, Stylohyoideus, and Sternocleidomastoideus, and to the parotid gland, this vessel gives off three branches:

1. Stylomastoid.

2. Auricular.
3. Occipital.

The **Stylomastoid Artery** (*a. stylomastoidea*) enters the stylomastoid foramen and supplies the tympanic cavity, the tympanic antrum and mastoid cells, and the semicircular canals. In the young subject a branch from this vessel forms, with the anterior tympanic artery from the internal maxillary, a vascular circle, which surrounds the tympanic membrane, and from which delicate vessels ramify on that membrane. It anastomoses with the superficial petrosal branch of the middle meningeal artery by a twig which enters the hiatus canalis facialis.

The **Auricular Branch** (*ramus auricularis*) ascends behind the ear, beneath the Auricularis posterior, and is distributed to the back of the auricula, upon which it ramifies minutely, some branches curving around the margin of the cartilage, others perforating it, to supply the anterior surface. It anastomoses with the parietal and anterior auricular branches of the superficial temporal.

The **Occipital Branch** (*ramus occipitalis*) passes backward, over the Sternocleidomastoideus, to the scalp above and behind the ear. It supplies the Occipitalis and the scalp in this situation and anastomoses with the occipital artery.

6. The **ascending pharyngeal artery** (*a. pharyngea ascendens*) (Fig. 10), the smallest branch of the external carotid, is a long, slender vessel, deeply seated in the neck, beneath the other branches of the external carotid and under the Stylopharyngeus. It *arises* from the back part of the external carotid, near the commencement of that vessel, and ascends vertically between the internal carotid and the side of the pharynx, to the under surface of the base of the skull, lying on the Longus capitis.

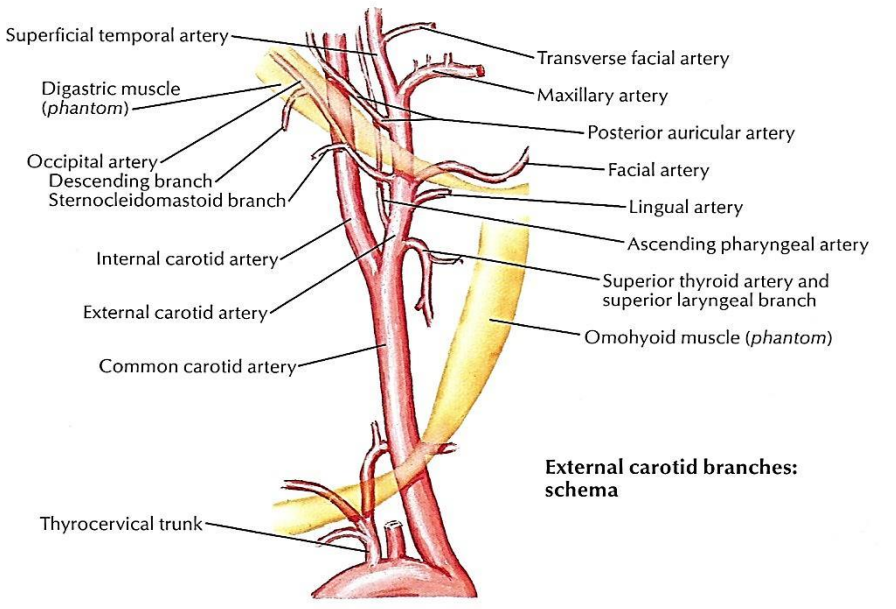

Figure.10. The ascending pharyngeal artery

Branches. (Fig. 11). Its branches are:

1. Pharyngeal.
2. Palatine.

3. Posterior Meningeal.
4. Prevertebral.
5. Inferior Tympanic.

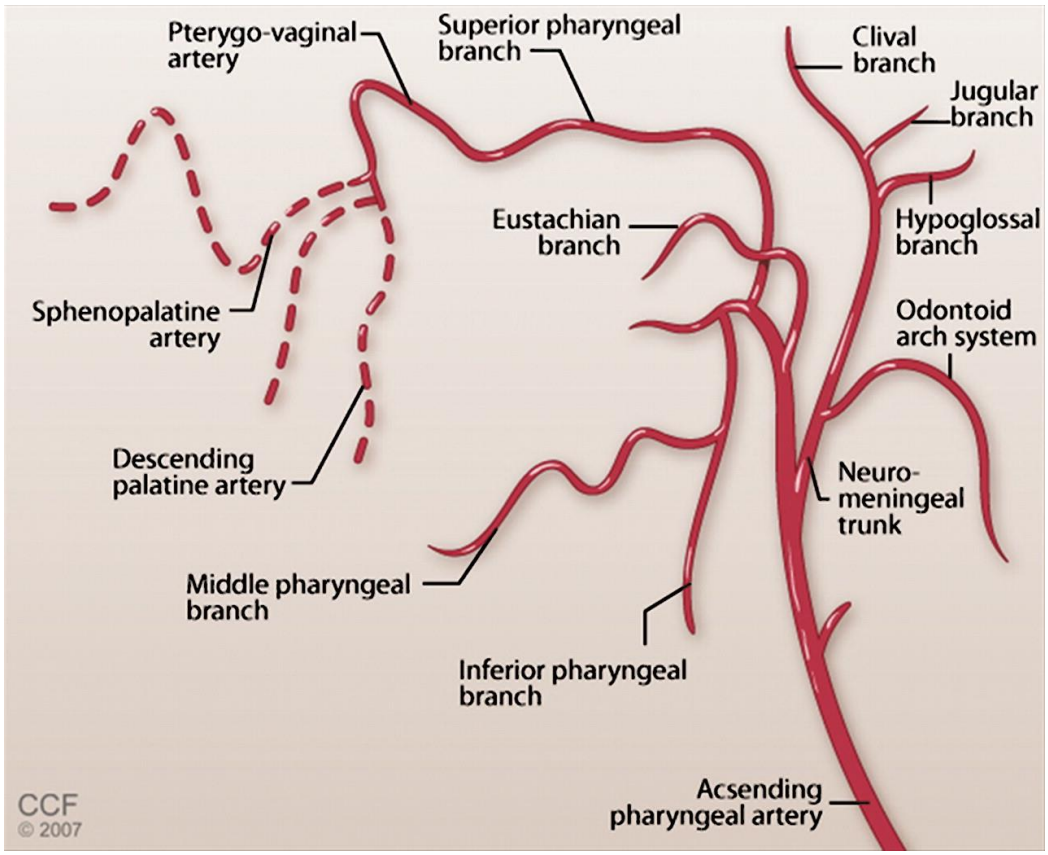

Figure.11. The branches of ascending pharyngeal artery

The **Pharyngeal Branches** (*rami pharyngei*) are three or four in number. Two of these descend to supply the Constrictores pharyngis medius and inferior and the Stylopharyngeus, ramifying in their substance and in the mucous membrane lining them.

The **Palatine Branch** varies in size, and may take the place of the ascending palatine branch of the facial artery, when that vessel is small. It passes inward upon the Constrictor pharyngis superior, sends ramifications to the soft palate and tonsil, and supplies a branch to the auditory tube.

The **Prevertebral Branches** are numerous small vessels, which supply the Longi capitis and colli, the sympathetic trunk, the hypoglossal and vagus nerves, and the The **Inferior Tympanic Artery** (*a. tympanica inferior*) is a small branch which passes through a minute foramen in the petrous portion of the temporal bone, in company with the tympanic branch of the glossopharyngeal nerve, to supply the medial wall of the tympanic cavity and anastomose with the other tympanic arteries.

The **Meningeal Branches** are several small vessels, which supply the dura mater. One, the **posterior meningeal,** enters the cranium through the jugular foramen; a second passes through the foramen lacerum; and occasionally a third through the canal for the hypoglossal nerve.

7. The **superficial temporal artery** (*a. temporalis superficialis*) (Fig. 12), the smaller of the two terminal branches of the external carotid, appears, from its direction, to be the continuation of that vessel. It begins in the substance of the parotid gland, behind the neck of the mandible, and corsses over the posterior root of the zygomatic process of the temporal bone; about 5 cm. above this process it divides into two branches, a frontal and a parietal.

Relations. As it crosses the zygomatic process, it is covered by the Auricularis anterior muscle, and by a dense fascia; it is crossed by the temporal and zygomatic branches of the facial nerve and one or two veins, and is accompanied by the auriculotemporal nerve, which lies immediately behind it.

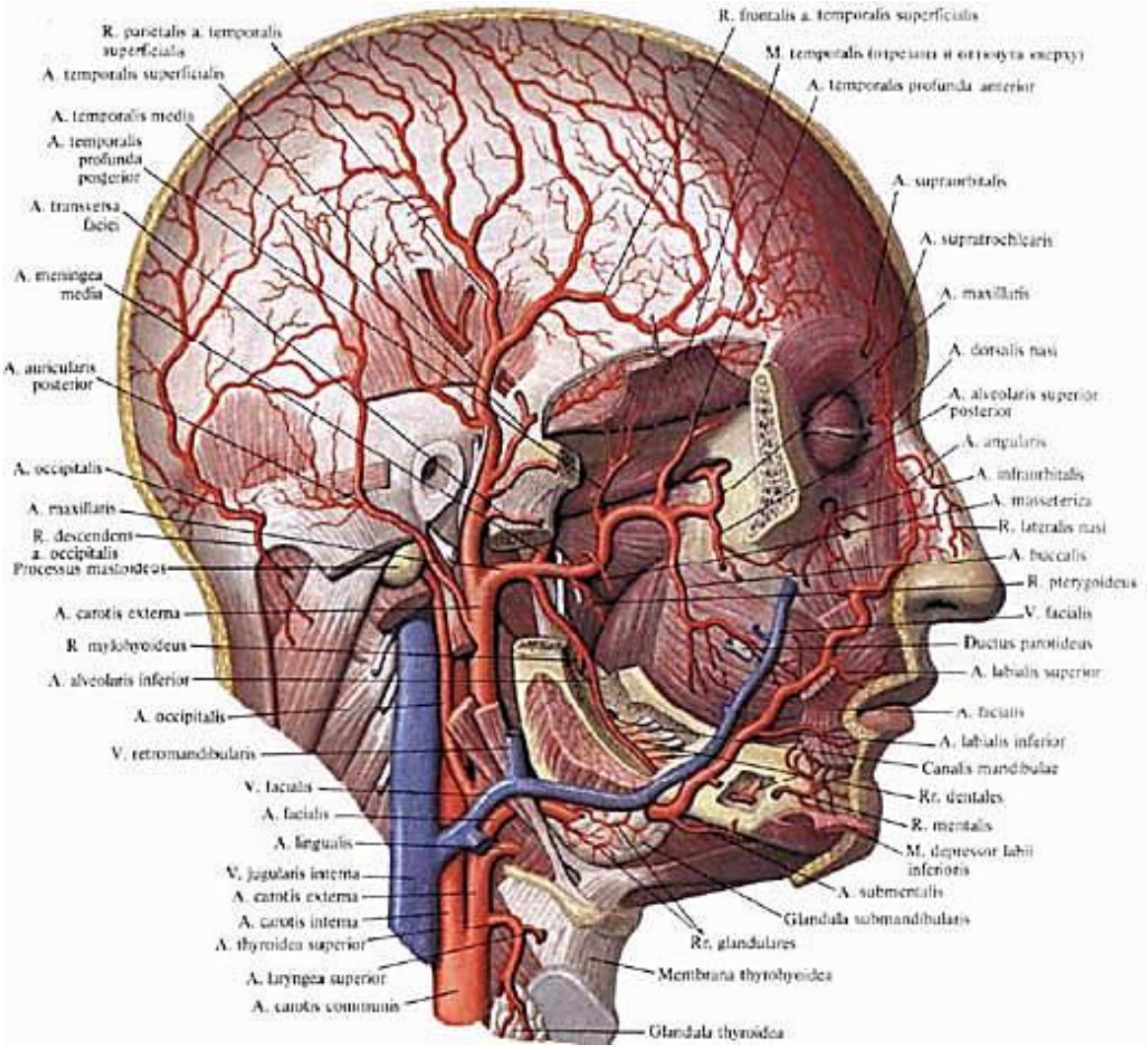

Figure.12. The superficial temporal artery

Branches. Besides some twigs to the parotid gland, to the temporomandibular joint, and to the Masseter muscle, its branches are:

1. Transverse Facial.
2. Middle Temporal.
3. Parietal.
4. Anterior Auricular.
5. Frontal.

The **Transverse Facial Artery** (*a. transversa faciei*) is givien off from the superficial temporal before that vessel quits the parotid gland; running forward through the substance of the gland, it passes transversely across the side of the face, between the parotid duct and the lower border of the zygomatic arch, and divides into numerous branches, which supply the parotid gland and duct, the Masseter, and the integument, and anastomose with the external maxillary, masseteric, buccinator, and infraorbital arteries. This vessel rests on the Masseter, and is accompanied by one or two branches of the facial nerve.

The **Middle Temporal Artery** (*a. temporalis media*) *arises* immediately above the zygomatic arch, and, perforating the temporal fascia, gives branches to the Temporalis, anastomosing with the deep temporal branches of the internal maxillary. It occasionally gives off a **zygomaticoorbital branch,** which runs along the upper border of the zygomatic arch, between the two layers of the temporal fascia, to the lateral angle of the orbit. This branch, which may arise directly from the superficial temporal artery, supplies the Orbicularis oculi, and anastomoses with the lacrimal and palpebral branches of the ophthalmic artery.

The **Anterior Auricular Branches** (*rami auriculares anteriores*) are distributed to the anterior portion of the auricula, the lobule, and part of the external meatus, anastomosing with the posterior auricular.

The **Frontal Branch** (*ramus frontalis; anterior temporal*) runs tortuously upward and forward to the forehead, supplying the muscles, integument, and pericranium in this region, and anastomosing with the supraorbital and frontal arteries.

The **Parietal Branch** (*ramus parietalis; posterior temporal*) larger than the frontal, curves upward and backward on the side of the head, lying superficial to the temporal fascia, and anastomosing with its fellow of the opposite side, and with the posterior auricular and occipital arteries.

8. The **internal maxillary artery** (*a. maxillaris interna*) (Fig. 6, 7, 13), the larger of the two terminal branches of the external carotid, *arises*behind the neck of the mandible, and is at first imbedded in the substance of the parotid gland; it passes forward between the ramus of the mandible and the sphenomandibular ligament, and then runs, either superficial or deep to the Pterygoideus externus, to the pterygopalatine fossa. It supplies the deep structures of the face, and may be divided into **mandibular, pterygoid,** and **pterygopalatine portions.**

The **first** or **mandibular portion** passes horizontally forward, between the ramus of the mandible and the sphenomandibular ligament, where it lies parallel to and a little below the auriculotemporal nerve; it crosses the inferior alveolar nerve, and runs along the lower border of the Pterygoideus externus.

The **second** or **pterygoid portion** runs obliquely forward and upward under cover of the ramus of the mandible and insertion of the Temporalis, on the superficial (very frequently on the deep) surface of the Pterygoideus externus; it then passes between the two heads of origin of this muscle and enters the fossa.

The **third** or **pterygopalatine portion** lies in the pterygopalatine fossa in relation with the sphenopalatine ganglion.

The branches of this vessel may be divided into three groups (Fig. 13), corresponding with its three divisions.

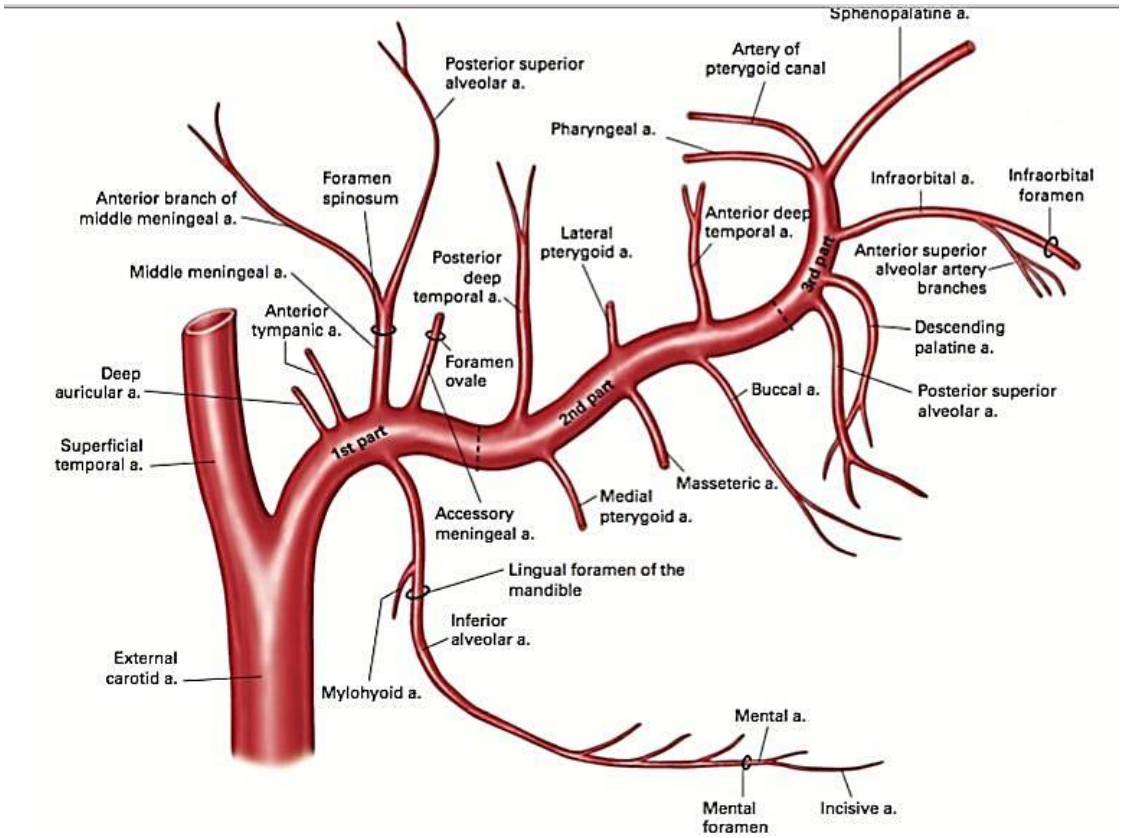

Figure.13. The internal maxillary artery

Branches of the First or Mandibular Portions.

