Functional Anatomy of the vascular system of the head and neck

Anatomical peculiarities of the cerebral arteries

Anatomical peculiarities of the cerebral veins

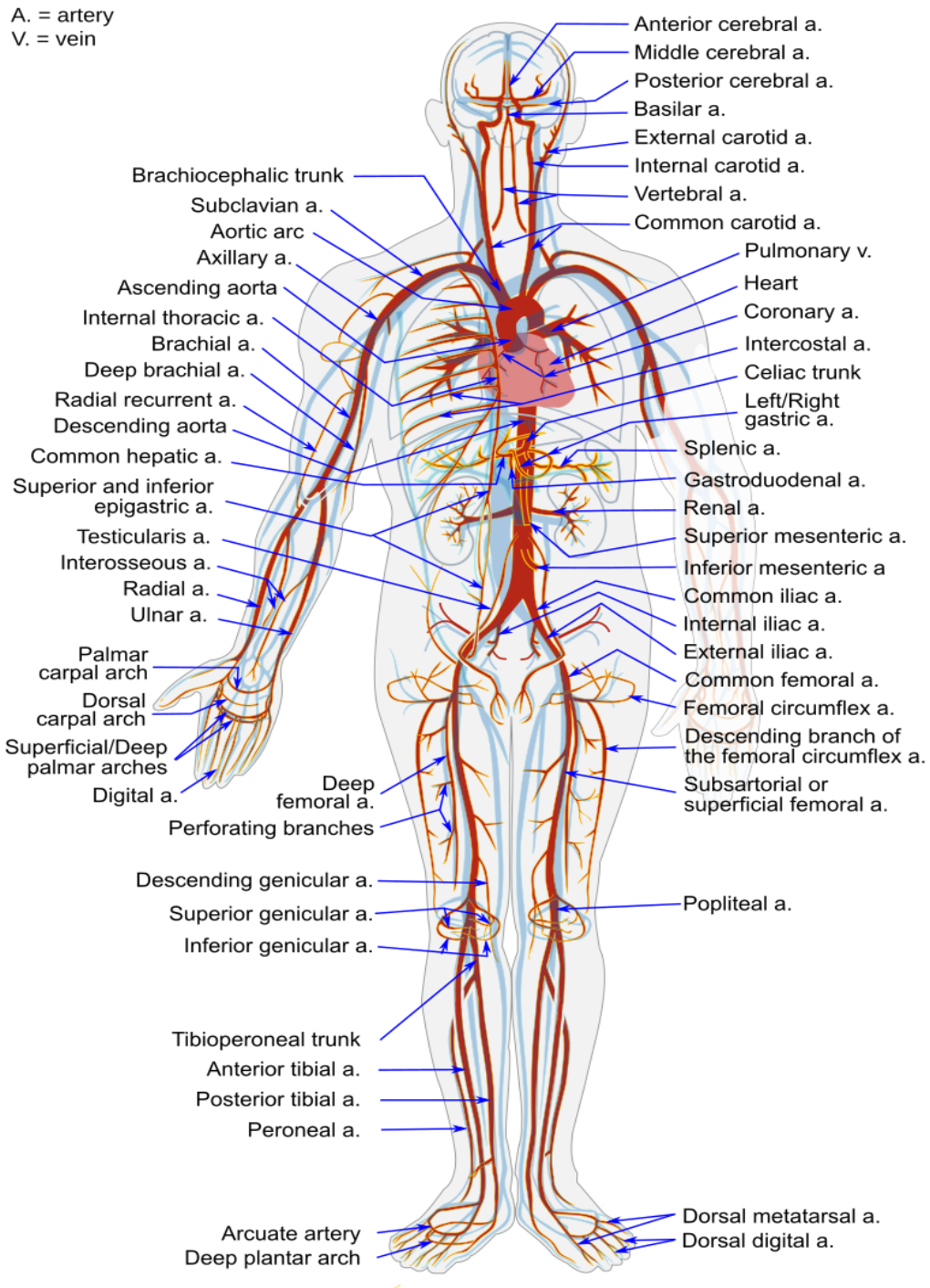
Vascular anastomoses of the head and neck

Variants and anomalies of the blood vessels of the head and neck

Blood supply to the organs of the head and neck

Lymphatic drainage of the head and neck

Lecturer: PhD, professor Tamara Hacina


A. = artery
V. = vein
Anterior cerebral a.
Middle cerebral a.
Posterior cerebral a.
Basilar a.
External carotid a.
Internal carotid a.
Vertebral a.
Common carotid a.
Brachiocephalic trunk
Subclavian a.
Aortic arc
Axillary a.
Ascending aorta
Internal thoracic a.
Brachial a.
Deep brachial a.
Radial recurrent a.
Descending aorta
Common hepatic a.
Superior and inferior epigastric a.
Testicularis a.
Interosseous a.
Radial a.
Ulnar a.
Palmar carpal arch
Dorsal carpal arch
Superficial/Deep palmar arches
Digital a.
Deep femoral a.
Perforating branches
Descending genicular a.
Superior genicular a.
Inferior genicular a.
Tibioperoneal trunk
Anterior tibial a.
Posterior tibial a.
Peroneal a.
Arcuate artery
Deep plantar arch
Pulmonary v.
Heart
Coronary a.
Intercostal a.
Celiac trunk
Left/Right gastric a.
Splenic a.
Gastroduodenal a.
Renal a.
Superior mesenteric a.
Inferior mesenteric a
Common iliac a.
Internal iliac a.
External iliac a.
Common femoral a.
Femoral circumflex a.
Descending branch of the femoral circumflex a.
Subsartorial or superficial femoral a.
Popliteal a.
Dorsal metatarsal a.
Dorsal digital a.

Arterial vessels of the brain

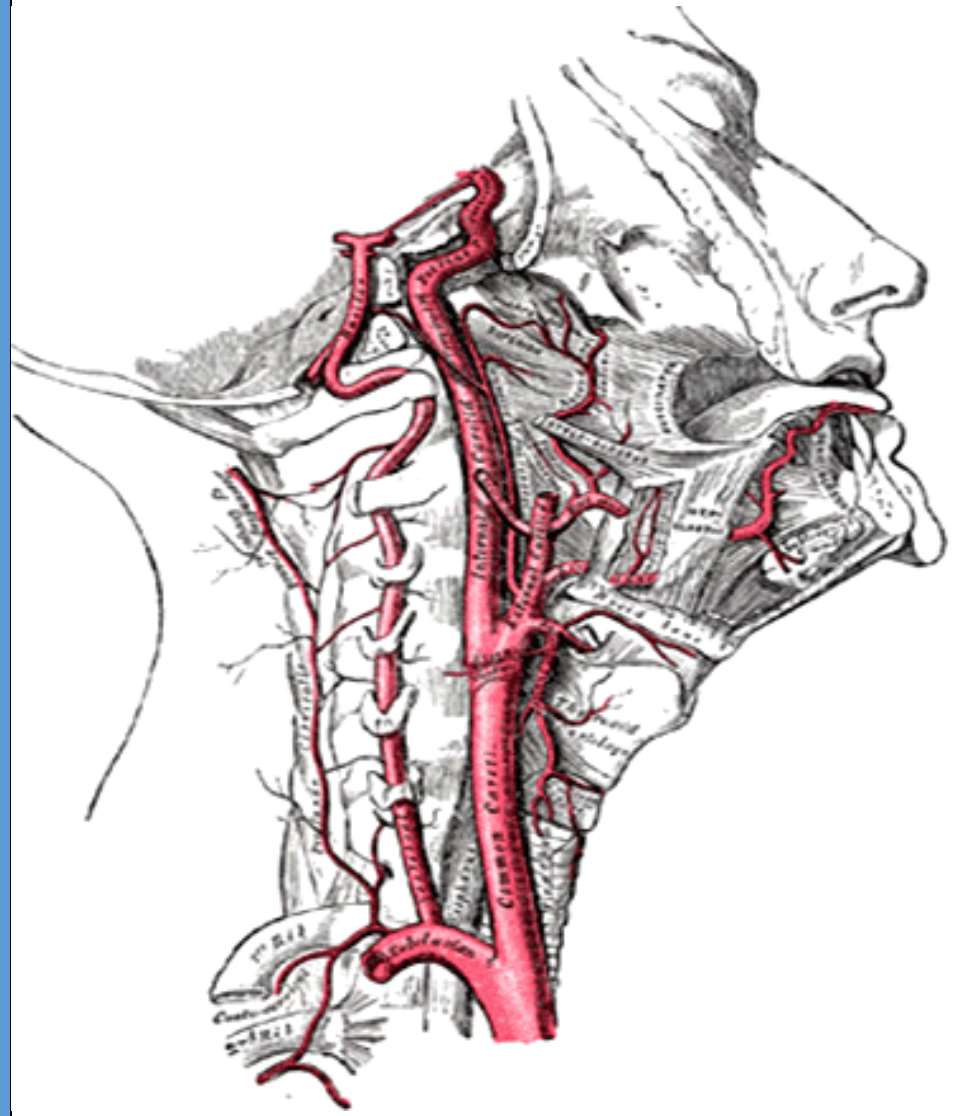
The brain is supplied by 2 systems of blood vessels:

*** *Internal carotid aa*. with diameter 4-5 mm;**

*** *Vertebral aa.* with diameter 2-3 mm, which give off cerebral arteries.**

Prezence of two systems of vascularization of the brain is very important.

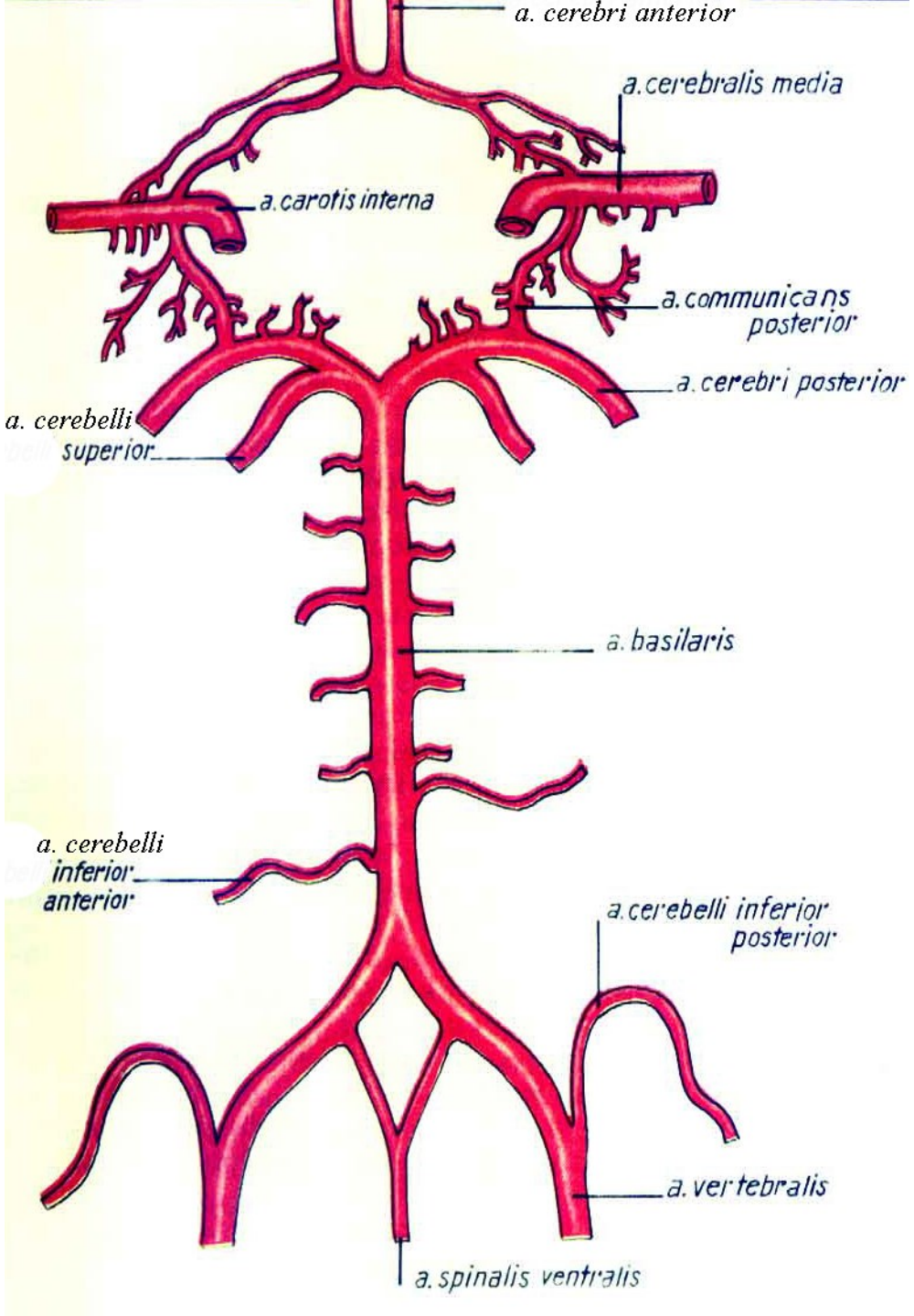
Blood torrent of different arteries changes during the head movements:
in extention **of the head the vertebral a. practic is closed at the level of the vertebra C3,**
during rotation **- 1/2 of the lumen of this vessel on the opposite side is reduced. !!!**



Anatomical peculiarities of the cerebral arteries

One peculiar feature **is the presence of anastomosis in the form of the arterial circle /*circle of Willis*/. it is formed: anteriorly by the anterior communicating artery, posteriorly by the basilar artery as it divides into the right and left posterior cerebral arteries, on each side by the anterior cerebral, internal carotid, posterior communicating and posterior cerebral arteries.**

It lies in the interpeduncular subarachnoid cistern. It equalizes pressure in the arteries of the two sides.

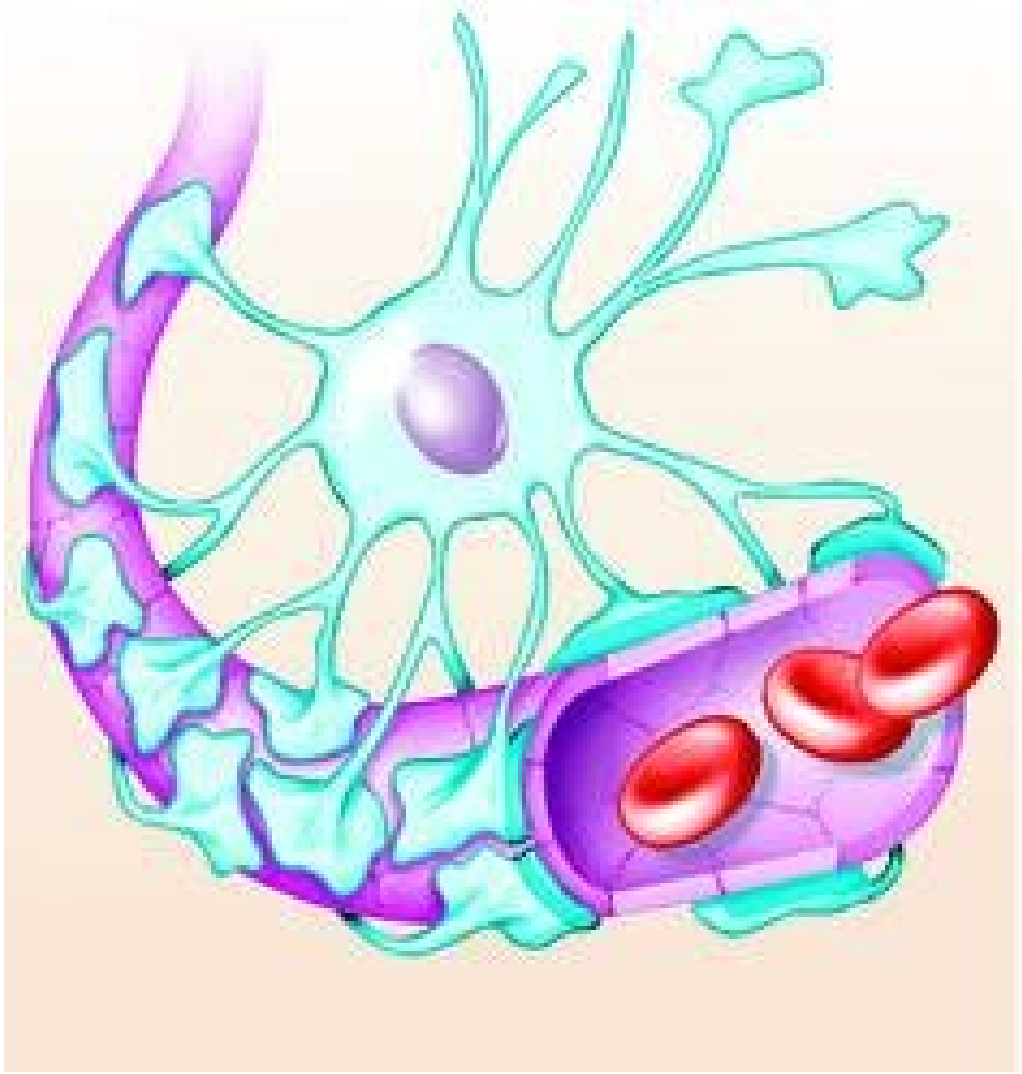


The second peculiarity **is the existence of a** ***„blood-brain" barrier*** **formed by structures between the blood and nerve cells of the brain.**

This barrier is made up of:

- the vessel wall;
- the neuroglia;
-the groud substance of the brain.

• The barrier, at the capillary level, is reduced merely to the capillary endothelium with neuroglia and ground substance.
• Toxic and harmful substances are ordinarily prevented from reaching the brain.



The blood-brain barrier - BBB – it is protective mechanism that helps to mentain a stable environment for the brain.

It includes:

1) the least permeable capillaries in the body due to the continuous endothelium of capillary walls

2) Relatively thick basal lamina

3) Bulbous feet of astrocytes.

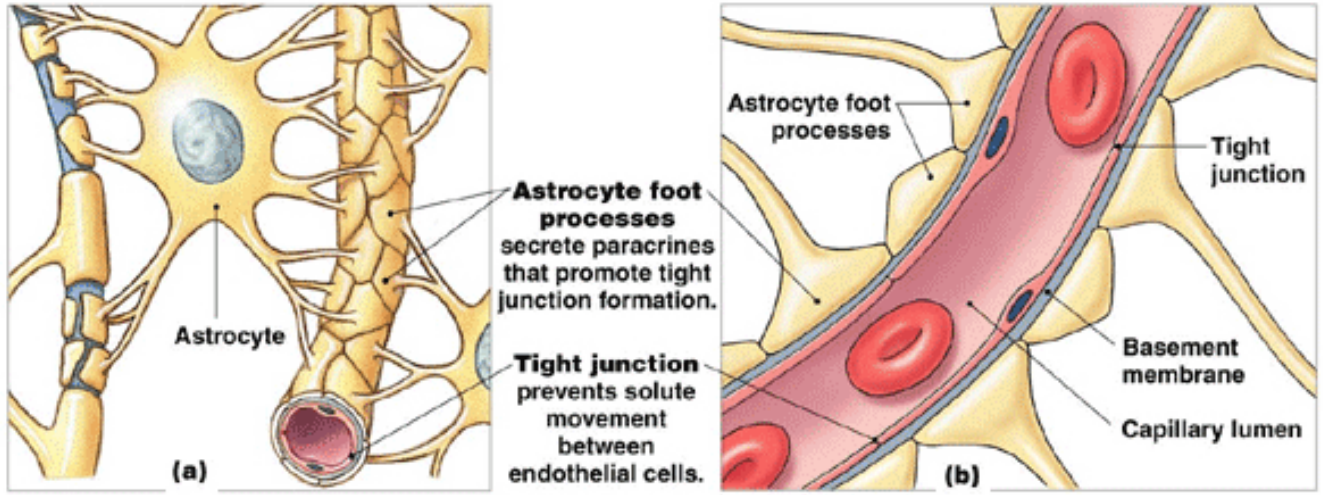
BBB

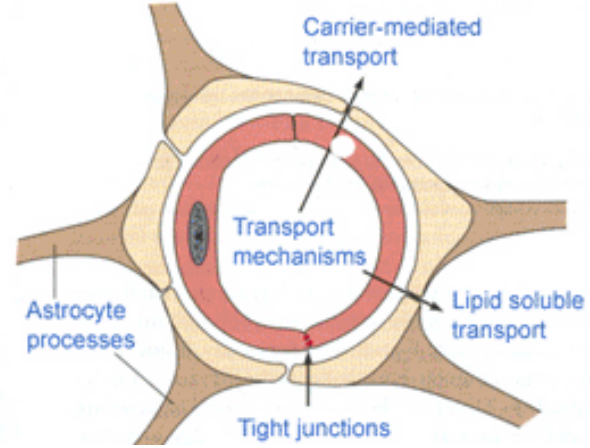
• **It is a separation of circulating blood and tissue of the central nervous system (CNS).**

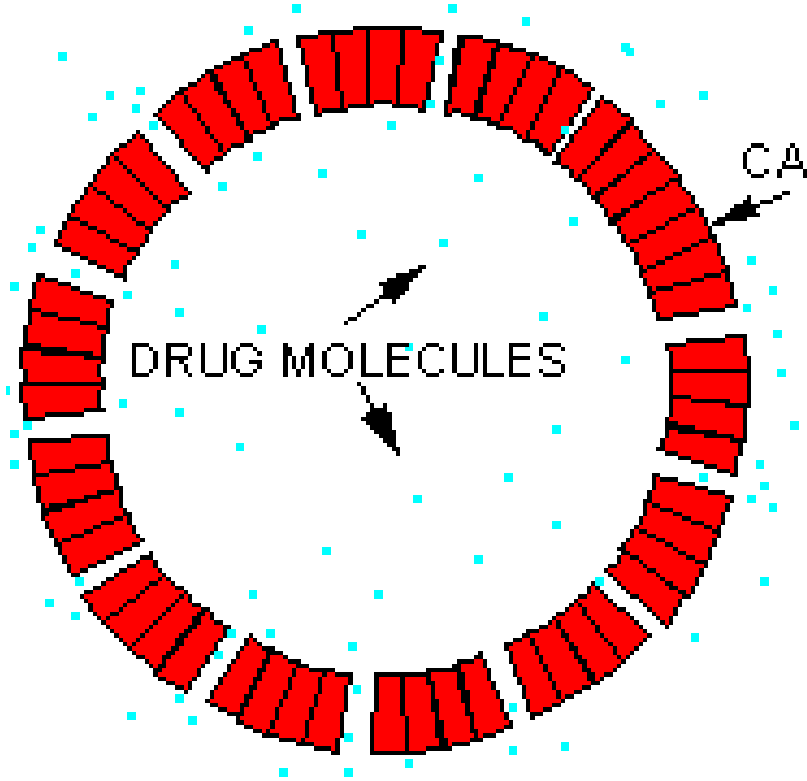
***Selective barrier that allows nutrients to pass freely.**

***Is ineffective against substances that can diffuse through plasma membranes (fats, gasses, alcohol)**

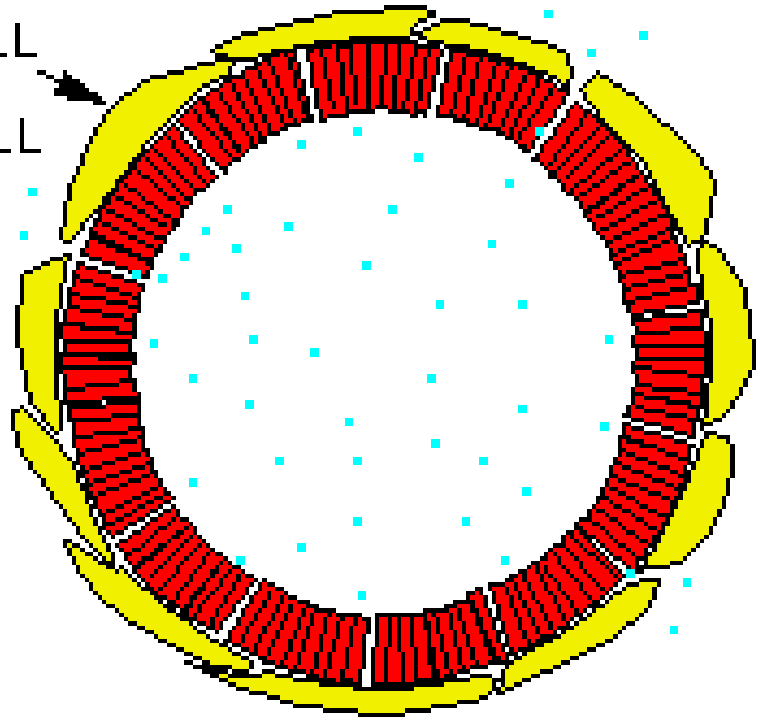
***Absent in some areas (vomiting center and the hypothalamus), allowing these areas to monitor the chemical composition of the blood**







General body capillaries allowdrug molecules to pass freely into the surrounding tissue.



Brain capillaries have a dense-walled structure and are surrounded by glial cells (lipid). This prevents many drug molecules from entering the surrounding tissue.

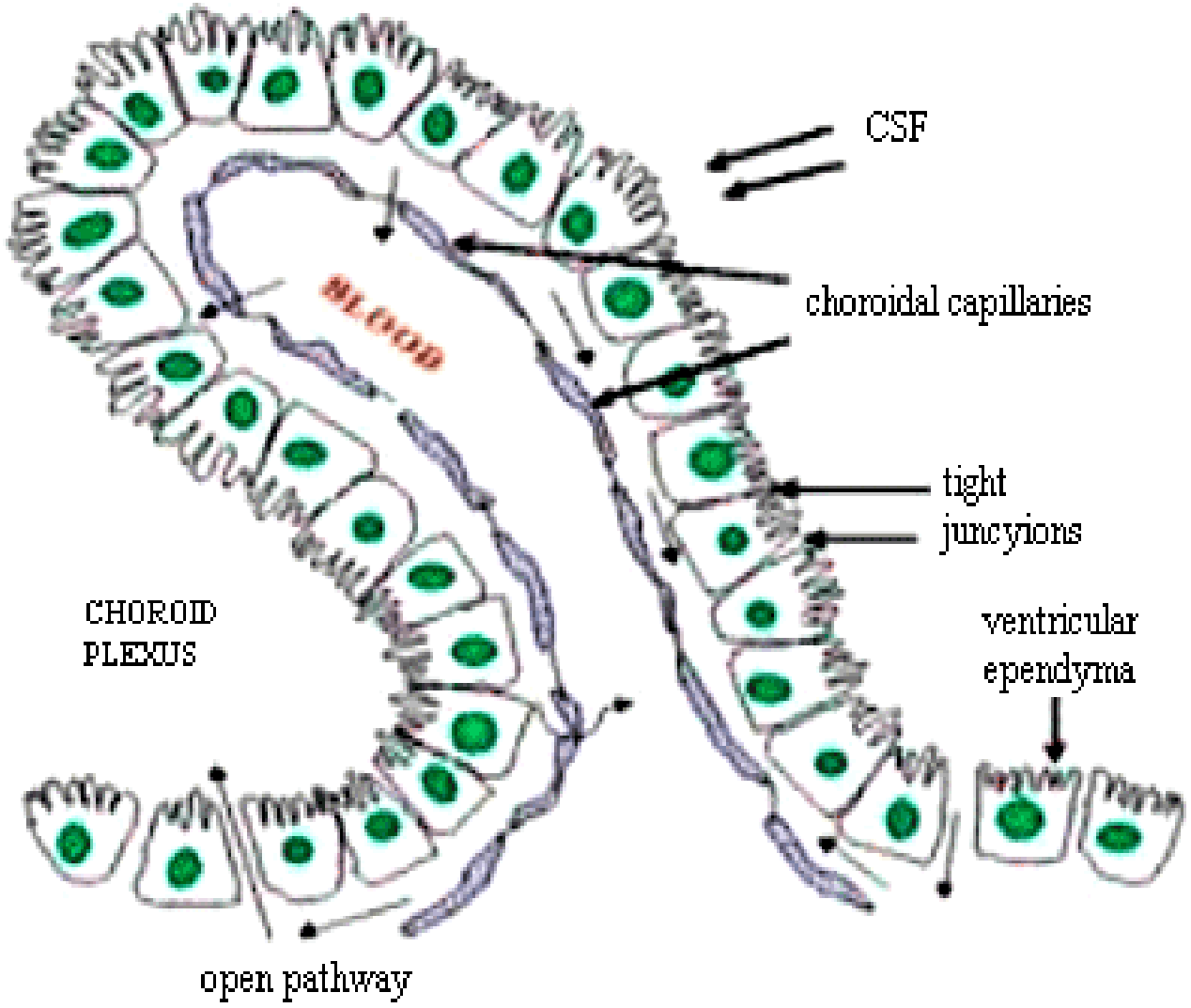
BCFB barrier is made up of:

- **the arachnoid layer of the perivascular sheath;**
- **the perivascular space;**
- **the pial layer of the perivascular sheath**

- The ***BBB*** is distinct from the quite similar ***blood-cerebrospinal fluid barrier***, which is a function of the choroidal cells of the choroid plexus, and from the blood-retinal barrier, which can be considered a part of the whole realm of such barriers.

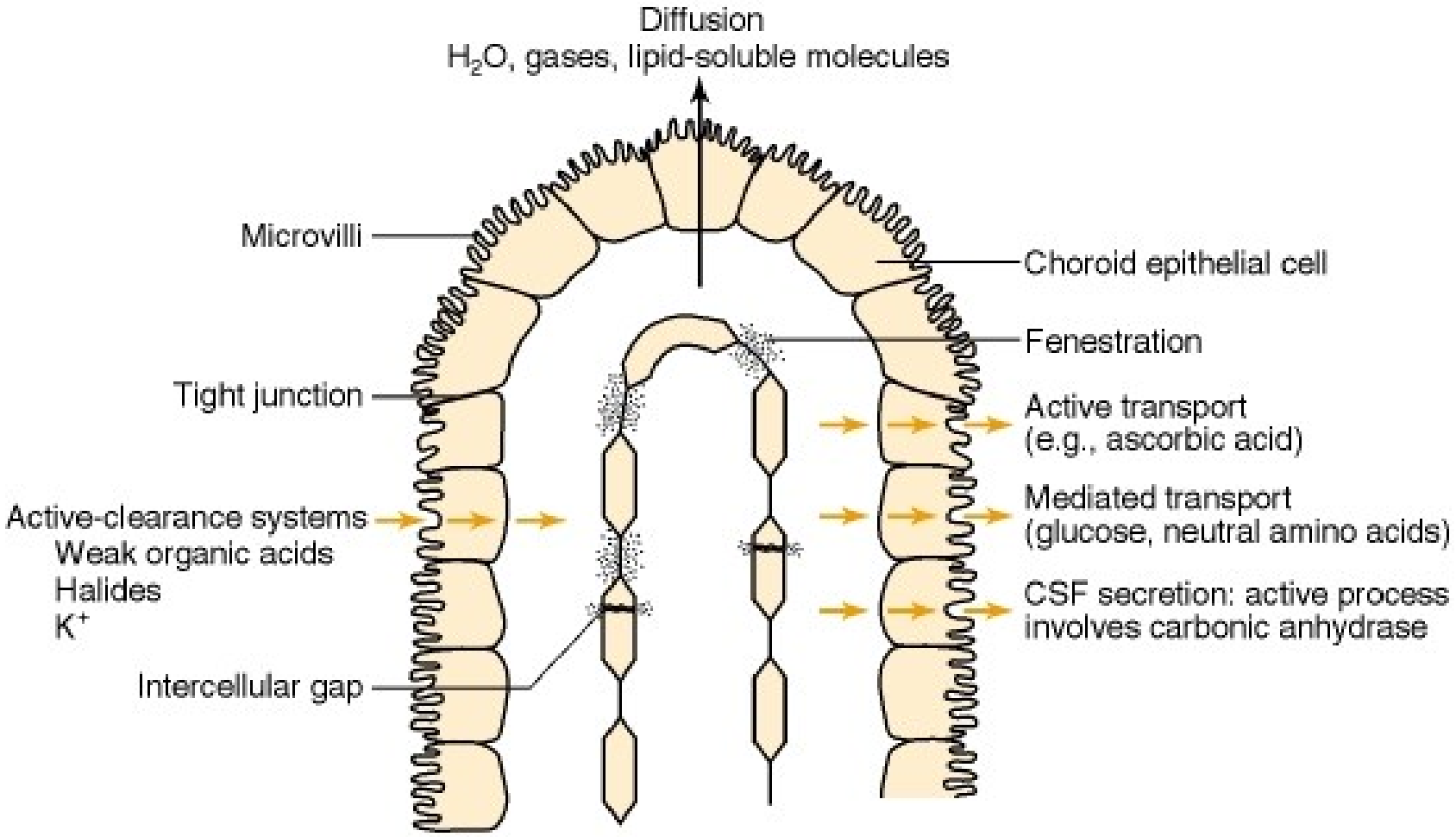
Several areas of the human brain are not "behind" the BBB. These include the circumventricular organs.

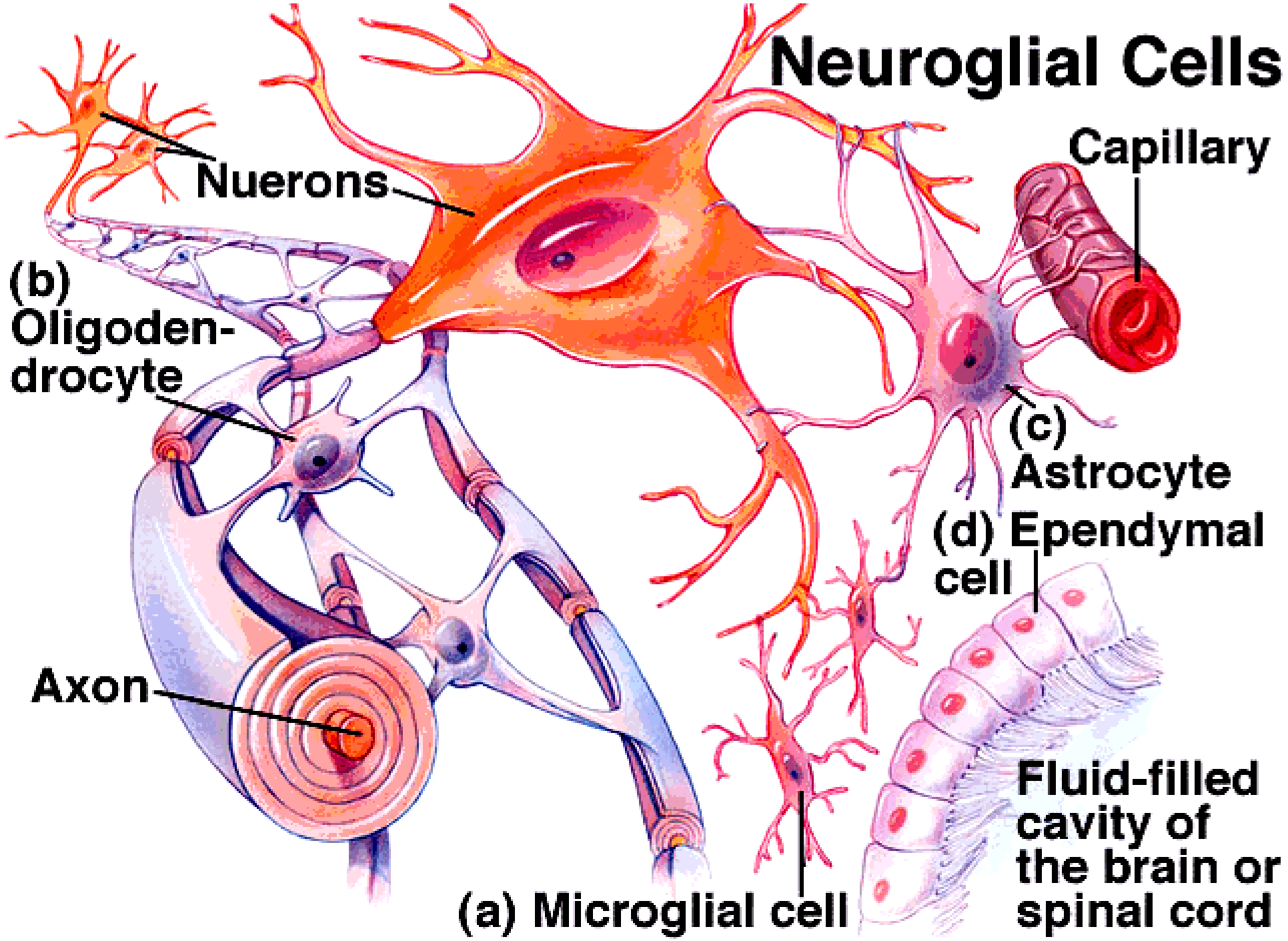
One example of this is the pineal gland, which secretes the hormone melatonin "directly into the systemic circulation“ as this hormone can pass through the blood-brain barrier.



