Blood Supply of BRAIN (arteries)

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Anatomical variants: see p. A201 >>

Syndromes of vascular territories: see p. Vas3 >>

- there are no end-arteries in brain, but precapillary anastomoses are insufficient in cases of occlusion – brain arteries act as end-arteries.
- extracranial arteries have structure of elastic or muscular arteries; intracranial arteries have no external elastic lamina (feature of muscular arteries) and there is no vasa vasorum.

Cerebral blood vessel innervation:

Motor innervation (mainly to large arteries):
- sympathetic (neurons in superior cervical ganglia) – norepinephrine, neuropeptide Y.
- parasympathetic (neurons in sphenopalatine ganglia) – acetylcholine, VIP, PHM-27.

Sensory innervation (to more distal arteries); neurons in trigeminal ganglia – contain substance P, neuropeptide A, CGPR.

Touching / pulling on cerebral vessels causes pain!

Aortic Arch
**Branching Patterns**

The most common (≈70-80%) aortic arch branching pattern:

The second most common pattern (13%; 25% blacks, 8% whites) - erroneously referred to as “bovine arch” - common origin for innominate and left CCA:

The third most common pattern (9%; 10% blacks, 5% whites) - also erroneously referred to as “bovine arch” - left CCA originates from innominate artery:
For bovine arch vessels, one needs Sims catheter to cannulate innominate artery due to acute angle.

The left CCA and left SCA share common origin (a "left brachiocephalic trunk") in 1-2%. The left VA originates directly from the AA-not the left SCA-in 0.5-1% of cases.

**True bovine arch** found in cattle - single great vessel (brachiocephalic trunk) originates from aortic arch and splits into bilateral subclavian arteries and bicarotid trunk:
For type II-III arches, one needs angled Sims catheter to cannulate innominate artery due to acute angle.

**ANOMALIES**

The most common congenital arch anomaly—seen in 0.5-1.0% of cases—is aberrant right subclavian. Here the right SCA is last-not first-branch to arise from the AA. Occasionally the aberrant right SCA arises from a dilated, diverticulum-like structure (Kommerell diverticulum). An aberrant right SCA is not associated with congenital heart disease.

Other important anomalies include a right AA with mirror image branching, which is strongly associated with cyanotic congenital heart disease (98% prevalence).

Two anomalies that are rarely associated with congenital heart disease include a right AA with aberrant left SCA and a double aortic arch (DAA). In a DAA, each arch gives rise to a ventral carotid and a dorsal subclavian artery (symmetric “four-artery” sign).

**COMMON CAROTID ARTERY (CCA)**

- right CCA is first main branch of **innominate artery (brachiocephalic trunk)**.
- left CCA is second main branch of aortic arch.
- CCA runs within fascial plane, carotid sheath, lateral to vertebral column.
- CCA bifurcates at C3-4 or C4-5 level (upper level of thyroid cartilage).

**EXTERNAL CAROTID ARTERY (ECA)**

- supplies most **extracranial head and neck structures** (except orbits) + important contribution to supply of meninges!

Branches (in order) – SAL FOP MS:

1. Superior thyroid
2. Ascending pharyngeal
3. Lingual
4. Facial
5. Occipital
6. Posterior auricular
7. Maxillary
8. Superficial temporal
BLOOD SUPPLY OF BRAIN (arteries)

- Superficial temporal a.
- Middle meningeal a.
- Maxillary a.
- Posterior auricular a.
- Inferior alveolar a.
- Occipital a.
- Facial a.
- External carotid a.