1. Anterior Tympanic.
2. Deep Auricular.
3. Inferior Alveolar.
4. Middle Meningeal.
5. Accessory Meningeal.

The **Anterior Tympanic Artery** (*a. tympanica anterior; tympanic artery*) (Fig. 13), passes upward behind the temporomandibular articulation, enters the tympanic cavity through the petrotympanic fissure, and ramifies upon the tympanic membrane, forming a vascular circle around the membrane with the stylomastoid branch of the posterior auricular, and anastomosing with the artery of the pterygoid canal and with the caroticotympanic branch from the internal carotid.

The **Deep Auricular Artery** (*a. auricularis profunda*) (Fig. 13), often arises in common with the preceding. It ascends in the substance of the parotid gland, behind the temporomandibular articulation, pierces the cartilaginous or bony wall of the external acoustic meatus, and supplies its cuticular lining and the outer surface of the tympanic membrane. It gives a branch to the temporomandibular joint.

The **Middle Meningeal Artery** (*a. meningea media; medidural artery*) (Fig. 13), is the largest of the arteries which supply the dura mater. It ascends between the

sphenomandibular ligament and the Pterygoideus externus, and between the two roots of the auriculotemporal nerve to the foramen spinosum of the sphenoid bone, through which it enters the cranium; it then runs forward in a groove on the great wing of the sphenoid bone, and divides into two branches, anterior and posterior. The **anterior branch,** the larger, crosses the great wing of the sphenoid, reaches the groove, or canal, in the sphenoidal angle of the parietal bone, and then divides into branches which spread out between the dura mater and internal surface of the cranium, some passing upward as far as the vertex, and others backward to the occipital region. The **posterior branch** curves backward on the squama of the temporal bone, and, reaching the parietal some distance in front of its mastoid angle, divides into branches which supply the posterior part of the dura mater and cranium. The branches of the middle meningeal artery are distributed partly to the dura mater, but chiefly to the bones; they anastomose with the arteries of the opposite side, and with the anterior and posterior meningeal.

The middle meningeal on entering the cranium gives off the following branches:

1. Numerous small vessels supply the semilunar ganglion and the dura mater in this situation.

2. A **superficial petrosal** branch enters the hiatus of the facial canal, supplies the facial nerve, and anastomoses with the stylomastoid branch of the posterior auricular artery.

3. A **superior tympanic artery** runs in the canal for the Tensor tympani, and supplies this muscle and the lining membrane of the canal.

4. **Orbital branches** pass through the superior orbital fissure or through separate canals in the great wing of the sphenoid, to anastomose with the lacrimal or other branches of the ophthalmic artery.

5. **Temporal branches** pass through foramina in the great wing of the sphenoid, and anastomose in the temporal fossa with the deep temporal arteries.

The **Accessory Meningeal Branch** (*ramus meningeus accessorius; small meningeal or parvidural branch*) is sometimes derived from the preceding. It enters the skull through the foramen ovale, and supplies the semilunar ganglion and dura mater.

The **Inferior Alveolar Artery** (*a. alveolaris inferior; inferior dental artery*) (Fig. 13), descends with the inferior alveolar nerve to the mandibular foramen on the medial surface of the ramus of the mandible. It runs along the mandibular canal in the substance of the bone, accompanied by the nerve, and opposite the first premolar tooth divides into two branches, incisor and mental. The **incisor branch** is continued forward beneath the incisor teeth as far as the middle line, where it anastomoses with the artery of the opposite side; the **mental branch**escapes with the nerve at the mental foramen, supplies the chin, and anastomoses with the submental and inferior labial arteries. Near its origin the inferior alveolar artery gives off a **lingual branch** which descends with the lingual nerve and supplies the mucous membrane of the mouth. As the inferior alveolar artery enters the foramen, it gives off a **mylohyoid branch** which runs in the mylohyoid groove, and ramifies on the under surface of the Mylohyoideus. The inferior alveolar artery and its incisor branch during their course through the substance of the bone give off a few twigs which are lost in the

cancellous tissue, and a series of branches which correspond in number to the roots of the teeth: these enter the minute apertures at the extremities of the roots, and supply the pulp of the teeth.

Branches of the Second or Pterygoid Portion (Fig. 13):

1. Deep Temporal.
2. Pterygoid.
3. Buccinator.
4. Masseteric.

The **Deep Temporal Branches,** two in number, **anterior** and **posterior,** ascend between the Temporalis and the pericranium; they supply the muscle, and anastomose with the middle temporal artery; the anterior communicates with the lacrimal artery by means of small branches which perforate the zygomatic bone and great wing of the sphenoid.

The **Pterygoid Branches** (*rami pterygoidei*), irregular in their number and origin, supply the Pterygoidei.

The **Masseteric Artery** (*a. masseterica*) is small and passes lateralward through the mandibular notch to the deep surface of the Masseter. It supplies the muscle, and anastomoses with the masseteric branches of the external maxillary and with the transverse facial artery.

The **Buccinator Artery** (*a. buccinatoria; buccal artery*) is small and runs obliquely forward, between the Pterygoideus internus and the insertion of the Temporalis, to the outer surface of the Buccinator, to which it is distributed, anastomosing with branches of the external maxillary and with the infraorbital.

Branches of the Third or Pterygopalatine Portion.

1. Posterior Superior Alveolar.
2. Infraorbital.
3. Descending Palatine.
4. Artery of the Pterygoid Canal.
5. Pharyngeal.
6. Sphenopalatine.

The **Posterior Superior Alveolar Artery** (*a. alveolaris superior posterior; alveolar or posterior dental artery*) (Fig. 13), is given off from the internal maxillary, frequently in conjunction with the infraorbital just as the trunk of the vessel is passing into the pterygopalatine fossa. Descending upon the tuberosity of the maxilla, it divides into numerous branches, some of which enter the alveolar canals, to supply the molar and premolar teeth and the lining of the maxillary sinus, while others are continued forward on the alveolar process to supply the gums.

The **Infraorbital Artery** (*a. infraorbitalis*) appears, from its direction, to be the continuation of the trunk of the internal maxillary, but often *arises* in conjunction with the posterior superior alveolar. It runs along the infraorbital groove and canal with the infraorbital nerve, and emerges on the face through the infraorbital foramen, beneath the infraorbital head of the Quadratus labii superioris. While in the canal, it gives off (*a*) **orbital branches** which assist in supplying the Rectus inferior and

Obliquus inferior and the lacrimal sac, and (*b*) **anterior superior alveolar branches** which descend through the anterior alveolar canals to supply the upper incisor and canine teeth and the mucous membrane of the maxillary sinus. On the face, some branches pass upward to the medial angle of the orbit and the lacrimal sac, anastomosing with the angular branch of the external maxillary artery; others run toward the nose, anastomosing with the dorsal nasal branch of the ophthalmic; and others descend between the Quadratus labii superioris and the Caninus, and anastomose with the external maxillary, transverse facial, and buccinator arteries. The four remaining branches *arise* from that portion of the internal maxillary which is contained in the pterygopalatine fossa.

The **Descending Palatine Artery** (*a. palatina descendens*) (Fig. 13), descends through the pterygopalatine canal with the anterior palatine branch of the sphenopalatine ganglion, and, emerging from the greater palatine foramen, runs forward in a groove on the medial side of the alveolar border of the hard palate to the incisive canal; the terminal branch of the artery passes upward through this canal to anastomose with the sphenopalatine artery. Branches are distributed to the gums, the palatine glands, and the mucous membrane of the roof of the mouth; while in the pterygopalatine canal it gives off twigs which descend in the lesser palatine canals to supply the soft palate and palatine tonsil, anastomosing with the ascending palatine artery.

The **Artery of the Pterygoid Canal** (*a. canalis pterygoidei; Vidian artery*) passes backward along the pterygoid canal with the corresponding nerve. It is distributed to the upper part of the pharynx and to the auditory tube, sending into the tympanic cavity a small branch which anastomoses with the other tympanic arteries.

The **Pharyngeal Branch** is very small; it runs backward through the pharyngeal canal with the pharyngeal nerve, and is distributed to the upper part of the pharynx and to the auditory tube.

The **Sphenopalatine Artery** (*a. sphenopalatina; nasopalatine artery*) (Fig. 13), passes through the sphenopalatine foramen into the cavity of the nose, at the back part of the superior meatus. Here it gives off its **posterior lateral nasal branches** which spread forward over the conchæ and meatuses, anastomose with the ethmoidal arteries and the nasal branches of the descending palatine, and assist in supplying the frontal, maxillary, ethmoidal, and sphenoidal sinuses. Crossing the under surface of the sphenoid the sphenopalatine artery ends on the nasal septum as the **posterior septal branches;** these anastomose with the ethmoidal arteries and the septal branch of the superior labial; one branch descends in a groove on the vomer to the incisive canal and anastomoses with the descending palatine artery.

Subclavian artery

Left Subclavian artery (Fig. 14, 15), starts from aortic arch and right one - from the brachiocephalic trunk (Fig. 16). It leaves thoracic cavity through the *superior aperture*, rounds a pleura cupola and gets into interscalenus space. Then artery lies under clavicle into same name sulcus of first rib and runs into axillary cavity, where has a name axillary artery.

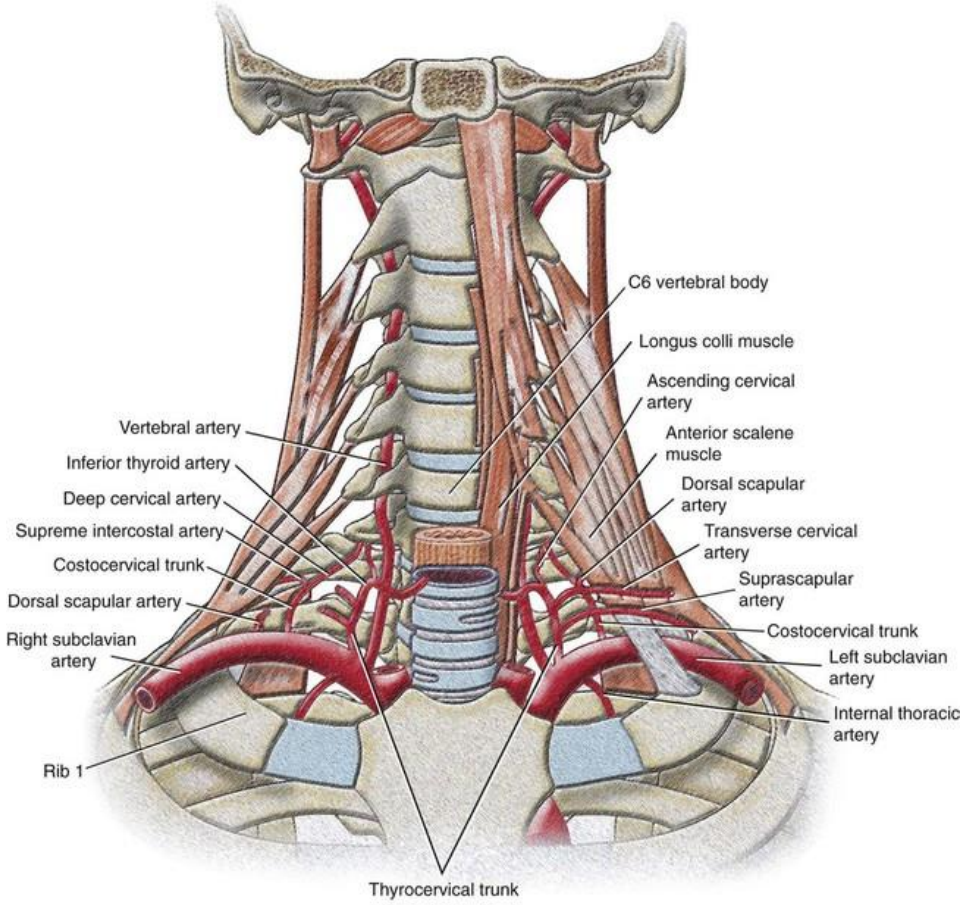

Figure.14. Subclavian **artery.**

Subclavian artery conventionally subdivides into three portions: before interscalenus space, in interscalenus space and after interscalenus space (Fig. 16).

Before interscalenus space subclavian artery gives off the following branches:

Vertebral artery (Fig. 15) is a largest branch of subclavian artery, passes in foramens of transversal processes of cervical vertebrae, transfixes a atlanto-occipital membrane and dura mater encephali and through occipital foramen magnum gets into skull cavity. Behind pons this right and left artery flows together and forms *basillar artery*. Vertebral artery gives off *anterior spinal artery* and *posterior spinal artery*, and *posterior inferior cerebellar artery*. From basillar artery start: *anterior inferior cerebellar artery, labyrinthic artery, pontini arteries* and *artery mesencephalic*. Vertebral artery together with anterior spinal arteries forms around medulla oblongata *circle of Zakharchenka*.

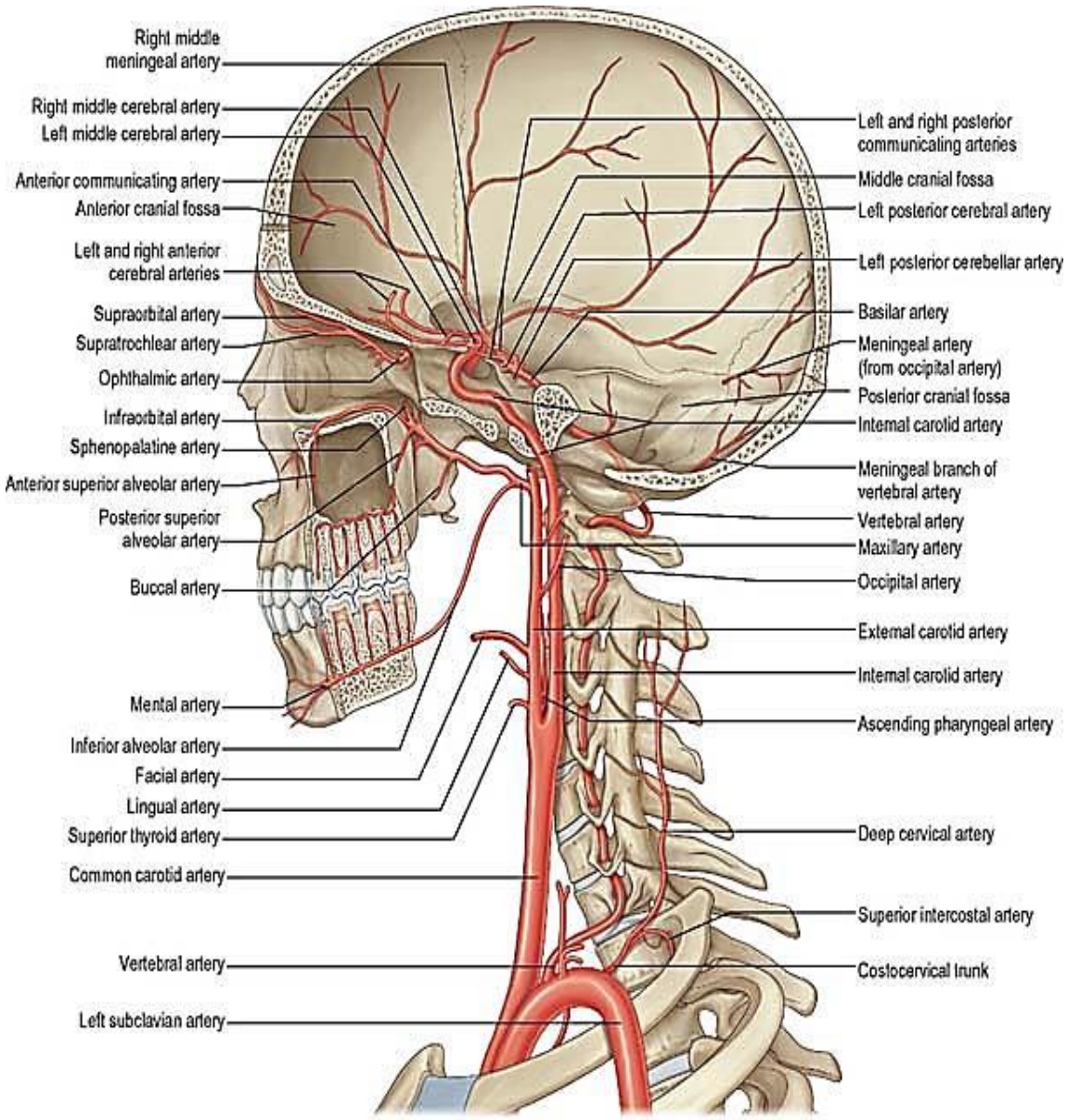

Figure.15. Left Subclavian **artery.**

Basillar artery (Fig. 15) on level of anterior margin pons ramifies on two *posterior cerebral arteries*, which supply occipital lobes of cerebrum. Posterior cerebral arteries connect by *posterior communicating artery* with *internal carotid artery*.