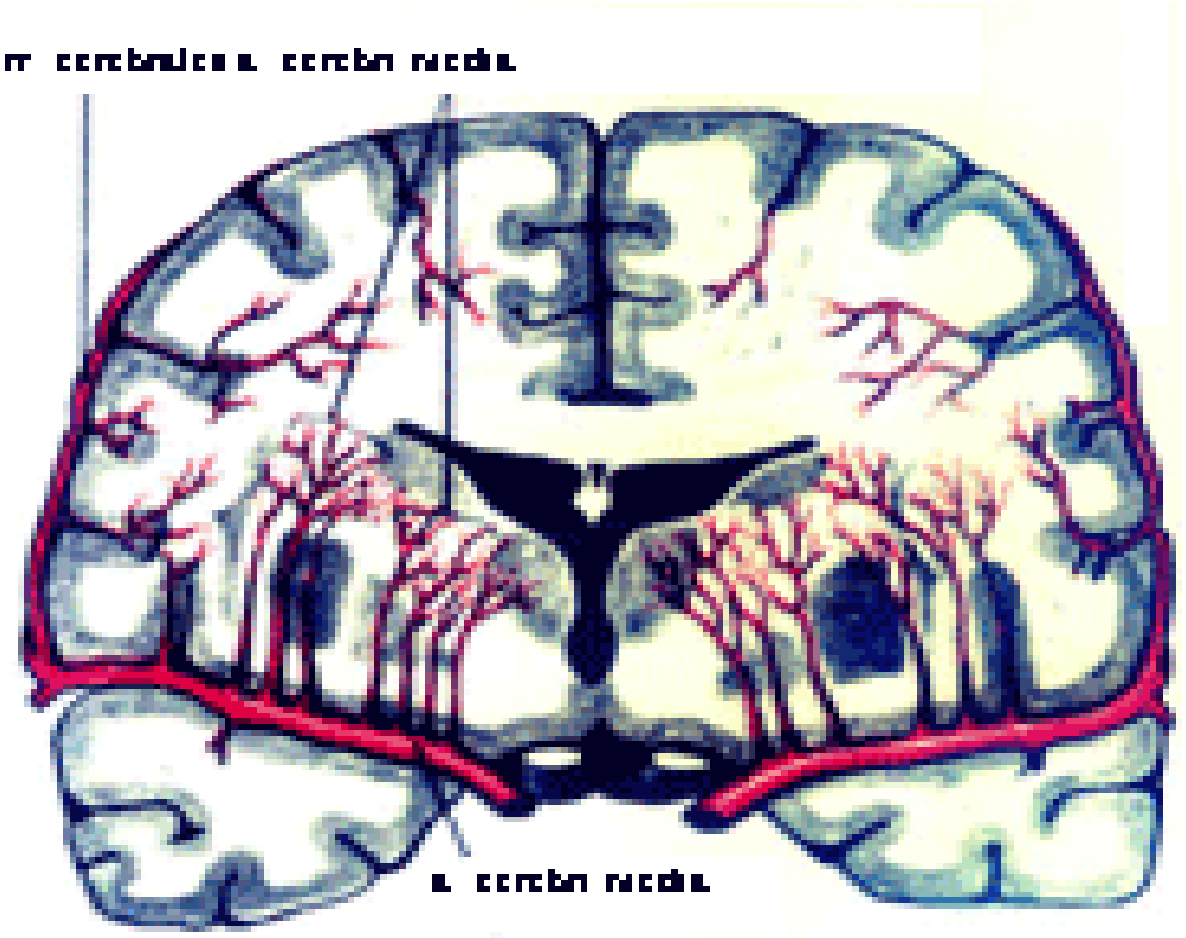
Unlike the capillaries that form the blood—brain barrier, *choroid plexus capillaries are fenestrated* and *have no tight junctions*. The endothelium, therefore, does not form a barrier to the movement of small molecules. Instead, the blood—CSF barrier at the choroid plexus is formed by the epithelial cells and the tight junctions that link them. The other part of the blood—CSF barrier is the arachnoid membrane, which envelops the brain.

The cells of this membrane also are linked by tight junctions.




Neuroglial Cells
Nuerons
Capillary
(b)
Oligoden-
drocyte
(c)
Astrocyte
(d) Ependymal
cell
Axon
Fluid-filled
cavity of
the brain or
spinal cord
(a) Microglial cell

The third significant fact **is that central branchews of cerebral arteries are *end arteries.***
An end artery is an artery that is the only supply of oxygenated blood to a portion of tissue.
End arteries are also known as terminal arteries.
Thrombosis of any one of them, invariably causes infarction.
The cortical branches establish very poor anastomoses with each other:
the anastomoses cannot compensate for any loss of blood supply to a particular area of the cortex.



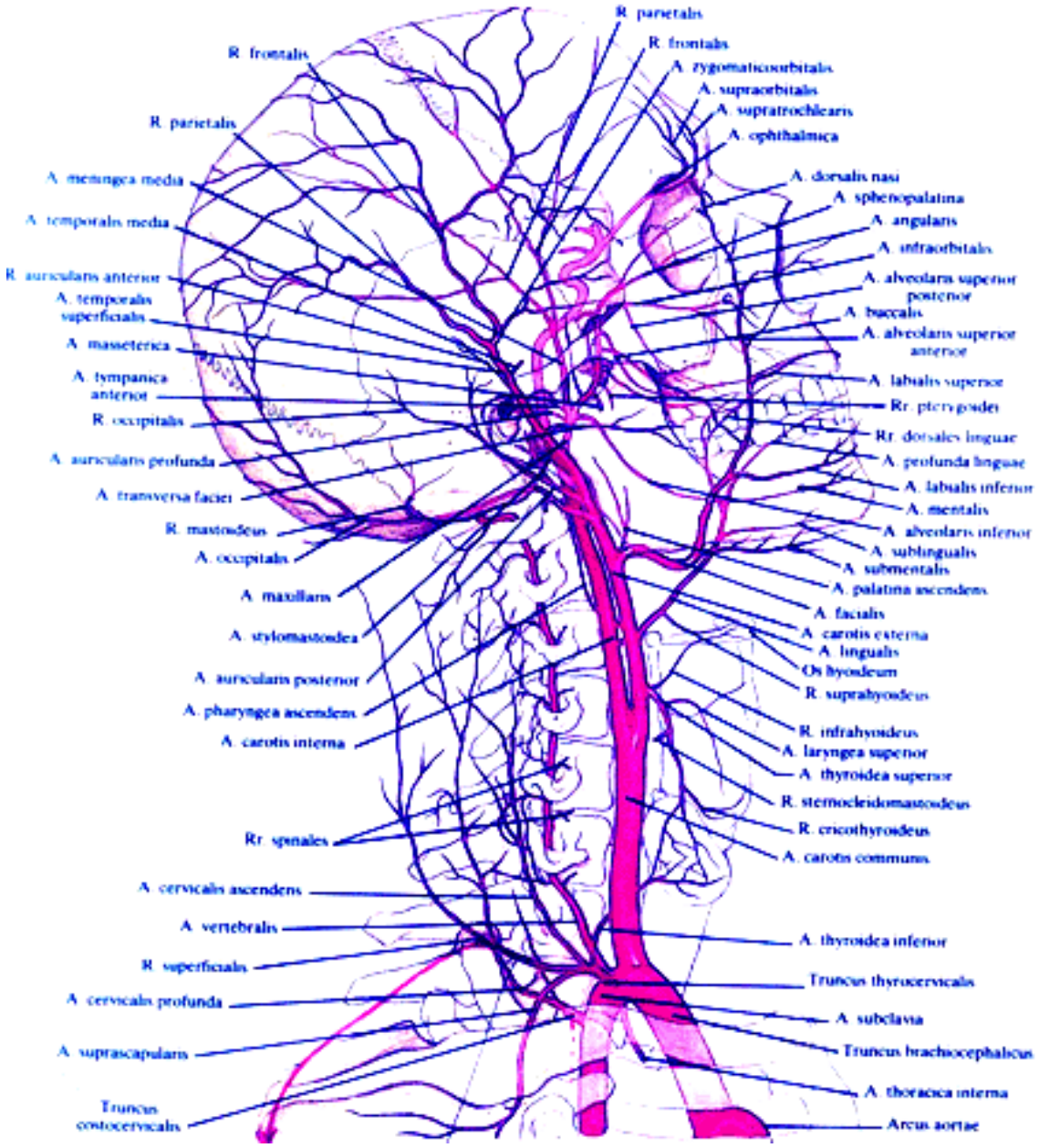
The types of end arteries are:

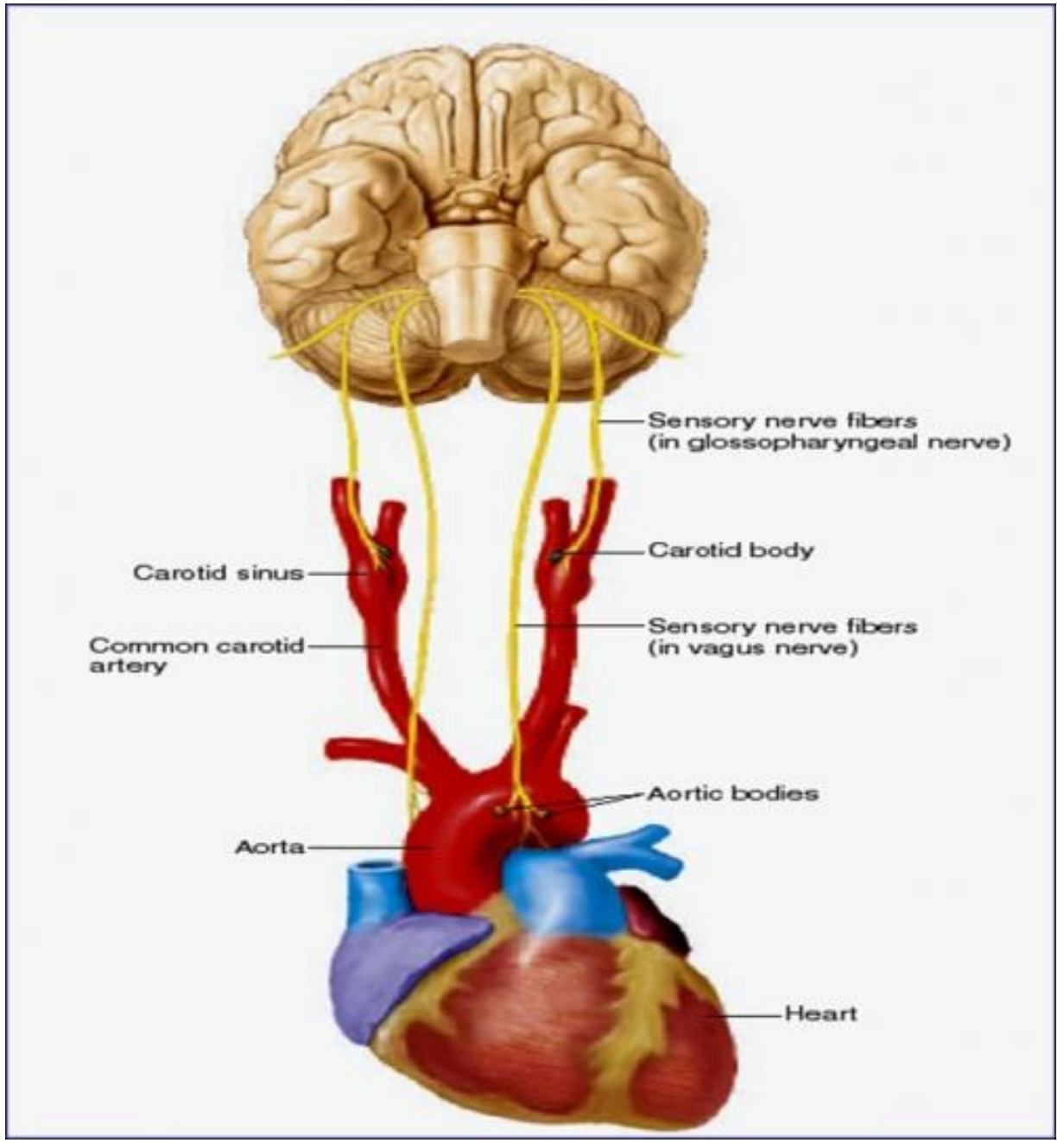
Anatomic (True) End Artery:

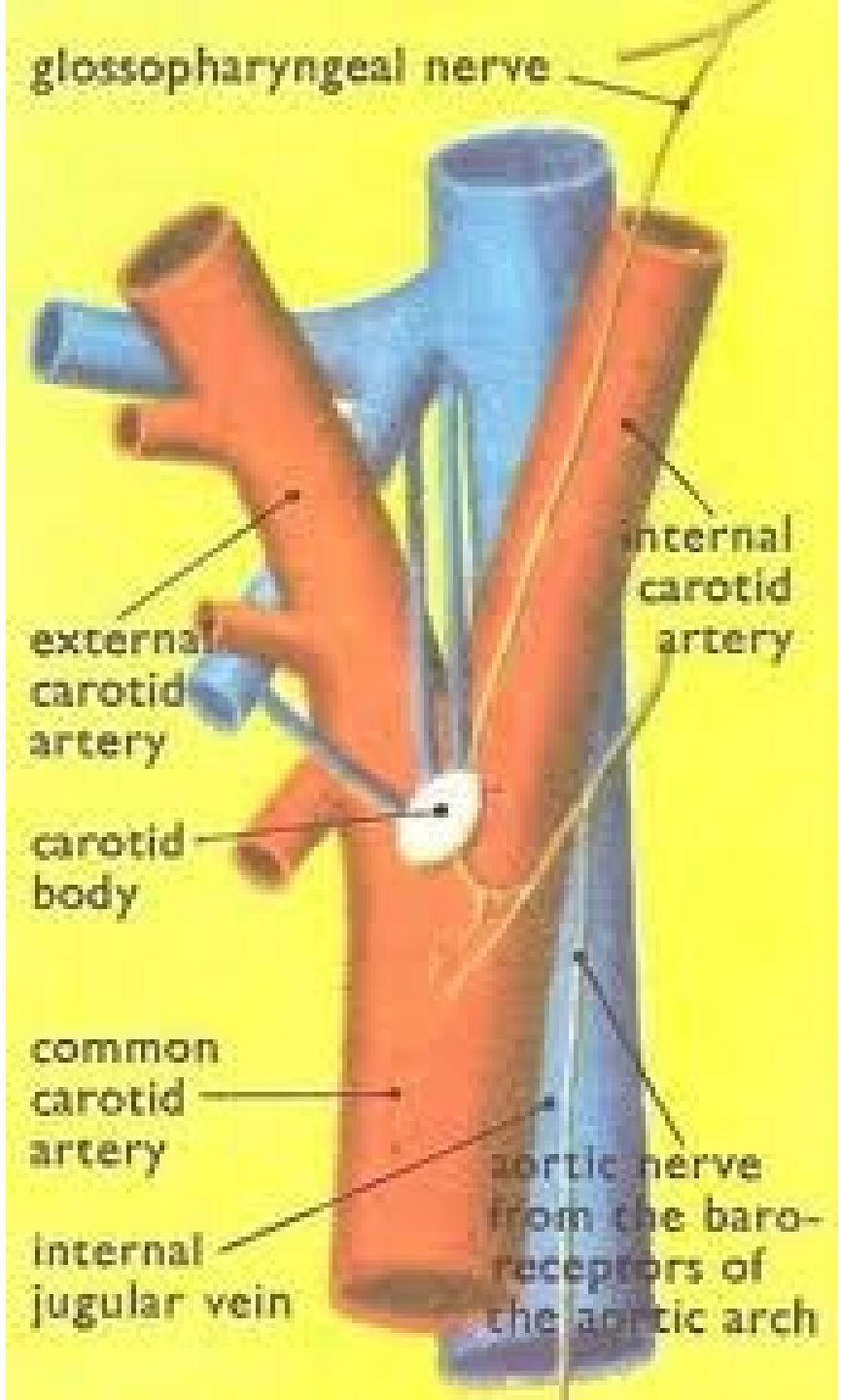
they do not undergo anastomoses

Functional End Artery: arteries with ineffectual Anastomoses

End artery one which undergoes progressive branching without development of channels connecting with other arteries, so that if occluded it cannot supply sufficient blood to the tissue depending on it.

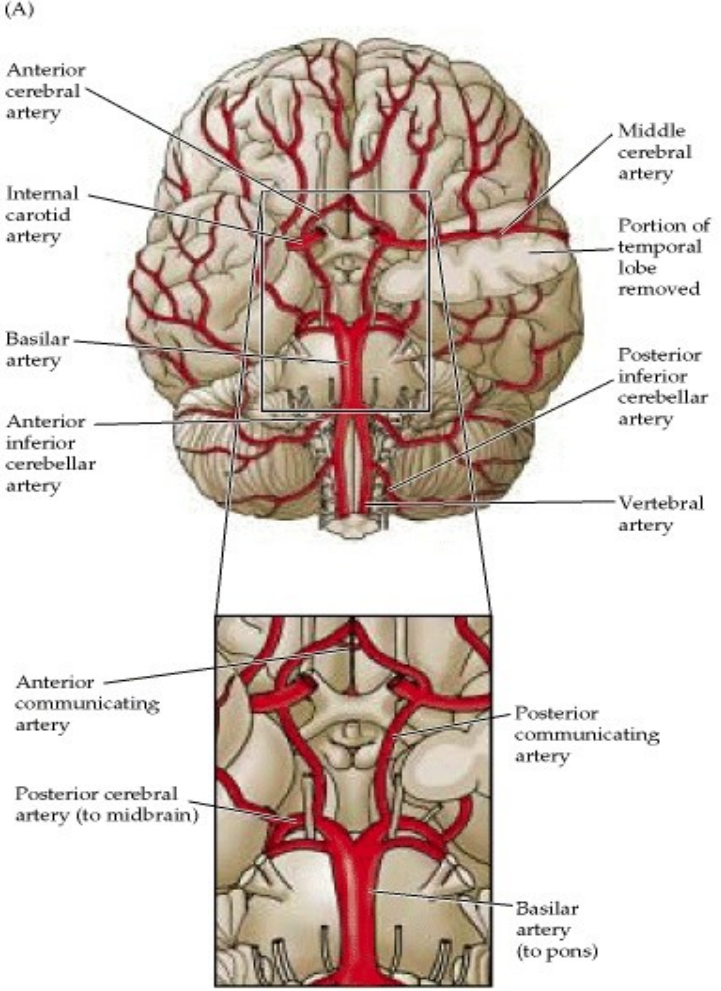

R. parietalis
R. frontalis
A. zygomaticoorbitalis
A. supraorbitalis
A. supratrochlearis
A. ophthalmica
R. frontalis
R. parietalis
A. meningea media
A. temporalis media
R. auricularis anterior
A. temporalis superficialis
A. masseterica
A. tympanica anterior
R. occipitalis
A. auricularis profunda
A. transversa faciei
R. mastoideus
A. occipitalis
A. maxillaris
A. stylomastoidea
A. auricularis posterior
A. pharyngea ascendens
A. carotis interna
Rr. spinales
A. cervicalis ascendens
A. vertebralis
R. superficialis
A. cervicalis profunda
A. suprascapularis
Truncus costocervicalis
A. dorsalis nasi
A. sphenopalatina
A. angularis
A. infraorbitalis
A. alveolaris superior posterior
A. buccalis
A. alveolaris superior anterior
A. labialis superior
Rr. pterygoidei
Rr. dorsales linguae
A. profunda linguae
A. labialis inferior
A. mentalis
A. alveolaris inferior
A. sublingualis
A. submentalis
A. palatina ascendens
A. facialis
A. carotis externa
A. lingualis
Os hyoideum
R. suprahyoideus
R. infrahyoideus
A. laryngea superior
A. thyroidea superior
R. sternocleidomastoideus
R. cricothyroideus
A. carotis communis
A. thyroidea inferior
Truncus thyrocervicalis
A. subclavia
Truncus brachiocephalicus
A. thoracica interna
Arcus aortae

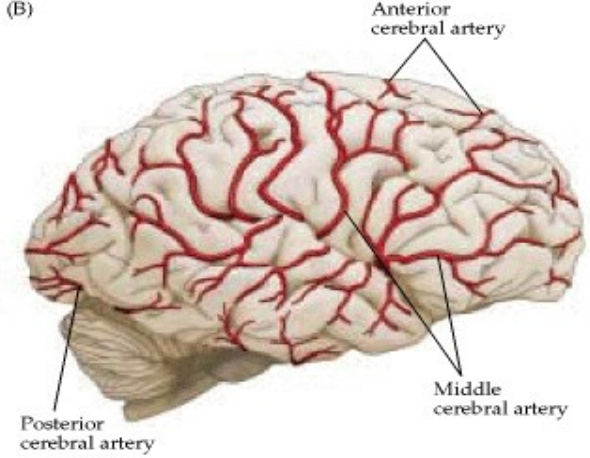

Sensory nerve fibers (in glossopharyngeal nerve)
Carotid body
Carotid sinus
Sensory nerve fibers (in vagus nerve)
Common carotid artery
Aortic bodies
Aorta
Heart

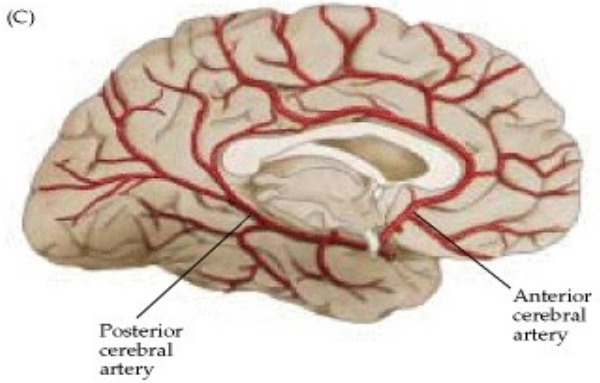


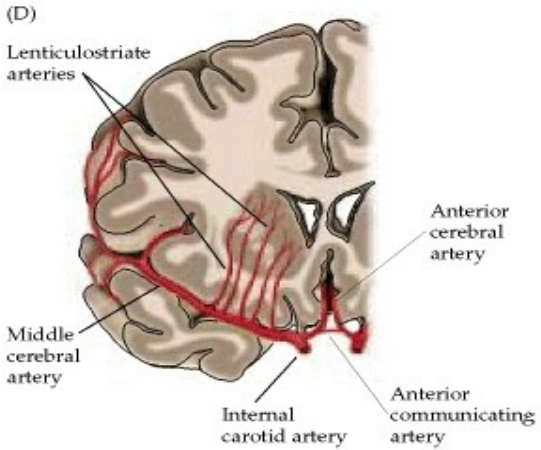
The carotid body (*carotid glomus* or *glomus caroticum*) is a small cluster of chemoreceptors and supporting cells located near the fork (bifurcation) of the carotid artery (which runs along both sides of the throat).
The carotid body detects changes in the composition of arterial blood flowing through it, mainly the partial pressure of oxygen, but also of carbon dioxide. Furthermore, it is also sensitive to changes in pH and temperature.

The carotid body is made up of two types of cells, called glomus cells: glomus type I (chief) cells, and glomus type II (sustentacular) cells.
•Glomus type I/chief cells are derived from neural crest, which, in turn are derived from neuroectoderm. They release a variety of neurotransmitters, including acetylcholine, ATP, and dopamine that trigger EPSPs in synapsed neurons leading to the respiratory center.
•Glomus type II/sustentacular cells resemble glia, they act as supporting cells.
The carotid body contains the most vascular tissue in the human body.









Cerebral aa. and their branches form 2 systems of the blood supply of the brain, which have of principle different structure.

1. Arterial network of the pia mater **from which short and long branches start to the cortex and adjacent white mater.**

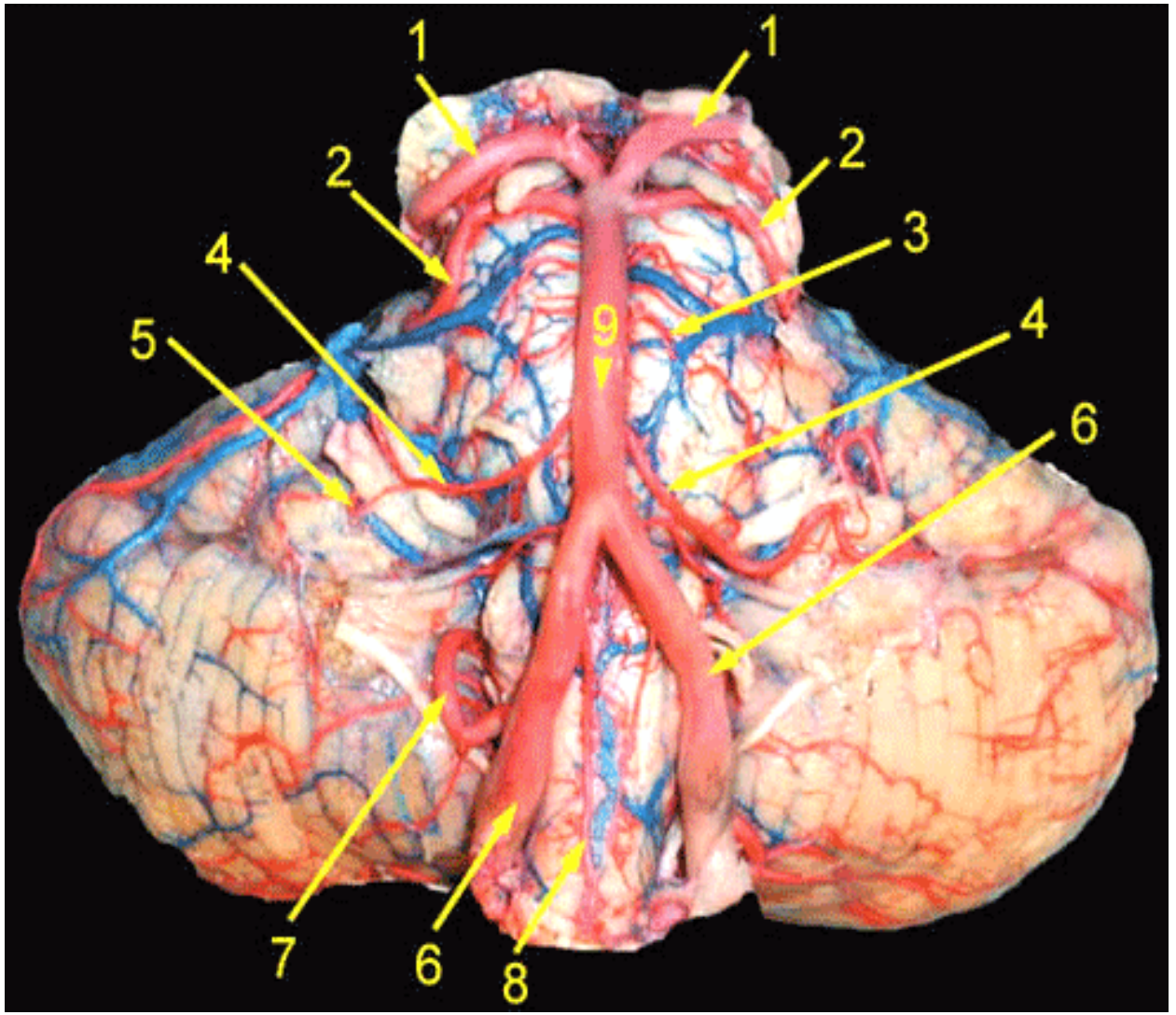
2. Vascular system of the subcortical structures, diencephalon and stem brain **made up of the branches given off by the initial parts of the cerebral arteries.**

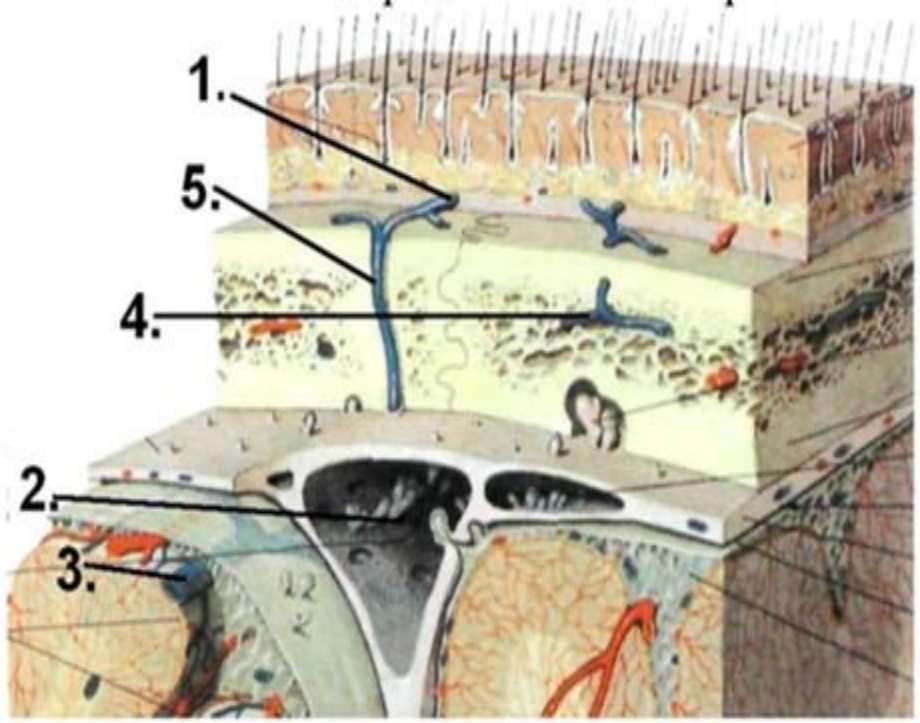
Arterial system of the brain stem

network, but due the multiple anastomoses it is not interrupted;

• its vessels represent the branches of the basilar and vertebral arteries;

• anastomoses of the arteries of the opposite sides form the arterial rings surrounding the brain stem, from which the intratrunkal



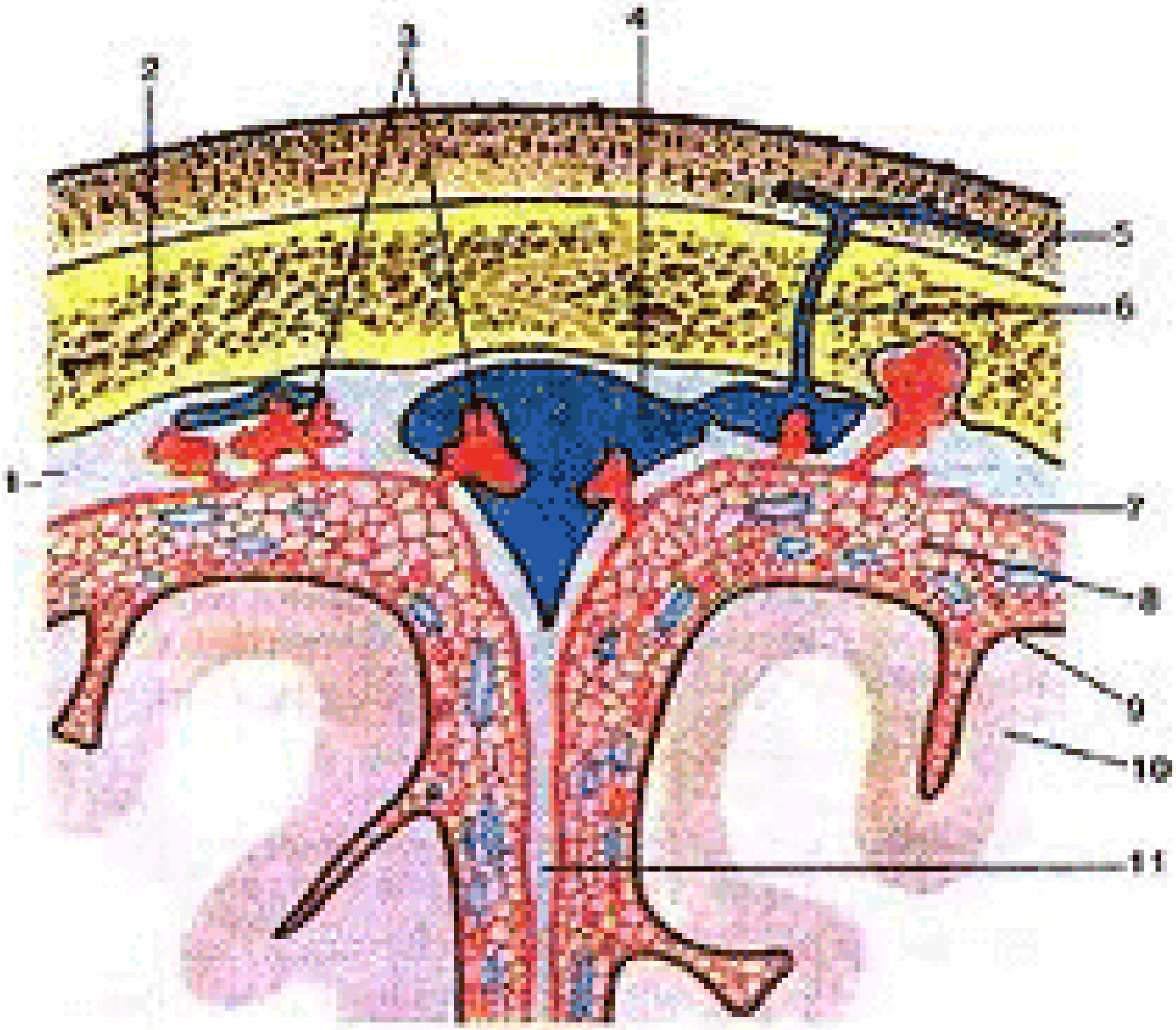


In the region of the skull there are ***special types of veins*** that do not exist in other parts of the human body:

- ***The pachimeningeal sinuses (2),***
- ***The diploic veins (4)***
- ***The emissary veins (5)***

Anatomical features of the cerebral veins:

- They form anastomoses with the ***diploic*** and ***extracranial veins***
- They have multiple ways of drainage
- Their walls are devoid of muscles
- The cerebral veins have no valves
- In order to maintain patency, some of them open into the venous sinuses against the direction of blood flow in the sinus,
- The ***pachimeningeal sinuses*** do not collapse and cause hemivacuum.
- All these specific features maintain constant blood pressure and pressure of the cerebrospinal fluid.
- There are two ***groups of the veins*** of the brain: ***superficial*** and ***deep***.