- Accessory meningeal
- Middle meningeal

- Anterior tympanic
- Deep auricular
- Superficial temporal artery

- Maxillary
- External carotid
- Inferior alveolar

- Masseter
- Pterygoid

- Maxillary artery
- Inferior alveolar artery
- Mandibular foramen
- Mental artery
Blood Supply of Brain (arteries)

Maxillary artery:
SUBCLAVIAN ARTERY

Branches (in order):
1. Vertebral
2. Thyrocerical trunk
3. Internal thoracic (mammary)
4. Costocervical trunk
5. Descending scapular
- continues as axillary artery
ANTERIOR circulation (INTERNAL CAROTID system)

**INTERNAL CAROTID ARTERY (ICA)**

- prasideda nuo A. CAROTIS COMMUNIS C₃-₄ aukštyje* (cart. thyroidea viršutinės kraštaso, 3 cm diegus ant mandibulo kampą); at CCA bifurcation, ICA lies usually (90%) posterior and lateral to ECA.
  *may be as rostral as C₁ or as caudal as T₂
- **carotid bulb** is the most proximal aspect of the cervical ICA and is seen as a prominent focal dilatation with a cross-sectional area nearly twice as large as that of the distal ICA.
- Slipstreams from the CCA strike the CCA bifurcation and divide, with approximately 30% of the flow passing into the ECA. The majority of the flow enters the anterior part of the proximal ICA and continues cephalad.
- A smaller slipstream actually reverses direction in the bulb, temporarily slowing and stagnating before reestablishing normal antegrade laminar flow with the central slipstream.
- **ends** in middle cranial fossa (in **vallecular region**) when A. CEREBRI ANT. branches off; ICA continuation — A. CEREBRI MEDIA.

Divided into four parts: relationship with cranial nerves – see p. Eye15 >>

1. **Cervical part** – has no branches.

2. **Petrous part** (lies in osseous carotid canal → courses over foramen lacerum) – šakos:
   - CAROTICOTYMPANIC arteries → tympanic cavity

3. **Cavernous part** (lies in cavernous sinus) – course almost horizontal, next to medial wall of cavernous sinus; branches:
   1) MENINGOHYPOHYSEAL TRUNK see below >>
   2) McConnell's capsular arteries see below >>

4. **Cerebral (s. suprACLINOID) part** (pierces Dura Mater [ICA was extradural until now!] medial to anterior clinoid process); branches (OSPA):
   1) **OPHTHALMIC** artery (arises at level of anterior clinoid process; traverses optic canal) → orbita, CN2, eyeball, etc
      Numerous anastomoses between **internal** and **external carotid arteries**
      involve ophthalmic artery (most important - **facial artery** and **superficial temporal artery** - anastomose with supratrochlear branches of ophthalmic artery)
   2) **SUPERIOR HYPOPHYSEAL** artery (usually as several vessels) → median eminence
   3) PComA
   4) **ANTERIOR CHOROIDAL** artery
   5) ICA terminus divides (lateral to optic chiasm) into ACA and MCA

   “**Carotid siphon**” = CAVERNOUS part + CEREBRAL part
Surgically ICA has 7 parts (C5 is between dural distal and proximal rings)
McConnell’s capsular arteries (first described in 1953) - medial branches of the cavernous ICA:

1) **anterior capsular artery** - originates from the **anteromedial aspect** of the anterior loop of the cavernous ICA; reaches the suprasellar space; important role in the vascularization of tuberculum sellae meningiomas

2) **inferior capsular artery** - originates from the **inferomedial aspect** of the cavernous ICA, at its horizontal portion; reaches the floor and anterior wall of the sella where it anastomoses to branches of the inferior hypophyseal artery.

- importance in the surgical treatment of tuberculum sellae and planum sphenoidale tumors through an endoscopic endonasal approach.

**Meningohypophyseal Trunk (MHT)**

- originates from proximal cavernous segment of ICA
- may come off as single trunk or collection of vessels.
- supplies: pituitary, portions of clivus, CN III, IV, V, and VI, tentorium cerebelli and adjacent dura.
- branches of MHT (A): *Variation is the rule!!!*
B. **LATERAL TENTORIAL artery** - along lateral edge of tentorium; in hemodynamic balance with petrosquamosal branches (L) of MMA and Occipital Artery (O)

C. **MARGINAL TENTORIAL artery** (s. BERNASCONI-CASSINARI artery) - along free edge of tentorium; feeds tentorial notch meningiomas.