Internal thoracic artery (Fig. 16,17) begins from inferior surface of subclavian artery and passes along I-VII cartilages of ribs near sternum, where disintegrates on two terminal branches are *musculo-phrenic artery* and *superior epigastric artery*. Internal thoracic artery gives off *rami* for *thymus, bronchi, pericardium* and *sternum*. Also from this artery moves away *rami mammarii, tracheal rami, anterior intercostal branches*, which supply intercostal muscles. *Superior epigastric artery* gets into sheath of rectus abdominal muscle, supplies this muscle and anastomoses with inferior epigastric artery on navel level.

Thyro-cervical trunk (Fig. 17) has length 1-2 cm and subdivides into four branches: *inferior thyroid artery*, (supplies thyroid gland, cervical esophagus department, cervical trachea portion and *inferior laryngeal artery* reaches mucous membrane of the larynx),*ascending cervical artery* (to neck muscles), *superficial cervical artery* (to trapezius, rhomboid and other neck muscles) and*suprascapular artery* (for supraspinatus and infraspinatus muscles).

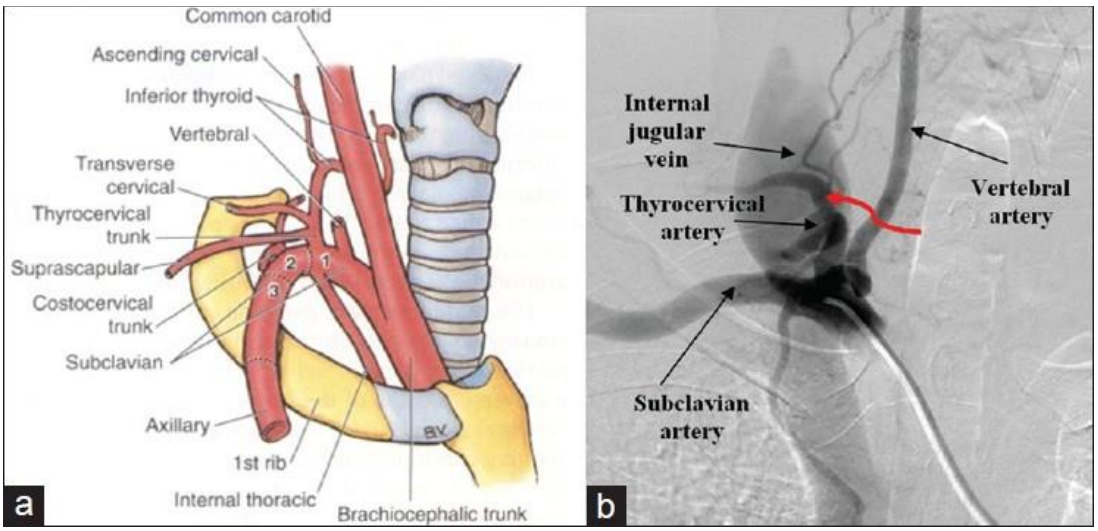

Figure.16. Brachiocephalic trunk. Branches.

In interscalenus space subclavian artery gives off *costo-cervical trunk* (Fig. 16, 17), which ramifies into *deep cervical artery*, which supplies semispinalis capitis and cervicis muscles and *suprema intercostal artery*, which ramifies into I and II intercostal spaces, supplying intercostal muscles.

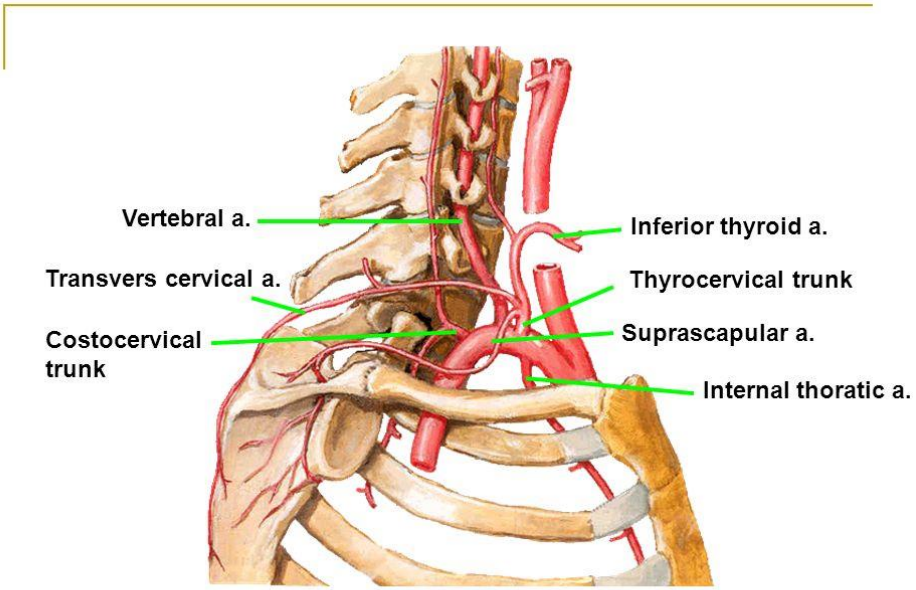

Figure.17. Subclavian artery. Branches.

After interscalenus space space (Fig. 18), subclavian artery gives off:

transverse colli artery, which continues into *dorsal scapulae artery*. They supply rhomboid, levator scapulae and shoulder girdle muscles.

The artery which supplies the upper extremity continues as a single trunk from its commencement down to the elbow; but different portions of it have received different names, according to the regions through which they pass. That part of the vessel which extends from its origin to the outer border of the first rib is termed the subclavian; beyond this point to the lower border of the axilla it is named the axillary; and from the lower margin of the axillary space to the bend of the elbow it is termed brachial; here the trunk ends by dividing into two branches the radial and ulnar.

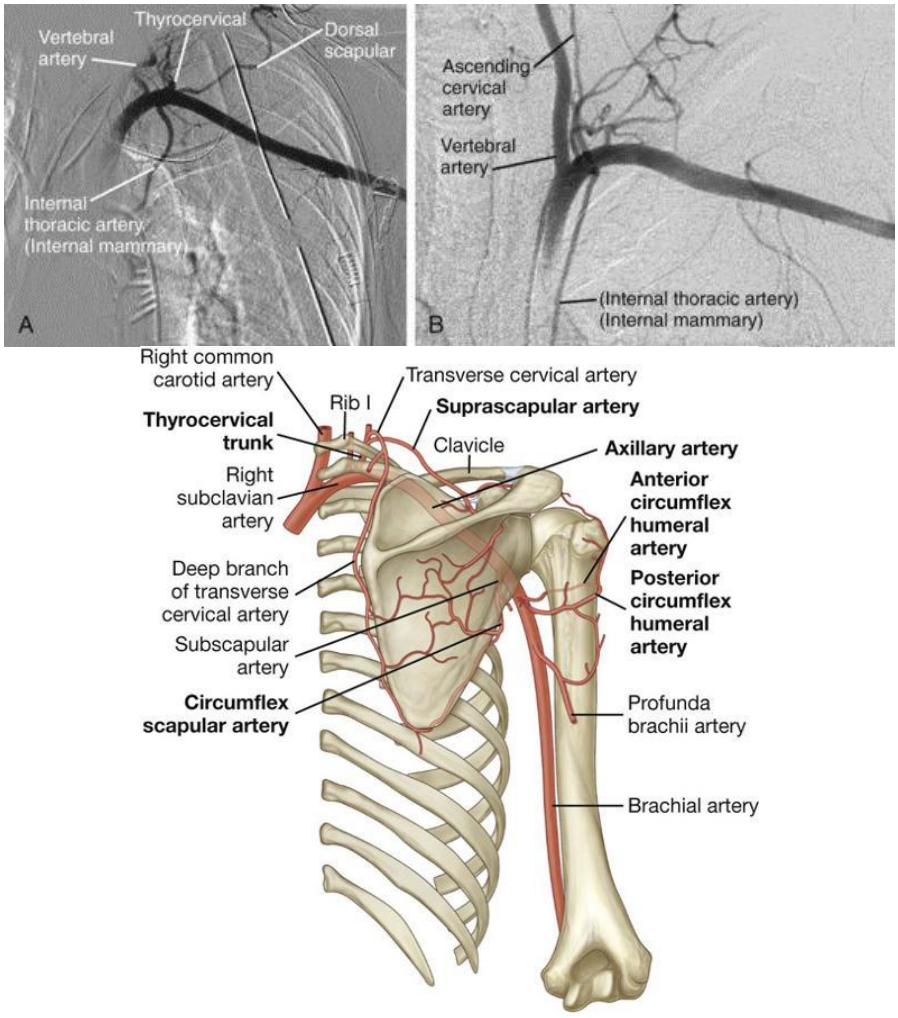

Figure.18. Subclavian artery. Branches.

—On the right side the subclavian artery (Fig. 14,16) *arises* from the innominate artery behind the right sternoclavicular articulation; on the left side it springs from the arch of the aorta. The two vessels, therefore, in the first part of their course, differ in length, direction, and relation with neighboring structures.

In order to facilitate the description, each subclavian artery is divided into three parts. The first portion extends from the origin of the vessel to the medial border of the Scalenus anterior; the second lies behind this muscle; and the third extends from the lateral margin of the muscle to the outer border of the first rib, where it becomes

the axillary artery. The first portions of the two vessels require separate descriptions; the second and third parts of the two arteries are practically alike.

First Part of the Right Subclavian Artery (Fig. 14,16) .—The first part of the right subclavian artery *arises* from the innominate artery, behind the upper part of the right sternoclavicular articulation, and passes upward and lateralward to the medial margin of the Scalenus anterior. It ascends a little above the clavicle, the extent to which it does so varying in different cases.

Relations.—It is covered, *in front,* by the integument, superficial fascia, Platysma, deep fascia, the clavicular origin of the Sternocleidomastoideus, the Sternohyoideus, and Sternothyreoideus, and another layer of the deep fascia. It is crossed by the internal jugular and vertebral veins, by the vagus nerve and the cardiac branches of the vagus and sympathetic, and by the subclavian loop of the sympathetic trunk which forms a ring around the vessel. The anterior jugular vein is directed lateralward in front of the artery, but is separated from it by the Sternohyoideus and Sternothyreoideus. *Below and behind* the artery is the pleura, which separates it from the apex of the lung; *behind* is the sympathetic trunk, the Longus collie and the first thoracic vertebra. The right recurrent nerve winds around the lower and back part of the vessel.

First Part of the Left Subclavian Artery (Fig. 14,16) —The first part of the left subclavian artery *arises* from the arch of the aorta, behind the left common carotid, and at the level of the fourth thoracic vertebra; it ascends in the superior mediastinal cavity to the root of the neck and then arches lateral ward to the medial border of the Scalenus anterior.

Relations.—It is in relation, *in front,* with the vagus, cardiac, and phrenic nerves, which lie parallel with it, the left common carotid artery, left internal jugular and vertebral veins, and the commencement of the left innominate vein, and is covered by the Sternothyreoideus, Sternohyoideus, and Sternocleidomastoideus; *behind,* it is in relation with the esophagus, thoracic duct, left recurrent nerve, inferior cervical ganglion of the sympathetic trunk, and Longus colli; higher up, however, the esophagus and thoracic duct lie to its right side; the latter ultimately arching over the vessel to join the angle of union between the subclavian and internal jugular veins. *Medial* to it are the esophagus, trachea, thoracic duct, and left recurrent nerve; *lateral* to it, the left pleura and lung.

Second and Third Parts of the Subclavian Artery(Fig. 14,16)

When a ligature is applied to the first part of the subclavian artery, the collateral circulation is carried on by: (1) the anastomosis between the superior and inferior thyroids; (2) the anastomosis of the two vertebrals; (3) the anastomosis of the internal mammary with the inferior epigastric and the aortic intercostals; (4) the costocervical anastomosing with the aortic intercostals; (5) the profunda cervicis anastomosing with the descending branch of the occipital; (6) the scapular branches

of the thyrocervical trunk anastomosing with the branches of the axillary, and (7) the thoracic branches of the axillary anastomosing with the aortic intercostals.

On the left side all four branches generally arise from the first portion of the vessel;

The **Transverse Cervical Artery** (*a. transversa colli; transversalis colli artery*) (Fig. 14,15,16,17) lies at a higher level than the transverse scapular; it passes transversely above the inferior belly of the Omohyoideus to the anterior margin of the Trapezius, beneath which it divides into an ascending and a descending branch. It crosses in front of the phrenic n(Fig. 15) erve and the Scaleni, and in front of or between the divisions of the brachial plexus, and is covered by the Platysma and Sternocleidomastoideus, and crossed by the Omohyoideus and Trapezius.

The **ascending branch** (*ramus ascendens; superficial cervical artery*) ascends beneath the anterior margin of the Trapezius, distributing branches to it, and to the neighboring muscles and lymph nodes in the neck, and anastomosing with the superficial branch of the descending ramus of the occipital artery.

The **descending branch** (*ramus descendens; posterior scapular artery*) passes beneath the Levator scapulæ to the medial angle of the scapula, and then descends under the Rhomboidei along the vertebral border of that bone as far as the inferior angle. It supplies the Rhomboidei, Latissimus dorsi and Trapezius, and anastomoses with the transverse scapular and subscapular arteries, and with the posterior branches of some of the intercostal arteries.

Peculiarities.—The ascending branch of the transverse cervical frequently arises directly from the thyrocervical trunk; and the descending branch from the third, more rarely from the second, part of the subclavian.

3. The **internal mammary artery** (*a. mammaria interna*) (Fig.15,16,) *arises* from the under surface of the first portion of the subclavian, opposite the thyrocervical trunk. It descends behind the cartilages of the upper six ribs at a distance of about 1.25 cm. from the margin of the sternum, and at the level of the sixth intercostal space divides into the musculophrenic and superior epigastric arteries.

Relations.—It is directed at first downward, forward, and medialward behind the sternal end of the clavicle, the subclavian and internal jugular veins, and the first costal cartilage, and passes forward close to the lateral side of the innominate vein. As it enters the thorax the phrenic nerve crosses from its lateral to its medial side. Below the first costal cartilage it descends almost vertically to its point of bifurcation. It is covered in front by the cartilages of the upper six ribs and the intervening Intercostales interni and anterior intercostal membranes, and is crossed by the terminal portions of the upper six intercostal nerves. It rests on the pleura, as far as the third costal cartilage; below this level, upon the Transversus thoracis. It is

accompanied by a pair of veins; these unite above to form a single vessel, which runs medial to the artery and ends in the corresponding innominate vein.

Branches.—The branches of the internal mammary are:

1. Pericardiacophrenic.
2. Intercostal.
3. Anterior Mediastinal.
4. Perforating.
5. Pericardial.
6. Musculophrenic.
7. Sternal.
8. Superior Epigastric.

The **Pericardiacophrenic Artery** (*a. pericardiacophrenica; a. comes nervi phrenici*) is a long slender branch, which accompanies the phrenic nerve, between the pleura and pericardium, to the diaphragm, to which it is distributed; it anastomoses with the musculophrenic and inferior phrenic arteries.

The **Anterior Mediastinal Arteries** (*aa. mediastinales anteriores; mediastinal arteries*) are small vessels, distributed to the areolar tissue and lymph nodes in the anterior mediastinal cavity, and to the remains of the thymus.

The **Pericardial Branches** supply the upper part of the anterior surface of the pericardium; the lower part receives branches from the musculophrenic artery.

The **Sternal Branches** (*rami sternales*) are distributed to the Transversus thoracis, and to the posterior surface of the sternum.

The anterior mediastinal, pericardial, and sternal branches, together with some twigs from the pericardiacophrenic, anastomose with branches from the intercostal and bronchial arteries, and form a subpleural mediastinal plexus.

The **Intercoastal Branches** (*rami intercostales; anterior intercostal arteries*) supply the upper five or six intercostal spaces. Two in number in each space, these small vessels pass lateralward, one lying near the lower margin of the rib above, and the other near the upper margin of the rib below, and anastomose with the intercostal arteries from the aorta. They are at first situated between the pleura and the Intercostales interni, and then between the Intercostales interni and externi. They supply the Intercostales and, by branches which perforate the Intercostales externi, the Pectorales and the mamma.

The **Perforating Branches** (*rami perforantes*) correspond to the five or six intercostal spaces. They pass forward through the intercostal spaces, and, curving lateralward, supply the Pectoralis major and the integument. Those which correspond to the second, third, and fourth spaces give branches to the mamma, and during lactation are of large size.

The **Musculophrenic Artery** (*a. musculophrenica*) is directed obliquely downward and lateralward, behind the cartilages of the false ribs; it perforates the diaphragm at the eighth or ninth costal cartilage, and ends, considerably reduced in size, opposite the last intercostal space. It gives off intercostal branches to the seventh, eighth, and ninth intercostal spaces; these diminish in size as the spaces

decrease in length, and are distributed in a manner precisely similar to the intercostals from the internal mammary. The musculophrenic also gives branches to the lower part of the pericardium, and others which run backward to the diaphragm, and downward to the abdominal muscles.

The **Superior Epigastric Artery** (*a. epigastrica superior*) (Fig. 14,15,16,17) continues in the original direction of the internal mammary; it descends through the interval between the costal and sternal attachments of the diaphragm, and enters the sheath of the Rectus abdominis, at first lying behind the muscle, and then perforating and supplying it, and anastomosing with the inferior epigastric artery from the external iliac. Branches perforate the anterior wall of the sheath of the Rectus, and supply the muscles of the abdomen and the integument, and a small branch passes in front of the xiphoid process and anastomoses with the artery of the opposite side. It also gives some twigs to the diaphragm, while from the artery of the right side small branches extend into the falciform ligament of the liver and anastomose with the hepatic artery.

