MH&NS school for mental health and neuroscience

School for Cardiovascular Diseases

Vascular supply of the brain

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MUMC+

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Content

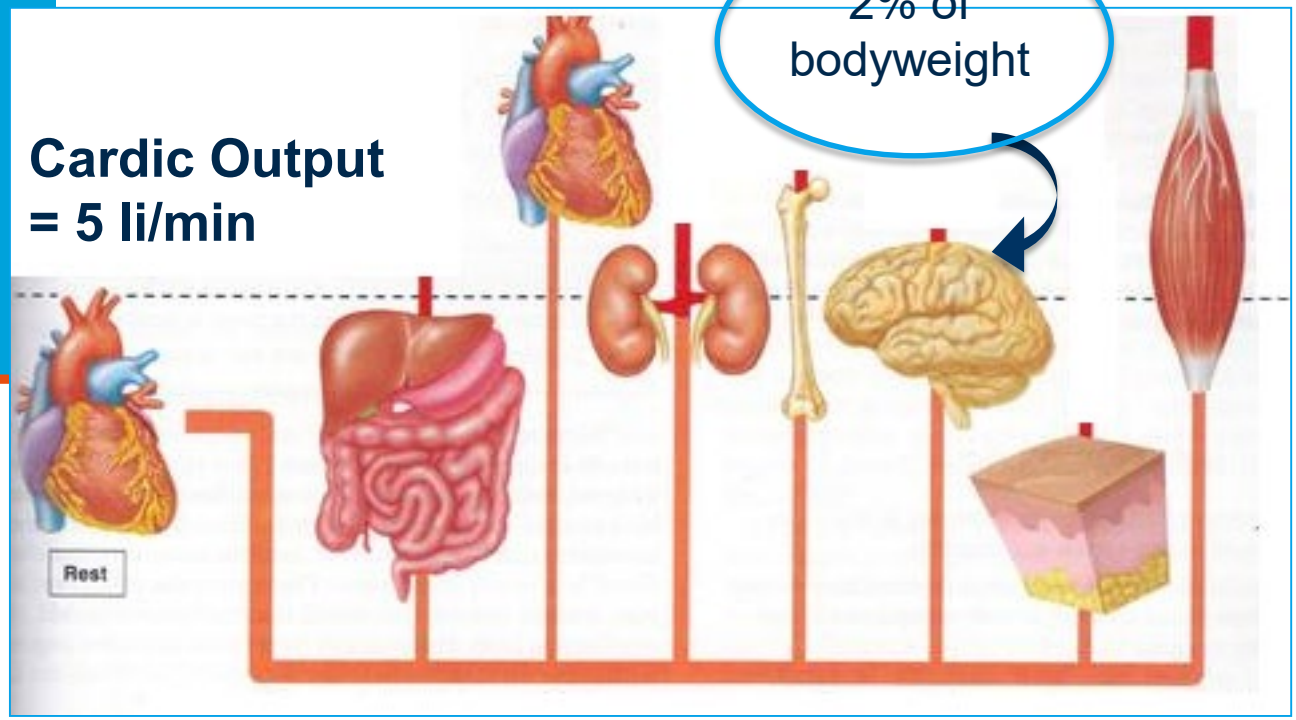
A. Arterial blood supply
B. Supply areas and Brain functions

C. Venous system

D. Disease: Stroke

Question

CBF ?



a. 0.5% of CO

b. 2% of CO

c. 5% of CO

d. 15% of CO

Our brain is very special

- Brain:
  - weight ~1500g = 2% body weight
  - CBF ~750 ml/min = 15% cardiac output