D. **INFERIOR HYPOPHYSEAL artery**, branching into:
   E: Hypophyseal branches → posterior and parts of anterior pituitary
   F: Inferior clival branch - descending along dorsum sella where it is in hemodynamic balance with ascending clival braches (K) of Ascending Pharyngeal

G. **LATERAL CLIVAL artery** - branching into:
   H: Lateral branch - runs alongside Superior Petrosal Sinus
   I: Medial branch - runs alongside Inferior Petrosal Sinus and is in balance with Jugular branches (J) of Ascending Pharyngeal

Checkered vessel connecting MHT with Basilar Artery (P) is Trigeminal Artery. Middle Meningeal Artery (M)
**POSTERIOR circulation (VERTEBROBASILAR system)**

- supplies ≈ 20% of total brain.
Blood Supply of Brain (arteries)

- Anterior cerebral artery (ACA)
- Anterior communicating artery (ACOMA)
- Ophthalmic artery
- Middle cerebral artery (MCA)
- Internal carotid artery (ICA)
- Posterior communicating artery (PCOMA)
- Posterior cerebral artery (PCA)
- Basilar artery (BA)
- Labyrinthine artery
- Vertebral artery (VA)
- Anterior spinal artery
- Posterior spinal artery

Additional labels:
- Superior cerebellar artery (SCA)
- Anterior inferior cerebellar artery (AICA)
- Posterior inferior cerebellar artery (PICA)
FIGURE 15-9. Ventral aspect of the brain stem and cerebrum with the arteries in place. ACA = anterior cerebral artery; AICA = anterior inferior cerebellar artery; AComA = anterior communicating artery; BA = basilar artery; IAA = internal auditory artery; ICA = internal carotid artery; MCA = middle cerebral artery; PCA = posterior cerebral artery; PICA = posterior inferior cerebellar artery; PComA = posterior communicating artery; SCA = superior cerebellar artery; VA = vertebral artery; VSA = ventral spinal artery.
BLOOD SUPPLY OF BRAIN (arteries)

- Thalamogeniculate artery
- Quadrigeminal artery

Anatomical structures labeled include:
- Choroid plexus, third ventricle
- Posterior choroidal arteries
- Lateral geniculate body
- Medial geniculate body
- Superior colliculus
- Crus cerebri
- Brachium of inferior colliculus
- Inferior colliculus
- Trochlear nerve
- Superior cerebellar peduncle
- Anterior medullary velum
- Middle cerebellar peduncle
- Vestibulocochlear nerve
- Facial nerve
- Posterior inferior cerebellar artery
- Choroid plexus, fourth ventricle
- Restiform body
- Cuneate tubercle
- Gracile tubercle
- Posterior spinal artery
- Vertebral artery

Other structures:
- Formic
- Optic tract
- Posterior cerebral artery
- Mammillary body
- Internal carotid artery
- Oculomotor nerve
- Superior cerebellar artery
- Trigeminal nerve
- Motor root
- Sensory root
- Basilar artery
- Anterior inferior cerebellar artery
- Labyrinthine artery
- Abducens nerve
- Glossopharyngeal nerve
- Vagus nerve
- Hypoglossal nerve
- Accessory nerve
- Posterior inferior cerebellar artery
- Anterior spinal artery
BLOOD SUPPLY OF BRAIN (arteries)

Vessels

- Thalamogeniculate arteries
- Medial and lateral posterior choroidal arteries
- Quadrigeminal artery
- Superior cerebellar artery:
  - Medial branch
  - Lateral branch
- Anterior inferior cerebellar artery
- Posterior inferior cerebellar artery
- Posterior spinal artery