4. The costocervical trunk (*truncus costocervicalis; superior intercostal artery*) (Fig. 14,15,16,17) *arises* from the upper and back part of the subclavian artery, behind the Scalenus anterior on the right side, and medial to that muscle on the left side. Passing backward, it gives off the profunda cervicalis, and, continuing as the highest intercostal artery, descends behind the pleura in front of the necks of the first and second ribs, and anastomoses with the first aortic intercostal. As it crosses the neck of the first rib it lies medial to the anterior division of the first thoracic nerve, and lateral to the first thoracic ganglion of the sympathetic trunk.

In the first intercostal space, it gives off a branch which is distributed in a manner similar to the distribution of the aortic intercostals. The branch for the second intercostal space usually joins with one from the highest aortic intercostal artery. This branch is not constant, but is more commonly found on the right side; when absent, its place is supplied by an intercostal branch from the aorta. Each intercostal gives off a posterior branch which goes to the posterior vertebral muscles, and sends a small spinal branch through the corresponding intervertebral foramen to the medulla spinalis and its membranes.

The **Profunda Cervicalis** (Fig. 14,15,16,17) (*a. cervicalis profunda; deep cervical branch*) *arises,* in most cases, from the costocervical trunk, and is analogous to the posterior branch of an aortic intercostal artery: occasionally it is a separate branch from the subclavian artery. Passing backward, above the eighth cervical nerve and between the transverse process of the seventh cervical vertebra and the neck of the first rib, it runs up the back of the neck, between the Semispinales capitis and colli, as high as the axis vertebra, supplying these and adjacent muscles, and anastomosing with the deep division of the descending branch of the occipital, and with branches of the vertebral. It gives off a spinal twig which enters the canal through the intervertebral foramen between the seventh cervical and first thoracic vertebræ.

The veins of the head and neck.

The veins of the head and neck may be subdivided into three groups:
1. The **veins of the exterior of the head and face.**
2. The **veins of the neck.**
3. The **diploic veins,** the **veins of the brain,** and the **venous sinuses of the dura mater.**

1. The Veins of the Exterior of the Head and Face

The veins of the exterior of the head and face (Fig. 19) are:

1. Frontal.
2. Supraorbital.
3. Angular.
4. Anterior Facial.
5. Occipital.
6. Superficial Temporal.
7. Internal Maxillary.
8. Posterior Facial.
9. Posterior Auricular.

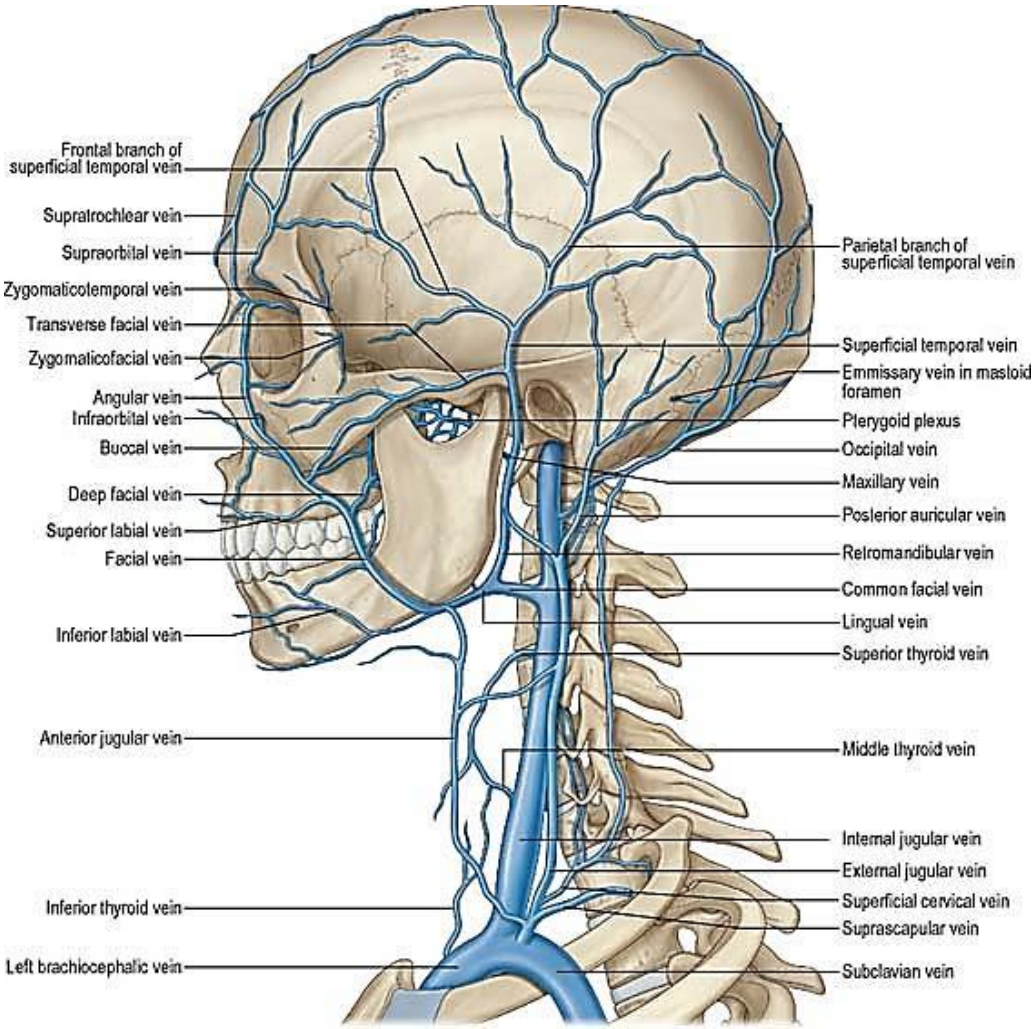

Figure.19. Veins of the head and neck.

The **frontal vein** (*v. frontalis*) (Fig. 19) begins on the forehead in a venous plexus which communicates with the frontal branches of the superficial temporal vein. The veins converge to form a single trunk, which runs downward near the middle line of the forehead parallel with the vein of the opposite side. The two veins are joined, at the root of the nose, by a transverse branch, called the **nasal arch,** which receives some small veins from the dorsum of the nose. At the root of the nose the veins diverge, and, each at the medial angle of the orbit, joins the **supraorbital vein,** to form the **angular vein.** Occasionally the frontal veins join to form a single trunk, which bifurcates at the root of the nose into the two angular veins.

The **supraorbital vein** (*v. supraorbitalis*) (Fig. 19) begins on the forehead where it communicates with the frontal branch of the superficial temporal vein. It runs downward superficial to the Frontalis muscle, and joins the frontal vein at the medial angle of the orbit to form the **angular vein.** Previous to its junction with the frontal vein, it sends through the supraorbital notch into the orbit a branch which communicates with the ophthalmic vein; as this vessel passes through the notch, it receives the frontal diploic vein through a foramen at the bottom of the notch.

The **angular vein** (*v. angularis*) (Fig. 19) formed by the junction of the frontal and supraorbital veins, runs obliquely downward, on the side of the root of the nose, to the level of the lower margin of the orbit, where it becomes the anterior facial vein. It receives the veins of the ala nasi, and communicates with the superior ophthalmic vein through the nasofrontal vein, thus establishing an important anastomosis between the anterior facial vein and the cavernous sinus.

The **anterior facial vein** (*v. facialis anterior; facial vein*) commences at the side of the root of the nose, and is a direct continuation of the angular vein. It lies behind the external maxillary (facial) artery and follows a less tortuous course. It runs obliquely downward and backward, beneath the Zygomaticus and zygomatic head of the Quadratus labii superioris, descends along the anterior border and then on the superficial surface of the Masseter, crosses over the body of the mandible, and passes obliquely backward, beneath the Platysma and cervical fascia, superficial to the submaxillary gland, the Digastricus and Stylohyoideus. It unites with the posterior facial vein to form the **common facial vein,** which crosses the external carotid artery and enters the internal jugular vein at a variable point below the hyoid bone. From near its termination a communicating branch often runs down the anterior border of the Sternocleidomastoideus to join the lower part of the anterior jugular vein. The facial vein has no valves, and its walls are not so flaccid as most superficial veins.

Tributaries. The anterior facial vein receives a branch of considerable size, the **deep facial vein,** from the pterygoid venous plexus. It is also joined by the superior and inferior palpebral, the superior and inferior labial, the buccinator and the masseteric veins. Below the mandible it receives the submental, palatine, and submaxillary veins, and, generally, the vena comitans of the hypoglossal nerve.

The **superficial temporal vein** (*v. temporalis superficialis*) (Fig. 19) *begins* on the side and vertex of the skull in a plexus which communicates with the frontal and supraorbital veins, with the corresponding vein of the opposite side, and with the posterior auricular and occipital veins. From this net-work frontal and parietal branches arise, and unite above the zygomatic arch to form the trunk of the vein,

which is joined in this situation by the **middle temporal vein,** from the substance of the Temporalis. It then crosses the posterior root of the zygomatic arch, enters the substance of the parotid gland, and unites with the internal maxillary vein to form the **posterior facial vein.**

Tributaries. The superficial temporal vein receives in its course some parotid veins, articular veins from the temporomandibular joint, anterior auricular veins from the auricula, and the **transverse facial** from the side of the face. The middle temporal vein receives the **orbital vein,** which is formed by some lateral palpebral branches, and passes backward between the layers of the temporal fascia to join the superficial temporal vein.

The **pterygoid plexus** (*plexus pterygoideus*) (Fig. 19) is of considerable size, and is situated between the Temporalis and Pterygoideus externus, and partly between the two Pterygoidei. It receives tributaries corresponding with the branches of the internal maxillary artery. Thus it receives the sphenopalatine, the middle meningeal, the deep temporal, the pterygoid, masseteric, buccinator, alveolar, and some palatine veins, and a branch which communicates with the ophthalmic vein through the inferior orbital fissure. This plexus communicates freely with the anterior facial vein; it also communicates with the cavernous sinus, by branches through the foramen Vesalii, foramen ovale, and foramen lacerum.

The **internal maxillary vein** (*v. maxillaris interna*) (Fig. 19) is a short trunk which accompanies the first part of the internal maxillary artery. It is *formed* by a confluence of the veins of the pterygoid plexus, and passes backward between the sphenomandibular ligament and the neck of the mandible, and unites with the temporal vein to form the posterior facial vein.

The **posterior facial vein** (*v. facialis posterior; temporomaxillary vein*) (Fig. 19), *formed* by the union of the superficial temporal and internal maxillary veins, descends in the substance of the parotid gland, superficial to the external carotid artery but beneath the facial nerve, between the ramus of the mandible and the Sternocleidomastoideus muscle. It divides into two branches, an **anterior,** which passes forward and unites with the anterior facial vein to form the common facial vein and a **posterior,** which is joined by the posterior auricular vein and becomes the external jugular vein.

The **posterior auricular vein** (*v. auricularis posterior*) (Fig. 19) *begins* upon the side of the head, in a plexus which communicates with the tributaries of the occipital, and superficial temporal veins. It descends behind the auricula, and joins the posterior division of the posterior facial vein to form the external jugular. It receive the stylomastoid vein, and some tributaries from the cranial surface of the auricula.

The **occipital vein** (*v. occipitalis*) (Fig. 19) *begins* in a plexus at the back part of the vertex of the skull, From the plexus emerges a single vessel, which pierces the cranial attachment of the Trapezius and, dipping into the suboccipital triangle, joins the deep cervical and vertebral veins. Occasionally it follows the course of the occipital artery and ends in the internal jugular; in other instances, it joins the posterior auricular and through it opens into the external jugular. The parietal emissary vein connects it with the superior sagittal sinus; and as it passes across the

mastoid portion of the temporal bone, it receives the mastoid emissary vein which connects it with the transverse sinus. The occipital diploic vein sometimes joins it.

The veins of the neck (Fig. 20), which return the blood from the head and face, are:

1. External Jugular.
2. Posterior External Jugular.
3. Vertebral.
4. Anterior Jugular.
5. Internal Jugular.

The **external jugular vein** (*v. jugularis externa*) (Fig. 20), receives the greater part of the blood from the exterior of the cranium and the deep parts of the face, being formed by the junction of the posterior division of the posterior facial with the posterior auricular vein. It commences in the substance of the parotid gland, on a level with the angle of the mandible, and runs perpendicularly down the neck, in the direction of a line drawn from the angle of the mandible to the middle of the clavicle at the posterior border of the Sternocleidomastoideus. In its course it crosses the Sternocleidomastoideus obliquely, and in the subclavian triangle perforates the deep fascia, and ends in the subclavian vein, lateral to or in front of the Scalenus anterior. It is separated from the Sternocleidomastoideus by the investing layer of the deep cervical fascia, and is covered by the Platysma, the superficial fascia, and the integument; it crosses the cutaneous cervical nerve, and its upper half runs parallel with the great auricular nerve. The external jugular vein varies in size, bearing an inverse proportion to the other veins of the neck, it is occasionally double. It is provided with two pairs of valves, the lower pair being placed at its entrance into the subclavian vein, the upper in most cases about 4 cm. above the clavicle. The portion of vein between the two sets of valves is often dilated, and is termed the **sinus.** These valves do not prevent the regurgitation of the blood, or the passage of injection from below upward.

Tributaries. This vein receives the occipital occasionally, the posterior external jugular, and, near its termination, the transverse cervical, transverse scapular, and anterior jugular veins; in the substance of the parotid, a large branch of communication from the internal jugular joins it.

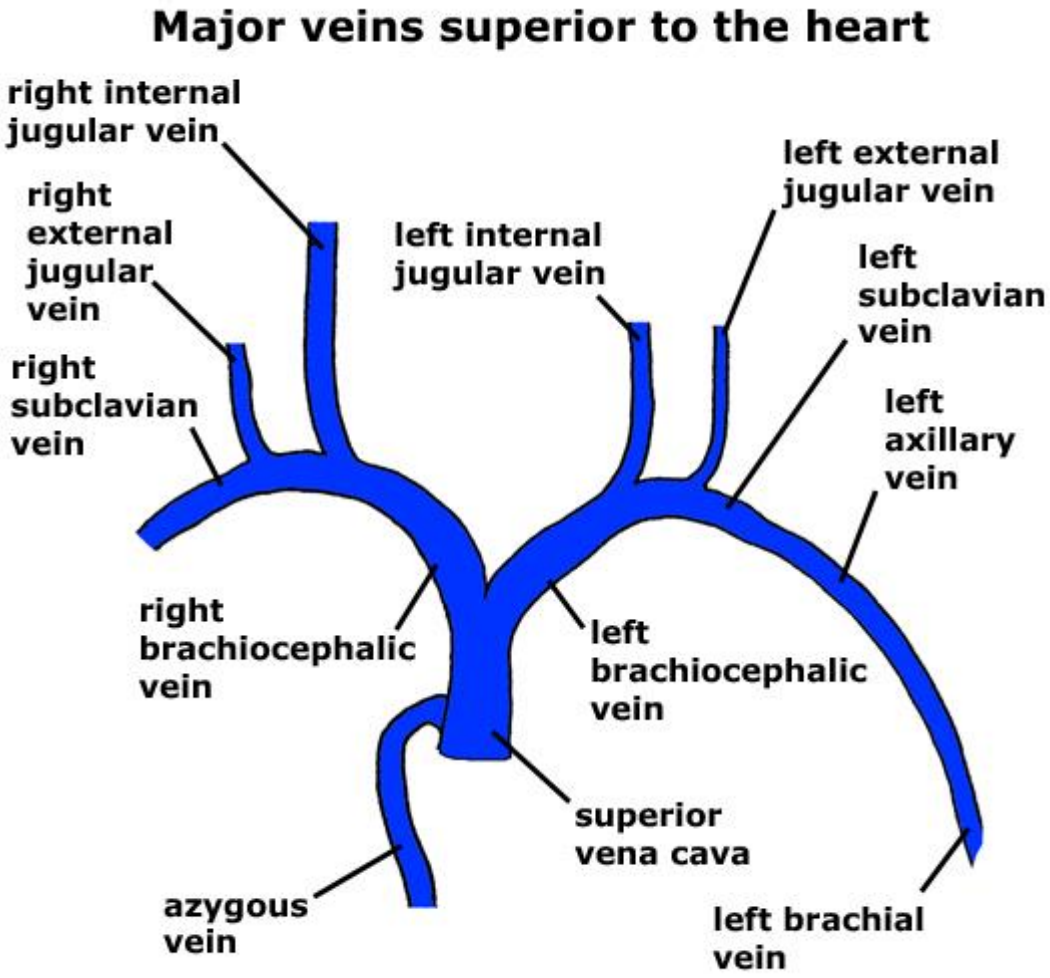

Figure.20. The veins of the neck, viewed from in front.

The **posterior external jugular vein** (*v. jugularis posterior*) (Fig. 20) begins in the occipital region and returns the blood from the skin and superficial muscles in the upper and back part of the neck, lying between the Splenius and Trapezius. It runs down the back part of the neck, and opens into the external jugular vein just below the middle of its course.

The **anterior jugular vein** (*v. jugularis anterior*) (Fig. 20), begins near the hyoid bone by the confluence of several superficial veins from the submaxillary region. It descends between the median line and the anterior border of the Sternocleidomastoideus, and, at the lower part of the neck, passes beneath that muscle to open into the termination of the external jugular, or, in some instances, into the subclavian vein (Fig. 14). It varies considerably in size, bearing usually an inverse proportion to the external jugular; most frequently there are two anterior jugulars, a right and left; but sometimes only one. Its tributaries are some laryngeal veins, and occasionally a small thyroid vein. Just above the sternum the two anterior jugular veins communicate by a transverse trunk, the **venous jugular arch,** which receive

tributaries from the inferior thyroid veins; each also communicates with the internal jugular. There are no valves in this vein.