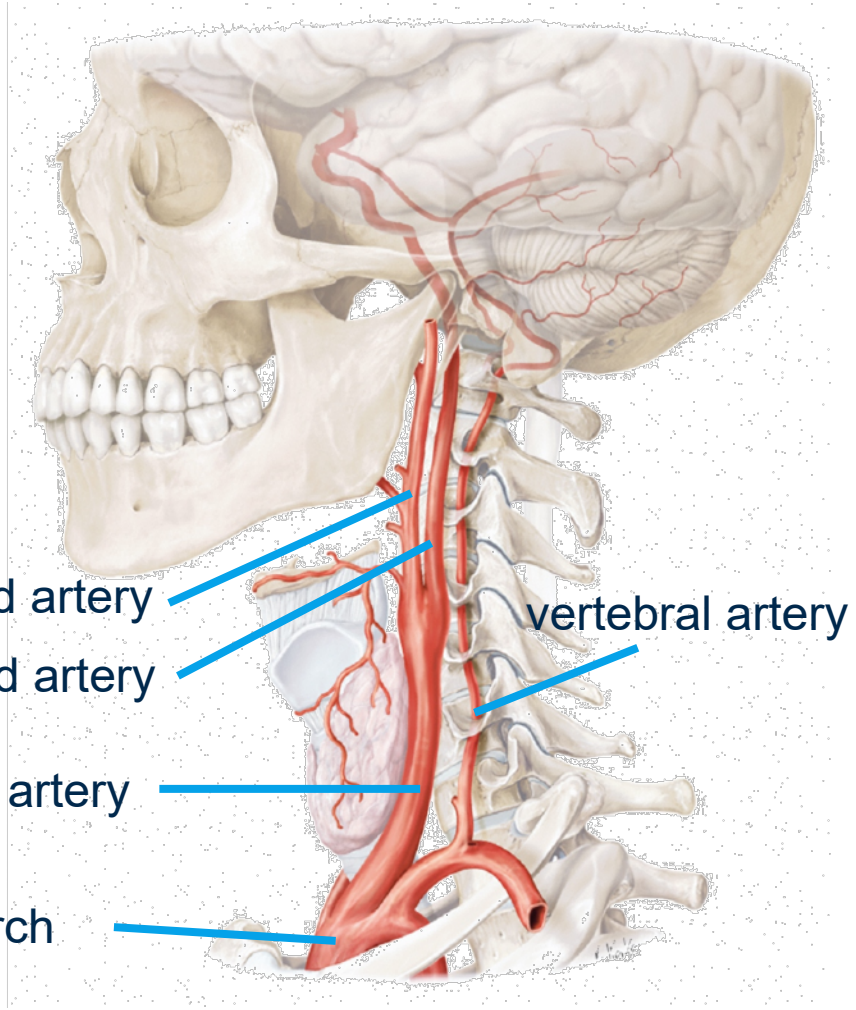
    ~50ml/100gr/min

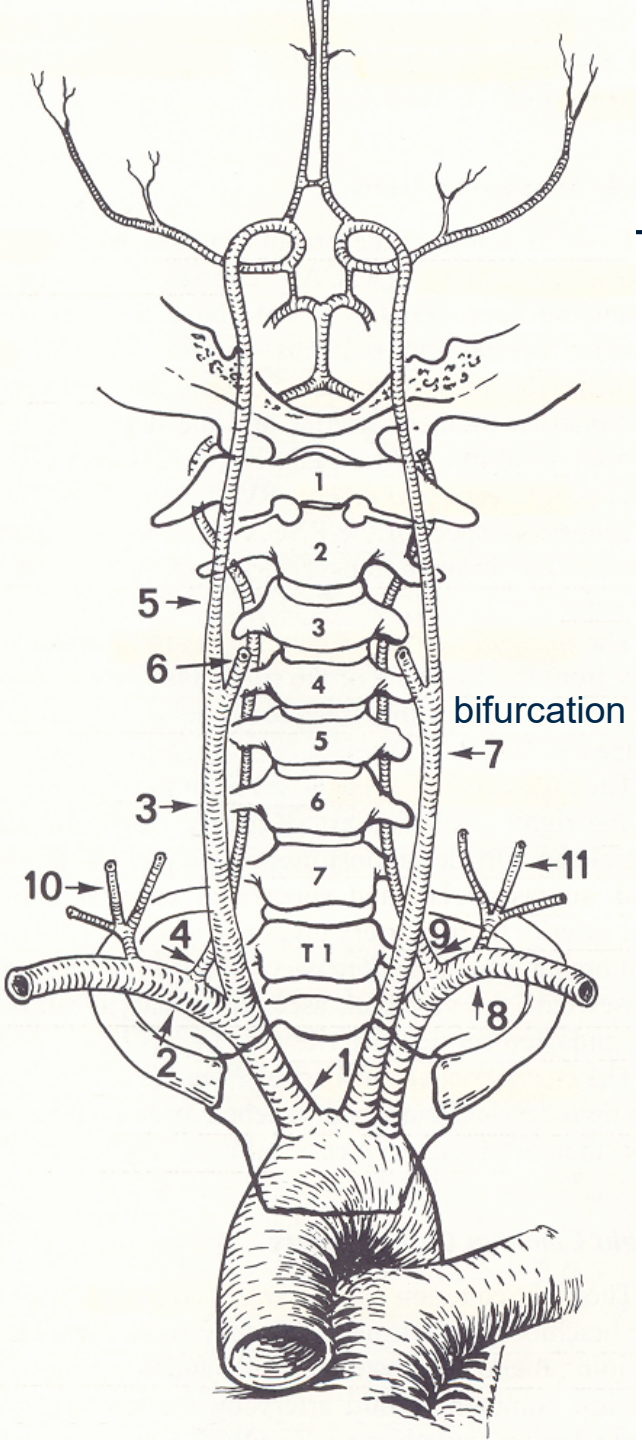
- Metabolism:
  - glucose
- No reserve or storage of oxygen and glucose
- Fully dependent on continuous blood supply

  → collateral circulation ("alternative ways")

Arterial supply - precerebral

- Common arotid arteries
  - External carotid artery
  - Internal carotid artery
- Vertebral arteries





Arterial supply

- Carotid (anterior circulation)