Structures

- Choroid plexus, third ventricle
- Pineal
- Habenula
- Medial thalamus
- Superior colliculus
- Lateral thalamus
- Pulvinar nucleus
- Internal capsule
- Choroid plexus, lateral ventricle
- Lateral geniculate body
- Medial geniculate body
- Brachium of inferior colliculus
- Crus cerebri
- Trochlear nerve (IV)
- Inferior colliculus
- Superior cerebellar peduncle
- Anterior medullary velum
- Facial colliculus
- Vestibular area
- Interior cerebellar peduncle
- Middle cerebellar peduncle
- Choroid plexus, fourth ventricle
- Hypoglossal trigone
- Glossopharyngeal nerve (IX)
- Vagus nerve (X)
- Accessory nerve (XI)
- Hypoglossal body
- Vagal trigone
- Trigeminal tubercle (tuber cinereum)
- Cuneate tubercle
- Gracile tubercle
- Gracile fasciculus
- Cuneate fasciculus
**Vertebral Artery (VA)**

- Vertebral arteries are commonly unequal in size:
  - left VA is as large or larger in caliber than right VA in ≈ 75% cases.
  - when one of arteries is very small, it frequently supplies only ipsilateral PICA territory (called “PICA termination of vertebral artery”).

- Kyla per foramina transversaria C1-6, pakeliui atiduoda RR. SPINALES.

- Ties atlas daro sudėtingą 90° vingį, praduria MEMBRANA ATLANTOOCIPITALIS POST. ir DURA MATER, per foramen magnum patenka į kaukolę.
  - portion of VA that loops behind atlantoaxial joint is prone to mechanical trauma, and head rotation to 60° may cause narrowing of ipsilateral VA.
Four segments:

V1 segment - from VA origin (at subclavian artery) to entry into costotransverse foramen of C6.

V2 segment - within transverse foramina C2-6;
- makes anastomoses with ascending cervical arteries, thyrocervical arteries, occipital artery (branch of external carotid artery).

V3 segment - tortuous course between C2 to suboccipital triangle between atlas and occiput, where it is covered by atlanto-occipital membrane.

V4 segment - intracranial portion (after VA has pierced dura mater to enter foramen magnum):
- eina medulla oblongata anterolateraliniu paviršiumi.
- šakos:
  1) paramedian arteries* – daugybinės, smulkios
  2) POSTERIOR SPINAL arteries*
  3) ANTERIOR SPINAL artery* – neporinė (formed by anastomosis of two branches of vertebral arteries). see A203 p.
  4) POSTERIOR INFERIOR CEREBELLAR artery (PICA)* – largest branch → lateral medulla, posteroinferior surface of cerebellum
  5) ties pontomedullarine jungtimi abi AA. VERTEBRALES susijungia į BASILAR artery.

* maitina medulla oblongata

VA course and normal variations:
Blood Supply of Brain (Arteries)

**Basilar Artery (BA)**
- kyla pons pilveliu (per clivus).
- branches:
  1) pontine arteries – daugybinės:
     - RR. MEDIALES (s. PARAMEDIAN) – wedge of pons on either side of midline
     - RR. LATERALES (s. SHORT CIRCUMFERENTIAL) – lateral 2/3 of pons, middle &
       superior cerebellar peduncles
  2) **Anterior Inferior Cerebellar Artery (AICA)** – atskyla PONS lygyje
     surgical anatomy of AICA – see Onc62 p.
  3) labyrinthine (s. internal auditory) artery (kartais atsišakoja nuo AICA) – cochlea,
     labyrinth, part of CN7
  4) **Superior Cerebellar Artery (SCA)** – atskyla MIDBRAIN lygyje
  5) ties interpeduncular fossa (just above tip of dorsum sellae) A. BASILARIS skyla į dvi AA.
     CEREBRI POST. (PCA)

**Embriologiškai** PCA vystosi iš PComA, o ne iš BA, todėl
segmentas, jungiantis PCA su BA yra tikroji “communicating
artery” (kai kurie autoriai vadina “basilar communicating artery”)

- *bifurcation of basilar arteries* can appear either V-shaped (caudal fusion of
  posterior cerebral arteries)* or T-shaped (cranial fusion of cerebral arteries).
  *frequently associated with basilar tip aneurysms

- tarp SCA ir PCA praeina CN3, tarp AICA ir A. LABYRINTHI praeina CN6 – aneurizmos gali spausti
  atitinkamus nervus.
Posterior (vertebrobasilar) circulation  
VENTRAL VIEW:

