Blood Supply of BRAIN (arteries)

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AORTIC ARCH ...................................................................................................................... 1
Branching patterns .................................................................................................................. 2
Types ...................................................................................................................................... 4
Anomalies ................................................................................................................................. 4
Common carotid artery (CCA) ................................................................................................. 4
External carotid artery (ECA) .................................................................................................. 4
Subclavian artery ..................................................................................................................... 8
ANTERIOR CIRCULATION (INTERNAL CAROTID SYSTEM) .................................................. 10
Internal carotid artery (ICA) ................................................................................................... 10
POSTERIOR CIRCULATION (VERTEBROBASILAR SYSTEM) ............................................... 15
Vertebral artery (VA) ............................................................................................................. 21
Basilar artery (BA) ................................................................................................................ 23
CIRCULUS ARTERIOSUS CEREBRI (CIRCLE OF WILLIS) .................................................. 26
REGIONAL CIRCULATION .................................................................................................... 26
CEREBRAL HEMISPHERES ................................................................................................... 28
Anterior cerebral artery (ACA) .............................................................................................. 34
Middle cerebral artery (MCA) ............................................................................................... 35
Posterior cerebral artery (PCA) ............................................................................................. 37
CHOROID PLEXUSES ........................................................................................................ 39
BASAL STRUCTURES ........................................................................................................... 40
Internal Capsule .................................................................................................................... 40
Corpus striatum ...................................................................................................................... 42
Thalamus ................................................................................................................................. 43
Hypothalamus ........................................................................................................................ 43
ANASTOMOSES / COLLATERALS ....................................................................................... 44
Extracranial–intracranial anastomoses ................................................................................. 44
Intracranial anastomoses ....................................................................................................... 44
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 INNERVERATION:

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, neuropepinin A, CGPR.

Touching / pulling on cerebral vessels causes pain!

AORTIC ARCH
**BRANCHING PATTERNS**

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

![Diagram of the most common 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:

![Diagram of the second most common aortic arch branching pattern]

The third most common pattern (9%; 10% blacks, 5% whites) - *also erroneously referred to as* “bovine arch” - left CCA originates from innominate artery:

![Diagram of the third most common aortic arch branching pattern]
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)
Maxillary artery:
SUBCLAVIAN ARTERY

Branches (in order):
1. Vertebral
2. Thyrocervical 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 viršutinis kraštas, 3 cm below angle of mandible); 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: 

1. **CERVICAL PART** — has no branches.

2. **PETROUS PART** (lies in osseus 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) **MENINGOHYPOPHYSEAL 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 branches (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.
Anterior cerebral artery (ACA)
Anterior communicating artery (ACoM)
Ophthalmic artery
Middle cerebral artery (MCA)
Internal carotid artery (ICA)
Posterior communicating artery (PCoM)
Posterior cerebral artery (PCA)
Basilar artery (BA)
Labyrinthine artery
Vertebral artery (VA)
Anterior spinal artery
Posterior spinal artery
Anterior inferior cerebellar artery (AICA)
Posterior inferior cerebellar artery (PICA)
Basilic communicating artery
Superior cerebellar artery (SCA)
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; PICA = posterior cerebral artery; PCA = posterior communicating artery; SCA = superior cerebellar artery; VA = vertebral artery; VSA = ventral spinal artery.
BLOOD SUPPLY OF BRAIN (arteries)

Vessels

- Superior cerebellar artery
- Anterior inferior cerebellar artery
- Labyrinthine artery
- Posterior inferior cerebellar artery
- Posterior spinal artery
- Vertebral artery

Structures

- Olfactory tract
- Optic chiasma
- Optic nerve
- Anterior perforated substance
- Optic tract
- Mamillary body
- Infundibulum
- Crus cerebri
- Oculomotor nerve (III)
- Trochlear nerve (IV)
- Basilar pons
- Trigeminal nerve (V)
- Abducens nerve (VI)
- Facial nerve (VII)
- Middle cerebellar peduncle
- Vestibulocochlear nerve (VIII)
- Choroid plexus
- Glossopharyngeal nerve (IX)
- Vagus nerve (X)
- Accessory nerve (XI)
- Hypoglossal nerve (XII)
- Olive (inferior)
- Olivary eminence
- Cerebellum
- Pyramid

Posterior choroidal arteries
Quadrigeminal artery
BLOOD SUPPLY OF BRAIN (arteries)
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 abì AA. VERTEBRALES susijungia į BASILAR artery.