2
3
4
5
6
1
7
8
9
10
11

The veins of the brain

Do not perform blood storage functions;

They can be divided into:

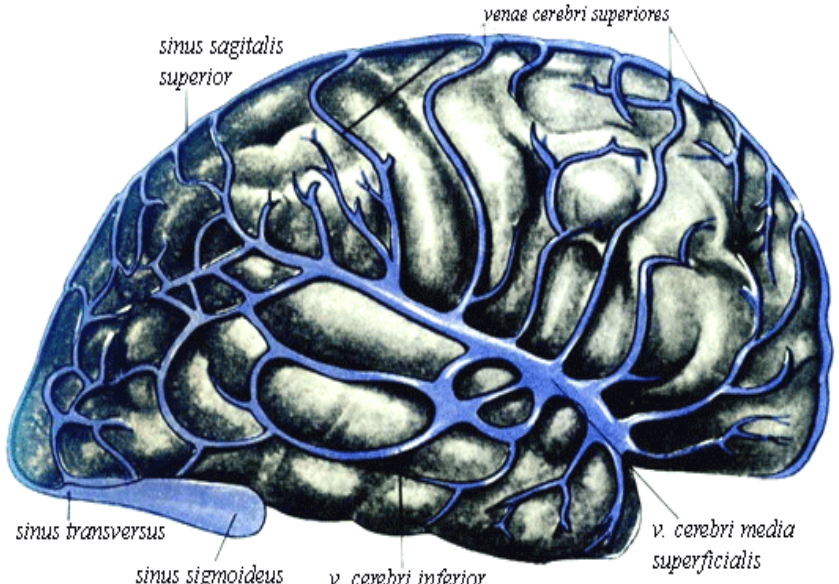
-intracerebral veins of the cortex;

-deep cerebral veins (internal cerebral veins and the great vein of the brain, Galen);

-superficial cerebral veins (upper, middle and lower);

➢ Venous blood from the cerebral cortex, the white matter is transmitted through the veins to the faces of the cerebral hemispheres where forms a venous anastomotic network, from which it is drained through superficial veins of the brain to the sinuses of the pachymeninx.

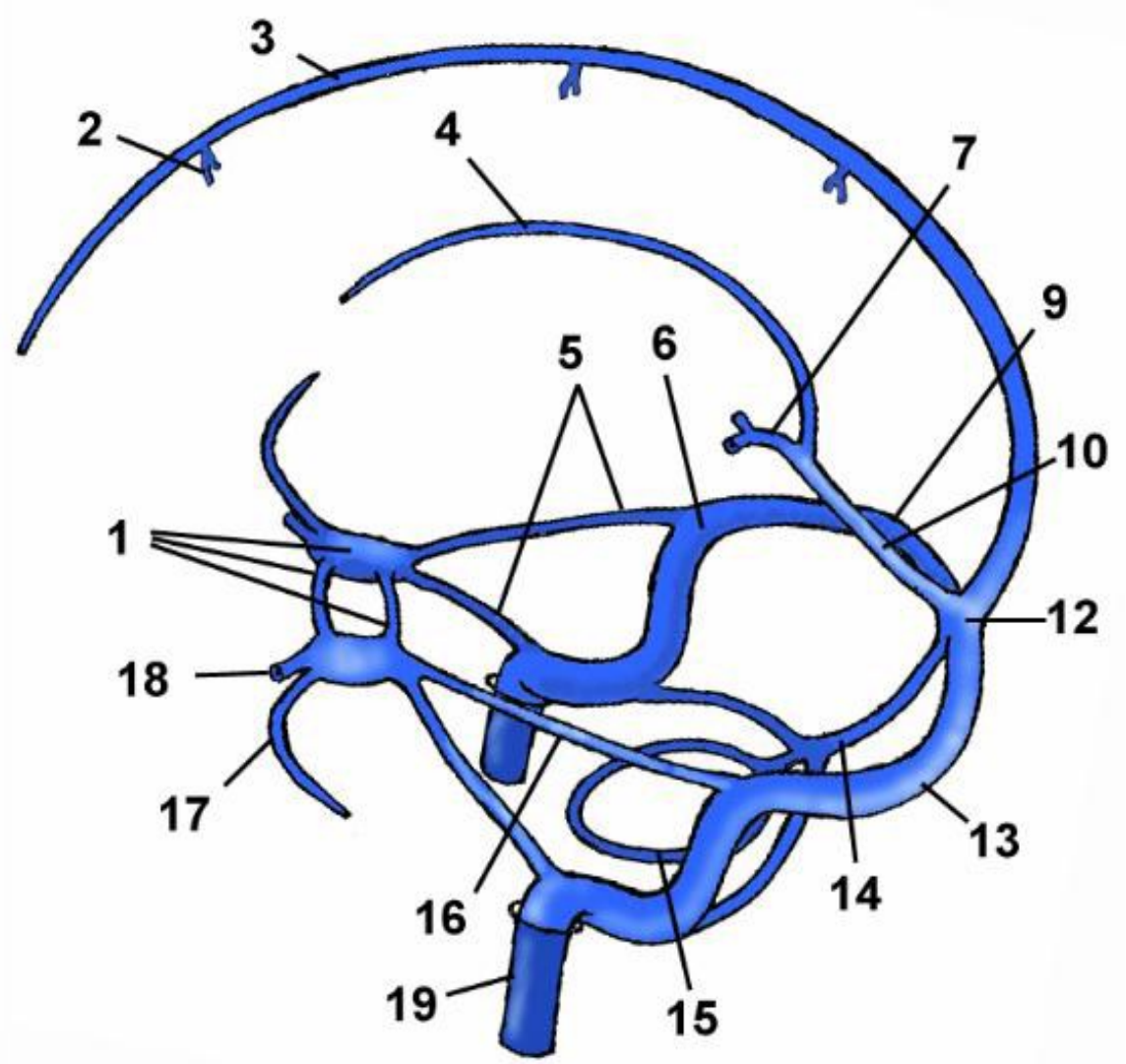
Veins	*Region of drainage*	*Termination*
The superior cerebral vv. /6-12/	Superolateral surface of the hemisphere	The superior sagittal sinus
The superficial middle cerebral v.	The area round the posterior branch of the lateral groove	The cavernous sinus or The sphenopalatine sinus
The deep middle cerebral v.	Surface of the insula	The basal vein
The inferior cerebral vv.	The orbit The temporal lobe	The superior cerebral vv. The superior sagittal sinus The cavernous or neighbouring sinuses
The anterior cerebral vv.	The corpus callosum The anterior part of the medial surface of the hemisphere	The basal vein



Extracerebral veins

Superficial cerebral veins

The pachimeningeal sinuses



1 – cavernous and intercavernous sinuses;

2 - superficial cerebral veins flowing into the superior sagittal sinus;

3 - superior sagittal sinus;

4 - inferior sagittal sinus;

5 - superior and inferior petrosal sinuses on the right;

6 - the right sigmoid sinus;

7 – greater cerebral vein (of Galen);

9 - the right transverse sinus;

10 - straight sinus;

12 – confluence of sinuses;

13 - left transverse sinus;

14 - occipital sinus;

15 - marginal sinus;

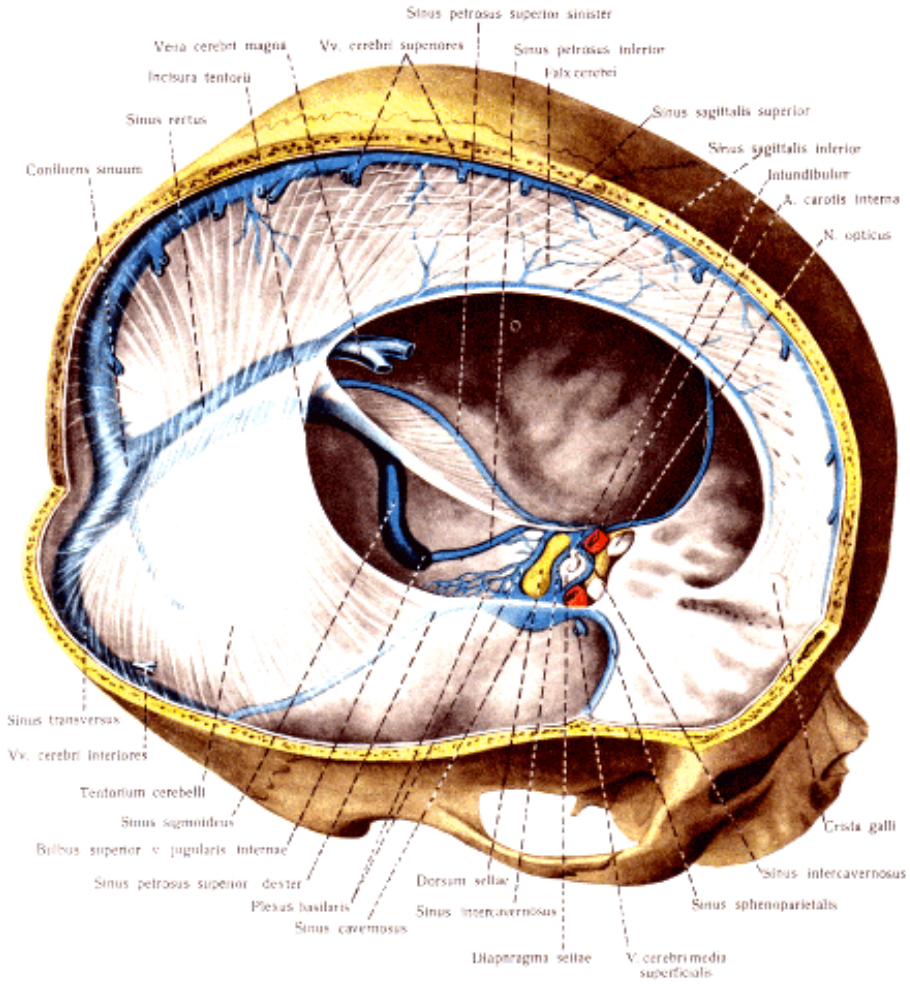
16 – superior petrosal sinus on the left;

17 - spheno-parietal sinus;

18 - superior ophthalmic vein;

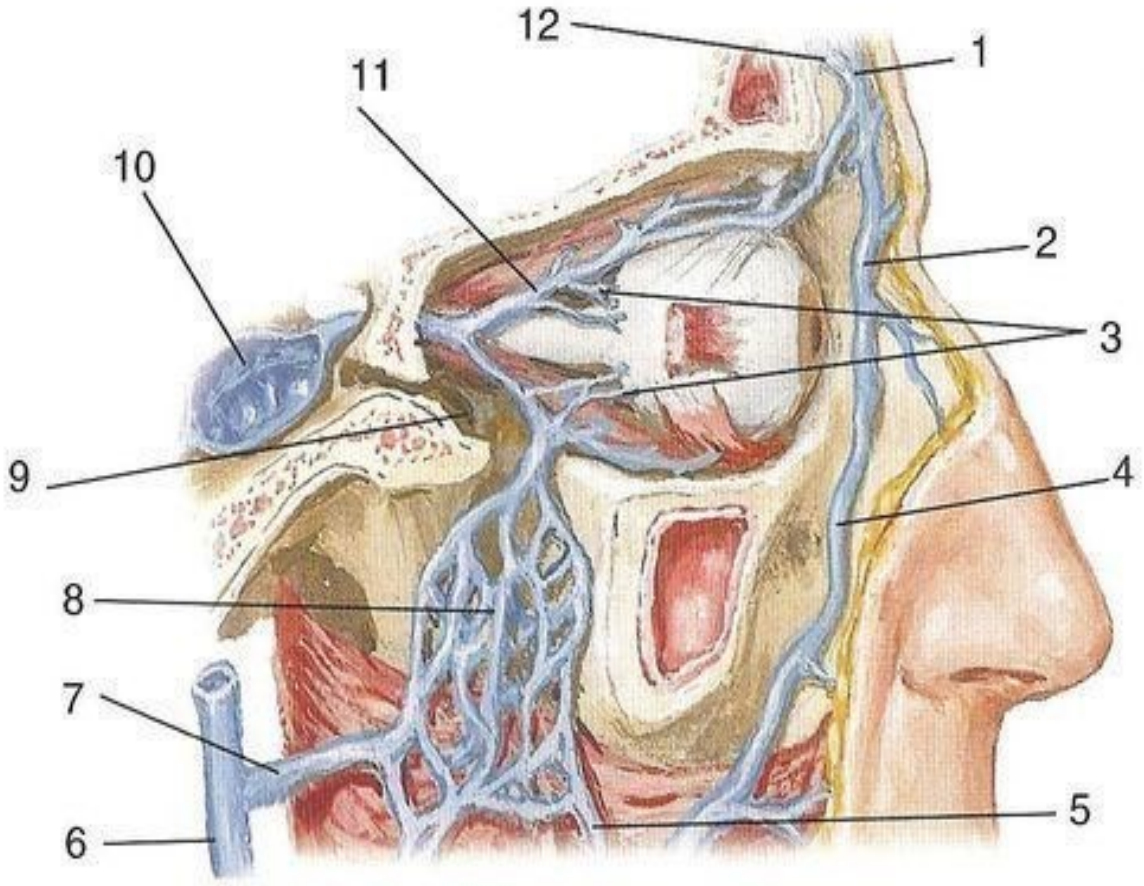
19 - internal jugular vein

Multiple ways
of the drenage



Some of veins
open into the
venous sinuses
against the
direction of blood
flow in the sinus

Anastomoses of cavernous sinus



https://medbe.ru/materials/litsevoy-skelet-i-cherep/diploicheskie-i-emissarnye-veny-veny-glaza-litsa-cherepa-i-shei/

Veins of the orbit

Orbital veins; lateral view.

(The lateral wall of the orbit is removed):

1 - supratrochlear vein;

2 - angular vein;

3 - vorticose veins;

4 - facial vein;

5 - deep facial vein;

6 – retromandibular vein;

7 - maxillary vein;

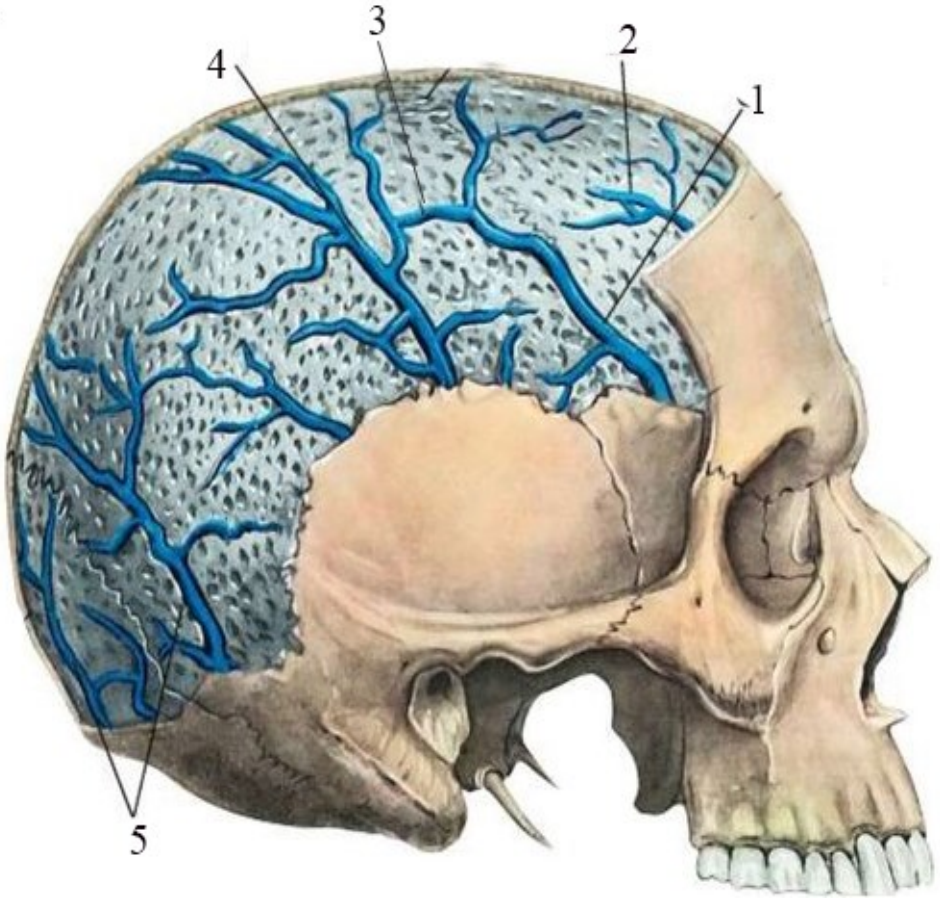
8 - pterygoid venous plexus;

9 – inferior ophthalmic vein;

10 - cavernous plexus;

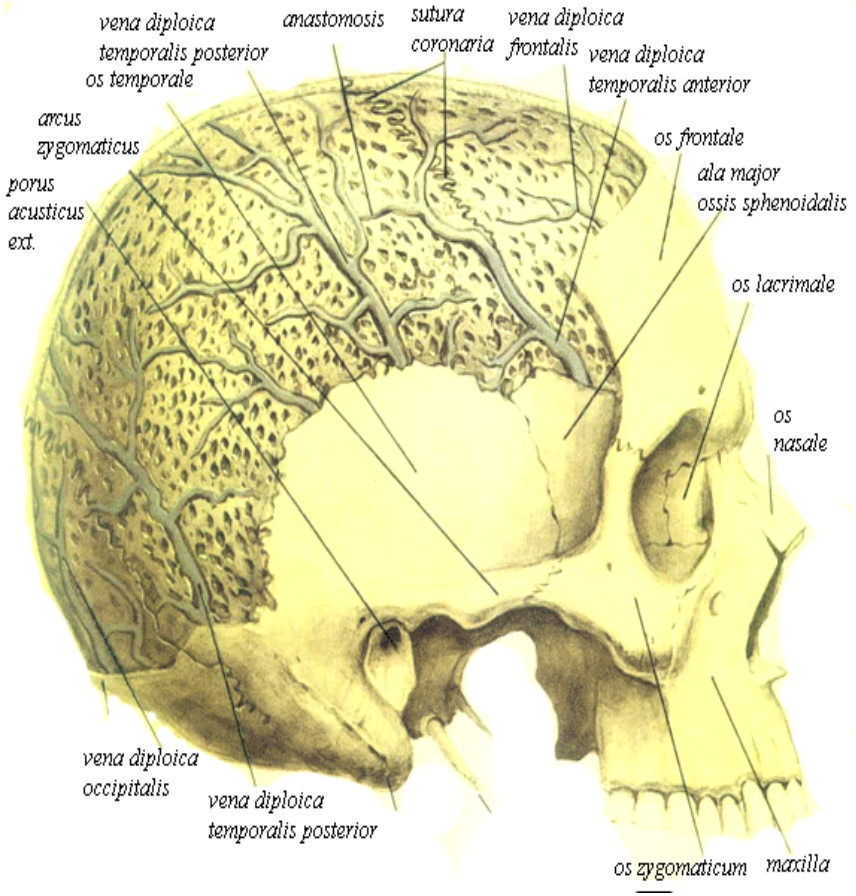
11 - superior ophthalmic vein

12 - supraorbital vein



- They are located in the spongy bone tissue of the diploic bones;
- They occupy an intermediate position between the intra- and extracranial tributaries to the internal jugular veins;
- There are ways to drain a bone blood;
- They serve as ways additional reflux of venous blood from the brain.

- ***Vv. diploicae*** - are located in the spongy substance of the bones of the cranial vault.
- Diploic veins anastomose with the sinuses of the dura mater, providing a link between the internal and external jugular veins.
- Valves in the diploic veins are absent, therefore, blood flow through them is possible in two directions.
- They go from top to bottom to the base of the skull, where they connect through openings in the bones of the skull or with the saphenous veins of the cranial vault, or with the venous sinuses of the dura mater.
- ***Frontal v. (2)***
- ***Anterior temporal v. (1)***
- ***Posterior temporal v. (4)***
- ***Occipital v. (5)***



Emissary veins (VE)

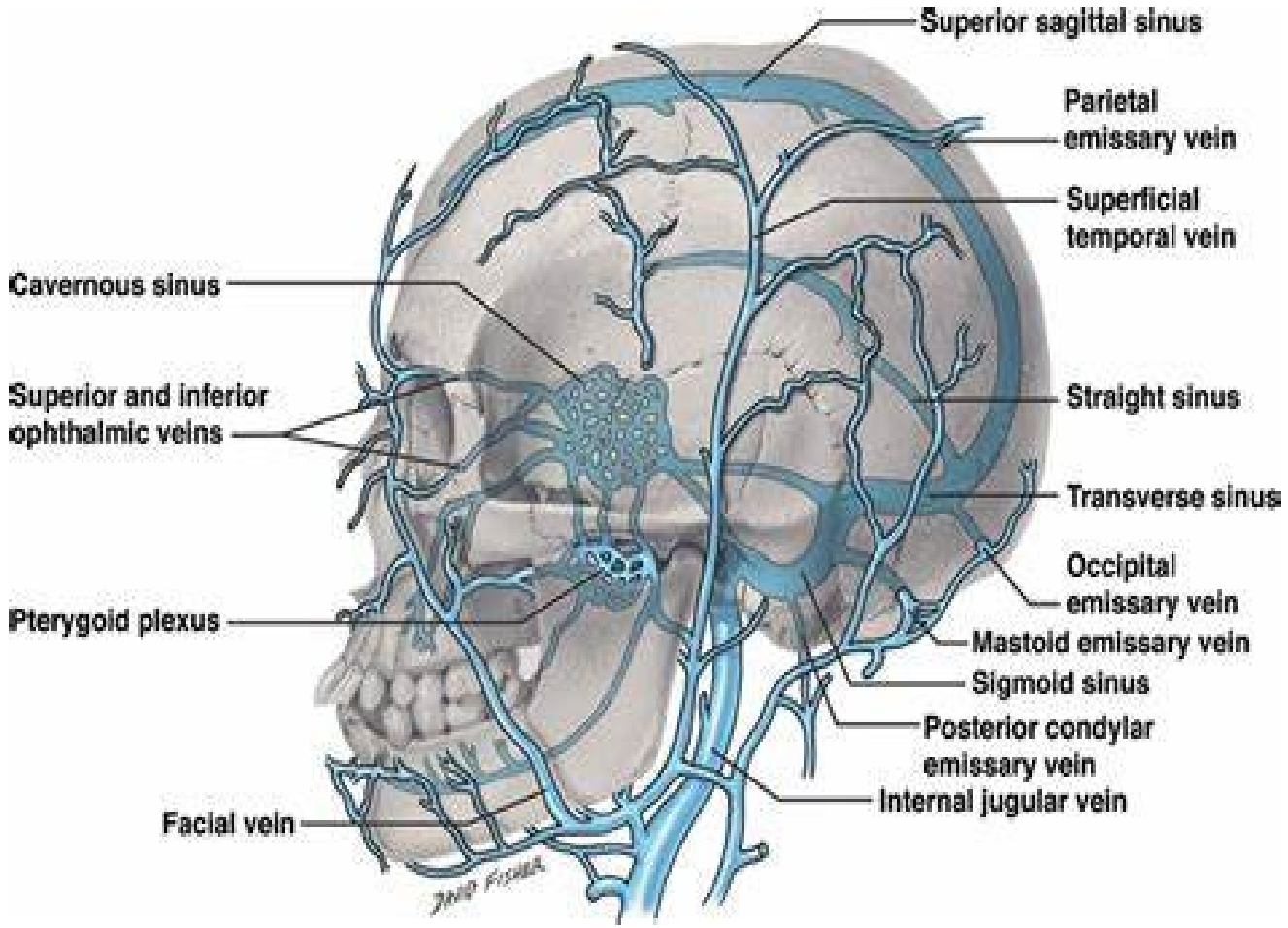
- Join the sinuses of the pachymeningis and the meningeal veins with the veins of the skull bones and the veins of the soft tissues of the head;
- Decrease venous stasis in the skull cavity;

▪ Can be grouped into:

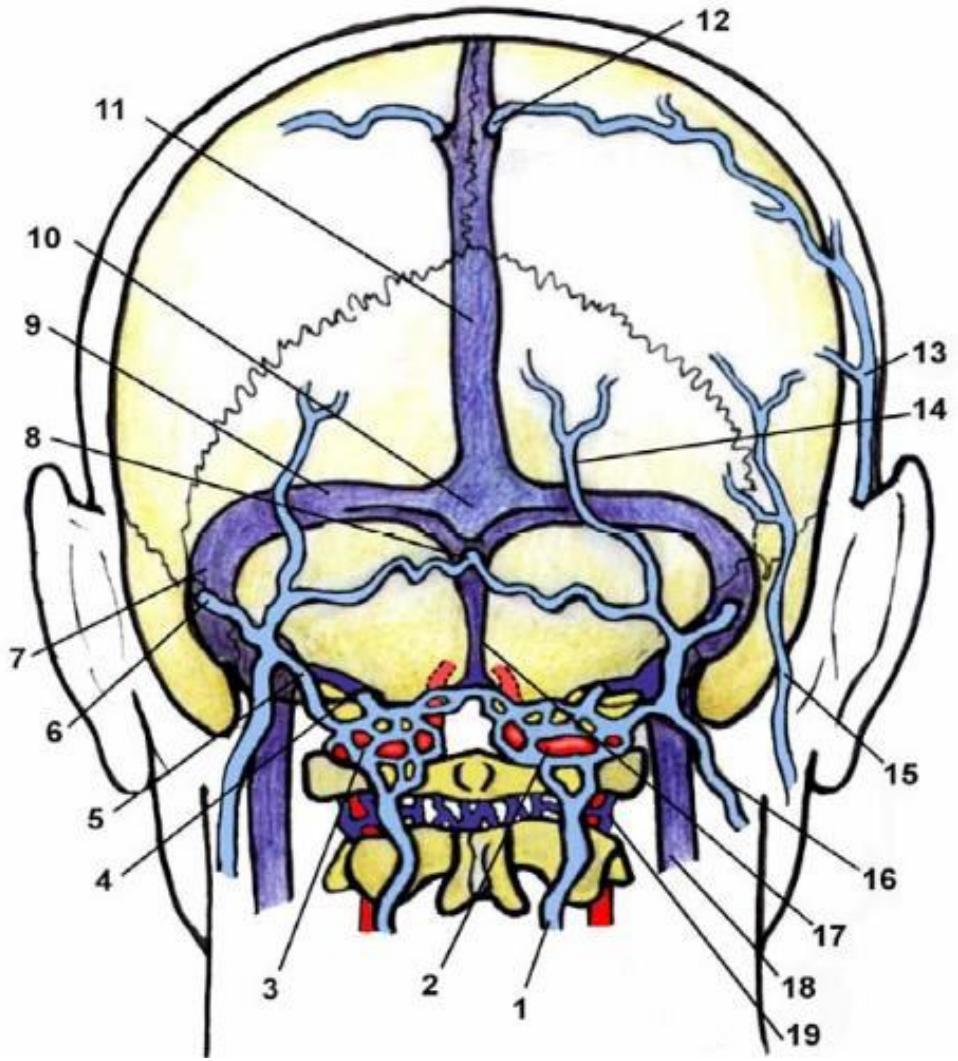
• ***True EVs***: ***mastoid, occipital, parietal, frontal, temporal*** (through them communicates sinuses with venous bedextracranial);

• ***False EVs*** - they ***originate from them diploic veins***;

• VE from the base of the skull: ***condylar***, the ***venous network of the round and oval foramina***



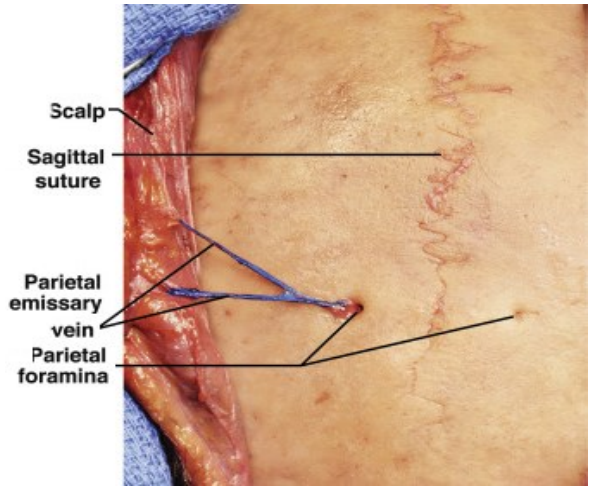
Emissary veins:

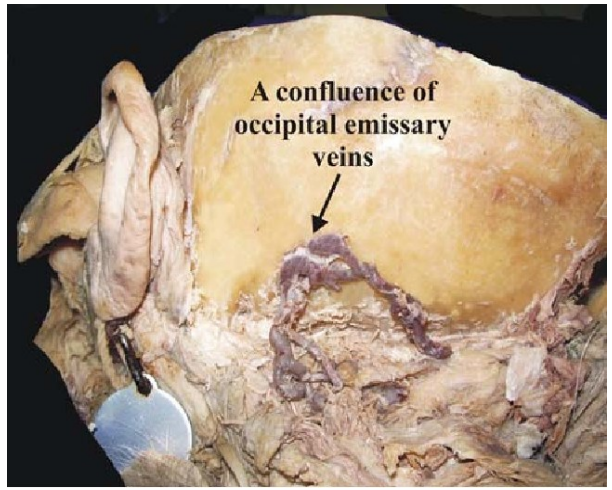


1 - deep cervical vein; 2 - vertebral artery;
3 - the atlanto-occipital sinus through which the vertebral artery passes;
4 - condylary emissary vein;
5 - anastomosis of the atlanto-occipital sinus with the occipital vein;
6 - mastoid emissary vein;
7 - sigmoid sinus;
8 - an occipital emissary vein;
9 - transverse sinus;
10 – confluence of sinuses;
11 - superior sagittal sinus;
12 - parietal emissary vein;
13 - superficial temporal vein;
14, 16 - occipital vein;
15 - posterior auricular vein;
17 - occipital sinus;
18 - internal jugular vein;
19 - vertebral vein

Through the ***vv. emissariae*** blood flows into the superficial veins of the head.

Emissary veins, vv. emissariae connect the sinuses of the dura mater and the diploic veins with the superficial veins of the head.



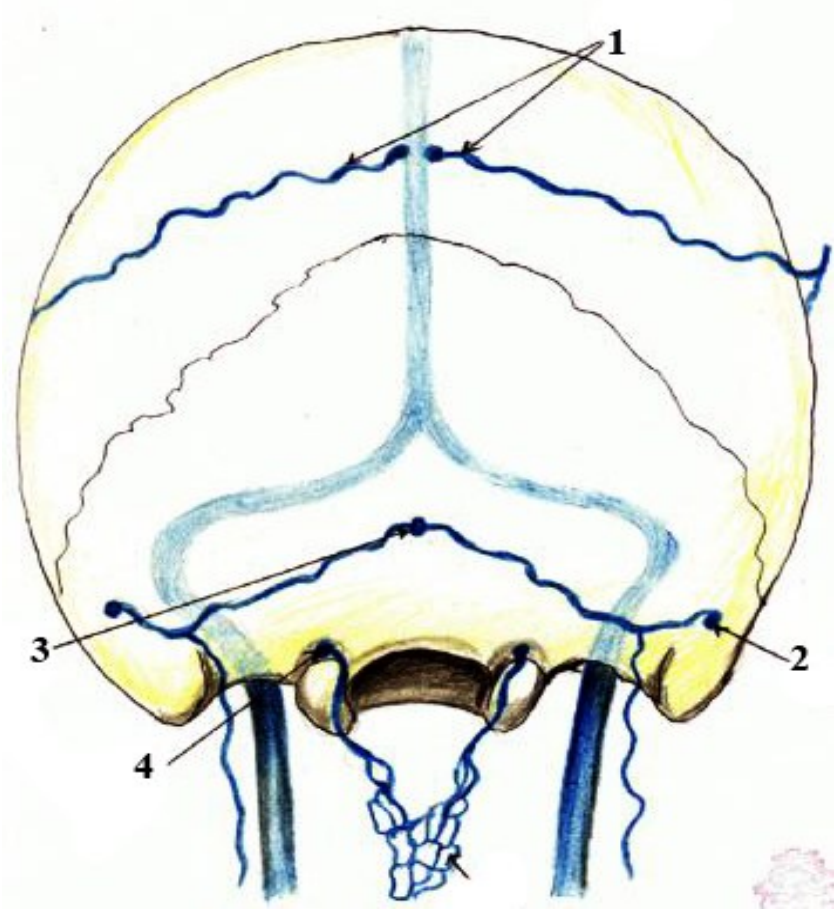


1. ***Parietal emissary vein*, *v. emissaria parietalis (1).*** It connects the superior sagittal sinus and superficial temporal vein and passes through the parietal opening.

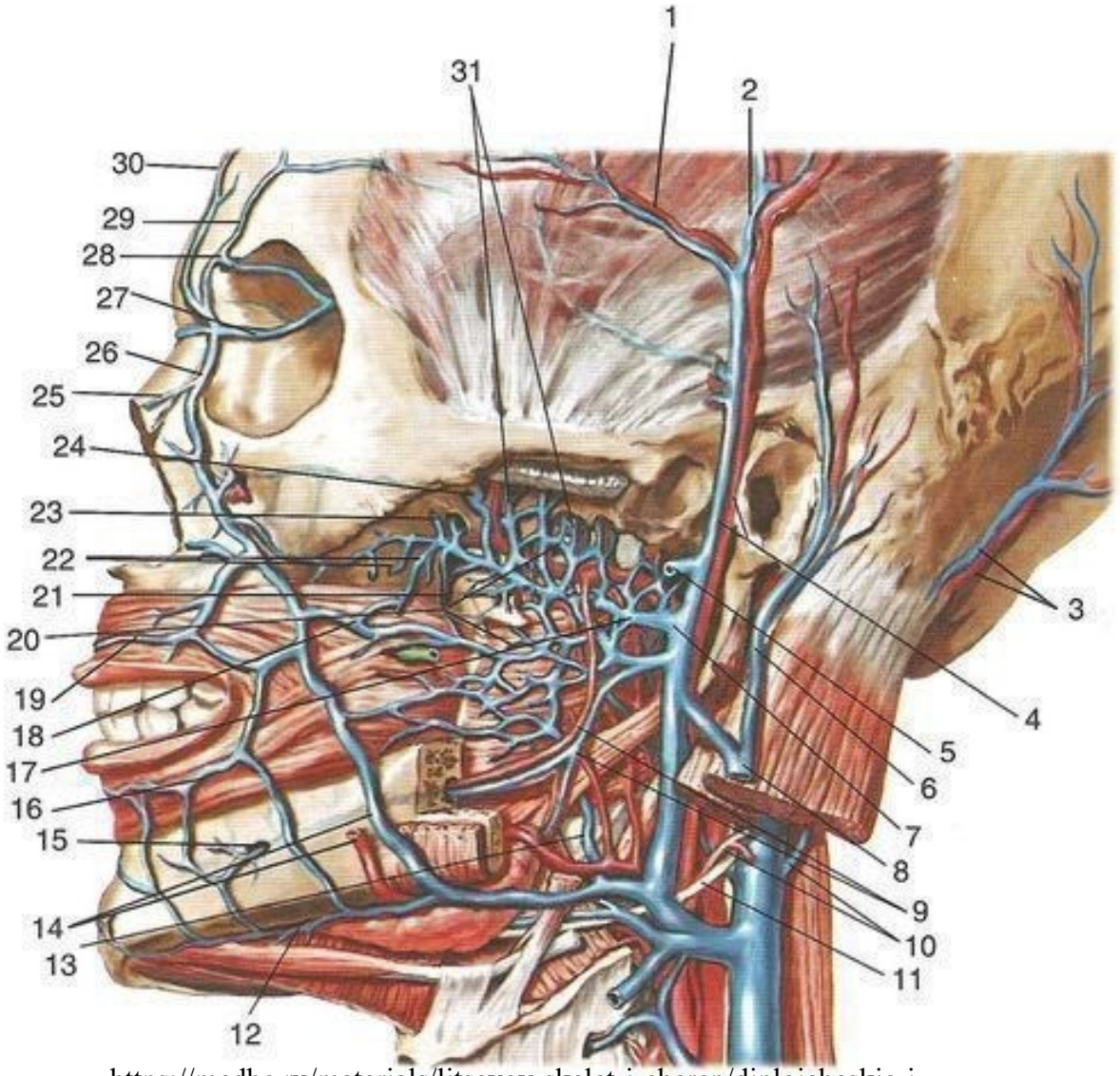
2. ***Mastoid emissary vein*, *v. emissaria mastoidea (2).*** Through the mastoid opening connects the sigmoid sinus with the occipital vein.