- PCA
- Pontine (paramedian) aa. of BA
- SCA
- AICA
- PICA

Paramedian aa. of VA and a. spinalis ant.

a. spinalis post.
BRAIN STEM (kraniotaka)

(in cross sections)

medulla-cervical junction

A. SPINALIS POST.

A. SPINALIS ANT. (paramedian branches)

A. VERTEBRALIS (paramedian branches)

A. CEREBELLARIS INF. POST. (PICA)

caudal medulla oblongata

A. BASILARIS (paramedian branches)

middle medulla oblongata

A. BASILARIS (short circumferential branches)

pons

A. CEREBELLARIS INF. ANT. (AICA) in

A. BASILARIS (long circumferential branches)

midbrain

A. CEREBELLARIS SUP. in

A. BASILARIS (long circumferential branches)
CIRCULUS ARTERIOSUS CEREBRI (CIRCLE of WILLIS)

- keturios pagrindinės smegenų arterijos jeina į kaukolę (AA. VERTEBRALES – per foramen magnum, AA. CAROTICI INTERNAE – per canalis caroticus) ir, susirinkę ventraliniame smegenų paviršiuje, susijungia į CIRCULUS ARTERIOSUS CEREBRI – pentagon in area of optic chiasm, hypothalamus, and interpeduncular fossa.
- > 50% normal individuals have incomplete circle of Willis:
  a) hypoplasia / atresia of one or both PComA (22%)
  b) hypoplasia / atresia of one A₁ segment (10%).
  c) hypoplasia* / absence** of P₁ segment (20-30%) – in such patients PComA cannot be sacrificed during surgery.
  *fetal origin of PCA with thick PComA / **fetal PCA.

REGIONAL circulation

From arterial circle of Willis and principal cerebral arteries (ACA, MCA, PCA, AComA, PComA) two types of branches arise:

1. Cortical branches – pass in pia mater to regions of cortex:
   - undergo considerable branching – form freely anastomosing superficial plexuses.
   - smaller arteries (arising from these plexuses) penetrate cortex at nearly right angles.

2. Central branches (arise from arterial circle of Willis and proximal portions of principal cerebral arteries) – supply deep structures (diencephalon, basal nuclei, internal capsule):
   - Anteromediial central arteries – branches of A₁ and AComA.
     - supply anteromedial thalamus & corpus striatum, anterior hypothalamus.
   - Anterolateral central (s. lenticuloostriate, lateral striate) arteries – branches of M₁; čia priklauso ir viena A₂ šaka – medial striate (s. recurrent of Heubner) artery.
     - jeina per ANTERIOR PERFORATED SUBSTANCE.
     - supply:
       1) capsula interna – viršutinė dalį ir didesnę anterior limb dalį!
       2) didžiąją corpus striatum dalį (įšsk. globus pallidus ir tail of nucl. caudatus)!
   - Posteromediial central arteries – branches of P₁ and PComA.
     - supply:
       1) medial part of pedunculus cerebri – P₁ branches entering POSTERIOR PERFORATED SUBSTANCE (interpeduncular fossa dugnas).
       2) posterior hypothalamus
Blood supply of brain (arteries)

3) Anteromedial thalamus (thalamo-perforating arteries)

Artery of Percheron (posterior thalamo-subthalamo-paramedian artery) - single small artery from right or left P1 (or top of BA) - divides in subthalamus to bilaterally supply inferomedial and anterior thalamus and subthalamus.

Posterolateral central arteries – branches of P2.
- Supplied posterolateral thalamus (thalamogeniculate arteries).