The **internal jugular vein** (*v. jugularis interna*) (Fig. 14), collects the blood from the brain, from the superficial parts of the face, and from the neck. It is directly continuous with the transverse sinus, and begins in the posterior compartment of the jugular foramen, at the base of the skull. At its origin it is somewhat dilated, and this dilatation is called the **superior bulb.** It runs down the side of the neck in a vertical direction, lying at first lateral to the internal carotid artery, and then lateral to the common carotid, and at the root of the neck unites with the subclavian vein to form the innominate vein; a little above its termination is a second dilatation, the **inferior bulb.** Above, it lies upon the Rectus capitis lateralis, behind the internal carotid artery and the nerves passing through the jugular foramen; lower down, the vein and artery lie upon the same plane, the glossopharyngeal and hypoglossal nerves passing forward between them; the vagus descends between and behind the vein and the artery in the same sheath, and the accessory runs obliquely backward, superficial or deep to the vein. At the root of the neck the right internal jugular vein is placed at a little distance from the common carotid artery, and crosses the first part of the subclavian artery, while the left internal jugular vein usually overlaps the common carotid artery. The left vein is generally smaller than the right, and each contains a pair of valves, which are placed about 2.5 cm. above the termination of the vessel.

Tributaries. This vein receives in its course the inferior petrosal sinus, the common facial, lingual, pharyngeal, superior and middle thyroid veins, and sometimes the occipital. The thoracic duct on the left side and the right lymphatic duct on the right side open into the angle of union of the internal jugular and subclavian veins.

The **Inferior Petrosal Sinus** (*sinus petrosus inferior*) (Fig. 29) leaves the skull through the anterior part of the jugular foramen, and joins the superior bulb of the internal jugular vein.

The **Lingual Veins** (*vv. linguales*) (Fig. 21) begin on the dorsum, sides, and under surface of the tongue, and, passing backward along the course of the lingual artery, end in the internal jugular vein. The vena comitans of the hypoglossal nerve (**ranine vein**), a branch of considerable size, begins below the tip of the tongue, and may join the lingual; generally, however, it passes backward on the Hyoglossus, and joins the common facial.

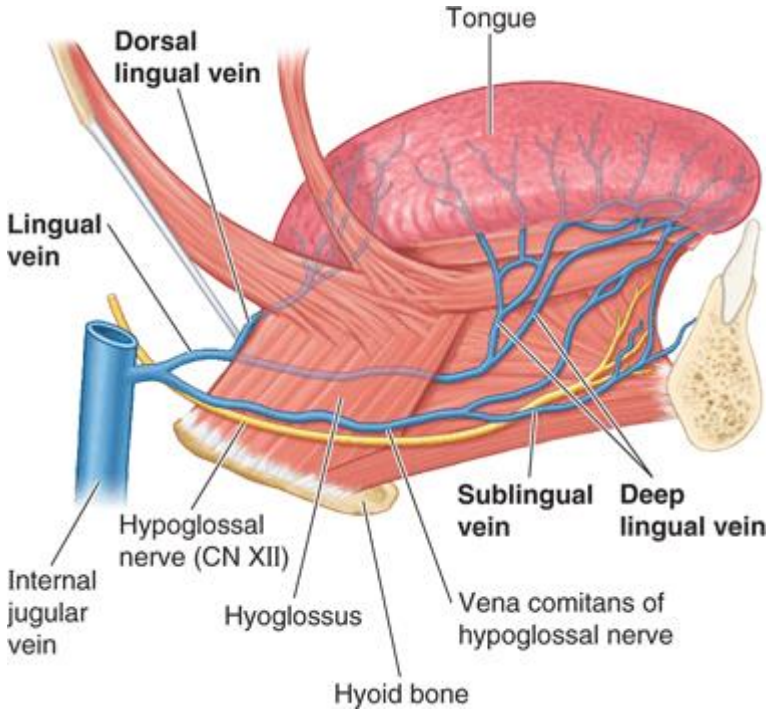

Figure.21. Veins of the tongue.

The **Pharyngeal Veins** (*vv. pharyngeæ*) begin in the **pharyngeal plexus** on the outer surface of the pharynx, and, after receiving some posterior meningeal veins and the vein of the pterygoid canal, end in the internal jugular. They occasionally open into the facial, lingual, or superior thyroid vein.

The **Superior Thyroid Vein** (*v. thyreoidea superioris*) (Fig. 21,22) begins in the substance and on the surface of the thyroid gland, by tributaries corresponding with the branches of the superior thyroid artery, and ends in the upper part of the internal jugular vein. It receives the superior laryngeal and cricothyroid veins.

The **Middle Thyroid Vein** (Fig. 21,22) collects the blood from the lower part of the thyroid gland, and after being joined by some veins from the larynx and trachea, ends in the lower part of the internal jugular vein.

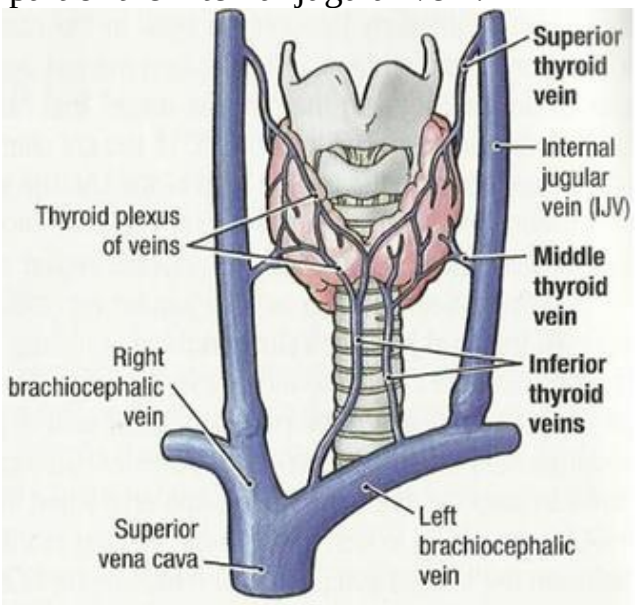

Figure.22The veins of the thyroid gland.

The **vertebral vein** (*v. vertebralis*) (Fig. 23) is formed in the suboccipital triangle, from numerous small tributaries which spring from the internal vertebral venous plexuses and issue from the vertebral canal above the posterior arch of the atlas. They unite with small veins from the deep muscles at the upper part of the back of the neck, and form a vessel which enters the foramen in the transverse process of the atlas, and descends, forming a dense plexus around the vertebral artery, in the canal formed by the foramina transversaria of the cervical vertebræ. This plexus ends in a single trunk, which emerges from the foramen transversarium of the sixth cervical vertebra, and opens at the root of the neck into the back part of the innominate vein near its origin, its mouth being guarded by a pair of valves. On the right side, it crosses the first part of the subclavian artery.

Tributaries.—The vertebral vein communicates with the transverse sinus by a vein which passes through the condyloid canal, when that canal exists. It receives branches from the occipital vein and from the prevertebral muscles, from the internal and external vertebral venous plexuses, from the anterior vertebral and the deep cervical veins; close to its termination it is sometimes joined by the first intercostal vein.

The **Anterior Vertebral Vein** (Fig. 23) commences in a plexus around the transverse processes of the upper cervical vertebræ, descends in company with the ascending cervical artery between the Scalenus anterior and Longus capitis muscles, and opens into the terminal part of the vertebral vein.

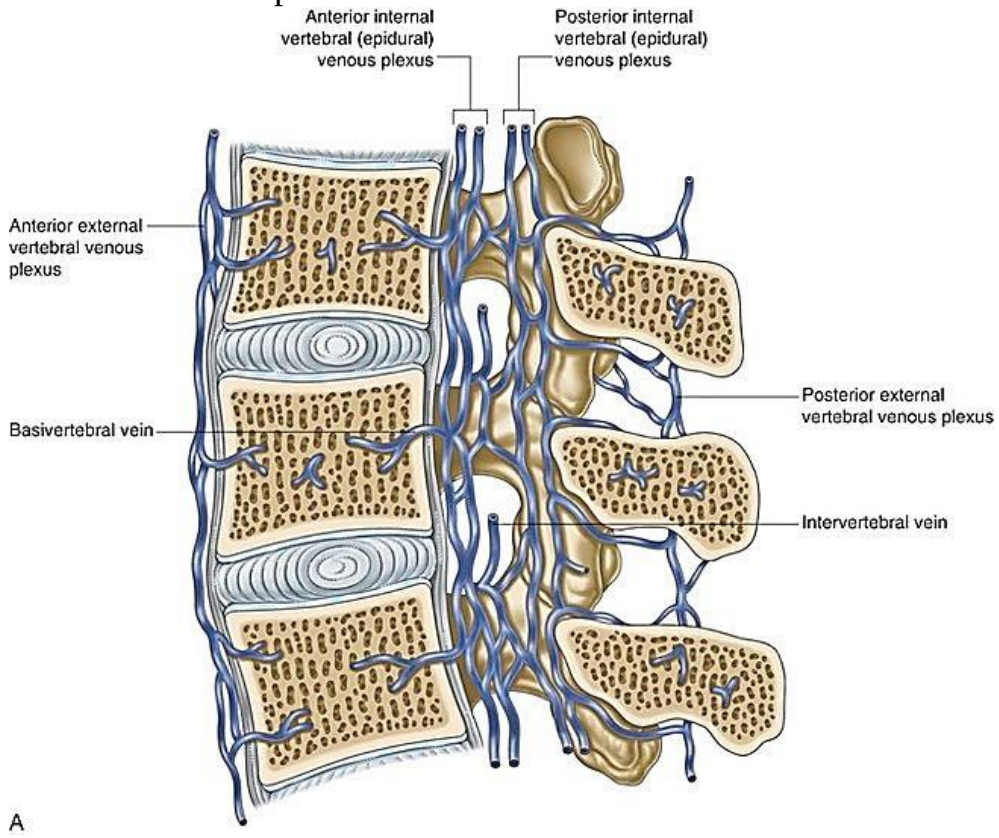

Figure.23. The vertebral vein.

The **Deep Cervical Vein** (*v. cervicalis profunda; posterior vertebral or posterior deep cervical vein*) accompanies its artery between the Semispinales capitis and colli. It *begins* in the suboccipital region by communicating branches from the occipital vein and by small veins from the deep muscles at the back of the neck. It receives tributaries from the plexuses around the spinous processes of the cervical vertebræ, and terminates in the lower part of the vertebral vein.

The diploic veins (Fig. 24) occupy channels in the diploë of the cranial bones. They are large and exhibit at irregular intervals pouch-like dilatations; their walls are thin, and formed of endothelium resting upon a layer of elastic tissue.

So long as the cranial bones are separable from one another, these veins are confined to the particular bones; but when the sutures are obliterated, they unite with each other, and increase in size. They communicate with the meningeal veins and the sinuses of the dura mater, and with the veins of the pericranium. They consist of (1) the **frontal,** which opens into the supraorbital vein and the superior sagittal sinus; (2) the **anterior temporal,** which is confined chiefly to the frontal bone, and opens into the sphenoparietal sinus and into one of the deep temporal veins, through an aperture in the great wing of the sphenoid; (3) the **posterior temporal,** which is situated in the parietal bone, and ends in the transverse sinus, through an aperture at the mastoid angle of the parietal bone or through the mastoid foramen; and (4) the **occipital,** the largest of the four, which is confined to the occipital bone, and opens either externally into the occipital vein, or internally into the transverse sinus or into the confluence of the sinuses (*torcular Herophili*).

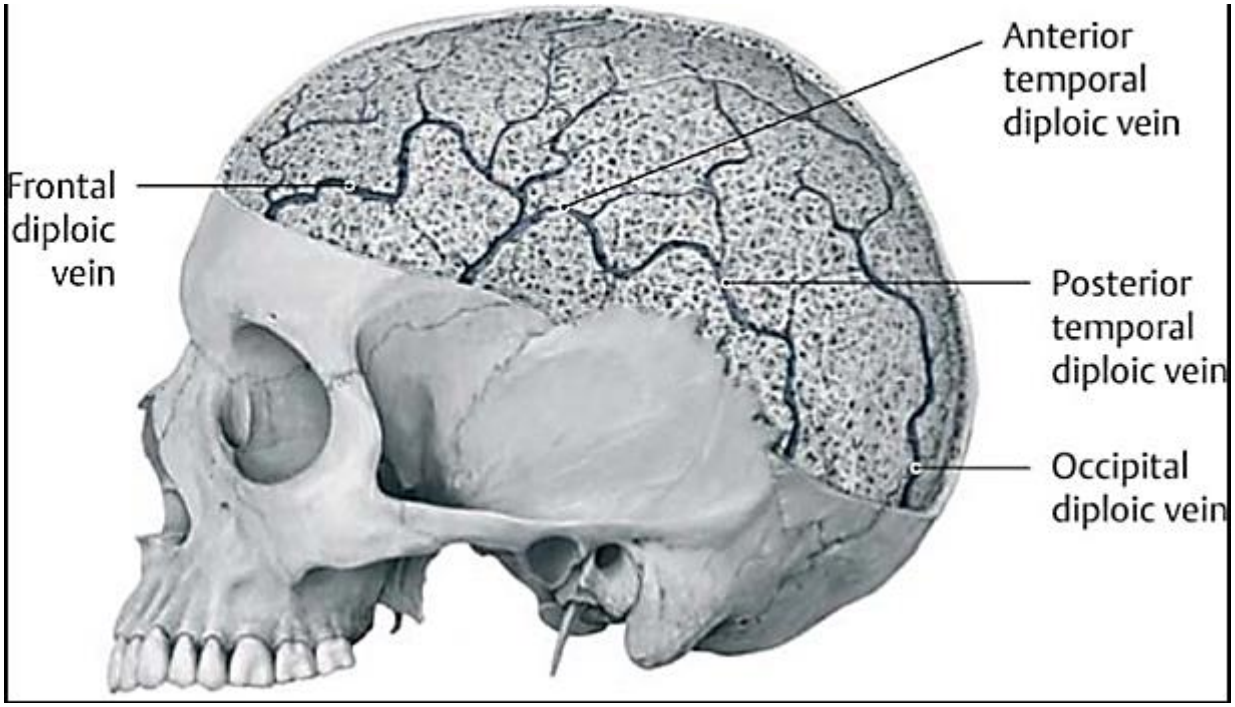

Figure.24. The diploic veins.

The veins of the brain (Fig. 25) possess no valves, and their walls, owing to the absence of muscular tissue, are extremely thin. They pierce the arachnoid membrane and the inner or meningeal layer of the dura mater, and open into the cranial venous sinuses. They may be divided into two sets, **cerebral** and **cerebellar.**

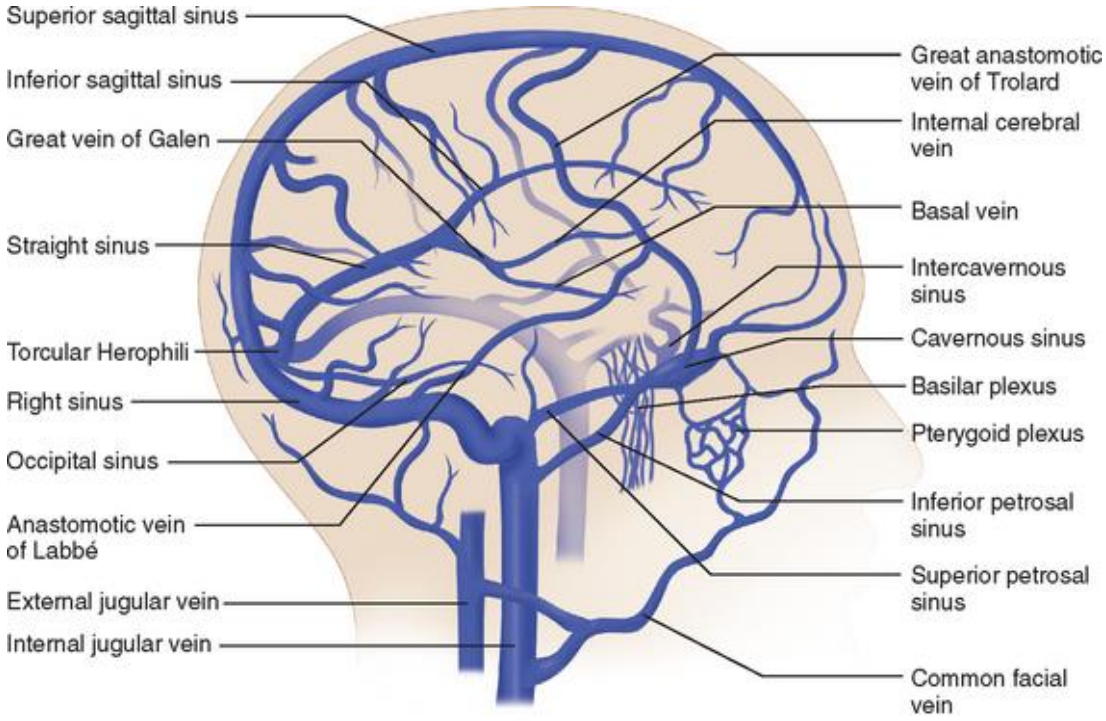

Figure.25. The veins of the brain.

The **cerebral veins** (*vv. cerebri*) (Fig. 26) are divisible into external and internal groups according as they drain the outer surfaces or the inner parts of the hemispheres.