3. ***Condylar emissary vein*, *v. emissaria condylaris (4).*** Through the condylar canal, the sigmoid sinus connects to the external vertebral venous plexus.

4. ***Occipital emissary vein*, *v. emissaria occipitalis (3).*** Connects the sinus drain with the occipital vein.



Deep veins of the face



https://medbe.ru/materials/litsevoy-skelet-i-cherep/diploicheskie-i-emissarnye-veny-veny-glaza-litsa-cherepa-i-shei/

1 - frontal branch of the superficial temporal vein;
2 - parietal branch of the superficial temporal vein;
3 - occipital artery and veins;
4 - superficial temporal artery and veins;
5 - transverse vein of the face;
6 - posterior ear vein;
7 - lower jaw vein;
8 - external jugular vein;
9 - lower alveolar artery and vein;
10 - occipital artery and vein;
11 - common trunk of the facial and mandibular veins;
12 - submental vein;
13 - external palatine vein;
14 - facial artery and vein;
15 - submental vein; 16 - inferior labial vein;
17 - maxillary vein; 18 - deep vein of the face;
19 - superior labial vein;
20 - pterygoid venous plexus; 21 - palatine vein;
22 - posterior superior alveolar veins;
23 - infraorbital vein; 24 - vein of the pterygoid canal;
25 - external nasal veins;

- 26 - angular vein; 27 - superior ocular vein;
- 28 - nasal vein; 29 - supraorbital vein;
- 30 - supra-block vein; 31 - deep temporal veins

Cerebral **Venous** Drainage

- The veins are thin walled and are devoid of (don't have) valves.
- The cortical veins are:

I. Superficial cortical veins

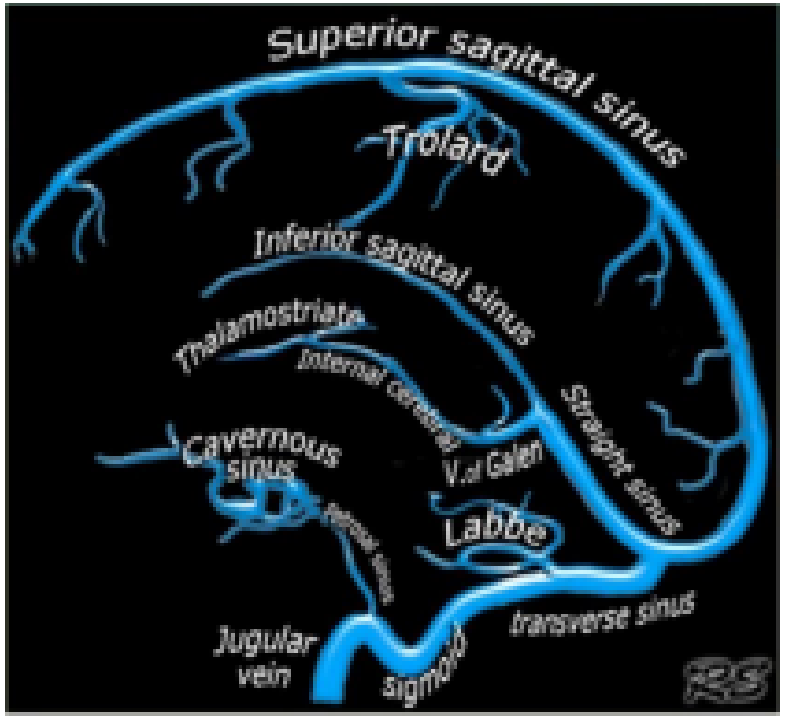
- Found in the subarachnoid space
- Drain the cortical surface

II. Deep veins

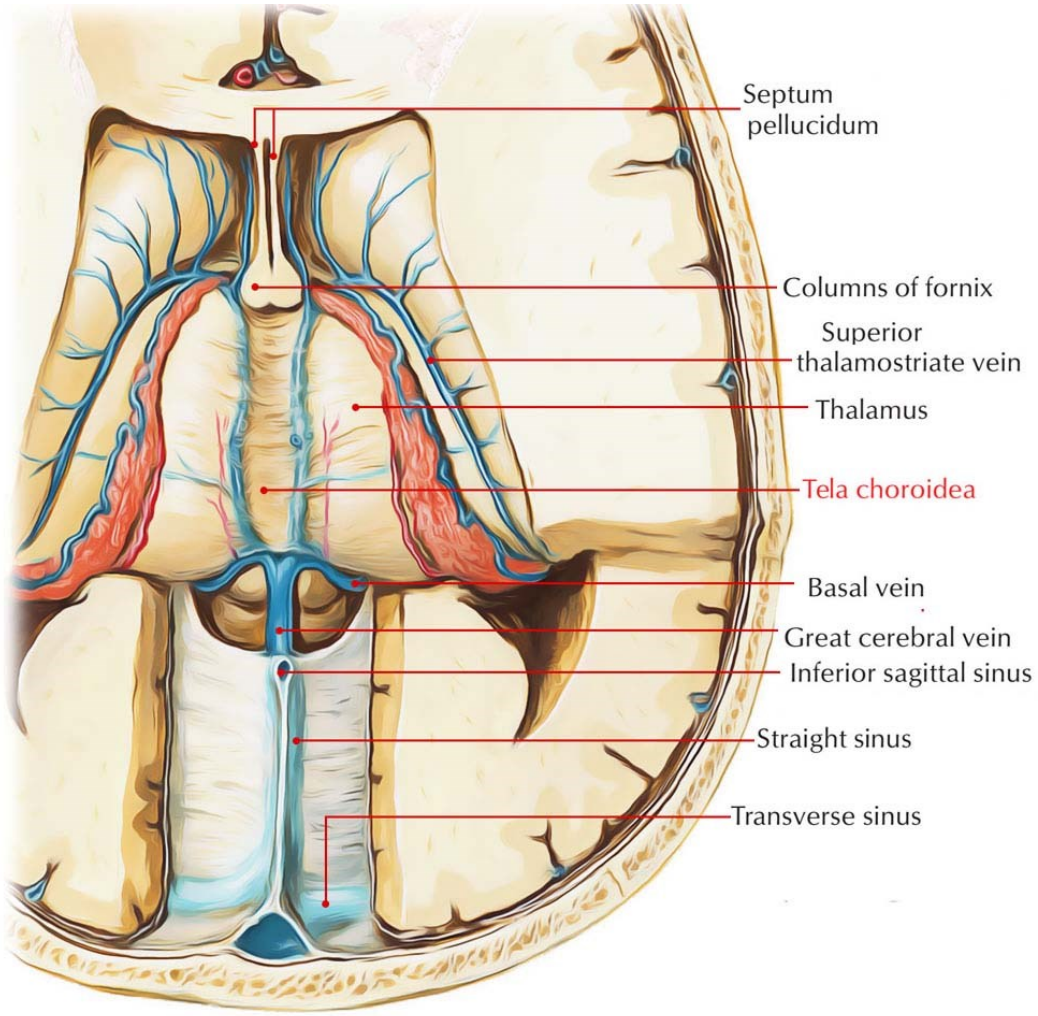
- Drain the deep structures

These veins ultimately drain into:

Dural venous sinuses



Intracerebral (deep) veins of the brain



- These veins do not typically follow the arterial supply and there is significant variation in anatomy between different subjects.

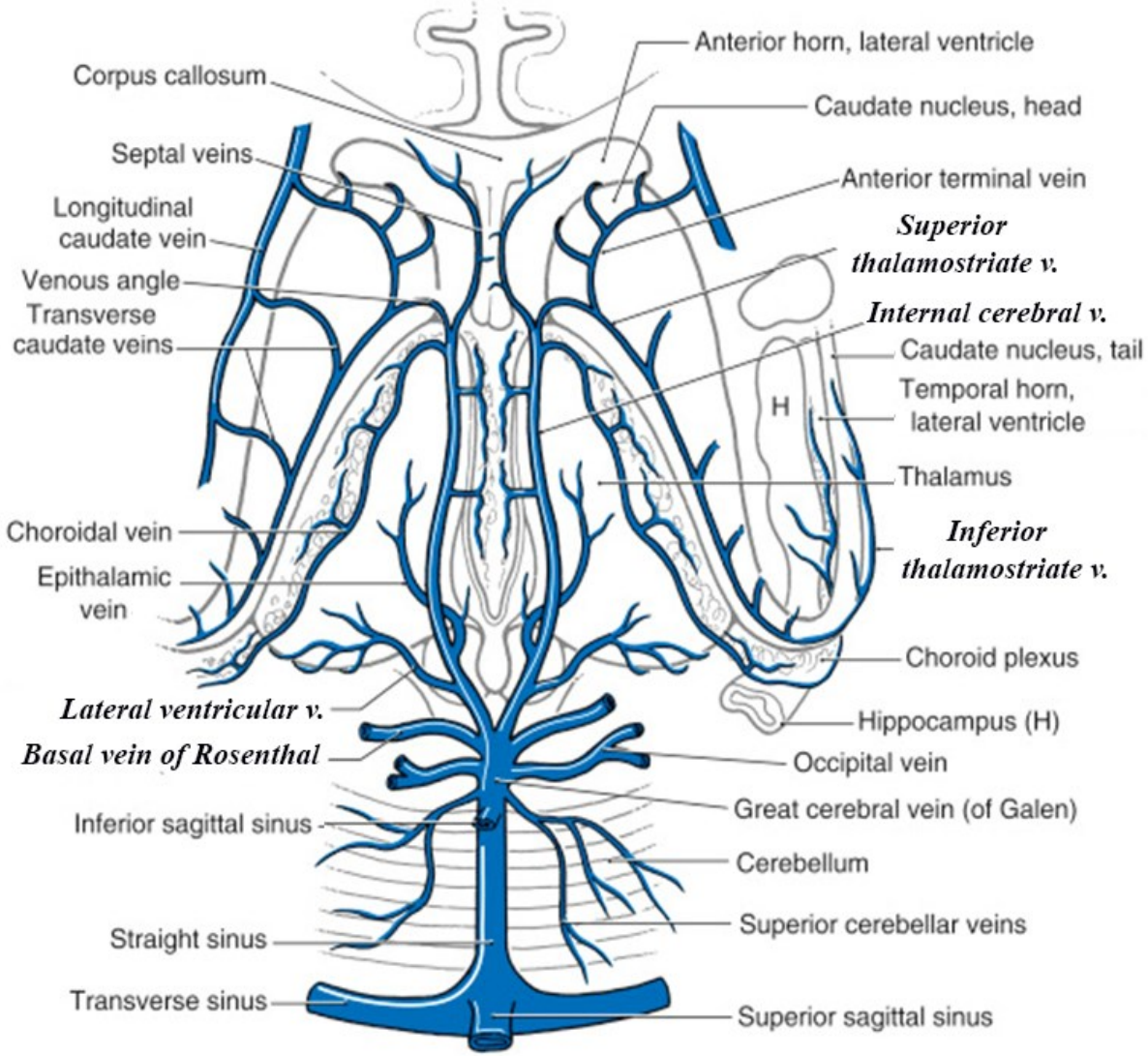
- They ***lack muscular walls*** and ***valves***.

- Through deep veins, blood flows from the ***basal nuclei, the walls of the lateral ventricles*** and ***their vascular plexuses*** and the ***diencephalon***.

- Topographically, the deep cerebral veins are divided into the ***superior*** and ***inferior groups***.

Superior group of deep veins of the brain

1. *V. thalamostriata superior* and its tributaries
2. *Vv. of the lateral ventricle*

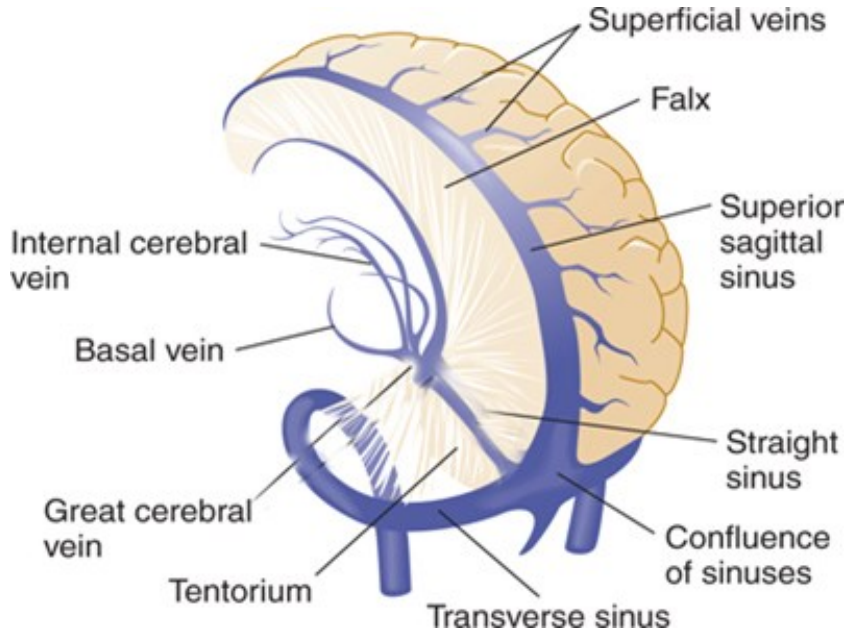


3. *Vv. internae cerebri* and their tributaries

- Each of them them is formed near the interventricular septum due to the merger of the thalamostriate and choroidal (villous) veins.
- The ***internal cerebral veins*** of both hemispheres go backward parallel to each other, between the layers of the vascular tissue of the third ventricle of the brain, and connect near the splenium of the corpus callosum, forming a short thick branch - the **Galen's vein.**
- *Before opening into the vein of Galen, a corresponding basal vein flows into internal cerebral vein.*

End veins

The great cerebral v.	Basal vein
•it is a single median vein, •it is formed by union of 2 internal cerebral veins, •it terminates in the straight sinus, •its tributaries - basal vv. - vv. from the pineal body - vv. from the colliculi - vv. from the cerebellum - vv. from the adjoining part of the occipital lobe	•there is one vein on each side, •it is formed by the union of the deep middle cerebral v., the anterior cerebral vv., the striate vv. •it runs posteriorly, winds round the cerebral peduncles, •terminates by joining the great cerebral v, •its tributaries: - vv. from the cerebral peduncles, - vv. from the interpeduncular structures, - vv. from the tectum of the midbrain - vv. from the parahippocampal gyrus



Ultimately all veins drain into the various venous sinuses which, in turn, drain into the internal jugular v.

The basal vein of Rosenthal originates on the medial surface of the temporal lobe and runs posteriorly and medially.

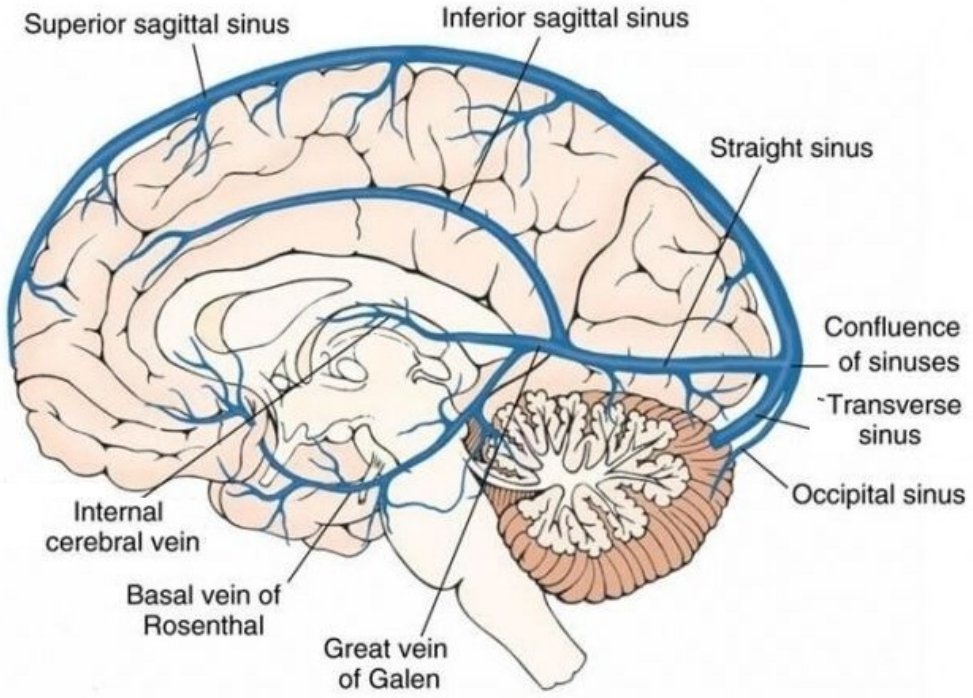
It passes lateral to the midbrain to drain into the vein of Galen.

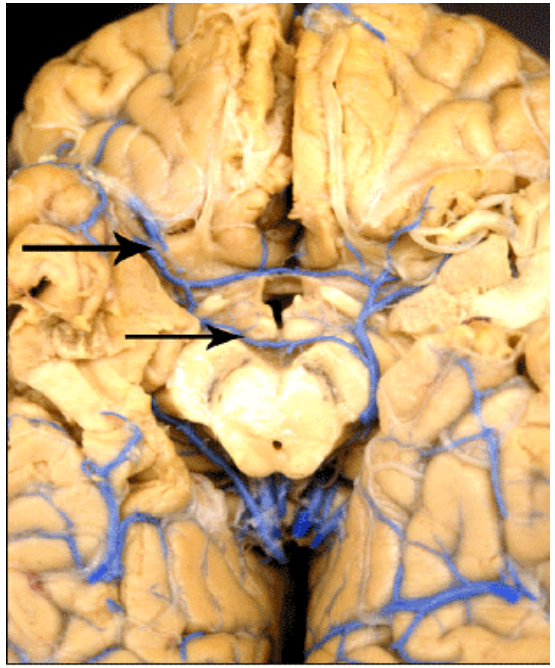
It is closely related to the posterior cerebral artery (PCA).

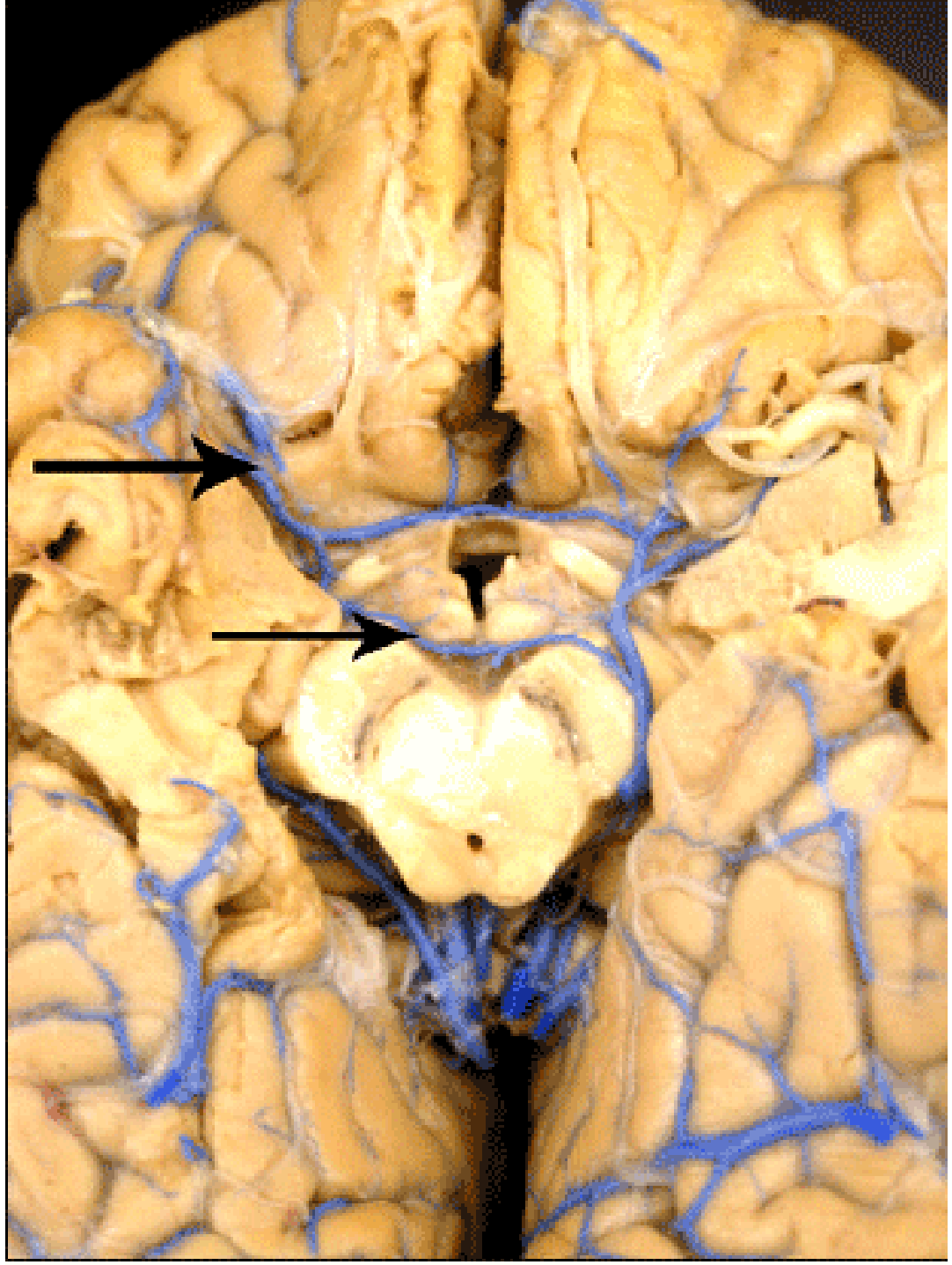
A venous anastomotic network /circle Trolard/ at the base of the brain closely resembles the vicinal arterial circle of Willis.

This venous polygon is composed of the
- anterior cerebral and
- communicating veins,
- the basal vein of Rosenthal ,
- the posterior communicating,
- lateral mesencephalic veins.

This venous circle might cause bleeding with such procedures as an endoscopic third ventriculostomy. This information regarding venous circle may be useful to neuroradiologists or neurosurgeons operating at the base of the brain.







Venous circle /Trolard's/ of the brain

Note the veinous ring

encircling the mamillary bodies and floor of the third ventricle.

- **The anterior cerebral veins are seen leaving the longitudinal fissure.**

- **Note the anterior communicating vein between the two anterior cerebral veins and deep Sylvian vein /*upper arrow*/.**

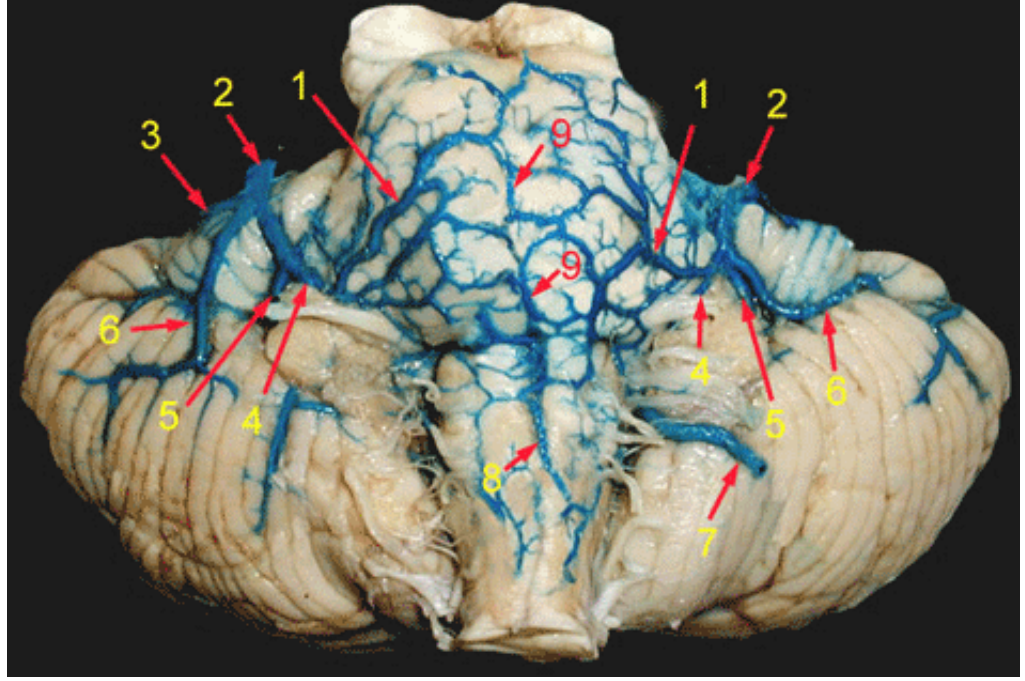
- **An anastomotic vein /*lower arrow*/ is seen linking the basal vein**

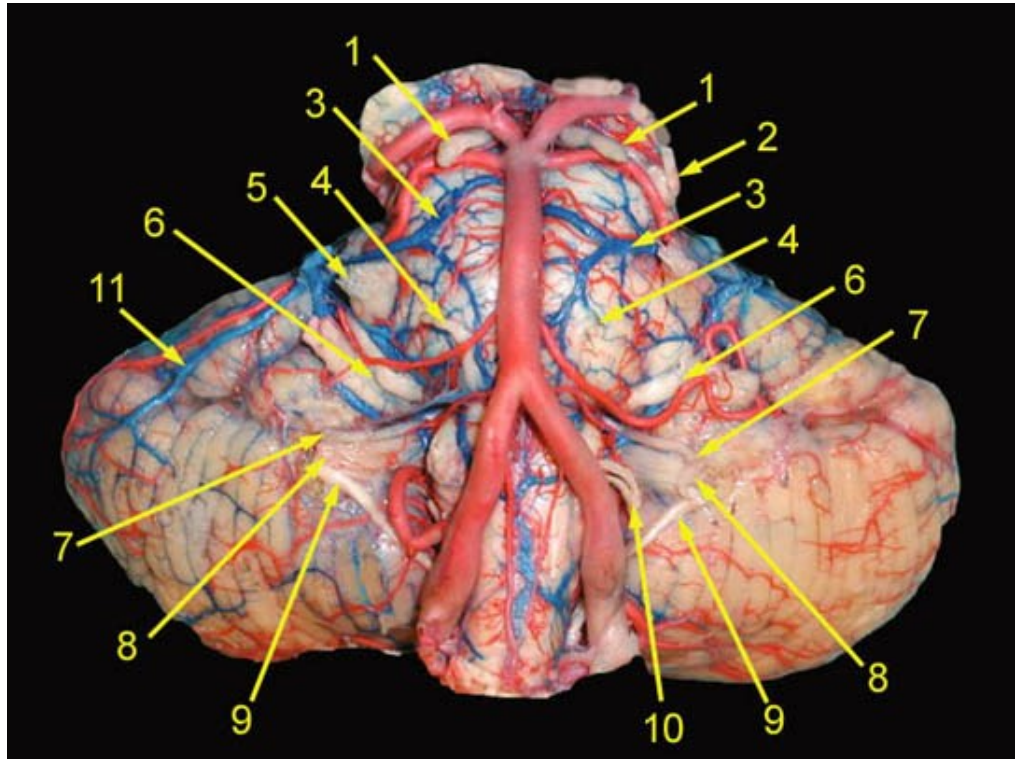
of Rosenthal just posterior to the mamillary bodies.

Blood of brain stem system drains into the *superficial veins of the leptomenings*.

Blood of subcortical structures flows into the *deep cerebral veins*.

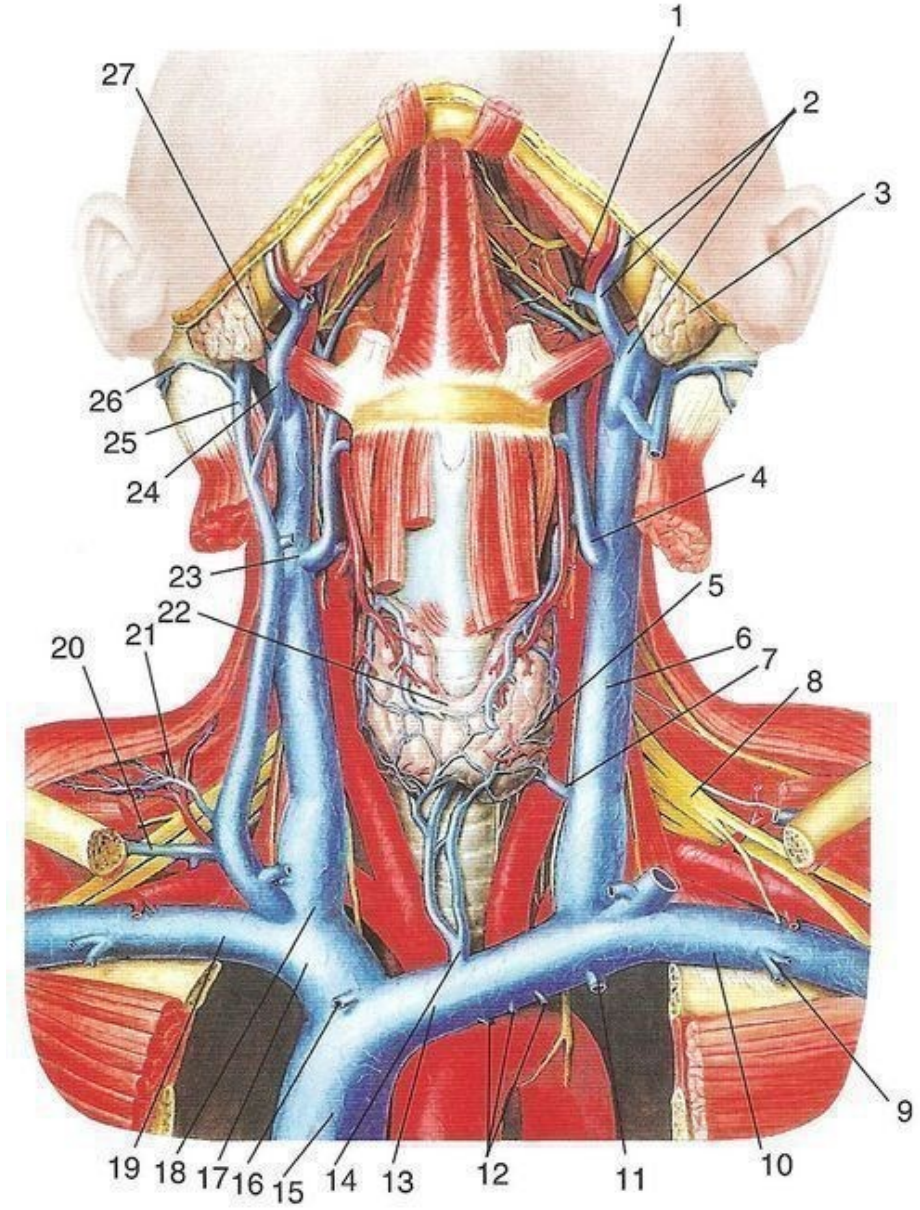
Ulterior, blood flows into the pahimeningeal sinuses, after that – into the internal and, partially, external jugular vein.