Anterior choroidal artery (AChA) (branch of supraclinoid ICA) – long subarachnoidal course and relatively small caliber.
- Proximal (cisternal) segment - passes caudally across and below optic tract (medial to uncus), and then laterally (through crural cistern and around cerebral peduncle) → enters inferior horn of lateral ventricle through choroidal fissure of temporal lobe.
- Distal (plexal) segment - goes posteriorly in cleft of temporal horn; terminates near lateral geniculate body (or may extend around pulvinar).
  - Rich anastomoses between AChA and lateral posterior choroidal artery, PComA, PCA - occlusion is usually tolerated fairly well!! (internal capsule infarct occurs in 15%)
- Supplies:
  1) choroidal plexus of temporal horn
  2) capsula interna – apatine posterior limb daļi ir visa retrolenticular limb.
  3) medial globus pallidus*, tail of nucl. caudatus
  4) piriform cortex and uncus, hippocampus and dentate gyri, amygdala
  5) ventrolateral thalamus, lateral geniculate body, optic tract and origin of optic radiations.

* ligation of AChA was utilized in treatment of Parkinsonism sometimes without ill effect

Posterior choroidal arteries (PChA) (branches of P2):
- Medial PChA – choroidal plexus of 3rd ventricle, dorsomedial thalamus;
- Lateral PChA – choroidal plexus of lateral ventricle.
CEREBRAL HEMISPHERES

Both receive three long circumferential arteries:

- cerebrum – ACA, MCA, PCA
- cerebellum – SCA, AICA, PICA

To remember distribution of ACA / MCA / PCA, pakanka atsiminti tik MCA baseina:

![Diagram of Blood Supply of Brain](image_url)
• trys smegenu poliai gauna kraują iš trijų baseinų:
  frontal pole – ACA
  temporal pole – MCA
  occipital pole – PCA
• junction zones between arterial territories are sites of “WATERSHED” infarcts that occur in hypotension / anoxia.
BLOOD SUPPLY OF BRAIN (arteries)

- Parietooccipital artery
- Calcarine artery
- Superior cerebellar artery
- Anterior inferior & Posterior inferior cerebellar arteries
- Pericallosal artery
- Callosomarginal artery
- Frontopolar artery
- Orbital artery
- Anterior cerebral artery
- Basilar artery
- Vertebral artery
- Rolandic artery
- Anterior parietal artery
- Posterior parietal artery
- Angular artery
- Posterior cerebral artery
- Superior cerebellar artery
- Anterior temporal artery
- Posterior temporal artery
BLOOD SUPPLY OF BRAIN (arteries)
Blood supply of brain (arteries):

Arterial areas (in coronal section):

Ant. choroidal artery

Anterior cerebral artery (ACA)

Middle cerebral artery (MCA)

Posterior cerebral artery (PCA)

Anterolateral central arteries (s. lenticulostriate aa.)
B. Plane through - head of caudate nucleus (HC), putamen (P), amygdala (A), tail of caudate nucleus (TC), hypothalamus, temporal lobe, midbrain, cerebellum.

C. Plane through frontal horn of lateral ventricle (FLV), head of caudate nucleus (HC), anterior and posterior limbs of internal capsule (AIC, PIC), putamen (P), globus pallidus (GP), thalamus (T), optic radiations (OR), posterior horn of lateral ventricle (PLV).

D. Plane through centrum semiovale.
**ANTERIOR CEREBRAL ARtery (ACA)**

- arises below *ANTERIOR PERFORATED SUBSTANCE*.
- passes anteromedially, dorsal to optic nerve.
- susijungia su kita puse (per AComA).
- runs superiorly, loops around genu corporis callosi.
- eina atgal in interhemispheric fissure.
- skirstoma į dvi dalis:
  - **A₁ segment (precommunicating)** – horizontal; gives anteromedial central arteries.
  - **A₂ segment (postcommunicating)** – branches:
    1) medial striate (s. recurrent of Heubner) artery
    2) medial frontobasal (s. medial orbitofrontal, orbital) artery
    - lateral frontobasal artery is MCA branch
    3) frontopolar artery
    4) pericallosal artery* – eina corpus callosum dorsaliniu paviršiumi.
    5) callosomarginal artery* – lies in cingulate sulcus.
    *some authors call them **A₃ segment**

- **AZYGOS ACA** – when both hemispheres are fed by one side ACA (has branch to opposite side) and opposite proximal A2 is missing.
**Middle Cerebral Artery (MCA)**