The **external veins** are the superior, inferior, and middle cerebral.

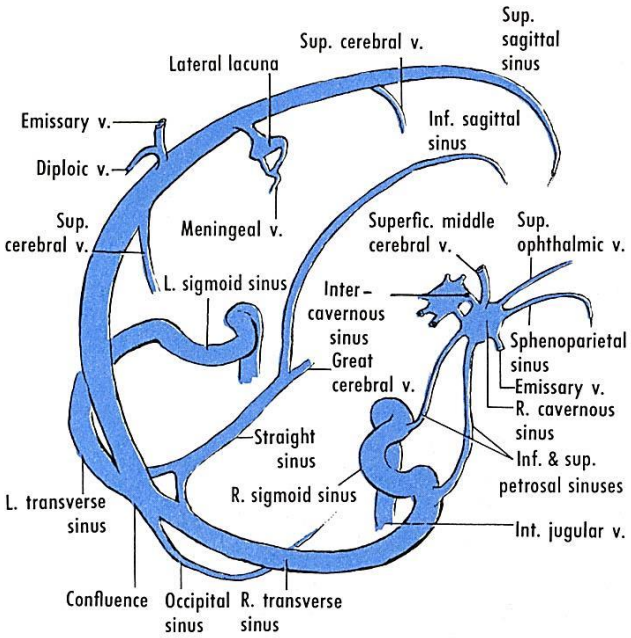

Figure.26. The cerebral veins.

The **Superior Cerebral Veins** (*vv. cerebri superiores*) (Fig. 25,26), eight to twelve in number, drain the superior, lateral, and medial surfaces of the hemispheres, and are mainly lodged in the sulci between the gyri, but some run across the gyri. They open into the superior sagittal sinus; the anterior veins runs nearly at right angles to the sinus; the posterior and larger veins are directed obliquely forward and open into the sinus in a direction more or less opposed to the current of the blood contained within it.

The **Middle Cerebral Vein** (*v. cerebri media; superficial Sylvian vein*) (Fig. 25,26) begins on the lateral surface of the hemisphere, and, running along the lateral cerebral fissure, ends in the cavernous or the sphenoparietal sinus. It is connected (*a*) with the superior sagittal sinus by the **great anastomotic vein of Trolard,** which opens into one of the superior cerebral veins; (*b*) with the transverse sinus by the **posterior anastomotic vein of Labbé,** which courses over the temporal lobe.

The **Inferior Cerebral Veins** (*vv. cerebri inferiores*) (Fig. 25,26), of small size, drain the under surfaces of the hemispheres. Those on the orbital surface of the frontal lobe join the superior cerebral veins, and through these open into the superior sagittal sinus; those of the temporal lobe anastomose with the middle cerebral and basal veins, and join the cavernous, sphenoparietal, and superior petrosal sinuses.

The **basal vein** is formed at the anterior perforated substance by the union of (*a*) a small **anterior cerebral vein** which accompanies the anterior cerebral artery, (*b*) the **deep middle cerebral vein** (*deep Sylvian vein*), which receives tributaries from the insula and neighboring gyri, and runs in the lower part of the lateral cerebral fissure, and (*c*) the **inferior striate veins,** which leave the corpus striatum through the anterior perforated substance. The basal vein passes backward around the cerebral peduncle, and ends in the internal cerebral vein (*vein of Galen*); it receives tributaries from the interpeduncular fossa, the inferior horn of the lateral ventricle, the hippocampal gyrus, and the mid-brain.

The **Internal Cerebral Veins** (*vv. cerebri internæ; veins of Galen; deep cerebral veins*) (Fig. 27), drain the deep parts of the hemisphere and are two in number; each is formed near the interventricular foramen by the union of the **terminal** and **choroid veins.** They run backward parallel with one another, between the layers of the tela chorioidea of the third ventricle, and beneath the splenium of the corpus callosum, where they unite to form a short trunk, the **great cerebral vein;** just before their union each receives the corresponding basal vein.

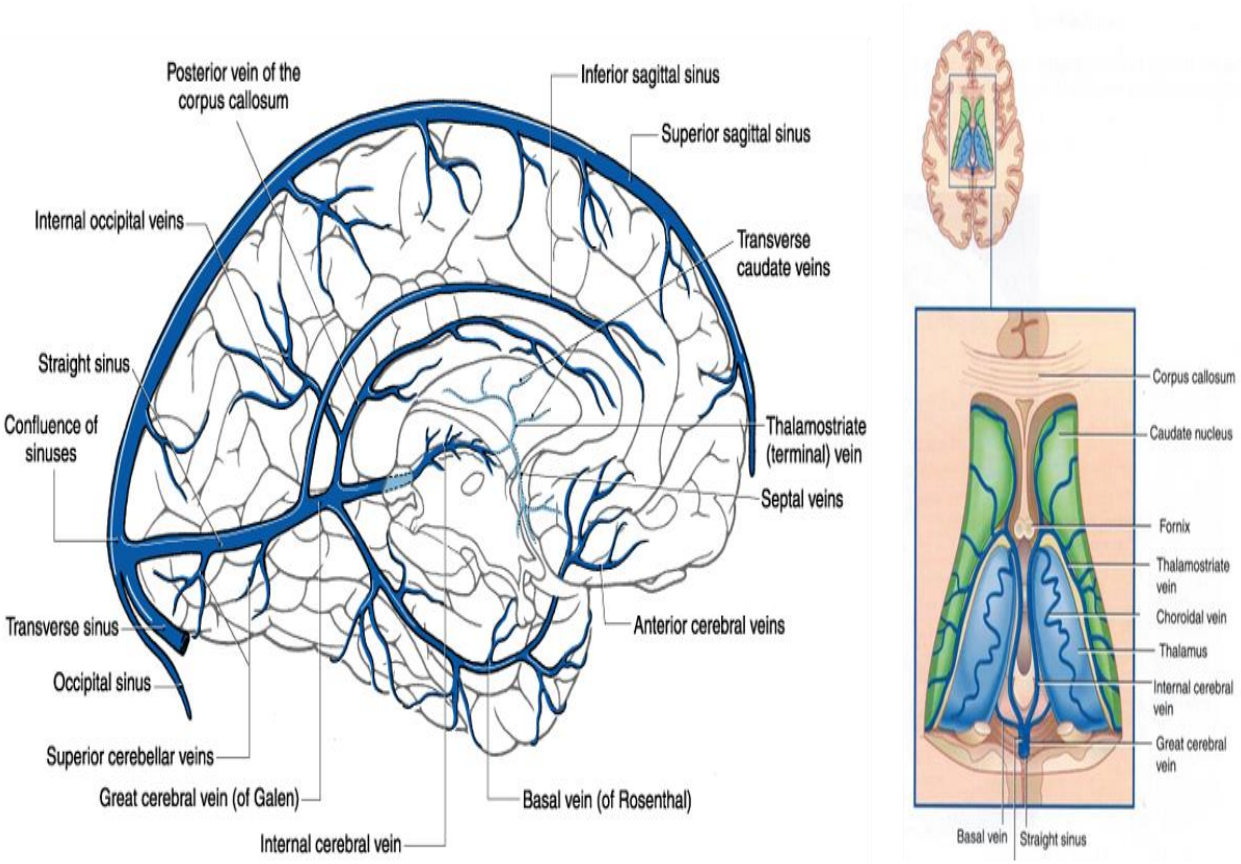

Figure.27. The Internal Cerebral Veins.

The **terminal vein** (*v. terminalis; vena corporis striati*) *commences* in the groove between the corpus striatum and thalamus, receives numerous veins from both of these parts, and unites behind the crus fornicis with the choroid vein, to form one of the internal cerebral veins. The **choroid vein** runs along the whole length of the choroid plexus, and receives veins from the hippocampus, the fornix, and the corpus callosum.

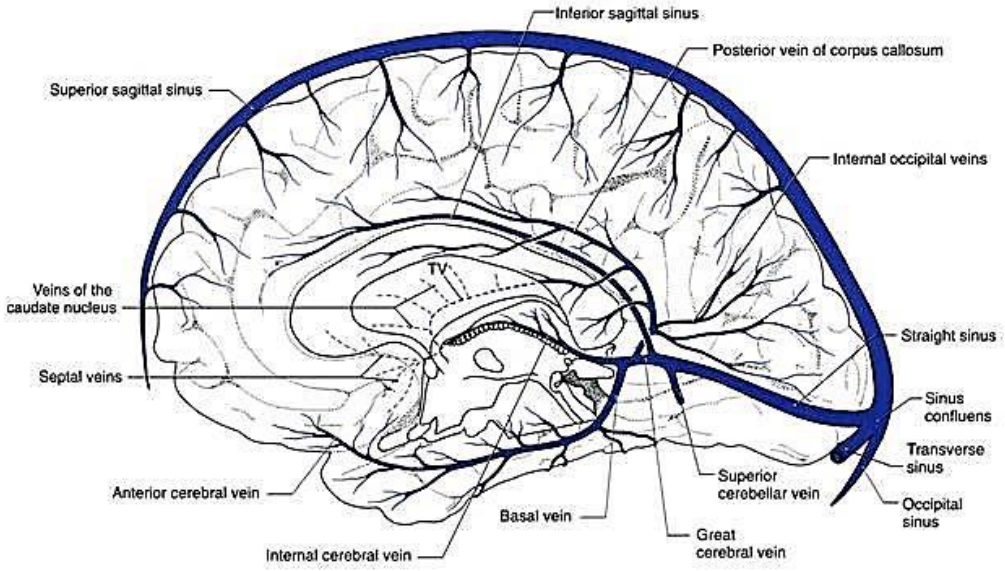

Figure.28 The Great Cerebral Vein.

The **Great Cerebral Vein** (*v. cerebri magna* [*Galeni*]; *great vein of Galen*) (Fig. 28), formed by the union of the two internal cerebral veins, is a short median trunk which curves backward and upward around the splenium of the corpus callosum and ends in the anterior extremity of the straight sinus.

The **cerebellar veins** are placed on the surface of the cerebellum, and are disposed in two sets, superior and inferior. The **superior cerebellar veins** (*vv. cerebelli superiores*) pass partly forward and medialward, across the superior vermis, to end in the straight sinus and the internal cerebral veins, partly lateralward to the transverse and superior petrosal sinuses. The **inferior cerebellar veins** (*vv. cerebelli inferiores*) of large size, end in the transverse, superior petrosal, and occipital sinuses.

Sinuses of the dura mater Ophthalmic Veins and Emissary Veins

The **sinuses of the dura mater** (Fig. 29) are venous channels which drain the blood from the brain; they are devoid of valves, and are situated between the two layers of the dura mater and lined by endothelium continuous with that which lines the veins. They may be divided into two groups: (1) a **postero-superior,** at the upper and back part of the skull, and (2) an **antero-inferior,** at the base of the skull.

The postero-superior group comprises the:

1. Superior Sagittal.
2. Inferior Sagittal.
3. Occipital.
4. Straight.
5. Two Transverse.

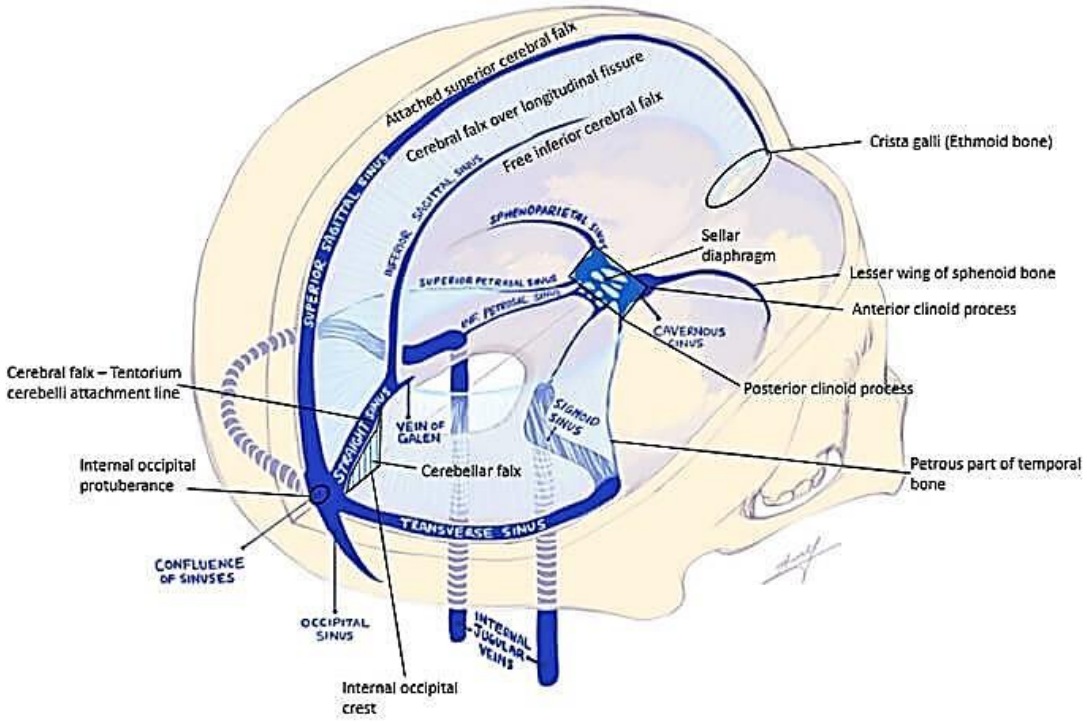

Figure.29. The sinuses of the dura mater.

The **superior sagittal sinus** (*sinus sagittalis superior; superior longitudinal sinus*) (Figs. 25, 26, 28) occupies the attached or convex margin of the falx cerebri.

Commencing at the foramen cecum, through which it receives a vein from the nasal cavity, it runs from before backward, grooving the inner surface of the frontal, the adjacent margins of the two parietals, and the superior division of the cruciate eminence of the occipital; near the internal occipital protuberance it deviates to one or other side (usually the right), and is continued as the corresponding transverse sinus. It is triangular in section, narrow in front, and gradually increases in size as it passes backward. Its inner surface presents the openings of the superior cerebral veins, which run, for the most part, obliquely forward, and open chiefly at the back part of the sinus, their orifices being concealed by fibrous folds; numerous fibrous bands (*chordæ Willisii*) extend transversely across the inferior angle of the sinus; and, lastly, small openings communicate with irregularly shaped venous spaces (*venous lacunæ*) in the dura mater near the sinus. There are usually three lacunæ on either side of the sinus: a small frontal, a large parietal, and an occipital, intermediate in size between the other two. Most of the cerebral veins from the outer surface of the hemisphere open into these lacunæ, and numerous **arachnoid granulations** (*Pacchionian bodies*) project into them from below. The superior sagittal sinus receives the superior cerebral veins, veins from the diploë and dura mater, and, near the posterior extremity of the sagittal suture, veins from the pericranium, which pass through the parietal foramina.

The numerous communications exist between this sinus and the veins of the nose, scalp, and diploe.

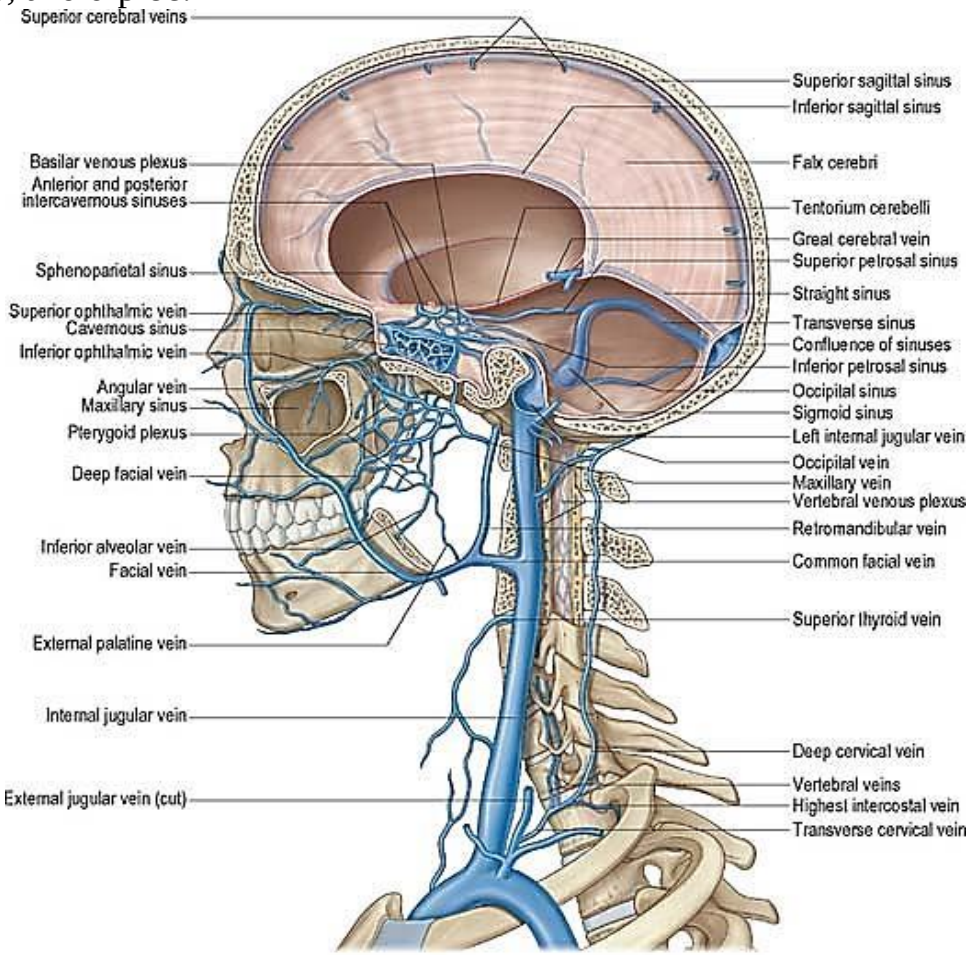

Figure. 30. Sinuses of the dura mater.