Veins of the neck,

anterior view



1 - sublingual vein; 2 - facial vein;

3 - parotid salivary gland; 4 - left superior thyroid vein; 5 - unpaired thyroid venous plexus;

6 - internal jugular vein; 7 - middle thyroid vein;

8 - lower bulb of the internal jugular vein;

9 - lateral cutaneous vein of the hand;

10 - subclavian vein; 11 - left internal chest vein;

12 - thymic veins; 13 - left brachiocephalic vein;

14 - lower thyroid vein; 15 - superior vena cava;

16 - right internal chest vein;

17 - right brachiocephalic vein; 18 - venous angle;

19 - right subclavian vein;

20 - transverse vein of the neck;

21 - superficial cervical vein; 22 - thyroid gland;

23 - right superior thyroid vein; 24 - left facial vein;

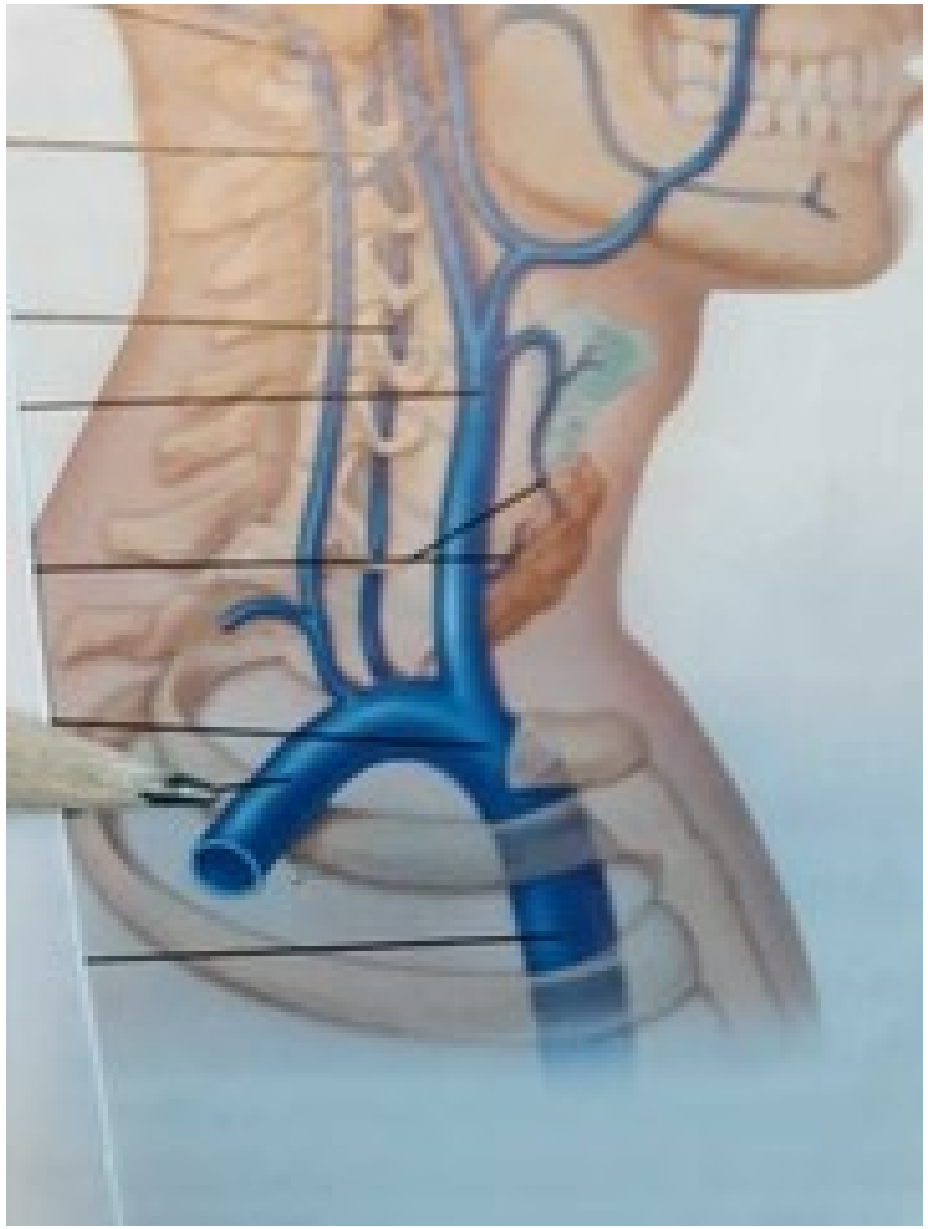
25 - external jugular vein; 26 - occipital vein;

27 - submandibular vein

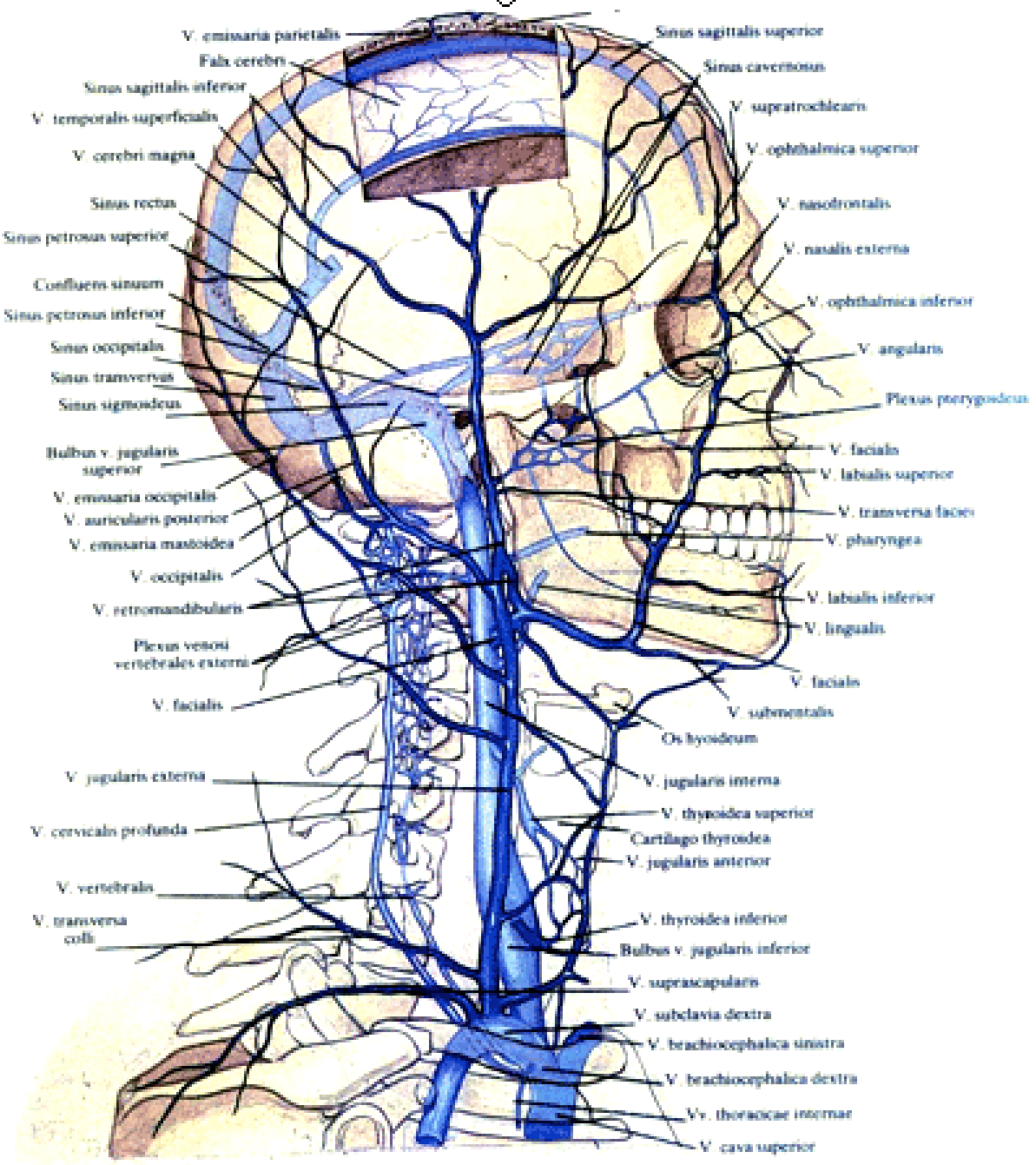
The veins of the cervicothoracic territories: internal and external jugular, subclavian.

- The subclavian vein is well fixed to the adjacent connective tissue because of which its lumen is constant, even at sudden decrease in blood volume when all the other peripheral veins collaborate.

- It is interested in its puncture and catheterization.



Intracranial tributaries of the internal jugular vein



Veins of head and neck; right aspect (semischematical representation).

Extracranial tributaries of the internal jugular vein

Vascular anastomoses of the head and neck

They are very important for blood redistribution, for unsurement of compensation in the cerebral blood system /intrasistemic & extrasistemic/.

Classification of the anastomoses in the region of the head & neck:

-Intracranial

-Extracranial

-Extraintracranial

- Intrasystemic

- Intersystemic

Unlike the other body regions anastomoses are also formed between the vascular of both sides (right and left)

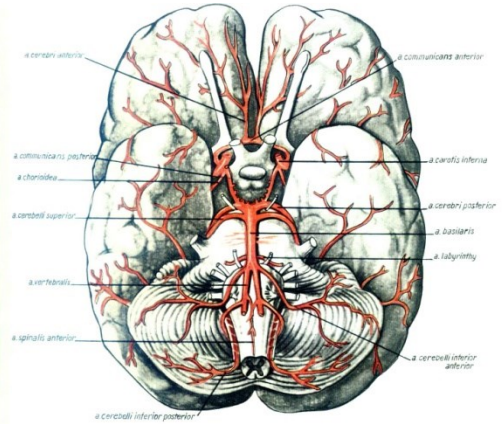
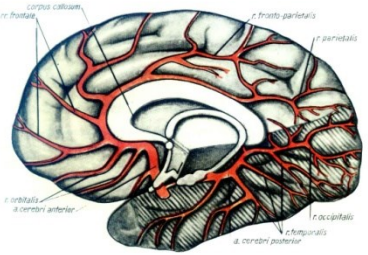
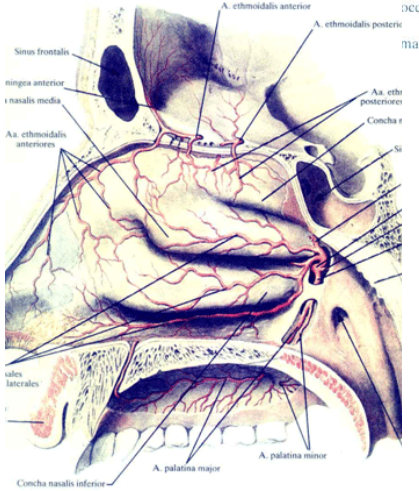
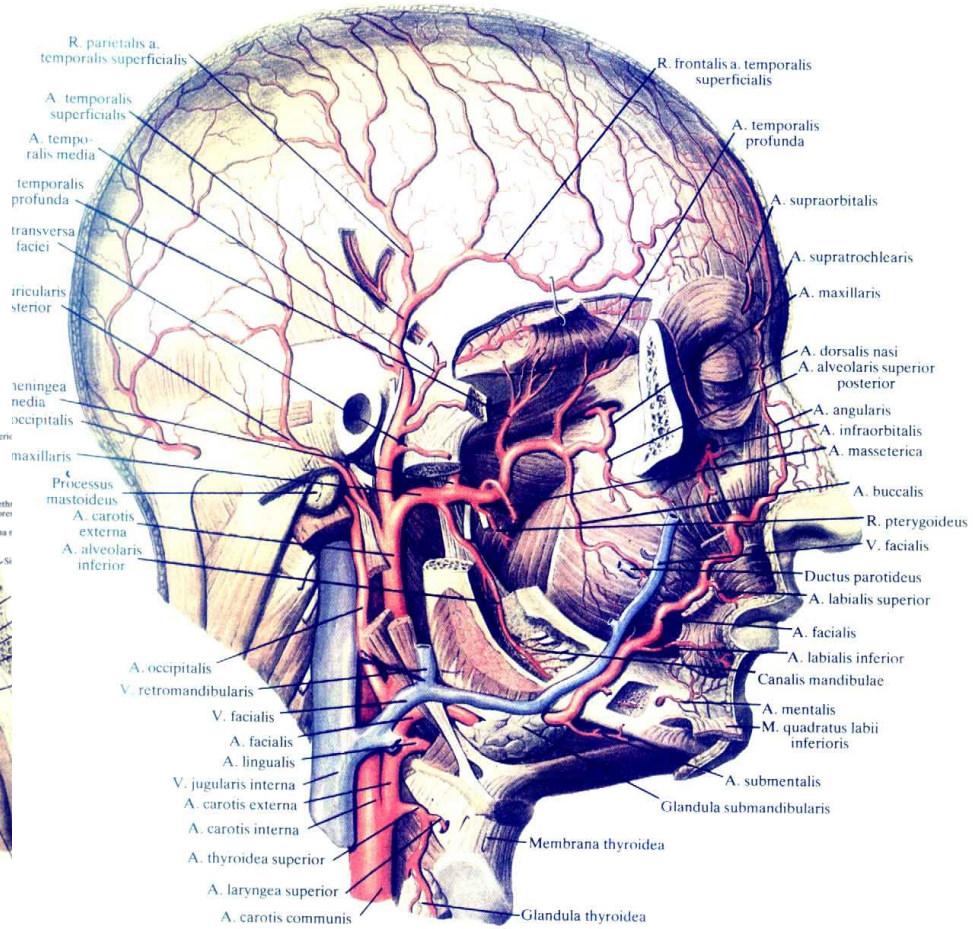


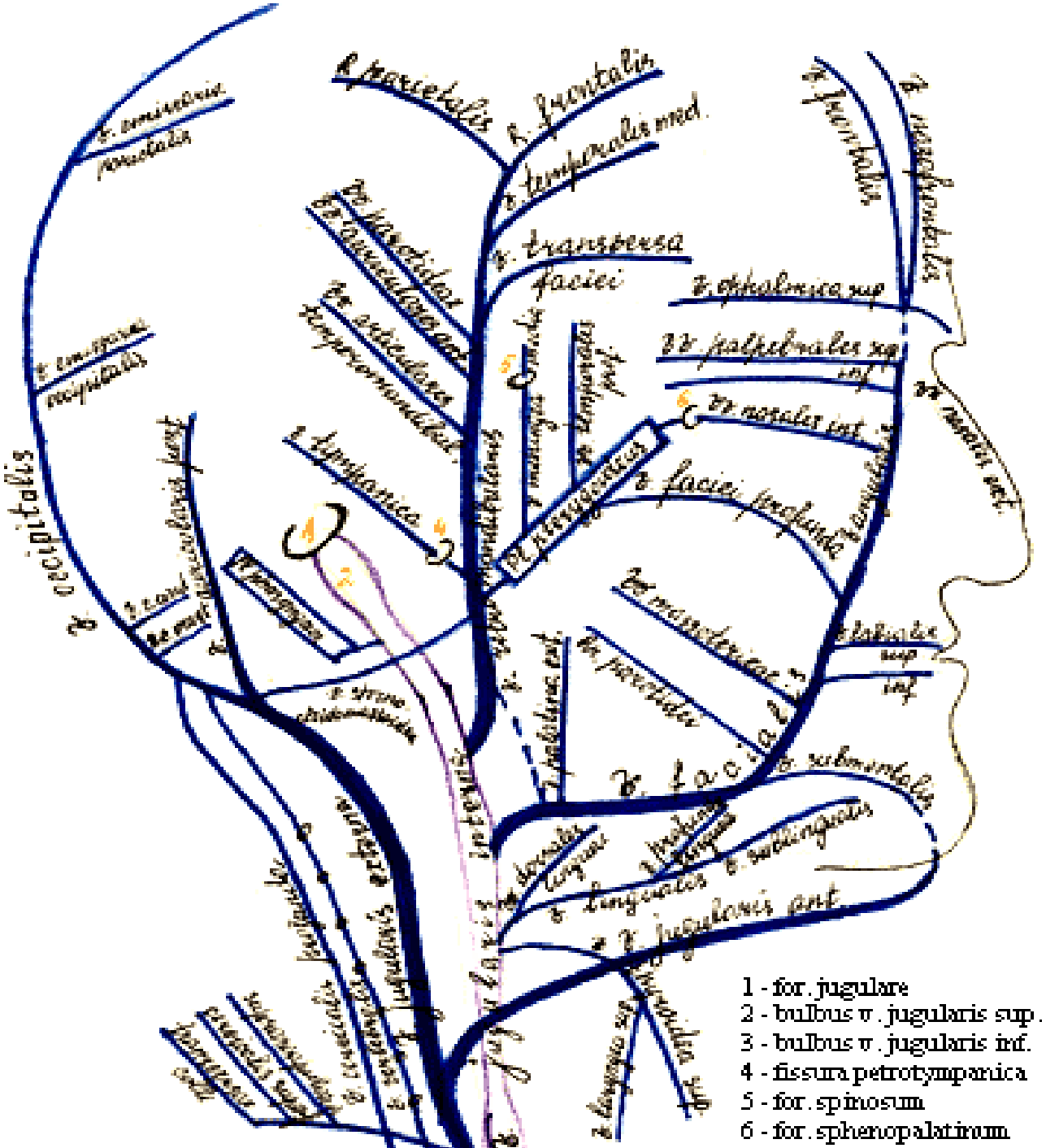
Fig. 152. Irigația arterială a encefalului – fața inferioară.

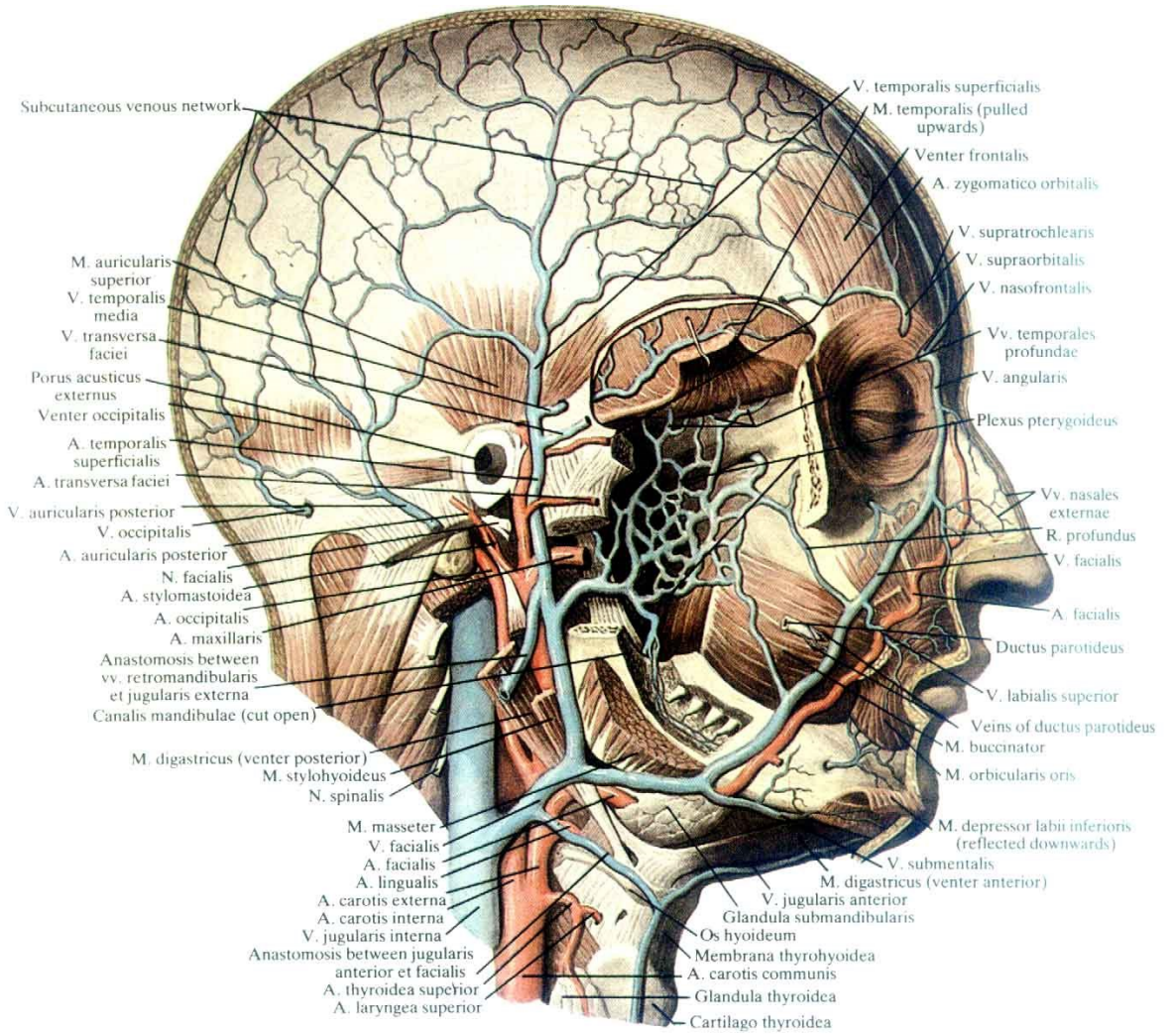






Extracranial veins

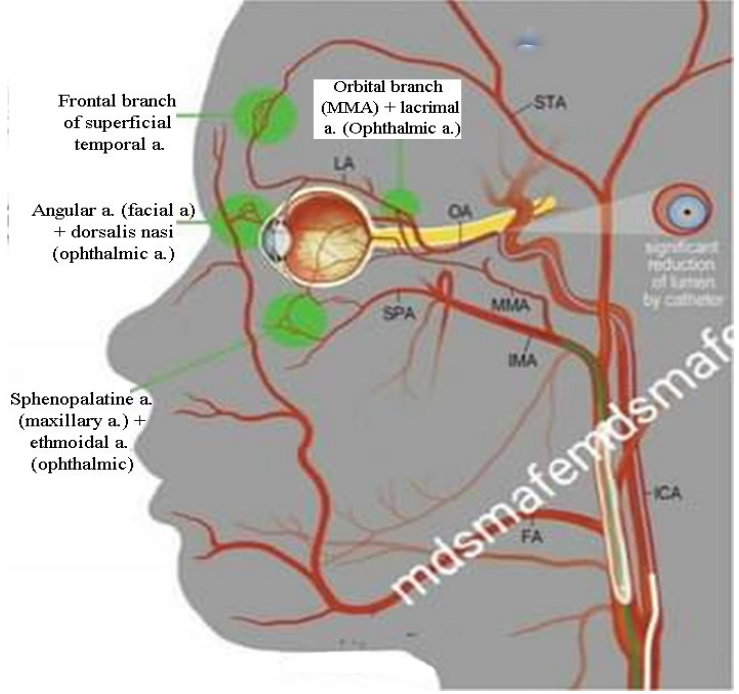


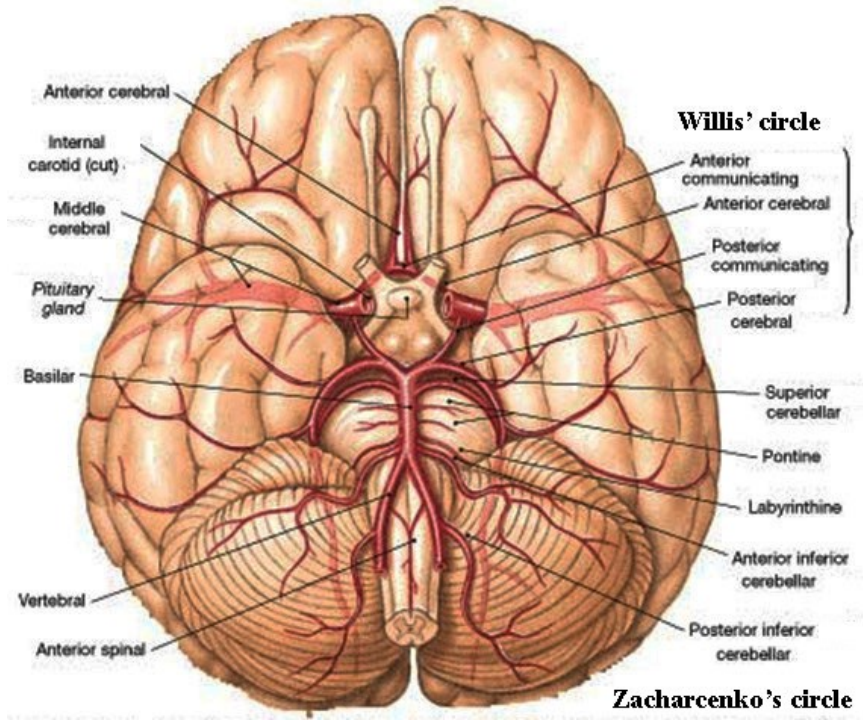

Subcutaneous venous network
M. auricularis superior
V. temporalis media
V. transversa faciei
Porus acusticus externus
Venter occipitalis
A. temporalis superficialis
A. transversa faciei
V. auricularis posterior
V. occipitalis
A. auricularis posterior
N. facialis
A. stylomastoidea
A. occipitalis
A. maxillaris
Anastomosis between vv. retromandibularis et jugularis externa
Canalis mandibulae (cut open)
M. digastricus (venter posterior)
M. stylohyoideus
N. spinalis
M. masseter
V. facialis
A. facialis
A. lingualis
A. carotis externa
A. carotis interna
V. jugularis interna
Anastomosis between jugularis anterior et facialis
A. thyroidea superior
A. laryngea superior
V. temporalis superficialis
M. temporalis (pulled upwards)
Venter frontalis
A. zygomatico orbitalis
V. supratrochlearis
V. supraorbitalis
V. nasofrontalis
Vv. temporales profundae
V. angularis
Plexus pterygoideus
Vv. nasales externae
R. profundus
V. facialis
A. facialis
Ductus parotideus
V. labialis superior
Veins of ductus parotideus
M. buccinator
M. orbicularis oris
M. depressor labii inferioris (reflected downwards)
V. submentalis
M. digastricus (venter anterior)
V. jugularis anterior
Glandula submandibularis
Os hyoideum
Membrana thyrohyoidea
A. carotis communis
Glandula thyroidea
Cartilago thyroidea

INTRACRANIAL ANASTOMOSES

At the level of the brain:

- the arteries in the Willis polygon;
- the arteries of the Zacharcenko polygon;
- cortical branches of the middle / anterior cerebral arteries (ICA);
- cortical branches of the middle / posterior cerebral arteries (last from a. basilar, AScv) etc.





Vascularization of the cerebral dura matter

Sources of blood supply to the cerebral dura mater include branches of the following arteries:

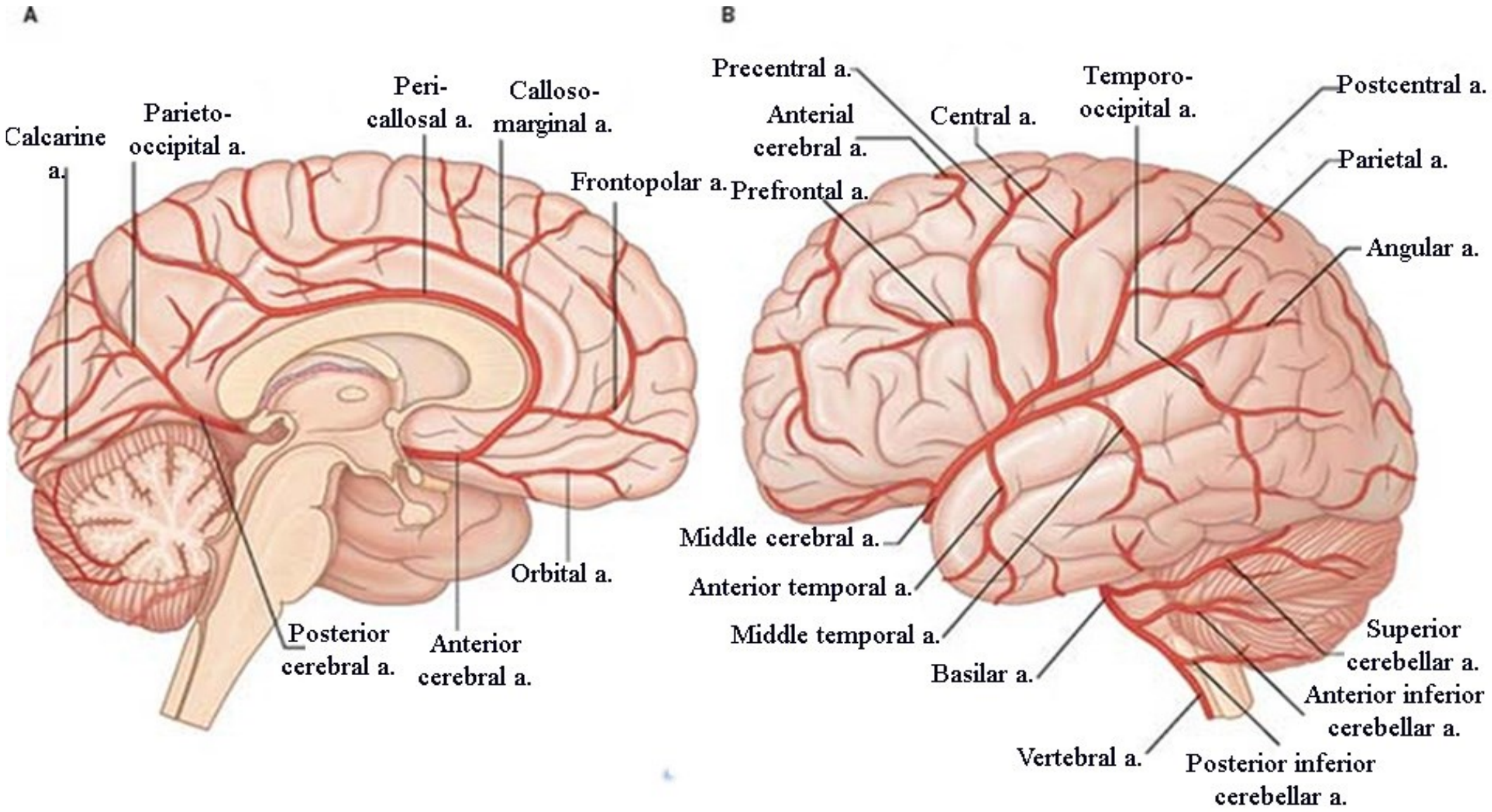
- ***maxillary artery*** (middle meningeal artery);
- ***vertebral artery*** (branch to the meninges);
- ***occipital artery*** (meningeal branch and mastoid branch);
- ***ophthalmic artery*** (anterior meningeal artery from anterior ethmoid artery). Venous blood is collected in the adjacent sinuses of the cerebral dura mater.

INTRACRANIAL ANASTOMOSES

At the level of pachymening:

- a. right / left middle meningeal (a. maxilla, ECA);
- a. middle and anterior meningeal (last of the ophthalmic a., ICA);
- right / left anterior ethmoidal a. (ophthalmic branches, ICA).

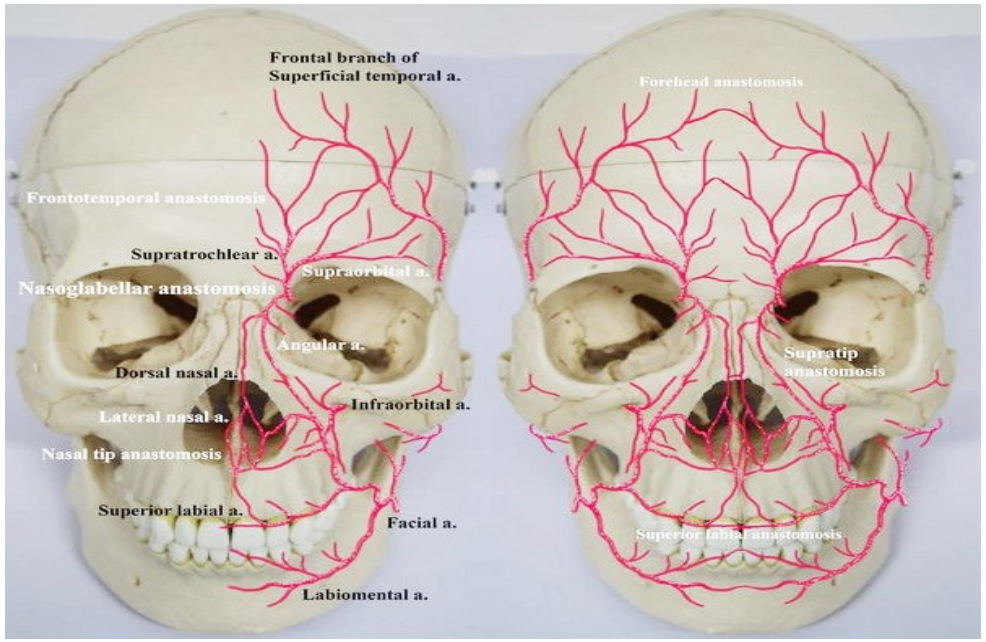
Anastomoses of cerebral arteries



EXTRACRANIAL ANASTOMOSES

▪ ***On the face:***

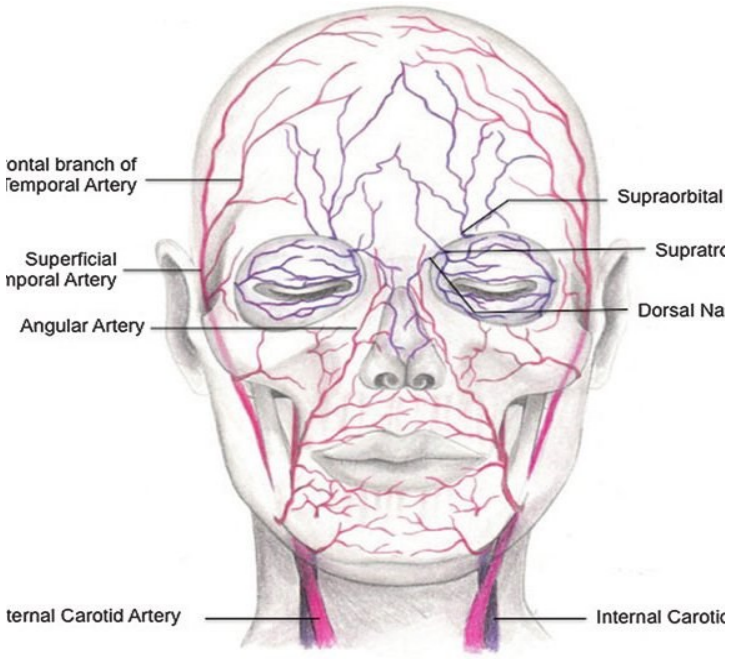
- both *upper* and *lower labial* (from the ACE);
- *angular* and *dorsal of the nose* (a. facial (ACE), a. ophthalmic (ACI));
- *a. infraorbital* and *a. dorsal of the nose* (a. maxillary (ACE),a. ophthalmic (ACI)) etc.

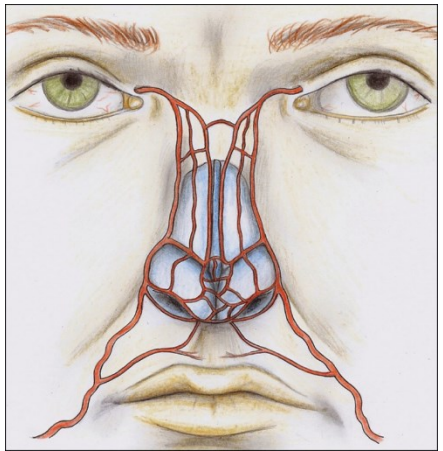


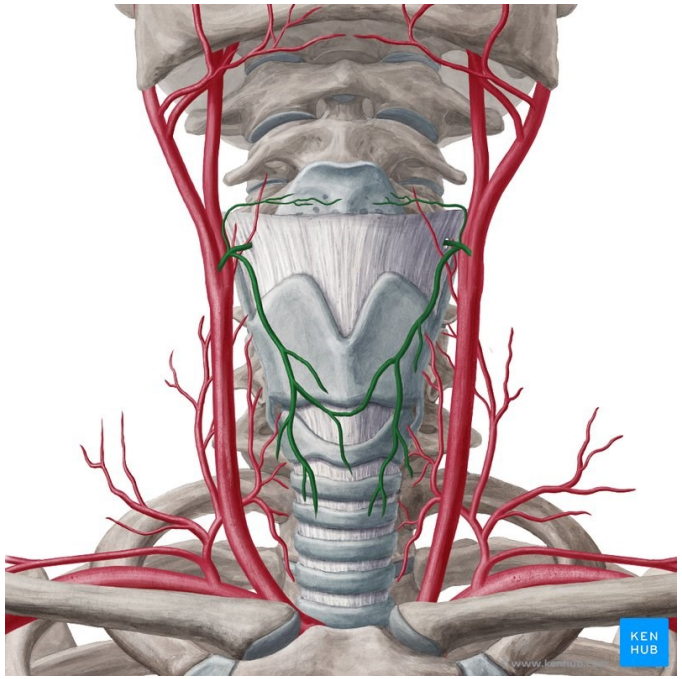
▪ ***At the level of the cranial vault:***

- both *occipital arteries* (from ECA);

- a. *auricularis posterior* and a. *auricularis anterior* (from ECA) etc.