- tai ICA tiesioginis tęsinys (arises below medial part of anterior perforated substance).
- passes laterally over anterior perforated substance to enter lateral cerebral fossa between temporal lobe and insula.
- then passes posteriorly in depth of lateral cerebral fissure.
- skirstoma į dvi dalis:
  - **M1 segment (sphenoidal part)** – gives anterolateral central arteries.
  - **M2 segment: insular part** – branches to insular cortex; cortical (s. terminal) part – branches to facies lateralis of cerebral hemisphere - superior and inferior divisions*:
    1) lateral frontobasal artery (s. orbitofrontal artery)
    2) artery of precentral sulcus (s. pre-Rolandic artery)
    3) artery of central sulcus (s. Rolandic artery)
    4) anterior & posterior temporal arteries - feed cortical surface below fissure
    5) anterior & posterior parietal arteries - feed cortical surface above fissure
    6) branch to angular gyrus – terminal branch.

*considerable variability in parietal lobe supply between two divisions (in ≈ 2/3 individuals inferior division supplies region above angular gyrus)
BLOOD SUPPLY OF BRAIN (arteries)
**Posterior Cerebral Artery (PCA)**

- arises as terminal bifurcation of Basilar Artery ventral to midbrain.
  - 70-75% people - both PCAs derive primarily from BA;
  - 20% - one PCA is supplied by ICA and other by BA.
  - 5-10% - both PCAs derive primarily from ICA (“fetal arrangement”);
    - N.B. **20-30% individuals have hypoplasia of at least one P₁ segment** (i.e. fetal origin of PCA from ICA).

- passes laterally around cerebral peduncle → passes dorsal to tentorium cerebelli, on medial-inferior surface (of temporal and occipital lobes) → branches into:
  - anterior division - inferior surface of temporal lobe (terminal branches anastomose with MCA branches);
  - posterior division - occipital lobe (terminal branches anastomose with both ACA and MCA).

**Skirstoma į keturias dalis** - Zeal and Rhoton classification:
**P1 segment (precommunicating)** – branches:
1) posteromedial central arteries (incl. thalamoperforating artery)
2) short circumferential arteries
3) collicular artery
- cerebral peduncle forms medial border of P1 segment, whereas oculomotor nerve runs laterally and inferiorly to P1 segment.
- fetal configuration of PCA with dominant PComA and rudimentary P1 segment has been observed in 16-22% of cases in cadaveric studies

**P2 segment (postcommunicating, s. ambient)** – branches:
1) posterolateral central arteries (incl. thalamogeniculate artery)
2) posterior choroidal artery
3) small circumferential branches - course around midbrain → lateral cerebral peduncles, medial lemniscus, midbrain tegmentum, superior colliculi, lateral geniculate body

**P3 segment (lateral occipital artery)**
- P3 segment starts at posterior edge of lateral midbrain and ends at origins of parieto-occipital and calcarine arteries.
- **collicular point** - point at which left and right PCAs are closest to each other.

**P4 segment (medial occipital artery) = cortical (s. terminal) part:**
- gausios vardinės šakos (svarbiausia – calcarine branch, parieto-occipital artery).
CHOROID PLEXUSES
- anterior and posterior (medial and lateral) choroidal arteries serve plexuses of lateral and third ventricles.
- choroid plexus in fourth ventricle and clump of choroid plexus protruding out of foramen of Luschka are served by PICA and AICA, respectively.

**BASAL STRUCTURES**

**INTERNAL CAPSULE**

**Anterior limb**, whole **upper part** – anterolateral central arteries (medial striate a. – rostromedial part of anterior limb).

**Genu** – tiesioginės ICA šakelės.

Lower part of **posterior limb, retrolenticular limb** – anterior choroidal artery.
Fig. 13-8. Diagram of the blood supply of the internal capsule and corpus striatum. The putamen and globus pallidus are shown rotated ventrally away from their normal position adjacent to the internal capsule. Regions supplied by branches of the middle and anterior cerebral arteries are shown in red; portions of the internal capsule and corpus striatum supplied by the anterior choroidal artery are in yellow. Direct branches of the internal carotid artery supply the genu of the internal capsule.
CORPUS STRIATUM

Globus pallidus – pagrinde anterior choroidal artery.