*maîtina 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

**LONG CIRCUMFERENTIAL (AICA, SCA):** → cerebellar hemispheres
- 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 (in cross sections)

- medullom-cervical junction
- caudal medulla oblongata
- middle medulla oblongata
- pons
- midbrain

**A. SPINALIS POST.**

**A. SPINALIS ANT.** (paramedian branches)

**A. VERTEBRALIS** (paramedian branches)

**A. CEREBELLARIS INF. POST.** (PICA)

**A. BASILARIS** (paramedian branches)

**A. BASILARIS** (short circumferential branches)

**A. CEREBELLARIS INF. ANT. (AICA)** in

**A. BASILARIS** (long circumferential branches)

**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 paviršiųje, 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 A<sub>1</sub> segment (10%).
  c) hypoplasia* / absence** of P<sub>1</sub> segment (20-30%) – in such patients PComA cannot be sacrificed during surgery.
* f<sub>fetal</sub> origin of PCA with thick PComA / **f<sub>fetal</sub> 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):

   **Anteromedial central arteries** – branches of A<sub>1</sub> and AComA.
   - supply anteromedial thalamus & corpus striatum, anterior hypothalamus.

   **Anterolateral central** (s. lenticulostriate, lateral striate) arteries – branches of M<sub>1</sub>; čia priklauso ir viena A<sub>2</sub> šaka – medial striate (s. recurrent of Heubner) artery.
   - įeina per **ANTERIOR PERFORATED SUBSTANCE**.
   - **supply:**
     1) **capsula interna** – viršutinę dalį ir didesnę anterior limb dalį!
     2) didžiąją corpus striatum dalį (išsk. globus pallidus ir tail of nucl. caudatus)!

   **Posteromedial central arteries** – branches of P<sub>1</sub> and PComA.
   - **supply:**
     1) medial part of pedunculus cerebri – P<sub>1</sub> branches entering **POSTERIOR PERFORATED SUBSTANCE** (interpeduncular fossa dugnas).
     2) posterior hypothalamus
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.
- supply 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 dalį ir visą 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**:

**FIGURE 15-17.** Ventral view of the circle of Willis showing the medial, lateral, and posterior perforating groups of arteries. **ACA** = anterior cerebral arteries; **AChA** = anterior choroidal artery; **ACoM A** = anterior communicating artery; **BA** = basilar artery; **ICA** = internal carotid artery; **LSAs** = lateral striate arteries; **MCA** = middle cerebral artery; **MSAs** = medial striate arteries; **PCA** = posterior cerebral artery; **PCom A** = posterior communicating artery; **PSAs** = posterior striate arteries; **RAH** = recurrent artery of Heubner; **SCA** = superior cerebellar artery.
trysmėgengū 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)
BLOOD SUPPLY OF BRAIN (arteries)
Arterial areas (in coronal section):

- Anterior choroidal artery
- Anterior lateral central arteries (s. lenticulostriate aa.)

Diagram labels:
- ACA
- MCA
- ICA
- PCA
- Anterior cerebral A.
- Middle cerebral A.
- Deep branches of middle cerebral A.
- Anterior choroidal A.
- Posterior cerebral A.
- Body of caudate
- Internal capsule
- Putamen
- Claustrum
- Globus pallidus
- Thalamus
- Red nucleus
- Uncus
- Subthalamic body
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.
  - common anatomical variation is hypo(a)plasia of A₁ - distal segments fill from other side via AComA.

  **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 dorsalinii 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)

- Putamen
- Caudate nucleus
- Internal capsule
- Globus pallidus
- Lenticulo-striate arteries
- Medial and lateral
- Cortical M3-segment
- Sylvian M2
- Horizontal M1

Central sulcus

Rolandic branches of MCA

Prerolandic branches of MCA

Orbitofrontal branches of MCA

Orbital branches of anterior cerebral artery

Middle cerebral artery (MCA) in lateral sulcus

Anterior and posterior parietal branches of MCA

Angular branches of MCA

Posterior temporal branches of MCA

Middle temporal branches of MCA

Anterior temporal branches of MCA
**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* (įšk. 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:

**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

**INTRACRANIAL anastomoses**
1. **Circle of Willis**  *see above*
2. **Other carotico-vertebral anastomoses**: 
### Blood Supply of Brain (Arteries)

<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>

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.

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][1]

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[1]: "Viktor's Notes" for the Neurosurgery Resident
Please visit website at www.NeurosurgeryResident.net