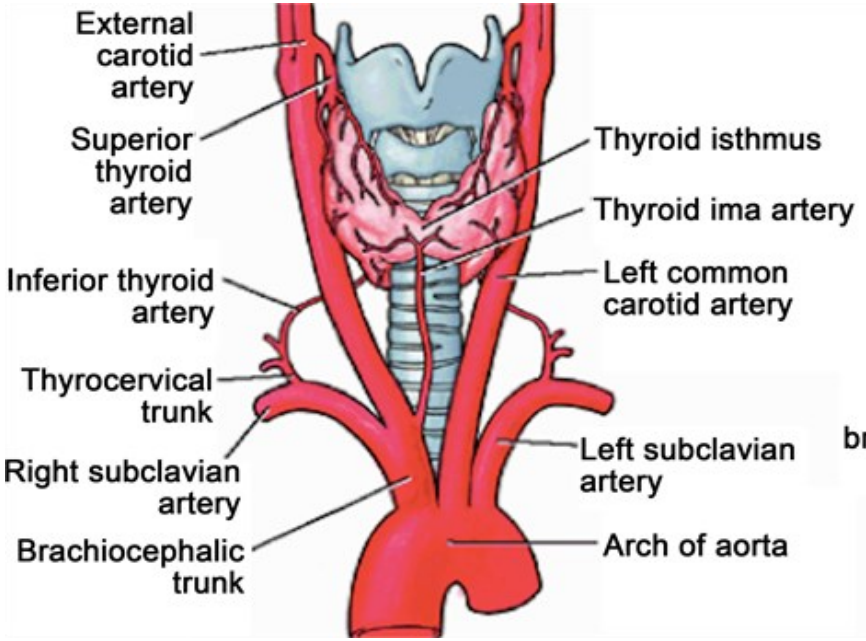
▪ *At the neck:*

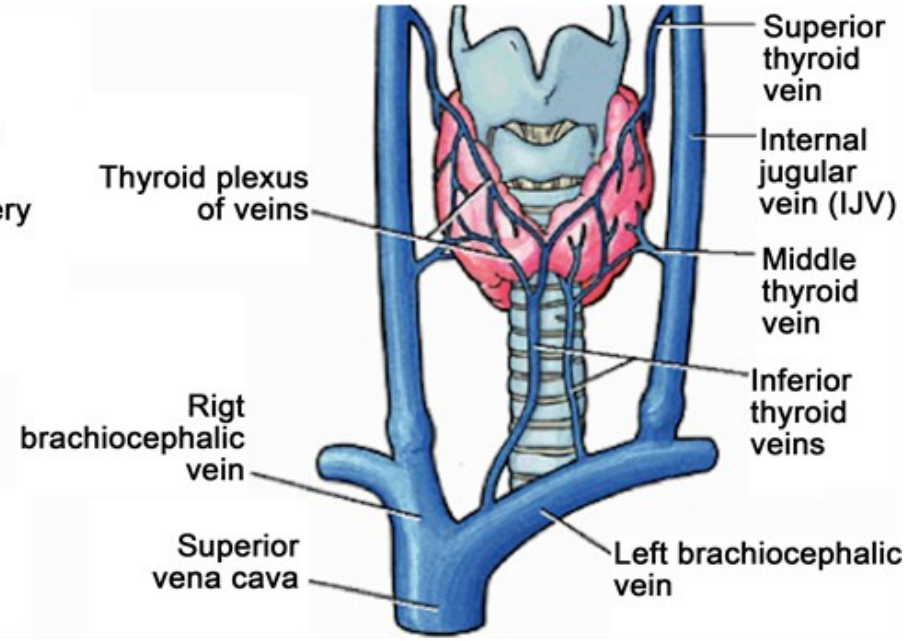
- both *upper / lower thyroid a.*

- *a. superior thyroid* + *a. ascending cervical* (last of thyrocervical trunk, AScv);

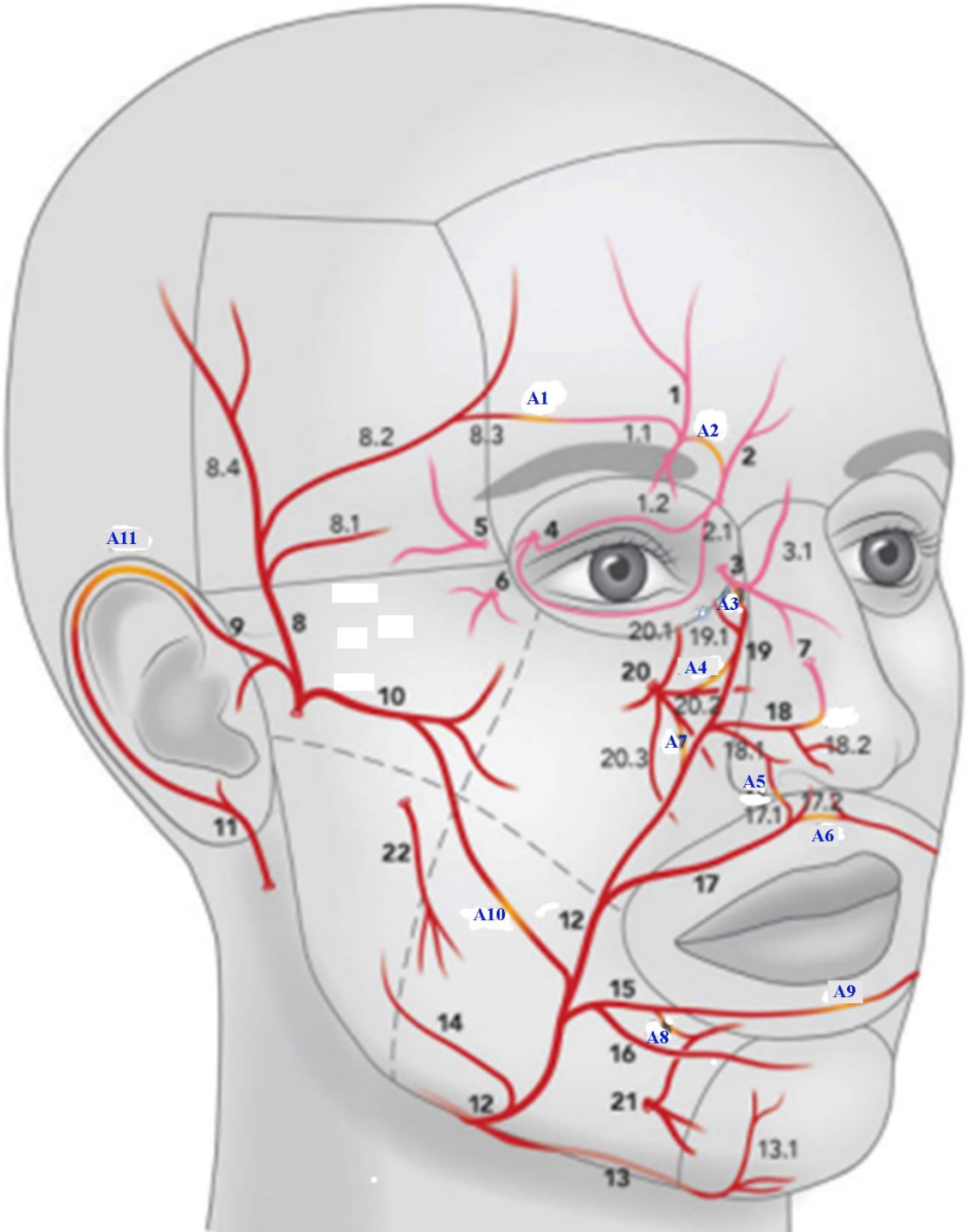
- a. *ascending pharyngeal* and *a. inferior thyroid* (ECA, thyrocervical trunk - AScv);

- *occipital a.* + *vertebral a.* (from ECA and AScv) etc.





- https://www.scirp.org/journal/paperinformation.aspx?paperid=85989



Anastomoses of the face arteries

A1- Supraorbital + Frontal branch of superficial temporal;

A2 - Supraorbital + Supratrochlear;

A3 – Dorsal nasal + Angular;

A4 – lateral nasal + external nasal branch (ant. ethmoid)

A5 – Superior labial a. + lateral nasal;

A6 – Bilateral superior labial;

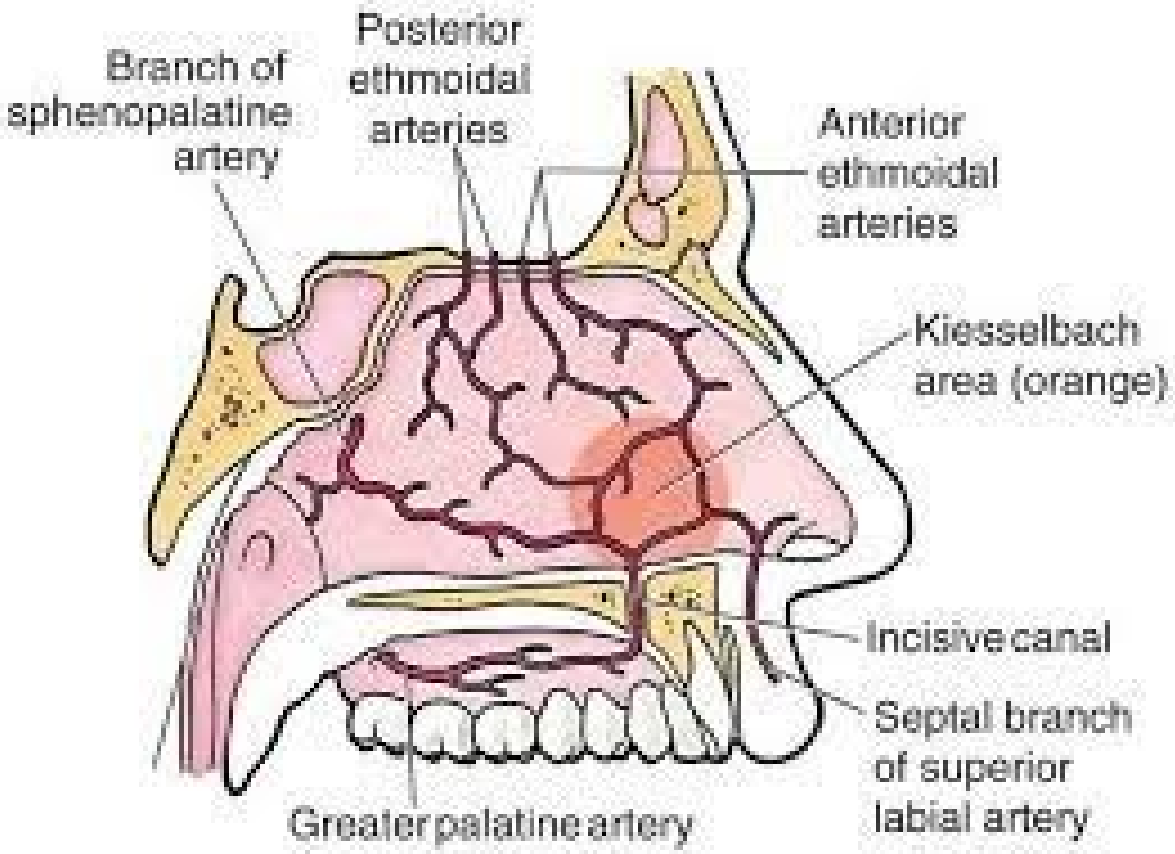
A7 – Facial + infraorbital;

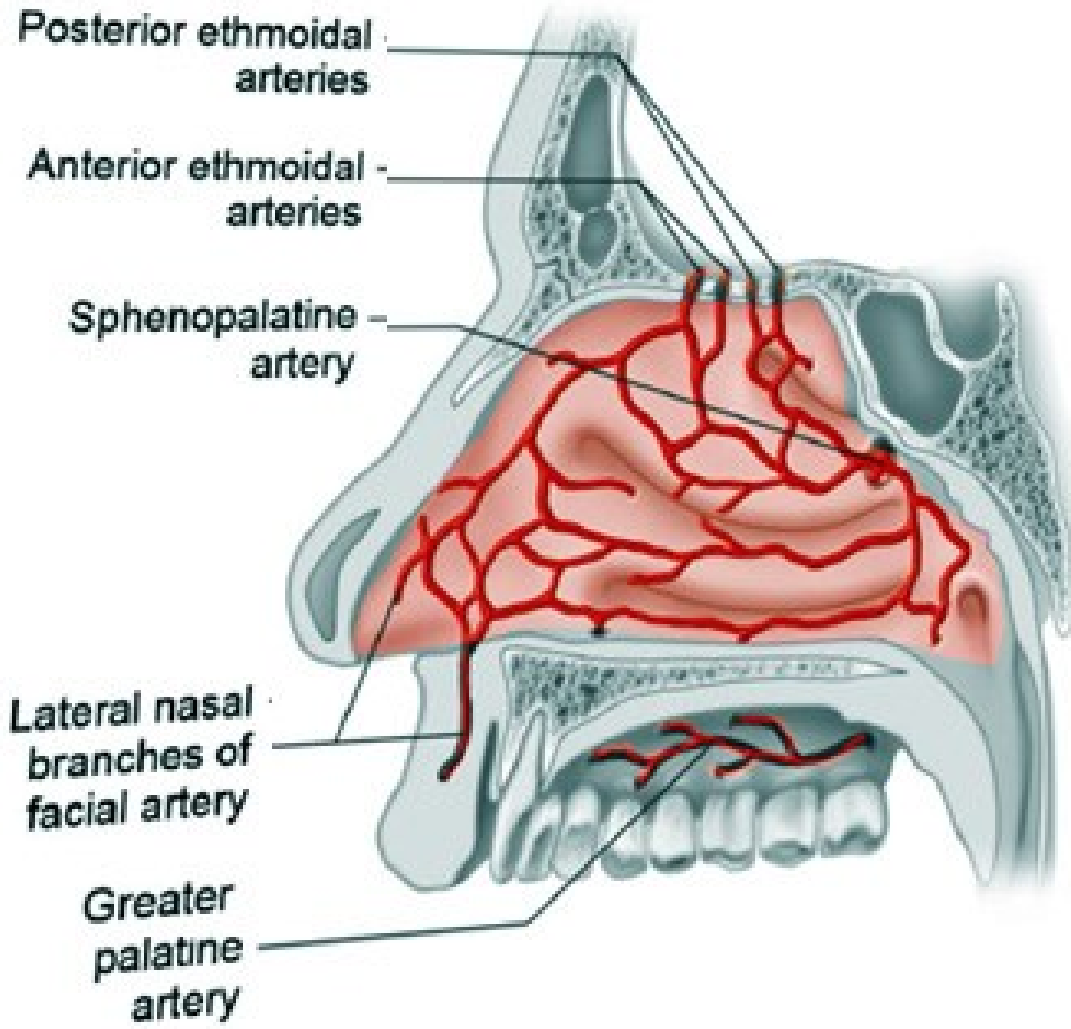
A8 - Inferior labial a. + mental;

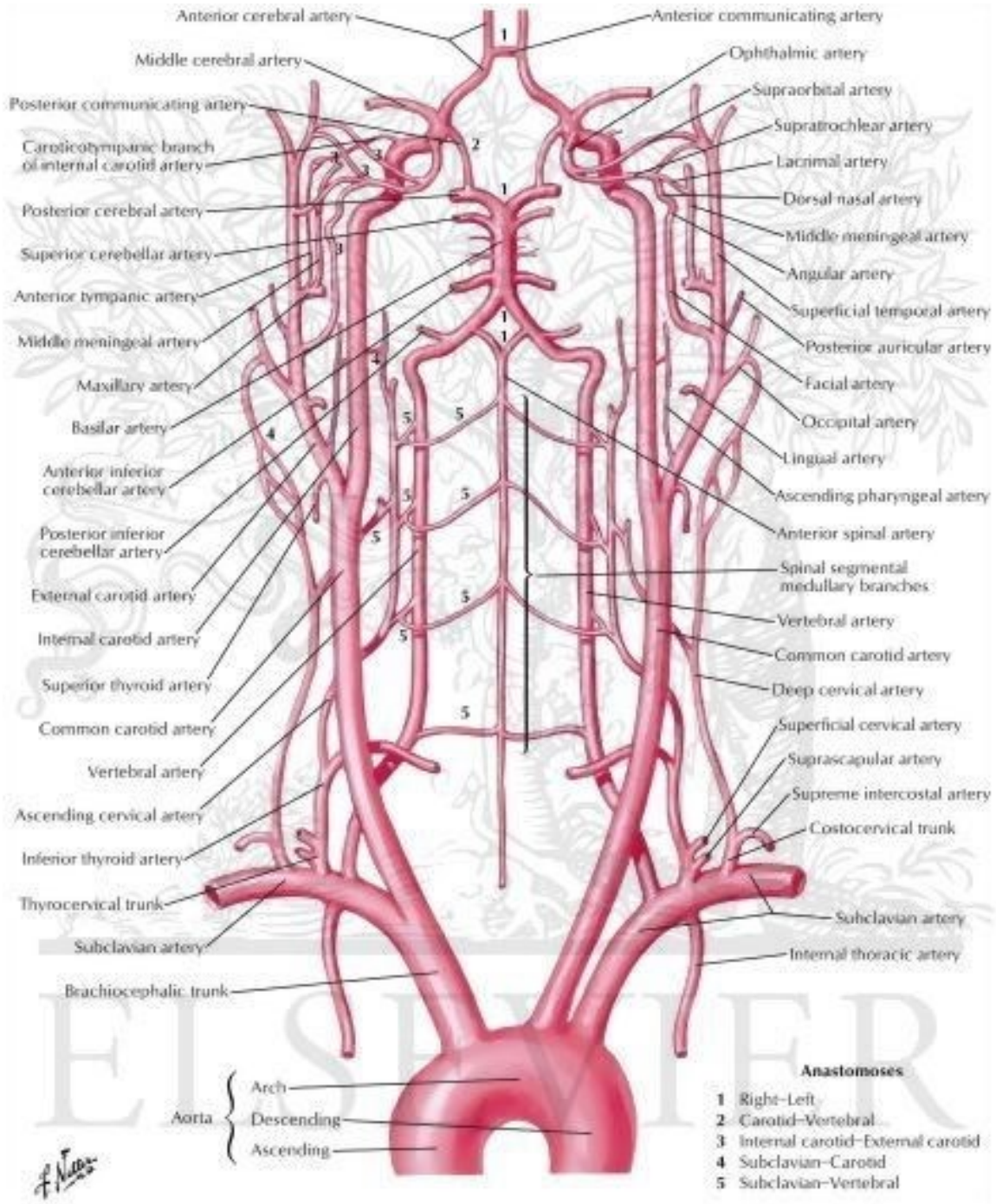
A9 - Bilateral inferior labial;

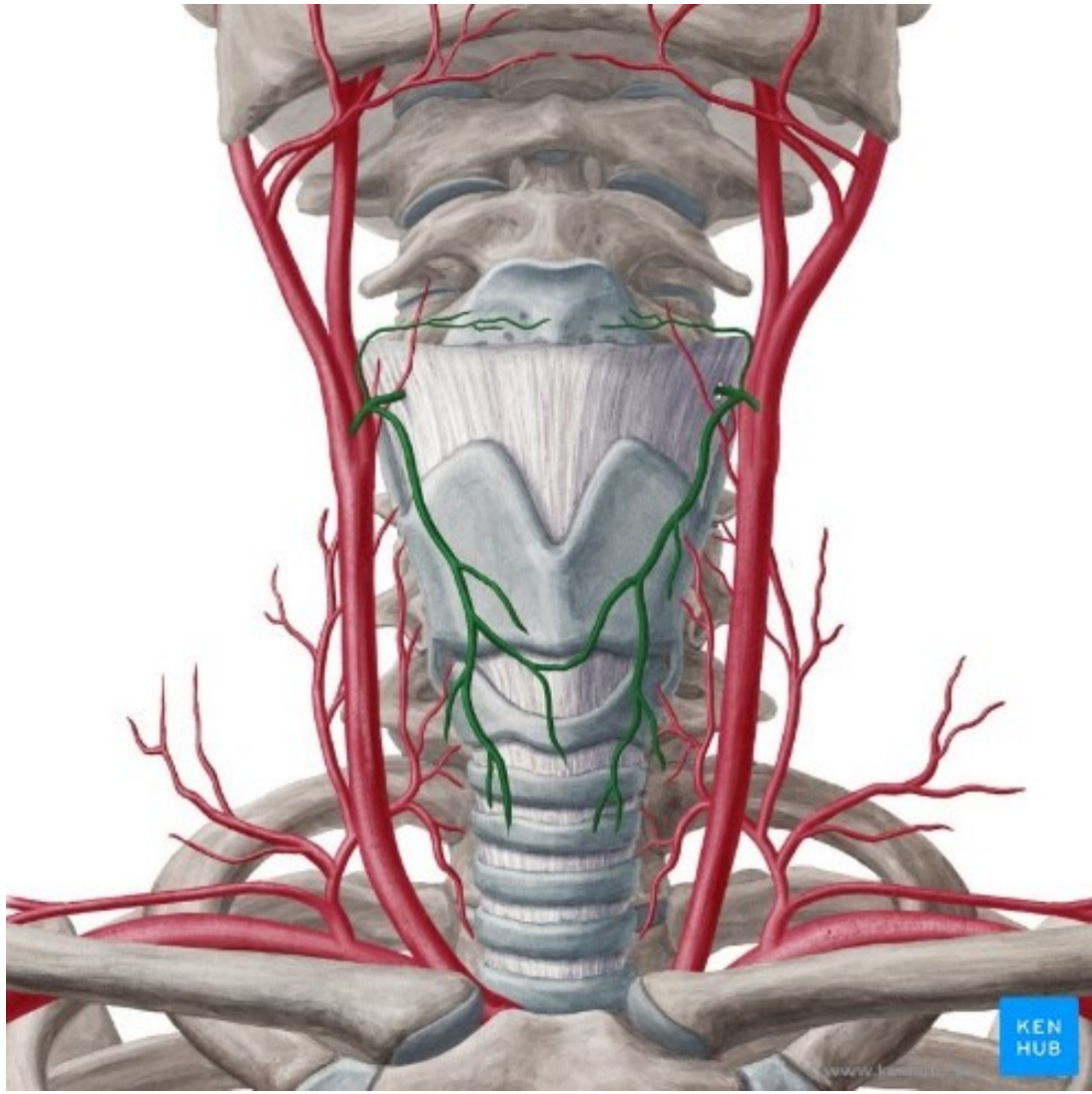
A10 – Facial + transverse facial;

A11 -Anterior auricular + posterior auricular a.


Branch of sphenopalatine artery
Posterior ethmoidal arteries
Anterior ethmoidal arteries
Kiesselbach area (orange)
Incisive canal
Septal branch of superior labial artery
Greater palatine artery


Posterior ethmoidal arteries
Anterior ethmoidal arteries
Sphenopalatine artery
Lateral nasal branches of facial artery
Greater palatine artery





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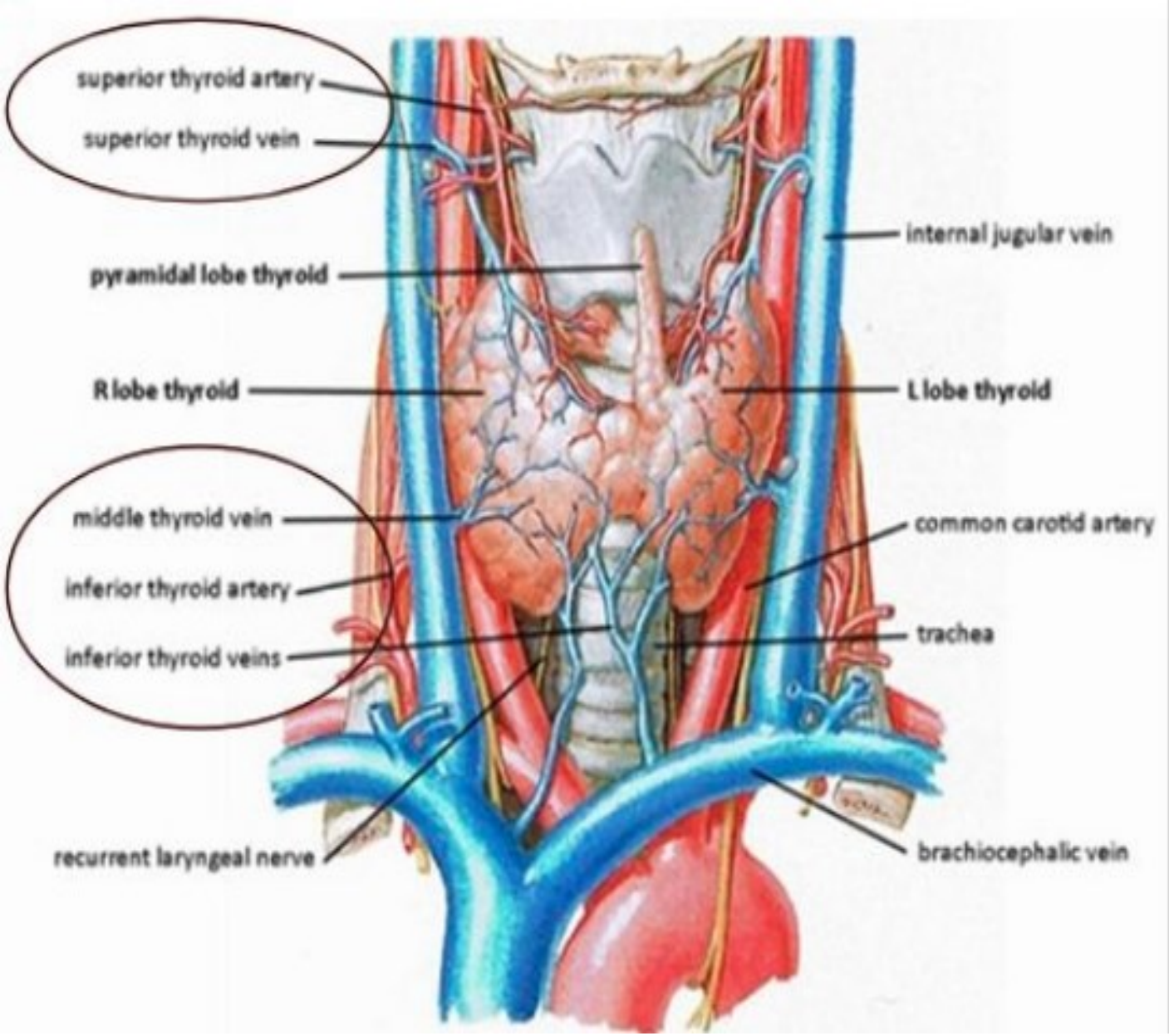
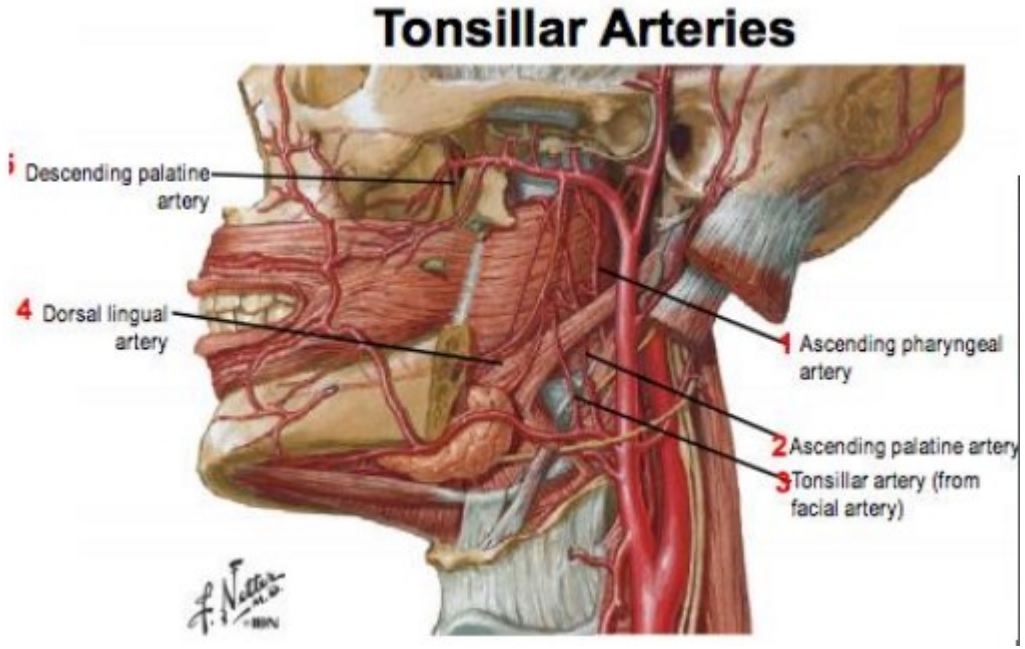
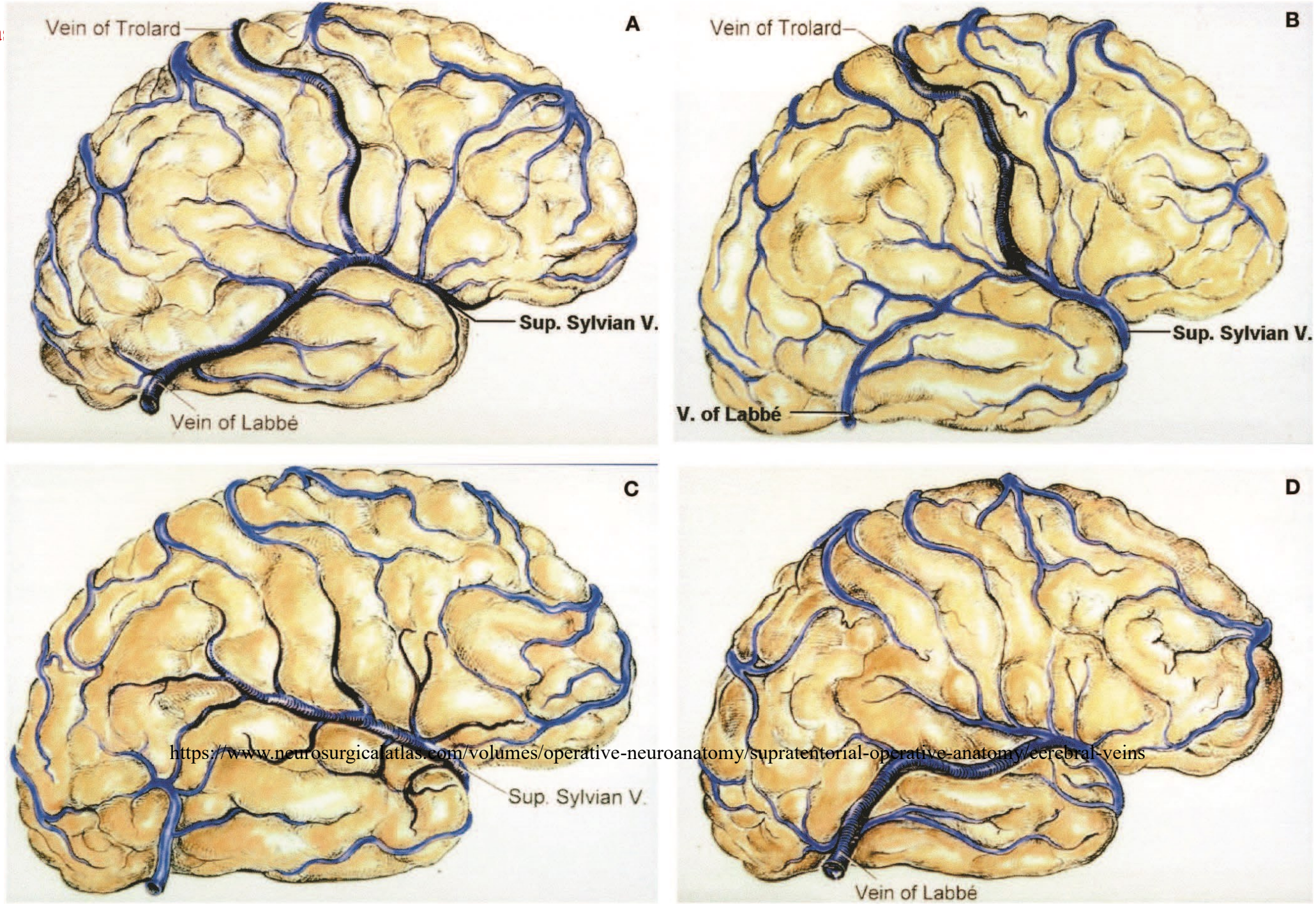




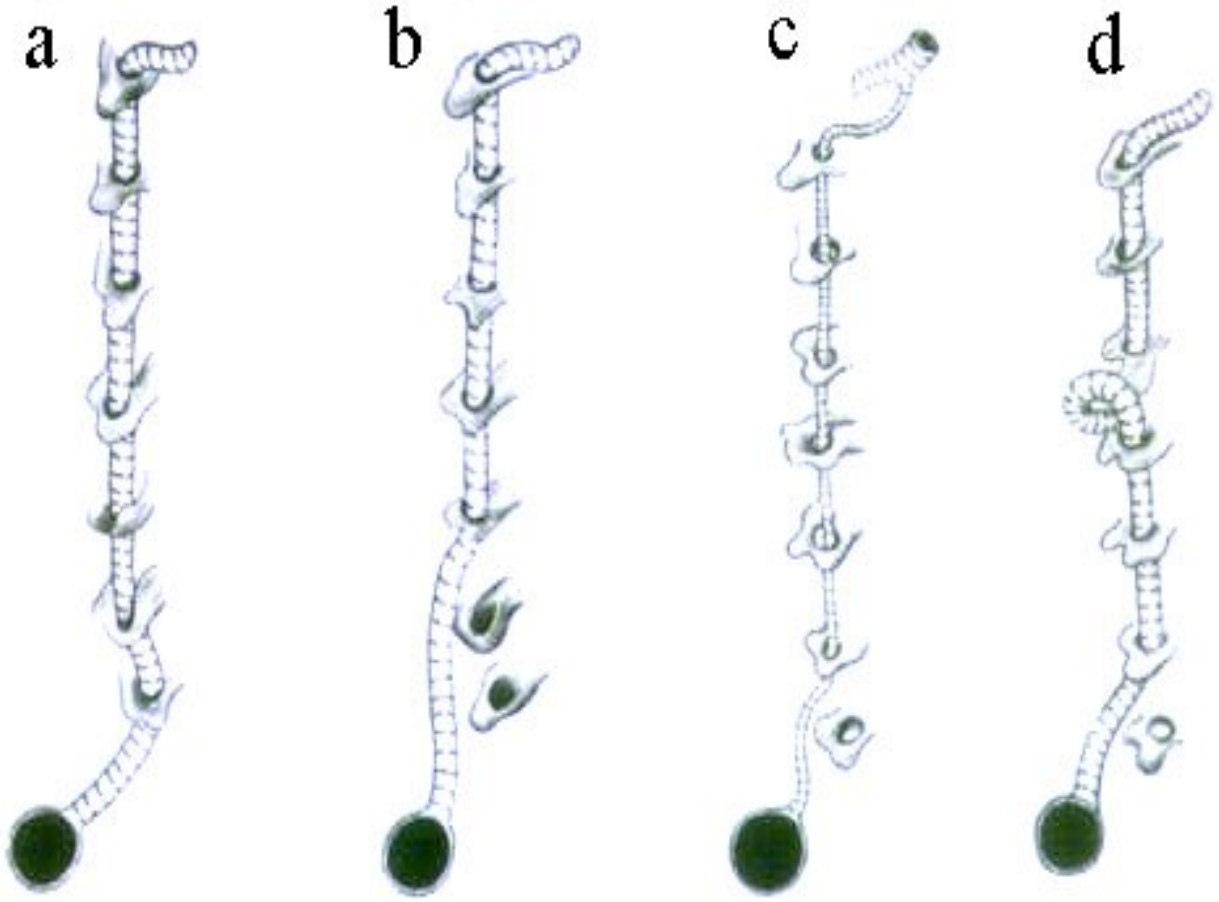
Thoma



https://www.neurosurgicalatlas.com/volumes/operative-neuroanatomy/supratentorial-operative-anatomy/cerebral-veins

Classification of the vascular anomalies

- of the origin
- of the traject
- of the branching



a,b - variants of traject of the vertebral artery;
c - hypoplasia; d - arterial loop .

The individual variants and particularities of the arteries belong to:

▪ Their origin, length, trajectory, branching, distribution area;

▪ The constitution of the individual.

For example:

• In brachymorphs, the aortic arch is projected lower, and its branches they are more distant from each other.

• In dolihomorphs - the aortic arch is projected upper and its branches are located closer.

Knowledge of anomalies and variants is necessary in performing angiography and surgery at this level.