Putamen, nucl. caudatus (įšsk. tail) – anterolateral central (s. lenticulostriate) arteries. 

medial striate a. – rostromedial part of head of nucl. caudatus.

Tail of nucl. caudatus – anterior choroidal artery.
**THALAMUS**

- **Anteromedial** part – posteromedial central (s. thalamo-perforating) arteries ← PCA, PComA
- **Posterolateral** part – posterolateral central (s. thalamogeniculate) arteries ← PCA
- ** Ventrolateral** part – anterior choroidal artery ← ICA
- **Dorsomedial** part – posterior medial choroidal artery ← PCA

**HYPOTHALAMUS**

- **Anterior** part – anteromedial central arteries.
- **Posterior** part – posteromedial central arteries.
ANASTOMOSES / COLLATERALS

EXTRACRANIAL–INTRACRANIAL anastomoses

Anastomoses between **ECA** and **ICA**:
- 1) facial artery
- 2) middle meningeal artery - ophthalmic artery
- 3) superficial temporal artery
- 4) artery of foramen rotundum
- 5) artery of pterygoid canal (from a. maxillaris or a. palatina major) - carotid siphon

Anastomoses between **ECA** and **posterior circulation**:
- 1) occipital artery
- 2) ascending pharyngeal artery - vertebral artery

Numerous anastomotic channels exist between all extracranial branches of the ECAs (except the superior thyroid and lingual arteries) and intracranial branches of the ICAs or musculospinal branches of VAs:

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**ECA-ICA-VA ANASTOMOSES**

**Ascending Pharyngeal Artery**
- Tympanic branch → petrous ICA
- Several rami → cavernous ICA
- Odontoid arch/musculospinal branches → VA

**Facial Artery**
- OA → intracranial ICA

**Occipital Artery**
- Transosseous perforators to VA
- To muscular branches of VAs

**Posterior Auricular Artery**
- Stylo mastoid branch to petrous ICA

**Superficial Temporal Artery**
- Transosseous perforators → anterior falx artery → OA

**Maxillary Artery**
- Vidian artery → petrous ICA
- MMA → inferolateral trunk → cavernous ICA
- Artery of foramen rotundum → inferolateral trunk → cavernous ICA
- Middle/recurrent meningeal arteries → OA → intracranial ICA
- Deep temporal → OA → intracranial ICA

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**INTRACRANIAL anastomoses**
1. **Circle of Willis**  *see above*
2. **Other carotico-vertebral anastomoses**
3. **Leptomeningeal (pial, cortical, border-zone, watershed) collaterals** - end-to-end anastomoses between distal branches of intracerebral arteries (ACA-MCA-PCA) - collateral flow across vascular watershed zones.
   - highly variable.
   - great importance in acute occlusion.

<table>
<thead>
<tr>
<th>Artery</th>
<th>Origin</th>
<th>Termination</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pro-atlantal intersegmental</td>
<td>Cervical ICA</td>
<td>VA</td>
<td>Via foramen magnum</td>
</tr>
<tr>
<td>Hypoglossal</td>
<td>ICA</td>
<td>VA</td>
<td>Via hypoglossal canal</td>
</tr>
<tr>
<td>Otic (exceptionally rare)</td>
<td>Petrous ICA</td>
<td>BA</td>
<td>Via internal auditory meatus</td>
</tr>
<tr>
<td>Trigeminal (&lt; 1% normal people)</td>
<td>Precavernous ICA</td>
<td>BA</td>
<td>Transdural</td>
</tr>
</tbody>
</table>

A. **Leptomeningeal** anastomotic channels.

B. Anastomotic channels **through orbit** (branches of external carotid artery → a. ophthalmica).

C. Extracranial anastomotic channels: muscular branches (of ascending cervical arteries and occipital artery) → distal vertebral artery.

**BIBLIOGRAPHY** for ch. “Vascular” → follow this LINK >>

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