The **inferior sagittal sinus** (*sinus sagittalis inferior; inferior longitudinal sinus*) (Figs. 25, 28, 29, 30) is contained in the posterior half or two-thirds of the free margin of the falx cerebri. It is of a cylindrical form, increases in size as it passes backward, and ends in the straight sinus. It receives several veins from the falx cerebri, and occasionally a few from the medial surfaces of the hemispheres.

The **straight sinus** (*sinus rectus; tentorial sinus*) (Figs. 25, 28, 29, 30) is situated at the line of junction of the falx cerebri with the tentorium cerebelli. It is triangular in section, increases in size as it proceeds backward, and runs downward and backward from the end of the inferior sagittal sinus to the transverse sinus of the opposite side to that into which the superior sagittal sinus is prolonged. Its terminal part communicates by a cross branch with the confluence of the sinuses. Besides the inferior sagittal sinus, it receives the great cerebral vein (*great vein of Galen*) and the superior cerebellar veins. A few transverse bands cross its interior.

The **transverse sinuses** (*sinus transversus; lateral sinuses*) (Figs. 25, 28, 29, 30) are of large size and begin at the internal occipital protuberance; one, generally the right, being the direct continuation of the superior sagittal sinus, the other of the straight sinus. Each transverse sinus passes lateralward and forward, describing a slight curve with its convexity upward, to the base of the petrous portion of the temporal bone, and lies, in this part of its course, in the attached margin of the tentorium cerebelli; it then leaves the tentorium and curves downward and medialward to reach the jugular foramen, where it ends in the internal jugular vein. In its course it rests upon the squama of the occipital, the mastoid angle of the parietal, the mastoid part of the temporal, and, just before its termination, the jugular process of the occipital; the portion which occupies the groove on the mastoid part of the temporal is sometimes termed the **sigmoid sinus.** The transverse sinuses are frequently of unequal size, that formed by the superior sagittal sinus being the larger; they increase in size as they proceed from behind forward. On transverse section the horizontal portion exhibits a prismatic, the curved portion a semicylindrical form. They receive the blood from the superior petrosal sinuses at the base of the petrous portion of the temporal bone; they communicate with the veins of the pericranium by means of the mastoid and condyloid emissary veins; and they receive some of the inferior cerebral and inferior cerebellar veins, and some veins from the diploë. The **petrosquamous sinus,** when present, runs backward along the junction of the squama and petrous portion of the temporal, and opens into the transverse sinus.

The **occipital sinus** (*sinus occipitalis*) (Figs. 25, 28, 29, 30) is the smallest of the cranial sinuses. It is situated in the attached margin of the falx cerebelli, and is generally single, but occasionally there are two. It commences around the margin of the foramen magnum by several small venous channels, one of which joins the terminal part of the transverse sinus; it communicates with the posterior internal vertebral venous plexuses and ends in the confluence of the sinuses.

The **Confluence of the Sinuses** (*confluens sinuum; torcular Herophili*) (Figs. 25, 28, 29, 30) is the term applied to the dilated extremity of the superior sagittal sinus. It is of irregular form, and is lodged on one side (generally the right) of the internal occipital protuberance. From it the transverse sinus of the same side is

derived. It receives also the blood from the occipital sinus, and is connected across the middle line with the commencement of the transverse sinus of the opposite side.

The antero-inferior group of sinuses comprises the:

1. Two Cavernous.
2. Two Intercavernous
3. Basilar Plexus.
4. Two Superior Petrosal.
5. Two Inferior Petrosal.

The **cavernous sinuses** (*sinus cavernosus*) (Figs. 25, 28, 29, 30, 31) are so named because they present a reticulated structure, due to their being traversed by numerous interlacing filaments. They are of irregular form, larger behind than in front, and are placed one on either side of the body of the sphenoid bone, extending from the superior orbital fissure to the apex of the petrous portion of the temporal bone. Each opens behind into the petrosal sinuses. On the medial wall of each sinus is the internal carotid artery, accompanied by filaments of the carotid plexus; near the artery is the abducent nerve; on the lateral wall are the oculomotor and trochlear nerves, and the ophthalmic and maxillary divisions of the trigeminal nerve (Figs. 25, 28, 29, 30, 31). These structures are separated from the blood flowing along the sinus by the lining membrane of the sinus. The cavernous sinus receives the superior ophthalmic vein through the superior orbital fissure, some of the cerebral veins, and also the small **sphenoparietal sinus,** which courses along the under surface of the small wing of the sphenoid. It communicates with the transverse sinus by means of the superior petrosal sinus; with the internal jugular vein through the inferior petrosal sinus and a plexus of veins on the internal carotid artery; with the pterygoid venous plexus through the foramen Vesalii, foramen ovale, and foramen lacerum, and with the angular vein through the ophthalmic vein. The two sinuses also communicate with each other by means of the anterior and posterior intercavernous sinuses.

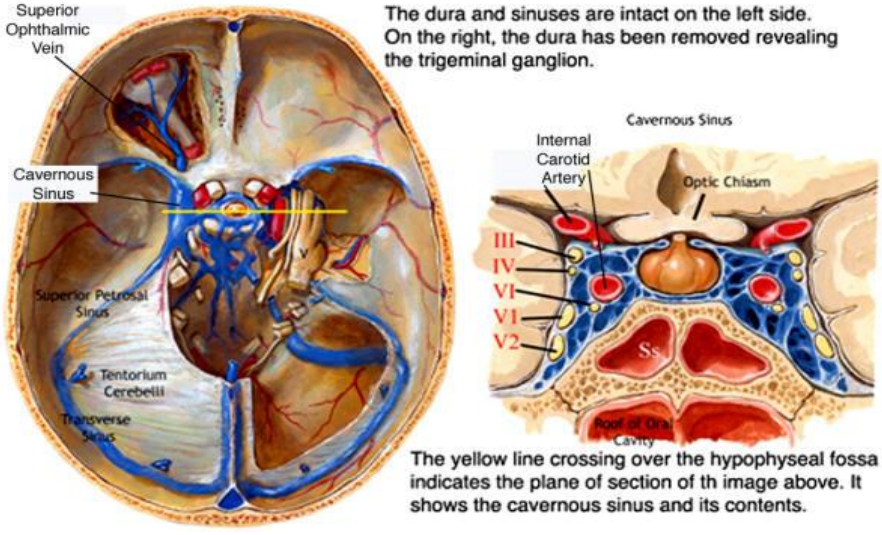

Figure.31. Oblique section through the cavernous sinus.

The **ophthalmic veins** (Fig. 31, 32), two in number, **superior** and **inferior,** are devoid of valves.

The **Superior Ophthalmic Vein** (*v. ophthalmica superior*) (Fig. 31, 32), begins at the inner angle of the orbit in a vein named the **nasofrontal** which communicates anteriorly with the angular vein; it pursues the same course as the ophthalmic artery, and receives tributaries corresponding to the branches of that vessel. Forming a short single trunk, it passes between the two heads of the Rectus lateralis and through the medial part of the superior orbital fissure, and ends in the cavernous sinus.

The **Inferior Ophthalmic Vein** (*v. ophthalmica inferior*) (Fig. 31, 32), begins in a venous net-work at the forepart of the floor and medial wall of the orbit; it receives some veins from the Rectus inferior, Obliquus inferior, lacrimal sac and eyelids, runs backward in the lower part of the orbit and divides into two branches. One of these passes through the inferior orbital fissure and joins the pterygoid venous plexus, while the other enters the cranium through the superior orbital fissure and ends in the cavernous sinus, either by a separate opening, or more frequently in common with the superior ophthalmic vein.

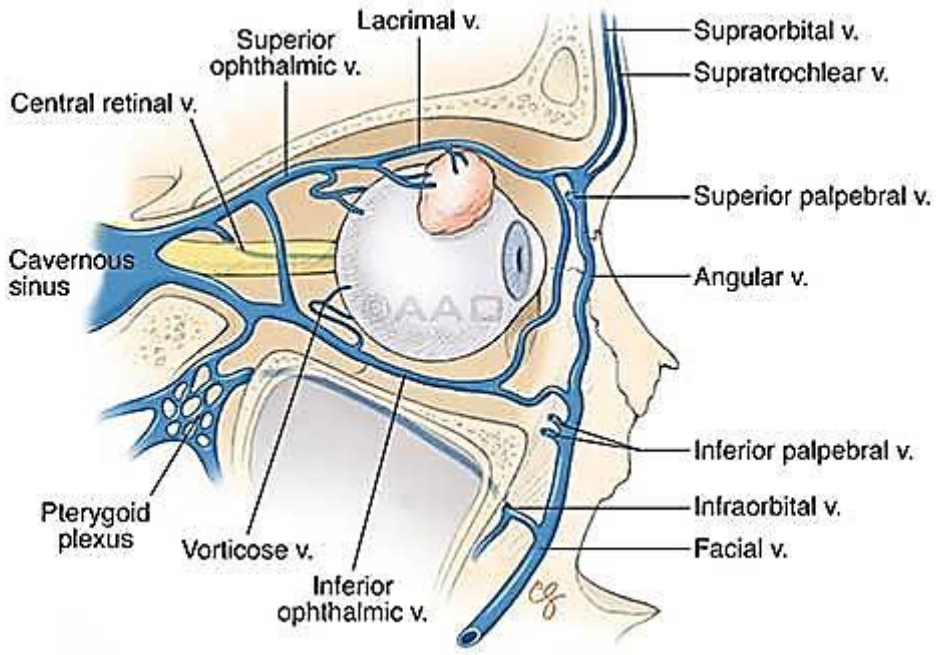

Figure.32. Veins of orbit.

The **intercavernous sinuses** (*sini intercavernosi*) (Fig. 31),are two in number, an anterior and a posterior, and connect the two cavernous sinuses across the middle line. The **anterior** passes in front of the hypophysis cerebri, the **posterior** behind it, and they form with the cavernous sinuses a venous circle (**circular sinus**) around the hypophysis. The anterior one is usually the larger of the two, and one or other is occasionally absent.

The **superior petrosal sinus** (*sinus petrosus superior*) (Fig. 31), small and narrow, connects the cavernous with the transverse sinus. It runs lateralward and backward, from the posterior end of the cavernous sinus, over the trigeminal nerve, and lies in the attached margin of the tentorium cerebelli and in the superior petrosal

sulcus of the temporal bone; it joins the transverse sinus where the latter curves downward on the inner surface of the mastoid part of the temporal. It receives some cerebellar and inferior cerebral veins, and veins from the tympanic cavity.

The **inferior petrosal sinus** (*sinus petrosus inferior*) (Fig. 31), is situated in the inferior petrosal sulcus formed by the junction of the petrous part of the temporal with the basilar part of the occipital. It begins in the postero-inferior part of the cavernous sinus, and, passing through the anterior part of the jugular foramen, ends in the superior bulb of the internal jugular vein. The inferior petrosal sinus receives the internal auditory veins and also veins from the medulla oblongata, pons, and under surface of the cerebellum.

The exact relation of the parts to one another in the jugular foramen is as follows: the inferior petrosal sinus lies medially and anteriorly with the meningeal branch of the ascending pharyngeal artery, and is directed obliquely downward and backward; the transverse sinus is situated at the lateral and back part of the foramen with a meningeal branch of the occipital artery, and between the two sinuses are the glossopharyngeal, vagus, and accessory nerves. These three sets of structures are divided from each other by two processes of fibrous tissue. The junction of the inferior petrosal sinus with the internal jugular vein takes place on the lateral aspect of the nerves.

The **basilar plexus** (*plexus basilaris; transverse or basilar sinus*) (Fig. 26, 27, 31), consists of several interlacing venous channels between the layers of the dura mater over the basilar part of the occipital bone, and serves to connect the two inferior petrosal sinuses. It communicates with the anterior vertebral venous plexus.

Emissary Veins (*emissaria*) (Fig. 26, 27, 31), —The emissary veins pass through apertures in the cranial wall and establish communication between the sinuses inside the skull and the veins external to it. Some are always present, others only occasionally so. The principal emissary veins are the following: (1) A mastoid emissary vein, usually present, runs through the mastoid foramen and unites the transverse sinus with the posterior auricular or with the occipital vein. (2) A parietal emissary vein passes through the parietal foramen and connects the superior sagittal sinus with the veins of the scalp. (3) A net-work of minute veins (*rete canalis hypoglossi*) traverses the hypoglossal canal and joins the transverse sinus with the vertebral vein and deep veins of the neck. (4) An inconstant condyloid emissary vein passes through the condyloid canal and connects the transverse sinus with the deep veins of the neck. (5) A net-work of veins (*rete foraminis ovalis*) unites the cavernous sinus with the pterygoid plexus through the foramen ovale. (6) Two or three small veins run through the foramen lacerum and connect the cavernous sinus with the pterygoid plexus. (7) The emissary vein of the foramen of Vesalius connects the same parts. (8) An internal carotid plexus of veins traverses the carotid canal and unites the cavernous sinus with the internal jugular vein. (9) A vein is transmitted through the foramen cecum and connects the superior sagittal sinus with the veins of the nasal cavity.

Lymphatic drainage

Lymph nodes in the head and neck are arranged in two horizontal rings and two vertical chains on either side of the neck (Fig. 33). The outer, superficial, ring consists of the occipital, preauricular (parotid), submandibular and submental nodes, and the inner, deep, ring is formed by clumps of mucosa associated lymphoid tissue (MALT) located primarily in the naso- and oro-pharynx (Waldeyer's ring). The vertical chain consists of superior and inferior groups of nodes related to the carotid sheath. All lymph vessels of the head and neck drain into the deep cervical nodes, either directly from the tissues or indirectly via nodes in outlying groups. Lymph is returned to the systemic venous circulation via either the right lymphatic duct or the thoracic duct.

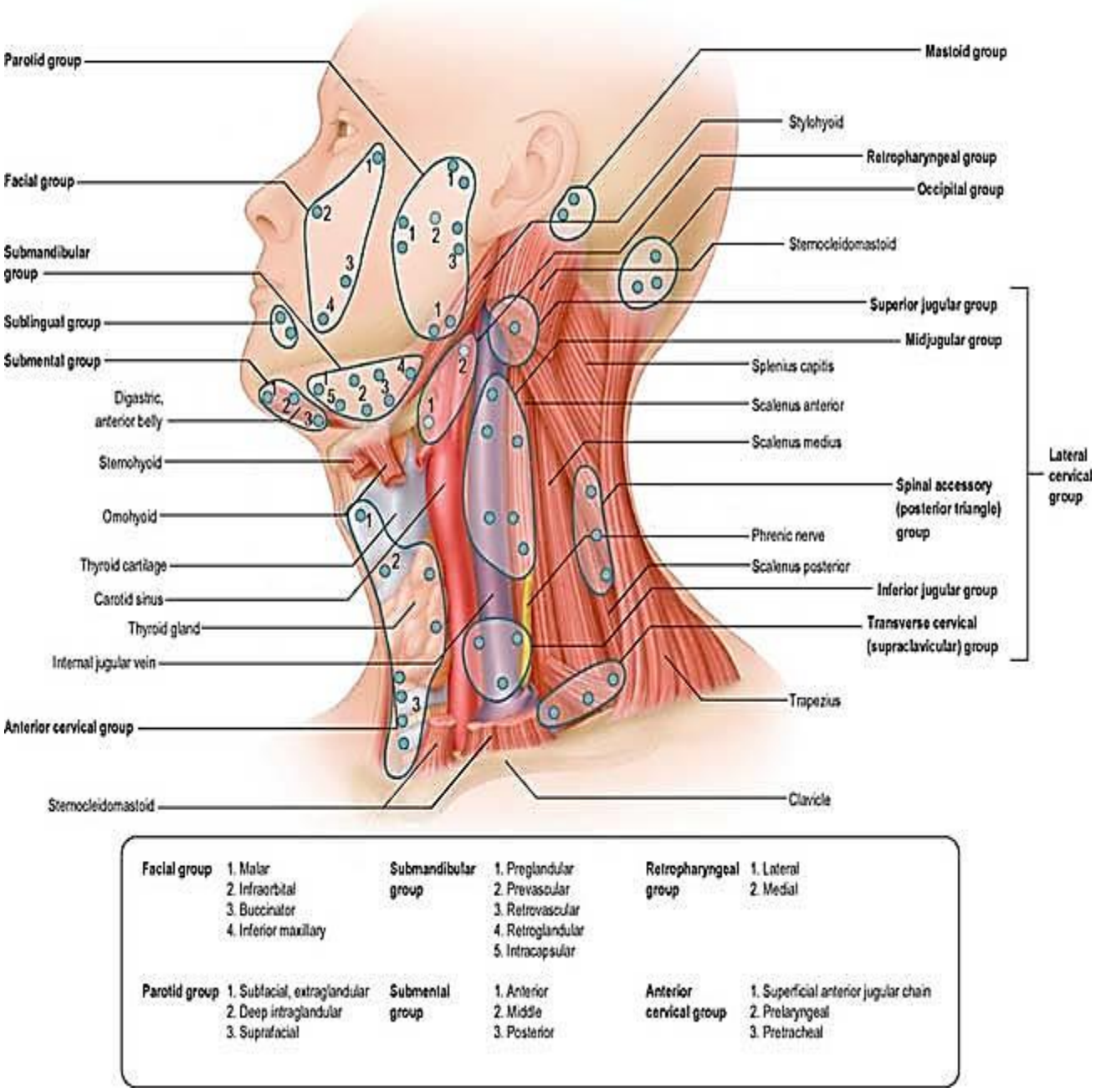

Figure.33. Lymph nodes in the head and neck.