▪ According to statistical data, ignorance of variants of arteries in the neck area causes of fatal bleeding in cases of tracheostomies (caused by damage to the brachiocephalic trunk, aortic arch, ACC, thyroid arteries, brachiocephalic veins

VARIANTS OF THE VESSELS OF THE HEAD AND NECK

1. Lack of brachiocephalic trunk - right common carotid and subclavian artery have separate origin

2. A. laryngea superior starts from a. carotis externa, not on a. thyroidea superior

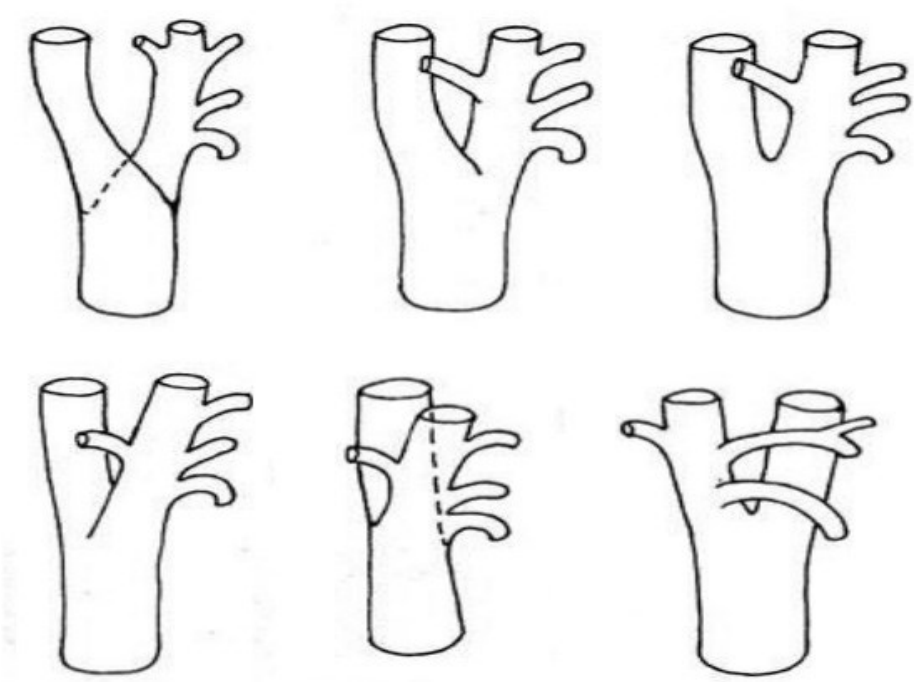
3. The presence of a common arterial trunk of the facial-lingual arteries

4. Variations of the location of the diploic veins

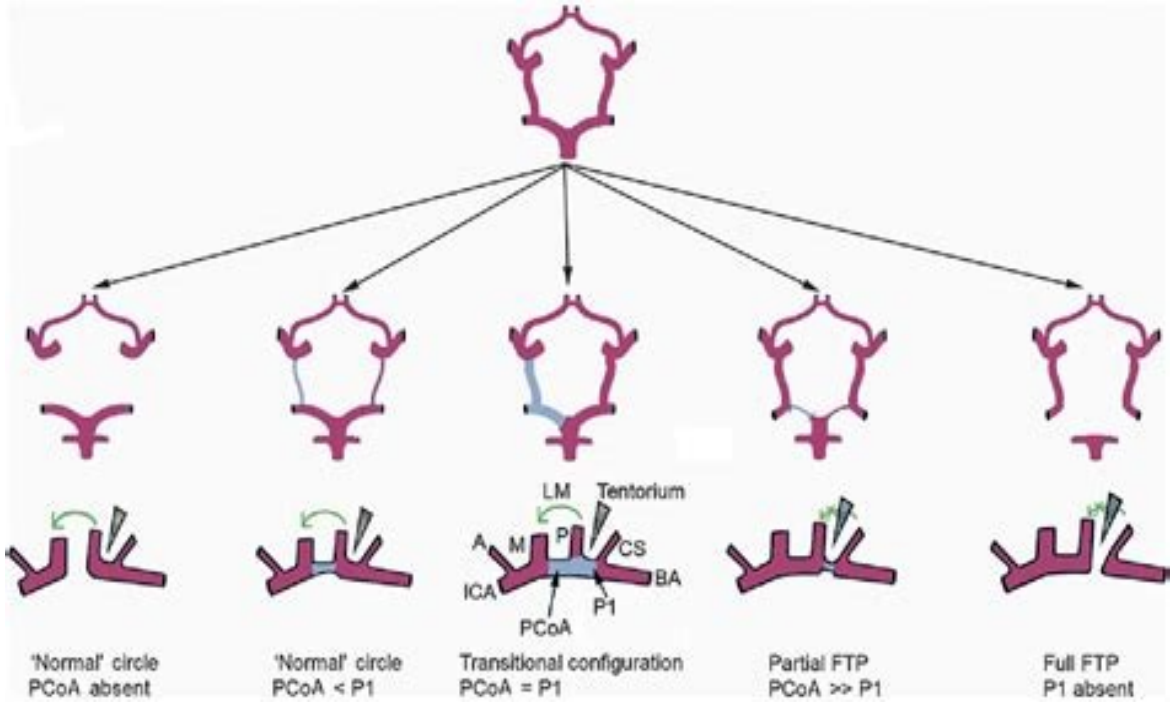
5. Unilateral v. jugularis anterior

6. Variants of the confluence of v. jugularis externa – into the venous angle or the internal jugular vein.

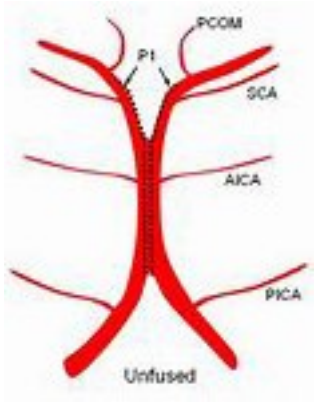
ECA variants

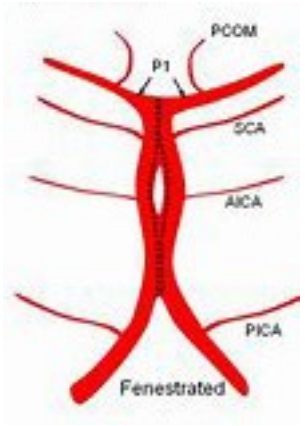


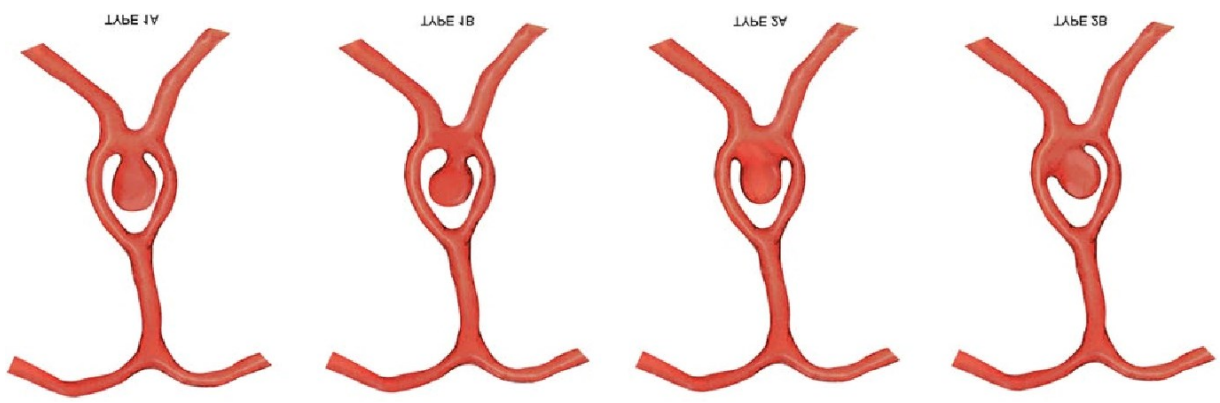
Willi's circle variants



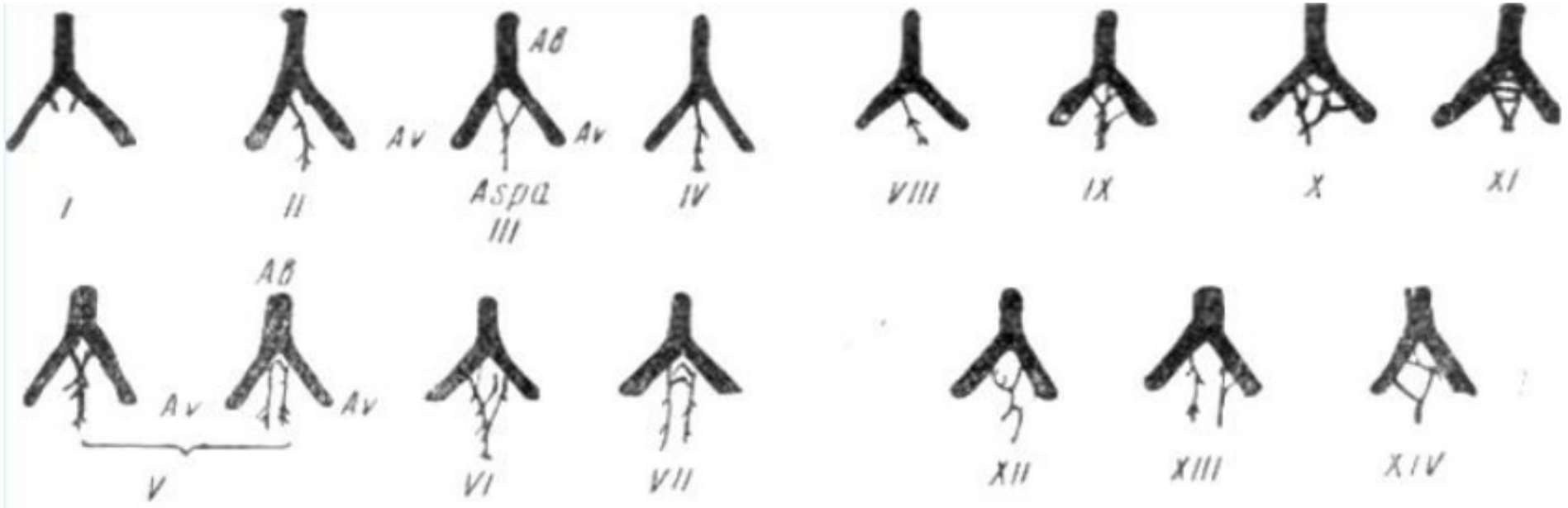
Anomalies of the basilar artery







Zacharcenko's circle variants



Anomalies of the blood vessels of the head and neck

1. Anomalies of the vertebral artery - can enter the spinal canal at the level of CIII-CIV, sometimes - dublication of vertebral artery
2. Asymmetric arrangement
3. Hypoplasia (underdevelopment)
4. Double a. basilaris.
5. Dystopia a. basilaris
6. The presence of the membrane that divides a. basilaris into 2 halves
7. Anomalies of the circle of Willis - hypoplasia or aplasia of the communicating arteries
8. Congenital cutaneous capillary hemangioma
9. Arterio-venous fistulas

Anomalies of the basilar artery

lateropositon,

existance of the septum,

plexiform type,

high fusion of the vertebral arteries

multiple superior cerebellar arteries

tortuous course of basilar artery

Anomalies of the arterial circle of the brain

hypoplasia of the communicating arteries,

diversity of the structure, size and location of the arteries,

absence, doubling or triplet of the anterior communicating a. ,

doubling of the anterior cerebral a. starting from the ACI „anterior triplet” în 1-7%,

anterior cerebral a. starts from the anterior communicating a. ,

“triplet of the ACI”: posterior cerebral a. starts from the ACI,

diameter of the anterior communicating is equal with the posterior cerebral a.

Internal carotid artery

Origin of occipital artery

Cervical internal carotid loops or coils

Recurrent artery of Heubner/ medial lenticulostriate arteries

Origin of ascending pharyngeal artery

Aberrant petrous portion

Cavernous ophthalmic artery origin

Origin of posterior cerebral artery, "fetal origin"

External carotid artery

Ophthalmic origin from middle meningeal

Origin of posterior meningeal artery

Vertebral artery

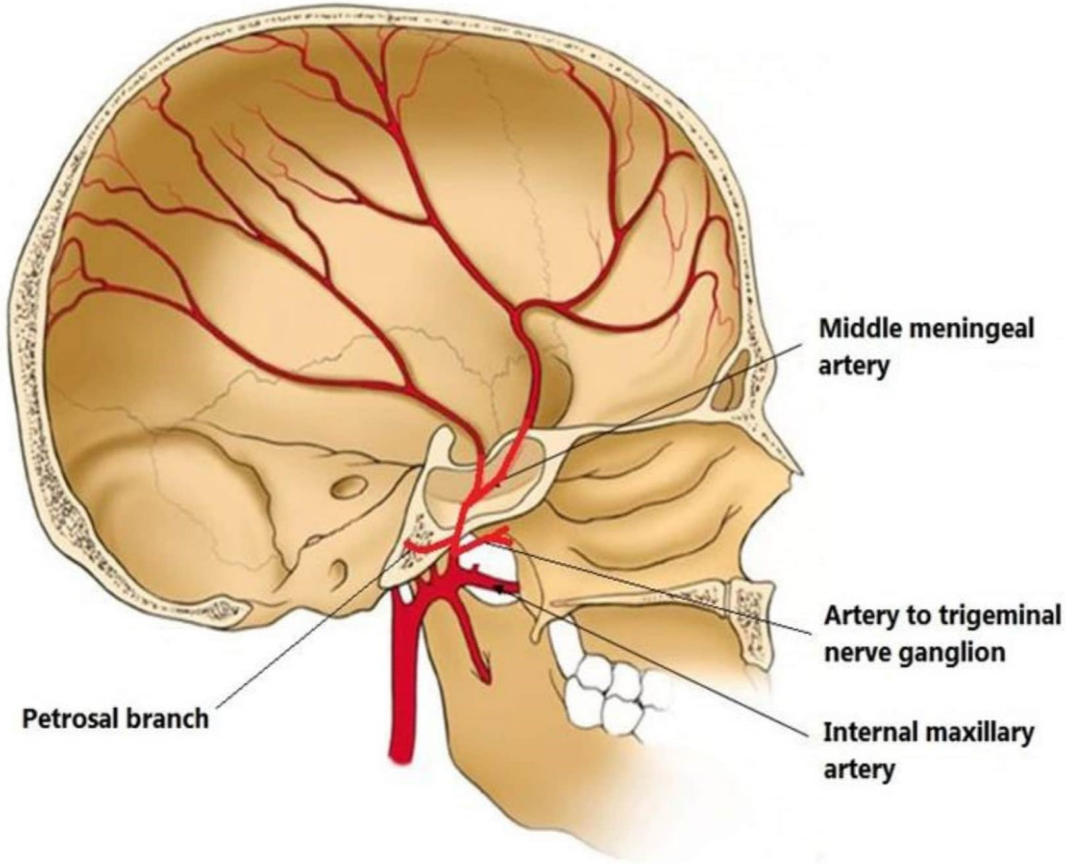
Isolated posterior inferior cerebellar artery

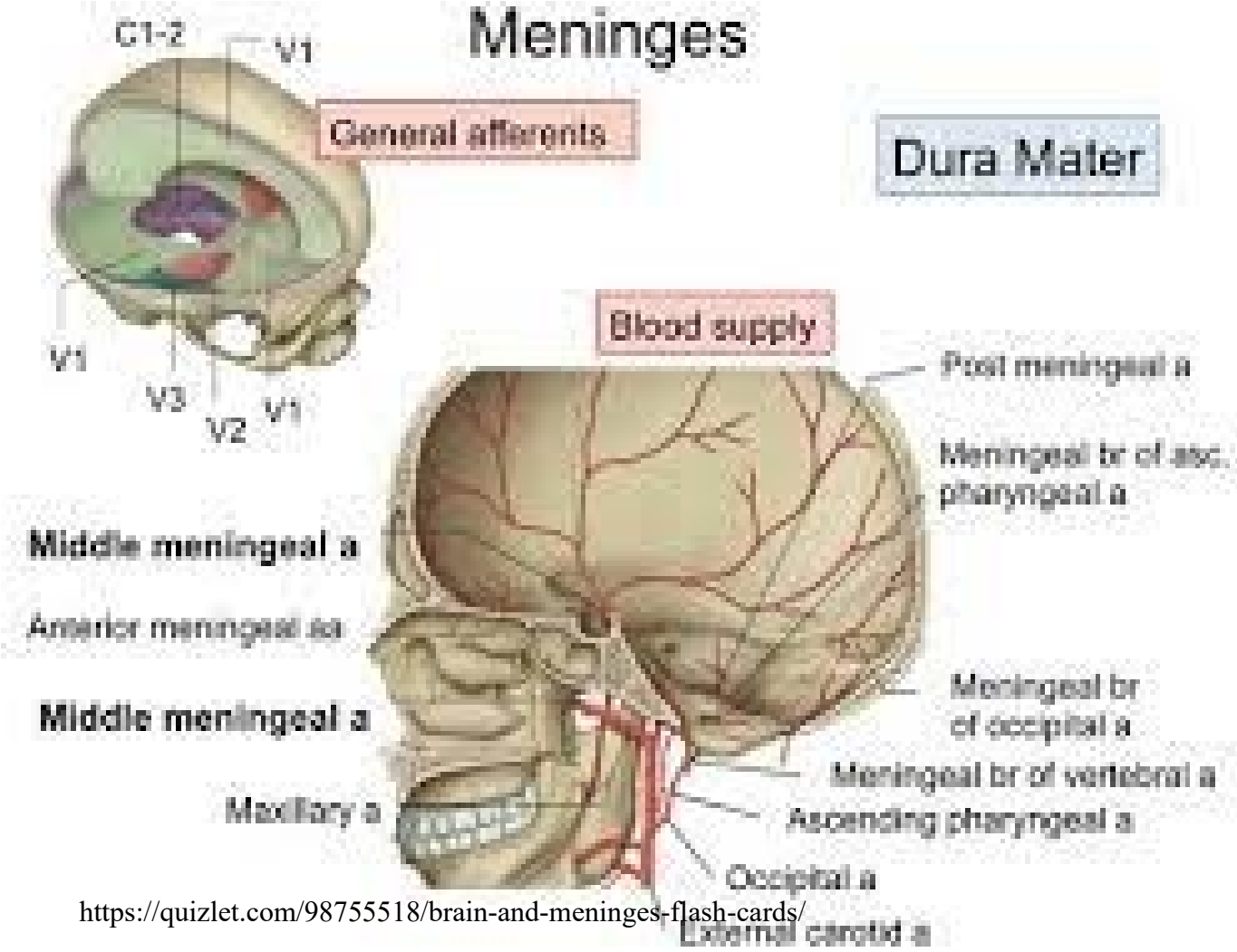
Inferior thyroid artery origin

Absent vertebral artery

Blood supply to the head and neck organs

- ***Blood supply to the cerebral dura matter***

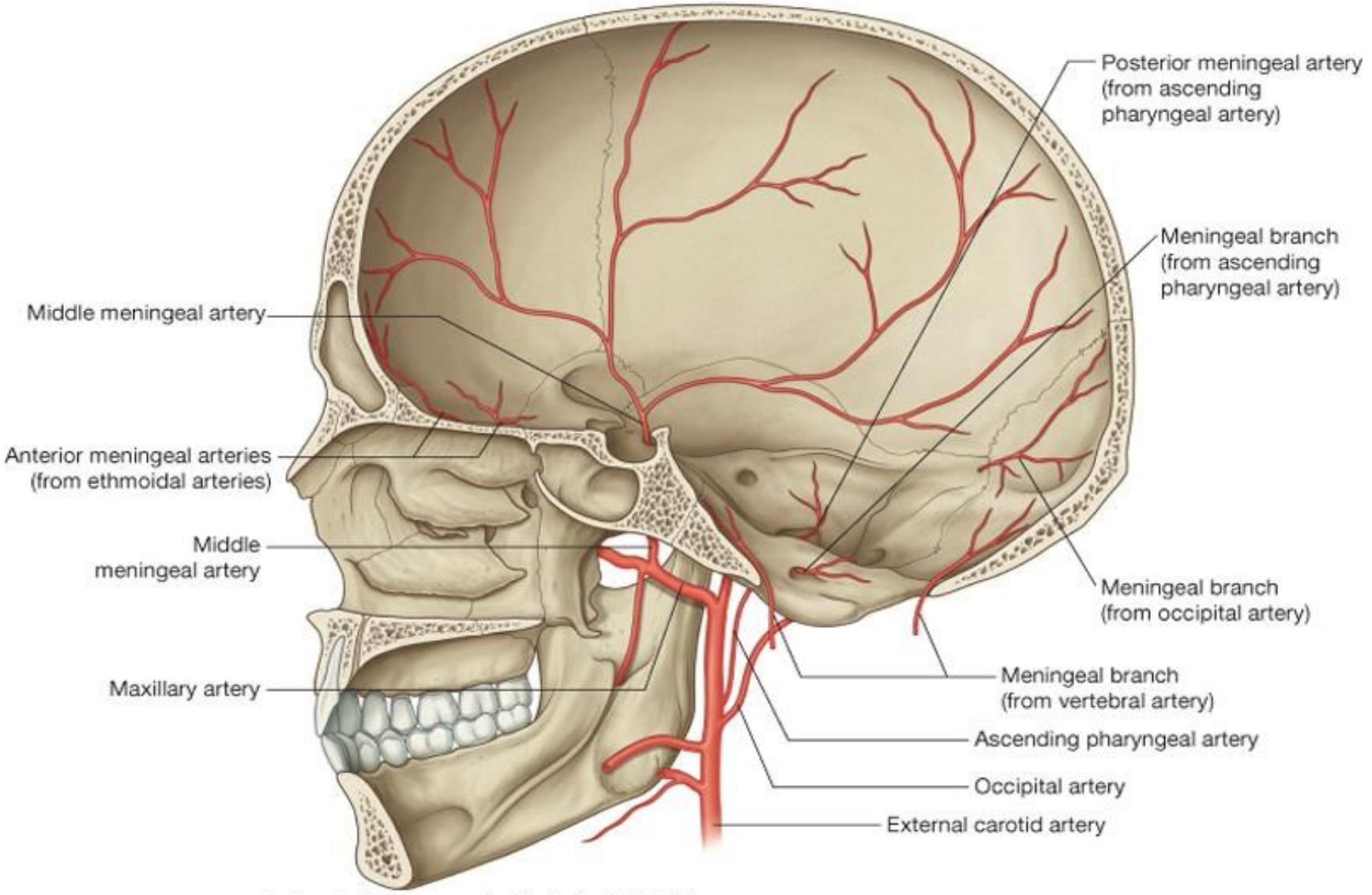




https://quizlet.com/98755518/brain-and-meninges-flash-cards/

Blood supply to the head and neck organs

Blood supply to the cerebral dura matter



Blood supply to the ear

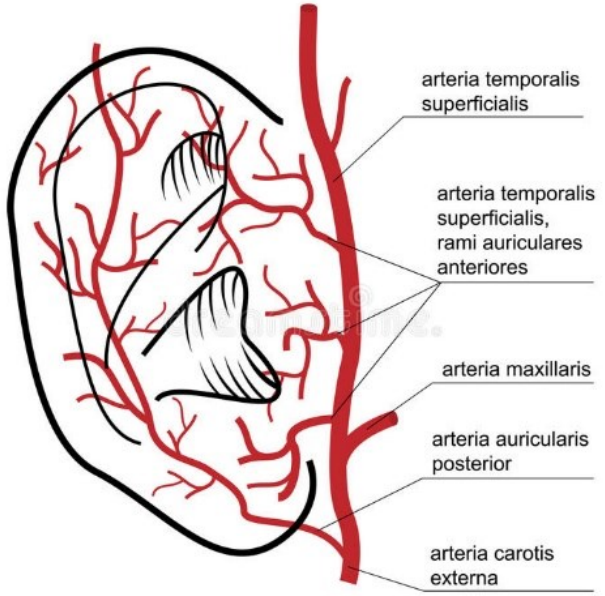
The blood supply of the ear differs according to each part of the ear.

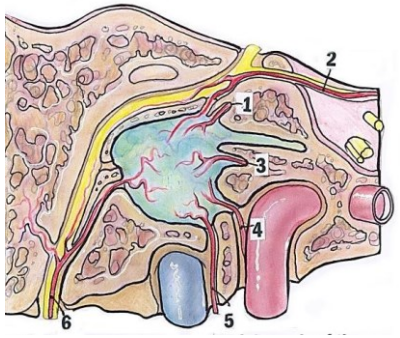
The external ear is supplied by the ***anterior*** and ***posterior*** ***auricular arteries***, which are branches of ***the*** ***superficial temporal artery*** and ***external carotid artery*** respectively, and branches of the ***occipital artery***.

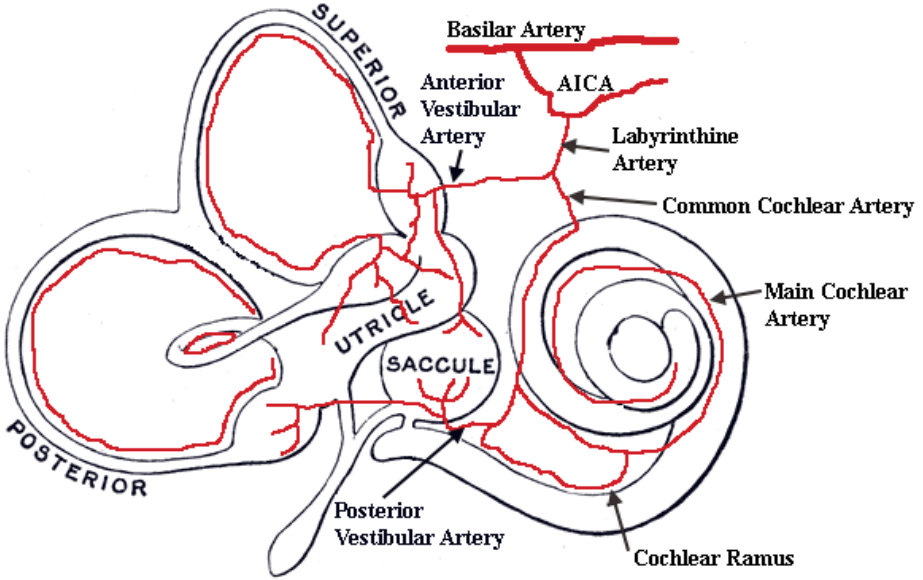
The middle ear is supplied by mastoid branch of the ***occipital*** or ***posterior auricular arteries***, tympanic branch of the ***maxillary artery*** and some branches from different arteries, including the ***middle meningeal artery***, ***ascending pharyngeal artery***, ***internal carotid artery,*** and the ***artery of pterygoid canal***.

The inner ear is supplied by the anterior tympanic branch of the ***maxillary artery***, stylomastoid branch of the ***posterior auricular artery***, petrosal branch of the ***middle meningeal artery,*** and the labyrinthine artery, arising from either the ***anterior inferior cerebellar artery***, or the ***basilar artery***.

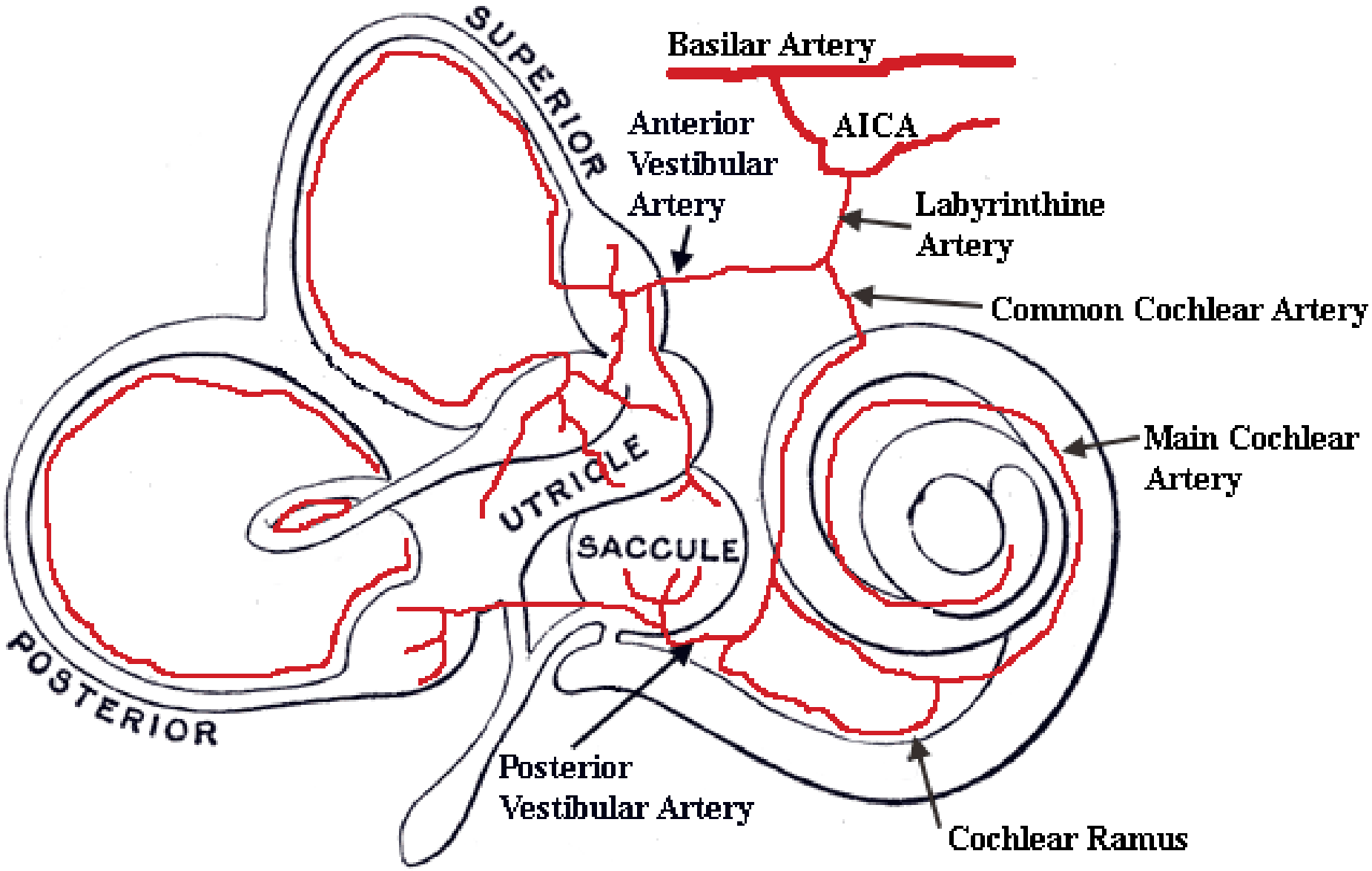
Venous drainage is via satellite veins to the **internal maxillary veins**.







Blood supply to the internal ear



https://www.vestib.com/arterial-supply.html

Blood supply to the neck muscles

Muscles	Blood supply
Platisma	The submental artery is the primary vessel to the platysma muscle. The superior thyroid artery, occipital artery, and posterior auricular artery are identified as secondary vessels. The external jugular vein provided the primary venous drainage, followed by the submental vein.
Sternocleidomastoid m.	The upper third - branches of the occipital artery. The middle third - branch of the superior thyroid artery (42%), the external carotid artery (23%) or both The lower - branches of the suprascapular artery
Suprahyoid muscles	
Digastric (anterior belly)	Lingual artery (branch of the ECA) Facial a. (branch of the ECA)
Digastric (posterior belly)	Occipital artery (branch of the ECA)
Geniohyoid	The sublingual artery, a branch of the lingual artery Submental artery, a branch of the facial artery
Stylohyoid	Facial artery
Mylohyoid	Sublingual artery, a branch of the lingual a. Submental artery, a branch of the facial artery

Infrahyoid muscles	
Sternohyoid	Superior thyroid artery (STA),
Sternothyroid	Inferior thyroid artery (ITA),
Thyrohyoid	Inferior thyroid artery (ITA),
Omohyoid (sup. belly)	?
Omohyoid (inf. belly)	Internal thoracic artery (IThA)
Deep muscles	
Anterior, middle, posterior scalene	Branches of ascending cervical a.
Longus colli	Muscular branches of the ascending cervical, vertebral and pharyngeal arteries.
Longus capitis	Ascending cervical artery, which is a small branch of the inferior thyroid artery originating from the thyrocervical trunk
Rectus capitis anterior	Ascending cervical artery
Rectus capitis lateralis	Ascending cervical artery
Anterior, middle, posterior scalene	Branches of ascending cervical a.

Blood supply to the teeth

All teeth are supplied by vessels that branch either directly or indirectly (***infraorbital a.***) from the ***maxillary artery***.

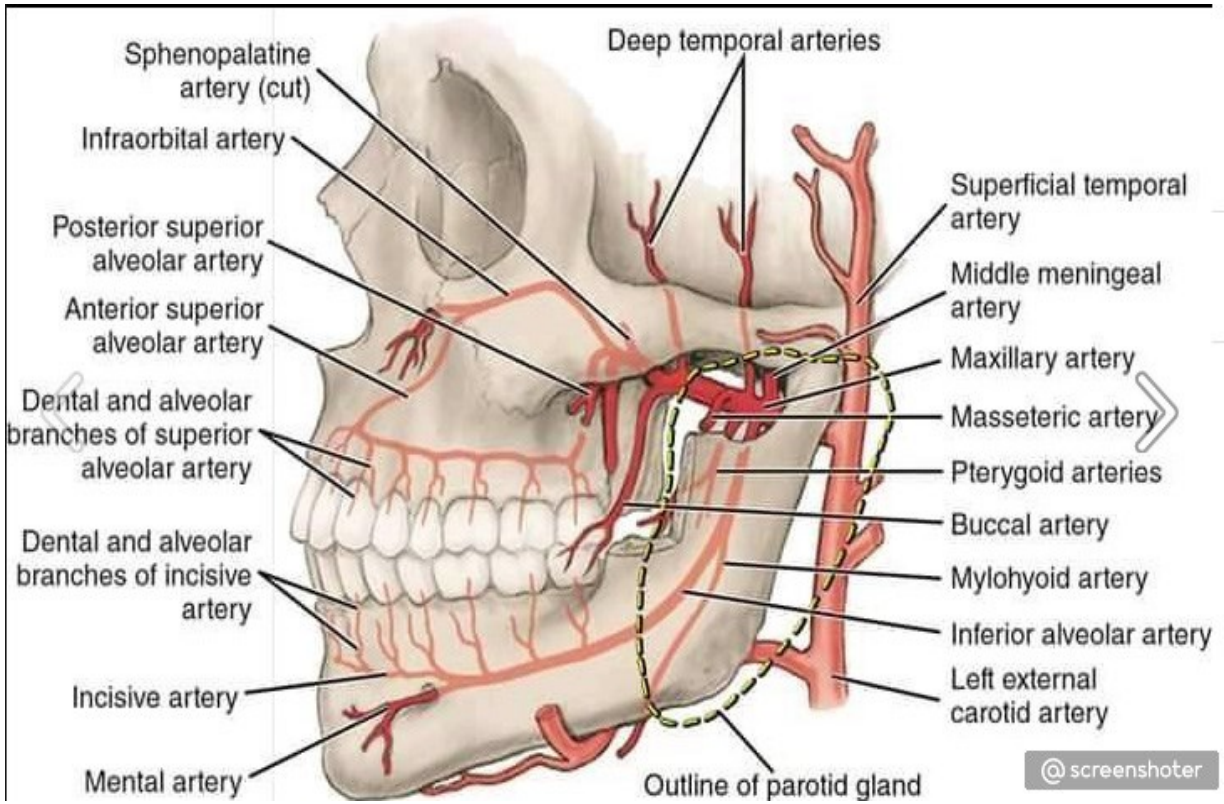
All upper teeth are supplied by ***anterior and posterior superior alveolar arteries***.