Cervical plexus

The **cervical plexus** (Fig. 34, 35) is formed in the neck, and lies deep to the sternocleidomastoid muscle, and anterolateral to the levator scapulae and middle scalene muscles. Each of the cervical nerves forming the plexus communicates with one another in a superior-inferior fashion close to their origins, thus the C2 accepts communicating fibres from C1, C3 from C2, and so on. These communicating fibres are the contributions from the sympathetic trunk (sympathetic nervous system) to the cervical plexus. Those fibres are "gray rami" communicantes (meaning blood vessel accompanied) descending from the superior cervical ganglion (which is the largest of the three cervical ganglia). Next they each (except the first, C1) divide into an ascending branch and a descending branch. They subsequently unite with branches of the adjacent cervical nerve to form loops, for example, the loop formed between C2 and C3 that contributes branches to the "ansa cervicalis". Those loops and the branches from them form the cervical plexus.

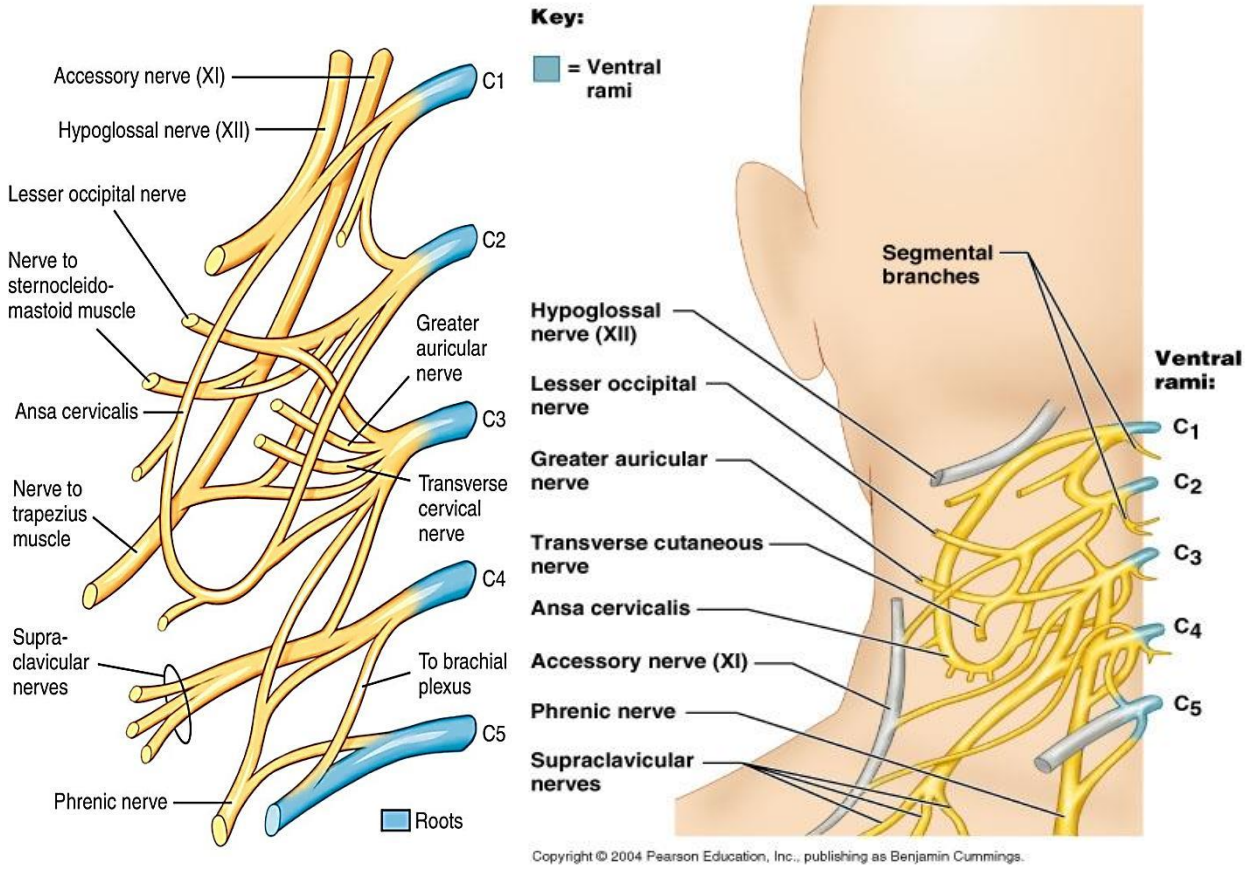

Figure.34. Cervical plexus.

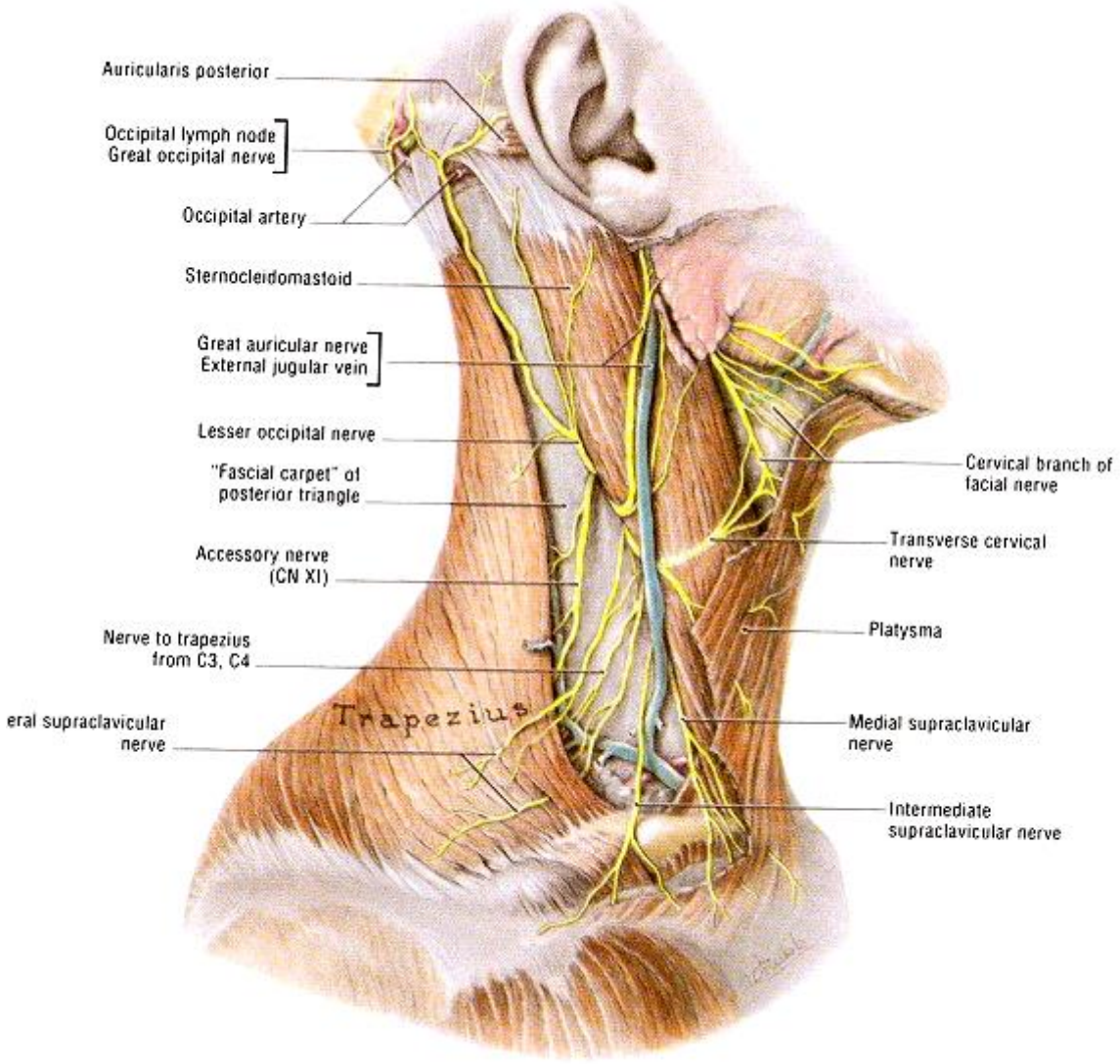

Figure. 35. The cervical plexus.

The cervical plexus (Fig. 34, 35, 36) is composed by rami of the first four cervical spinal nerves on both sides of the neck (C1-C4). The accessory and hypoglossal nerves and the sympathetic trunk form anastomosis with branches of the cervical plexus, which contain ***cutaneous (somatosensory)*** and ***muscular (somatomotor) fibers***. Branches of the cervical plexus include the motor branches supplying muscles, and the cutaneous branches innervating the skin of the anterolateral neck, the superior part of the thorax (superolateral thoracic wall) and scalp between the auricle (pinna) and the external occipital protuberance.

Somatosensory (Fig. 34, 35, 36) fibers innervate the back of the head while somatomotor fibers innervate deep nuchal muscles. The branches of the cervical plexus emerge from the posterior triangle at the nerve point of the neck (punctum nervosum), a point which lies midway on the posterior border of the sternocleidomastoid muscle. This area is clinically significant and recognized as the nerve point of the neck.

Cutaneous branches (somatosensory):

- C2, C3 - great auricular nerve - skin near the outer ear and external acoustic meatus. Great Auricular Nerve: This sensory branch originates from the C2 and C3 nerves. It courses upwards in a diagonal fashion and crosses the sternocleidomastoid muscle onto the parotid gland. It then divides and innervates the skin over the parotid gland, the posterior aspect of the auricle, and an area of skin extending from the angle of the mandible of the mastoid process.
- C2, C3 - transverse cervical nerve - anterior region of neck. Transverse Cervical Nerve: The transverse cervical nerve is formed by axons from the second and third cervical nerves. It supplies the skin covering the anterior triangle of the neck. This branch curves around the middle of the posterior border of the sternocleidomastoid muscle and crosses it deep to the platysma muscle.
- C2 - lesser occipital nerve - skin and the scalp behind and above the auricle. Lesser Occipital Nerve: The branch is formed by the second cervical nerve (C2) only, and courses to supply the skin of the neck and the scalp posterosuperior to the clavicle.
- C3, C4 - supraclavicular nerves - skin above and below the clavicle. Supraclavicular Nerve: This branch is formed by the C3 and C4 nerves, and it emerges as a common trunk under cover of the sternocleidomastoid muscle and sends small branches to the skin of the neck. Some of those branches of this branch (supraclavicular) also cross the clavicle to supply the skin over the shoulder.

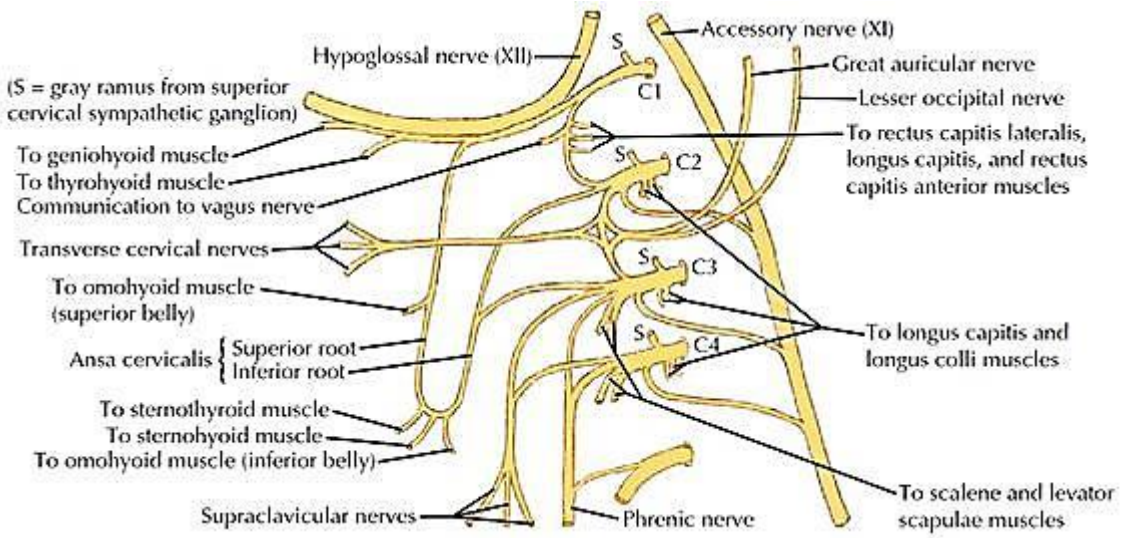

Figure.36. Cervical plexus.

Somatomotor (Fig. 34, 35, 36) fibers on the other hand, the motor branches of the cervical plexus form the ansa cervicalis, which is a nerve loop innervating the infrahyoid muscles in the anterior cervical triangle. They also form the phrenic

nerve which supply the diaphragm and the pericardium of the heart. Some motor branches also reach the rhomboid muscles – nerves to the rhomboids [dorsal scapular nerve (formed by C4 and C5)] and serratus anterior muscle (long thoracic nerve – formed by fibres from C5, C6 and C7 nerves, hence formed by both the cervical and the brachial plexus mainly). Therefore the motor branches include:

Muscular branches (somatomotor):

- loop of C1 - C3 - ansa cervicalis. The Ansa Cervicalis: The five motor branches of the ansa cervicalis loop listed above, originate from C1 to C3 nerves. They supply the infrahyoid muscles in the anterior cervical triangle.
    - sternothyroid muscle
    - sternohyoid muscle
    - omohyoid muscle
- C1 – geniohyoid muscle
- C1 - thyrohyoid muscle
- segmental branches of C1 to C4 - anterior and middle scalene muscles
- posterior roots of C2–C3 - preauricular nerve
- posterior roots of C3–C4 - postauricular nerve

- C3 - C5 (primarily C4) phrenic nerve – diaphragm, pericardium. Phrenic Nerve: The phrenic nerve originates chiefly from the 4th cervical nerve (C4) but receives contributions from the 3rd and 5th cervical nerves (C3 and C5). It is formed at the superior part of the lateral border of the anterior scalene muscle, at the level of the superior border of the thyroid cartilage. The phrenic nerve contains motor, sensory, and sympathetic nerve fibres. It provides the sole motor supply to the diaphragm as well as sensation to its central part. In the thorax, the phrenic nerve innervates the mediastinal pleura and pericardium of the heart. The phrenic nerve descends obliquely across the anterior scale us muscle, deep to the prevertebral layer of deep cervical fascia and the transverse cervical and suprascapular arteries. It runs posterior to the subclavian vein and anterior to the internal thoracic artery as it enters the thorax.

The cervical plexus is a conglomeration of cervical nerves formed by the ventral rami of the first four cervical nerves (C1 – C4). These are the roots (limbs) of the cervical plexus. However, most authors include the fifth cervical nerve (i.e. the ventral ramus of C5) to the plexus owing to its contribution to the formation of one of the motor branches of the cervical plexus called the phrenic nerve. Therefore, the cervical plexus can also be defined as a network of nerves formed by the ventral rami of C1 – C5 nerves and gives off both motor (anterior) and sensory (posterior) branches (Fig. 34, 35, 36).

Question's:

1. Aorta: parts, their topography. Aortic arch. Its branches.
2. External carotid artery: maxillary artery, its topography, parts, branches, areas of blood supply.
3. External carotid artery; topography, classification of branches.
4. External carotid artery: anterior group of branches, their topography, areas of blood supply.
5. External carotid artery: lingual artery, its topography, branches, areas of blood supply.
6. External carotid artery: posterior group of branches, their topography, areas of blood supply.
7. External carotid artery: medial group of branches, their topography, areas of blood supply.
8. External carotid artery: superficial temporal artery, its topography, branches, areas of blood supply.
9. External carotid artery: facial artery, its topography, branches, areas of blood supply.
10. Common carotid artery: origin (right and left), their topography, branches.
11. Internal carotid artery: parts, their topography.
12. Internal carotid artery: ophthalmic artery, its topography, branches.
13. Basilar artery: formation, topography, branches.
14. Arterial circle of brain: topography, formation, functional meaning.
15. Cervical plexus: formation, topography, branches, areas of innervations.
16. Internal carotid artery; cerebral part, its topography, branches, areas of blood supply.
17. Internal jugular vein: formation, topography, classification of tributaries.
18. Intracranial tributaries of internal jugular vein.
19. Subclavian artery: internal thoracic artery, topography, branches, areas of blood supply.
20. Subclavian artery: origin (of right and left) arteries, topographical parts of subclavian artery, main branches.
21. Subclavian artery: thyro-cervical trunk, its branches, areas of blood supply.
22. Subclavian artery: vertebral artery, parts, their topography, branches of each part, areas of blood supply.
23. Subclavian artery: costo-cervical trunk, its branches, areas of blood supply.
24. Ways of outflow of venous blood from venous sinuses of dura mater of brain.
25. Veins of the brain. Classification. Formation. Tributaries.
26. Extracranial tributaries of internal jugular vein.
27. Anastomoses between intracranial and extra cranial tributaries of internal jugular vein.
28. External jugular vein: formation, topography, tributaries.

29. Anterior jugular vein: formation, topography, tributaries. Jugular venous arch: topography, formation.
30. Brachiocephalic vein : formation, topography, tributaries.
31. Venous angle: formation,topography.. Formation of superior vena cava.

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for students of Medical Faculty

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