The posterior superior alveolar artery originates from the maxillary artery just after the maxillary artery enters the pterygopalatine fossa.

The ***anterior superior alveolar artery*** originates from the infraorbital artery in the infraorbital canal.

All lower teeth are supplied by the ***inferior alveolar artery***, which

originates from the maxillary artery in the infratemporal fossa.



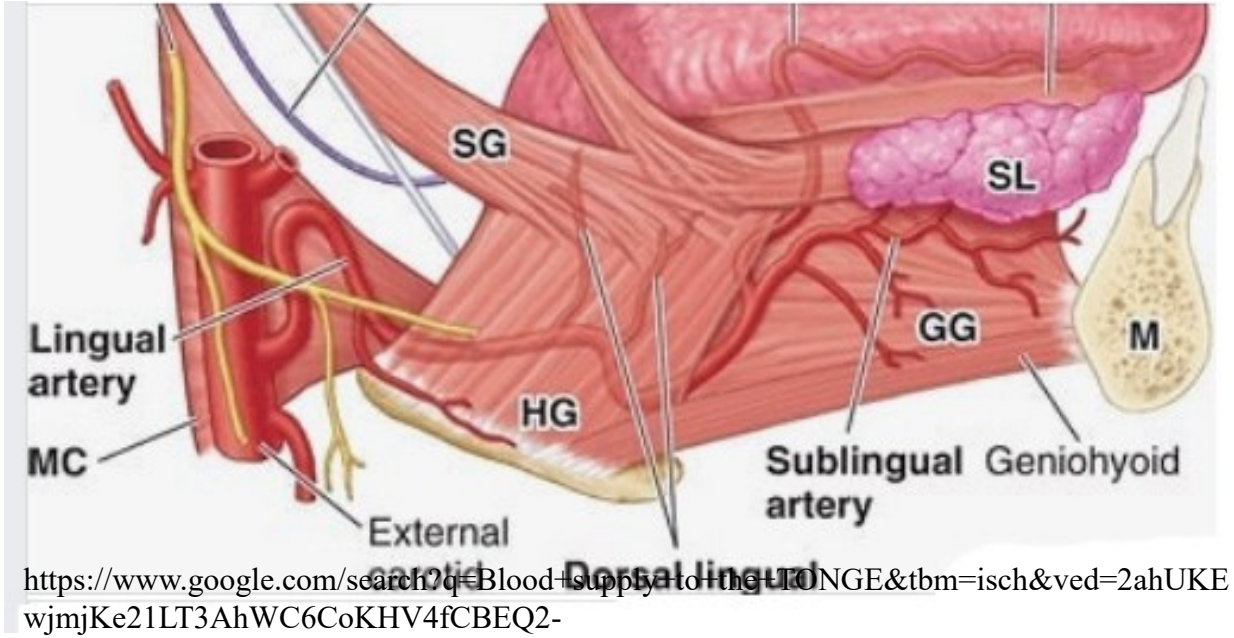
Vascularization of the salivary glands

Gland	Blood supply
Parotid	Posterior auricular artery and the transverse facial (ECA) Venous return is to the retromandibular vein
Submandibular, Sublingual	Facial and lingual arteries

Blood supply to the tongue

The main blood supply to the tongue is via the ***lingual artery***, a branch of the external carotid artery.

The secondary blood supply to the tongue is provided via
-the ***tonsillar branch of the facial artery***;
- ***the ascending pharyngeal artery.***



https://www.google.com/search?q=Blood+supply+to+the+TONGE&tbm=isch&ved=2ahUKEwjmjKe21LT3AhWC6CoKHV4fCBEQ2-cCegQIABAA&oq=Blood+supply+to+the+TONGE&gs_lcp=CgNpbWcQAzoECAAQE1CvGljsxgFgvMwBaABwAHgAgAFqiAHIBZIBAzIuNZgBAKABAaoBC2d3cy13aXotaW1nwAEB&sclient=img&ei=ym5pYub_H4LRqwHevqCIAQ&bih=705&biw=1024#imgrc=uBD7mRWNh43QiM

Blood supply to the eye

Blood flow to the orbit (and beyond) comes from branches of the ***internal carotid artery***, chiefly via the ***ophthalmic artery*** and its branches.
The eyeball receives its blood supply from ***the ophthalmic artery*** (1) through the ***central artery of the retina*** (2)***, short*** (5) and ***long posterior ciliary arteries,*** and ***the anterior ciliary arteries*** (3) (branches of the ophthalmic artery).

Short posterior ciliary arteries**:** branch from the ophthalmic artery and pierce the sclera near the optic nerve; they supply the choroid and the rods and cones of the retina

Long posterior ciliary arteries**:** branch from the ophthalmic artery and pierce the sclera to supply the ciliary body and iris

Anterior ciliary artery**:** runs from the muscular branches of the ophthalmic artery through the sclera near the rectus muscles and forms an arterial network in the iris and ciliary body.

Central artery of the retina**:** runs from the ophthalmic artery to the eyeball alongside the optic nerve; it branches at the optic disc and supplies the retina

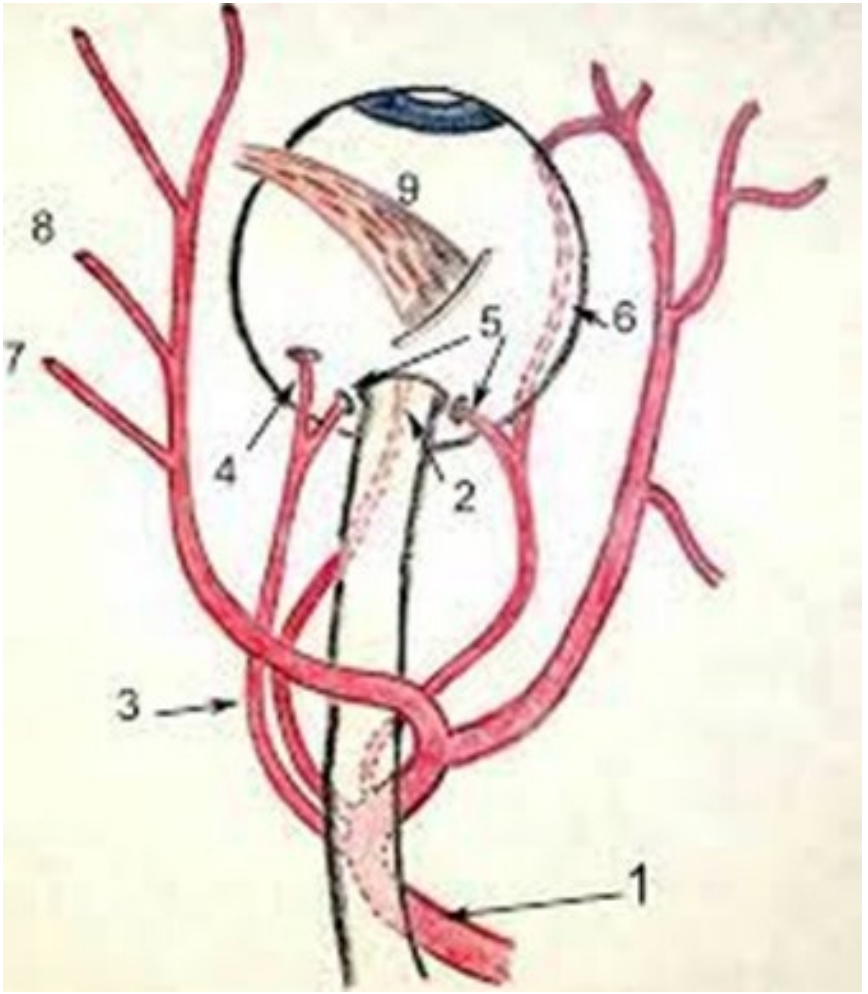
Lacrimal artery: runs from the ophthalmic artery along the lateral rectus muscle to supply the lacrimal gland, conjunctiva and eyelids

Blood is returned from the orbits via the ***superior*** and ***inferior ophthalmic veins***.

Most of the **veins of the eye** accompany the arteries and drain into ***the cavernous sinus*** by means of ***the superior ophthalmic veins***.

Inferior ophthalmic veins open into ***the pterygoid plexus,*** from there blood flows into the ***retromandibular vein*** via ***the maxillary veins***.

The central vein of the retina may join the ophthalmic vein or enter the cavernous sinus directly.



Blood vessels of the nose

Branches of facial artery supplying the vestibule of the nasal cavity. The human nose is well vascularized with arteries and veins.

Two principal sources of arterial supply to the nose exist:

I) branches of the ***internal carotid artery***: the branch of ***the anterior ethmoid artery*** and the branch of ***the posterior ethmoid artery*** which derive from the ophthalmic artery;

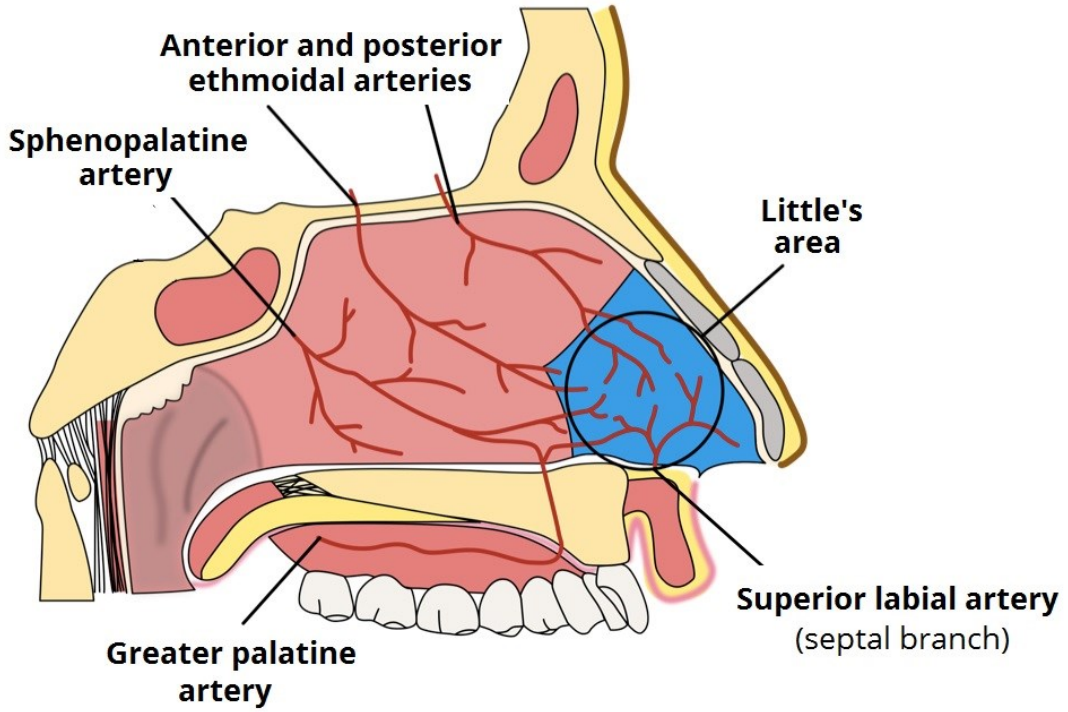
II) branches of the ***external carotid artery***: ***the sphenopalatine artery***, ***greater palatine artery, superior labial artery*** and ***angular artery.***

Blood supply to the nasal cavity

Blood supply comes from branches of both the ***internal*** and ***external carotid arteries***, including branches of the ***facial artery*** and ***maxillary arteries***.

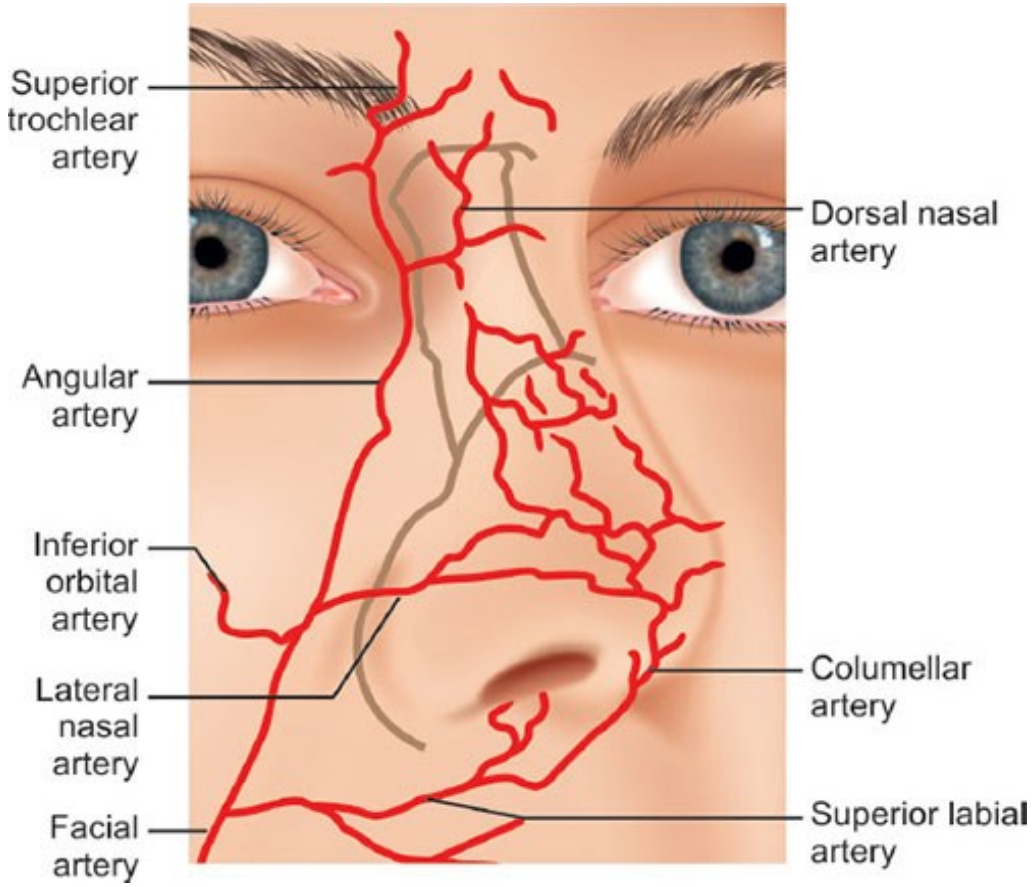
The named arteries of the nose are:

- ***Sphenopalatine*** and ***greater palatine arteries***, branches of the maxillary artery.
- ***Ethmoidal arteries***, branches of the ophthalmic artery.



Arteries of the external nose

The ***external nose*** is supplied with blood by the ***facial artery*** (branch of the ECA), which becomes the ***angular artery*** that courses over the superomedial aspect of the nose.
The dorsal region of the nose is supplied with blood by branches of the ***maxillary artery*** (infraorbital artery, branch of the ECA) and ***ophthalmic arteries*** (branch of the ICA).



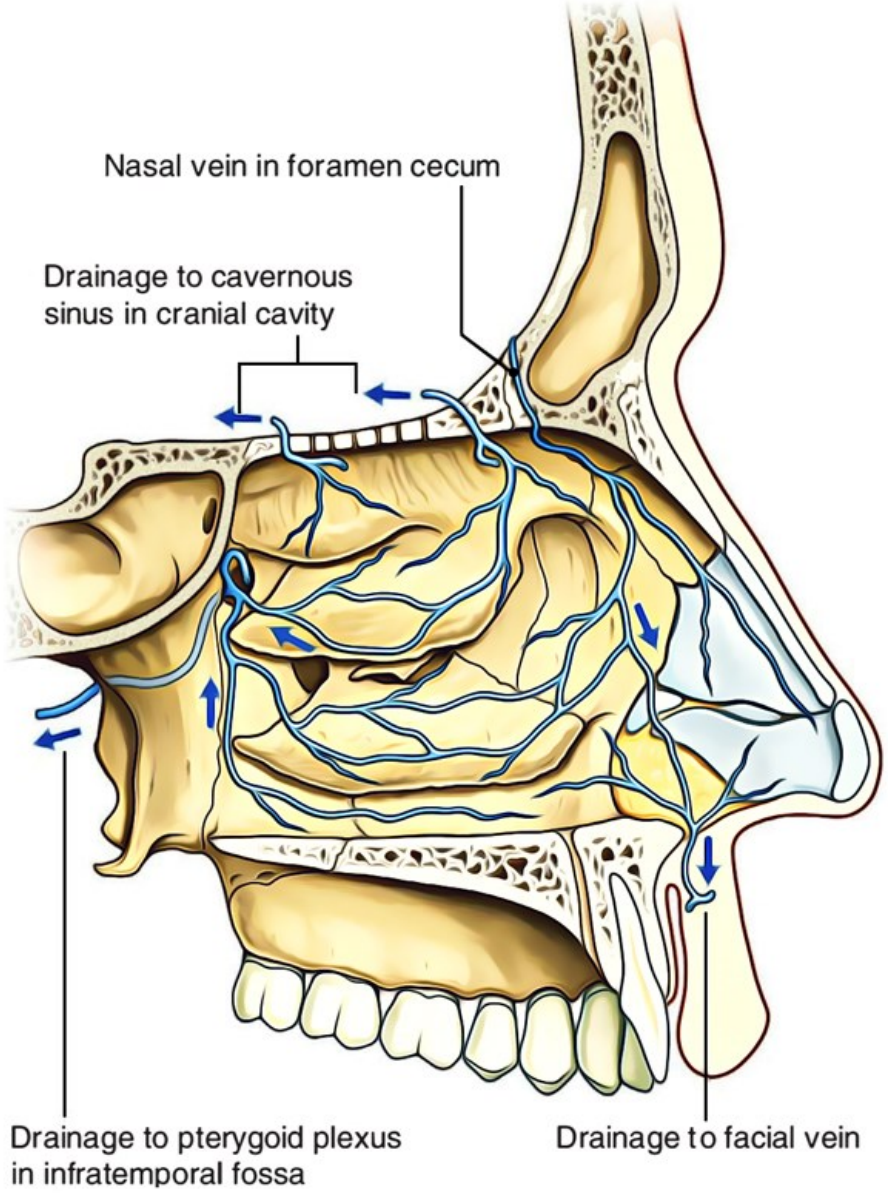
The **lateral nasal wall** is supplied with blood by ***the sphenopalatine artery*** (from behind and below) and by ***the anterior ethmoid artery*** and ***posterior ethmoid artery*** (from above and behind).

The **nasal septum** also is supplied with blood by ***the sphenopalatine artery,*** and by ***the anterior and posterior ethmoid arteries***, with the additional circulatory contributions of the ***superior labial artery*** and ***greater palatine artery.***

These vascular sources supply to the nasal cavity, converge in the ***Kiesselbach plexus*** (***the Little area***), which is a region in the anteroinferior third of the nasal septum, (in front and below).

Furthermore, the **nasal vein** generally follows the arterial pattern of nasal vascularization.

The ***nasal veins are biologically significant,*** because they have no vessel valves, and because of their direct, circulatory communication to the cavernous sinus, which makes possible the potential ***intracranial spread of bacterial infection of the nose.***



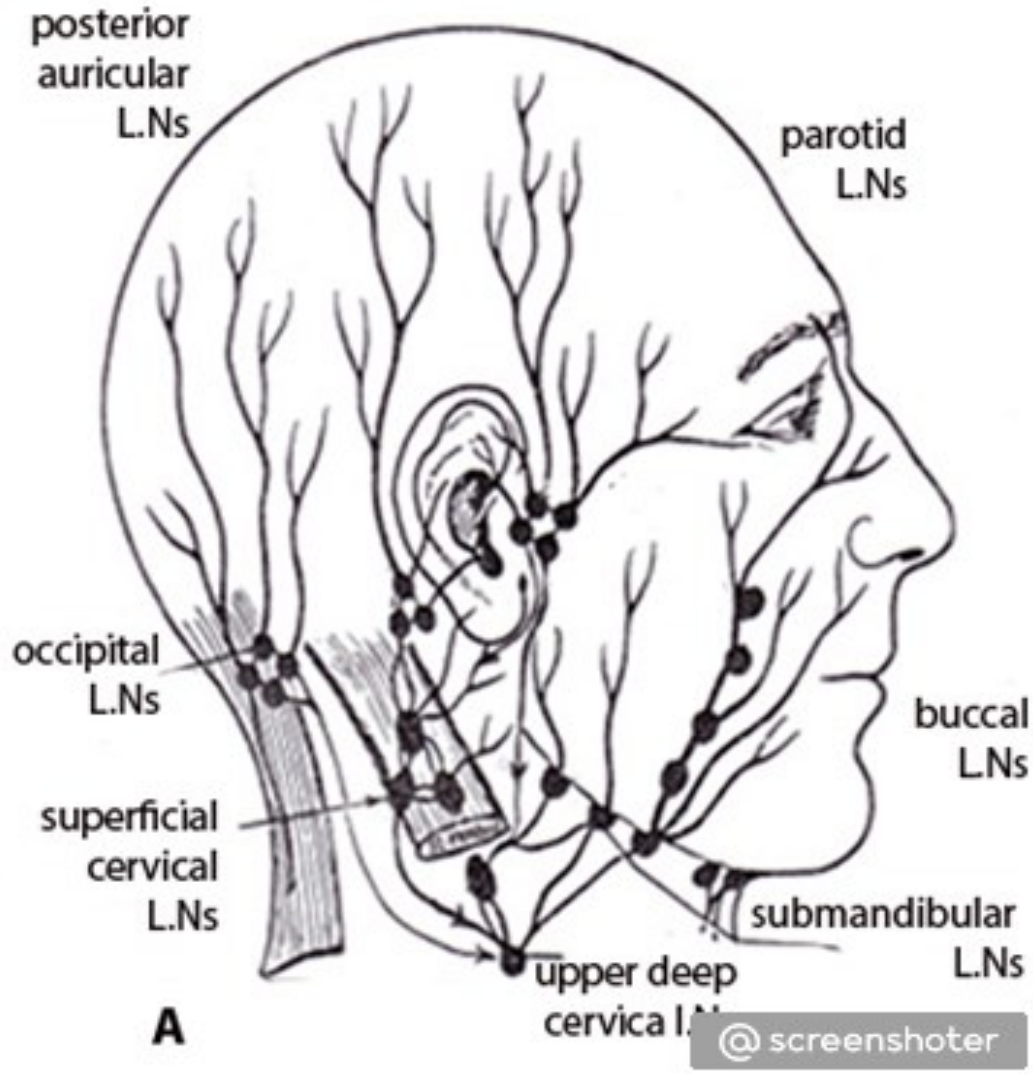
https://www.earthslab.com/anatomy/nasal-cavity/

Ways of lymph drainage of the head and neck

There are ***four groups*** of lymph nodes in the region of the head and neck.

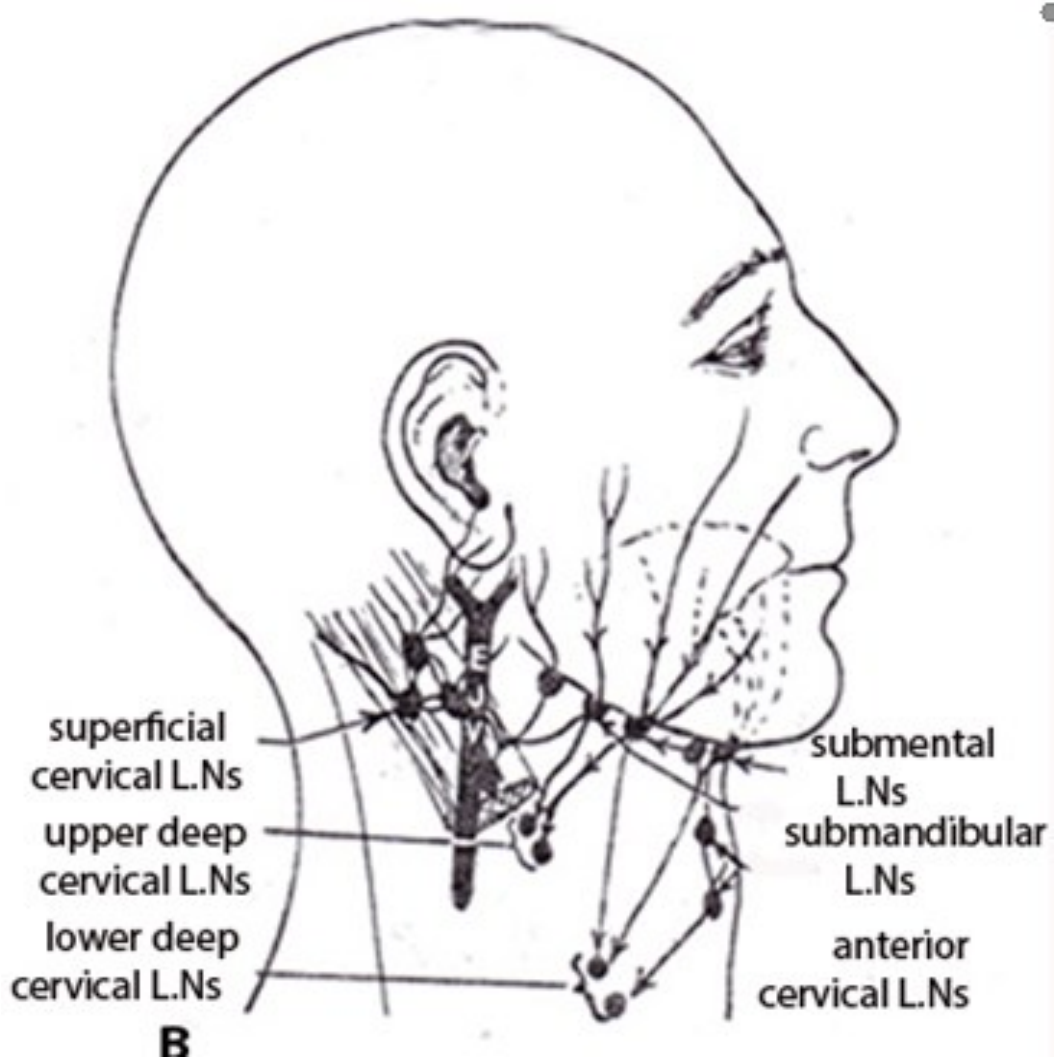
A.Superficial circular lymph nodes of the head

Lymph nodes	Site	Area drained	Efferent lymphatics pass to nodes
Occipital	Along the posterior occipital a., at the apex of posterior triangle of the neck	* posterior part of the scalp; * posterior region of the neck	**Superior deep cervical**
Posterior auricular	Along the posterior auricular a.	* posterior part of the scalp; *external ear	**Superior deep cervical**
Parotid	At the parotid and embedded inside it	* temporal region, * external ear; * superior part of the face and eyelids; *gums	**Superior deep cervical** **Superficial cervical**
Buccal	**Along the facial artery, on the buccinator m.**	***cheeks;** ***lips**	**Submandibular**



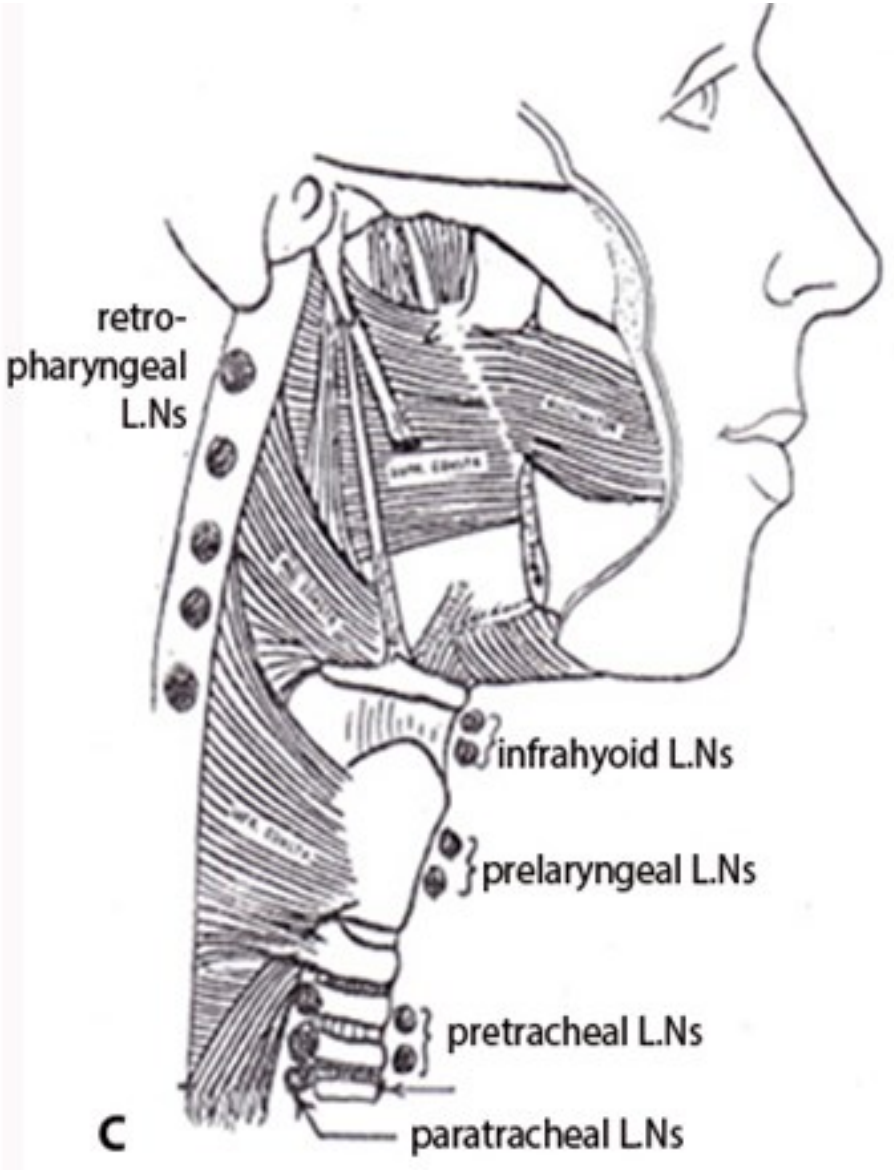
B. **Superficial circular lymph nodes of the neck**

Lymph nodes	Site	Area drained	Efferent lymphatics pass to nodes
Submental	Submental triangle on the mylohyoid m.	*top of the tongue; *floor of the mouth	* submandibular; * deep inferior cervical
Submandibular	Submandibular triangle between the submandibular gland and mandible	*cheeks, lips, nose ; * floor of the mouth; * lateral parts of the tongue	* deep superior cervical; * deep inferior cervical
Anterior cervical	Along the anterior jugular vein and suprasternal region	* anterior region of the neck under the hyoid bone	* pretracheal; * deep superior cervical
Superficial cervical	**Along the external jugular vein on the sternocleidomastoid m.**	***lobulus of auricle and external auditory meatus; * parotid gland**	* deep superior and inferior cervical



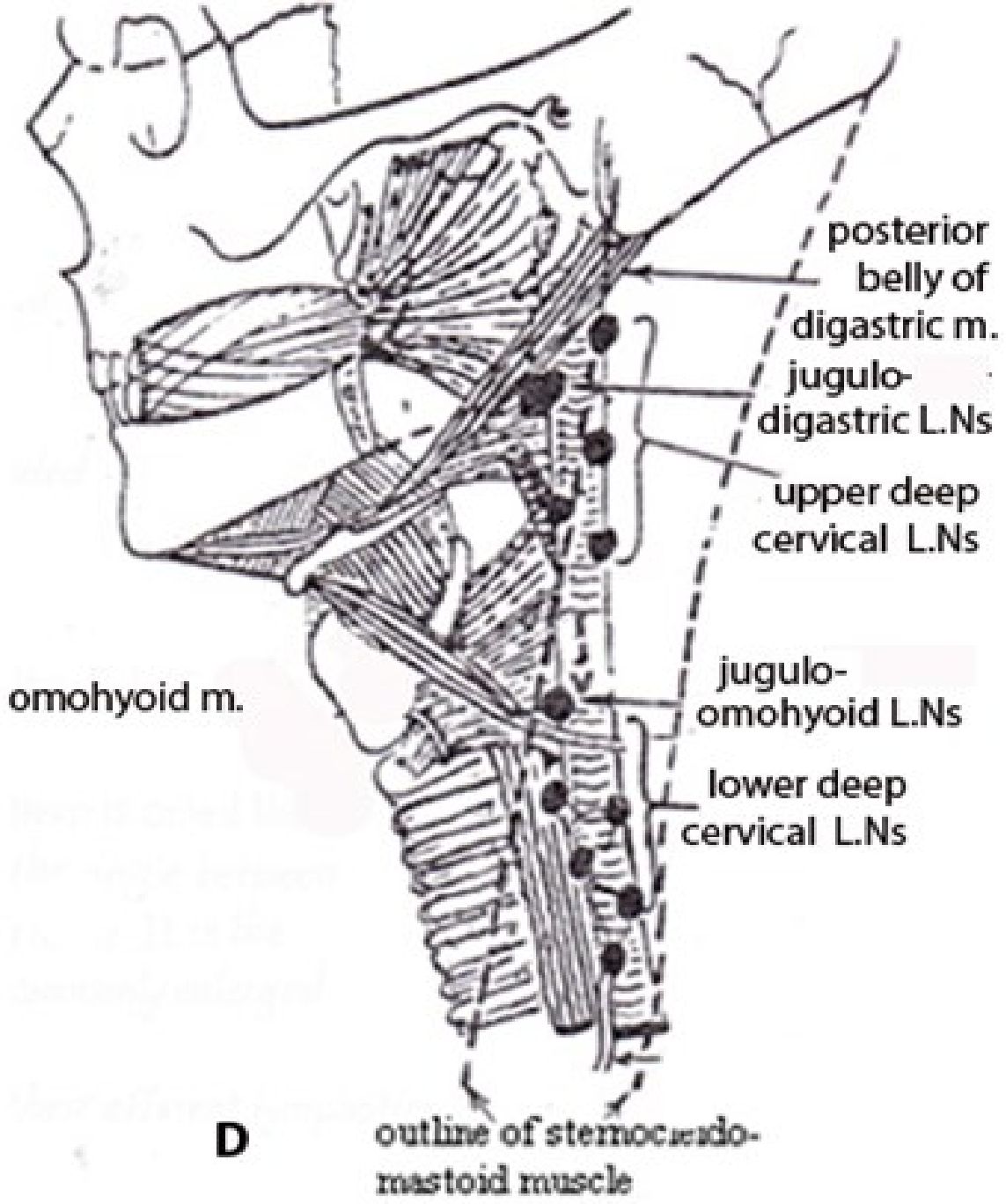
C. Deep circular lymph nodes of the head and neck

Lymph nodes	Site	Area drained	Efferent lymphatics pass to nodes
Retro-pharyngeal	*behind the pharynx, in front of theprevertebral fascia	* nasopharynx; * paranasal sinuses; * Eustachian tube	**deep superior cervical**
Paratracheal	*along the trachea and oesophagus	*pharynx, larynx; *trachea and oesophagus; *thyroid gland	**deep superior and inferior cervical**
Infrahyoid **Prelaryngeal** **Pretracheal**	*** in front of thyrohyoid membrane;** *** in front of the larynx;** ***along the inferior thyroid veins**	***larynx**	**deep superior and inferior cervical**



D. Deep vertical lymph nodes of the neck

- They are located along the internal jugular vein,
- ***Two subgroups*** are distinguished: ***superior*** and ***inferior***,
- Efferent lymph vessels of the ***superior group*** drain into the ***inferior group***,
- Efferent lymph vessels of the inferior lymph nodes form the ***jugular lymph trunk*** which opens into the ***thoracic lymph duct*** /on the left/ and ***right lymph duct*** /on the right/.



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