80%

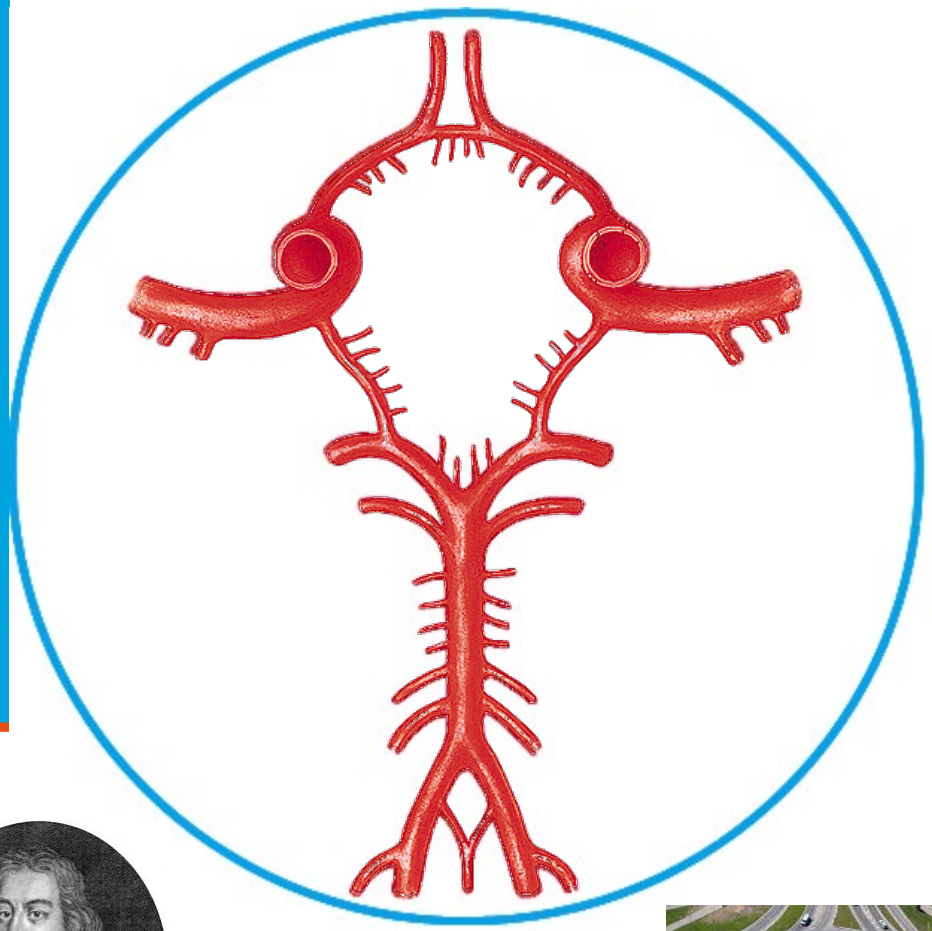
Common carotid artery→

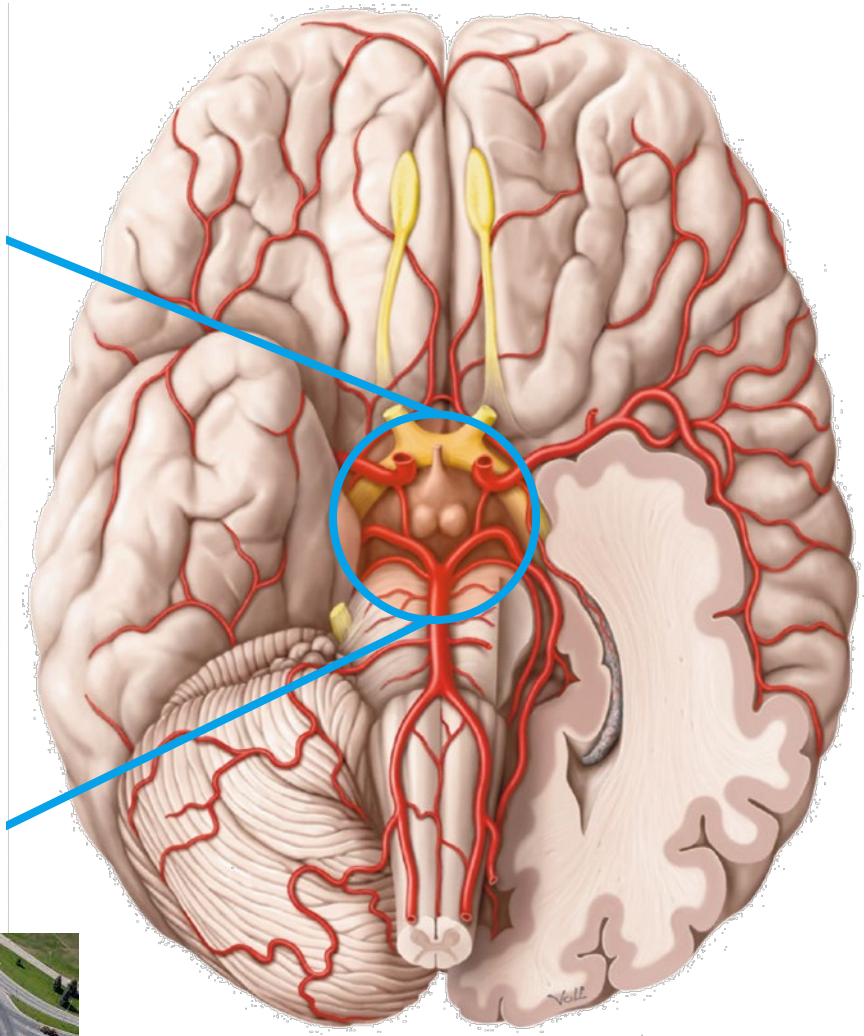
  - Internal carotid a. (ICA)→
    - Middle cerebral a. (MCA)
    - Anterior cerebral a. (ACA)

- Vertebrobasilar (posterior circulation)
  - Vertebral a. →
  - Basilar a. →
    - Posterior cerebral a. (PCA)

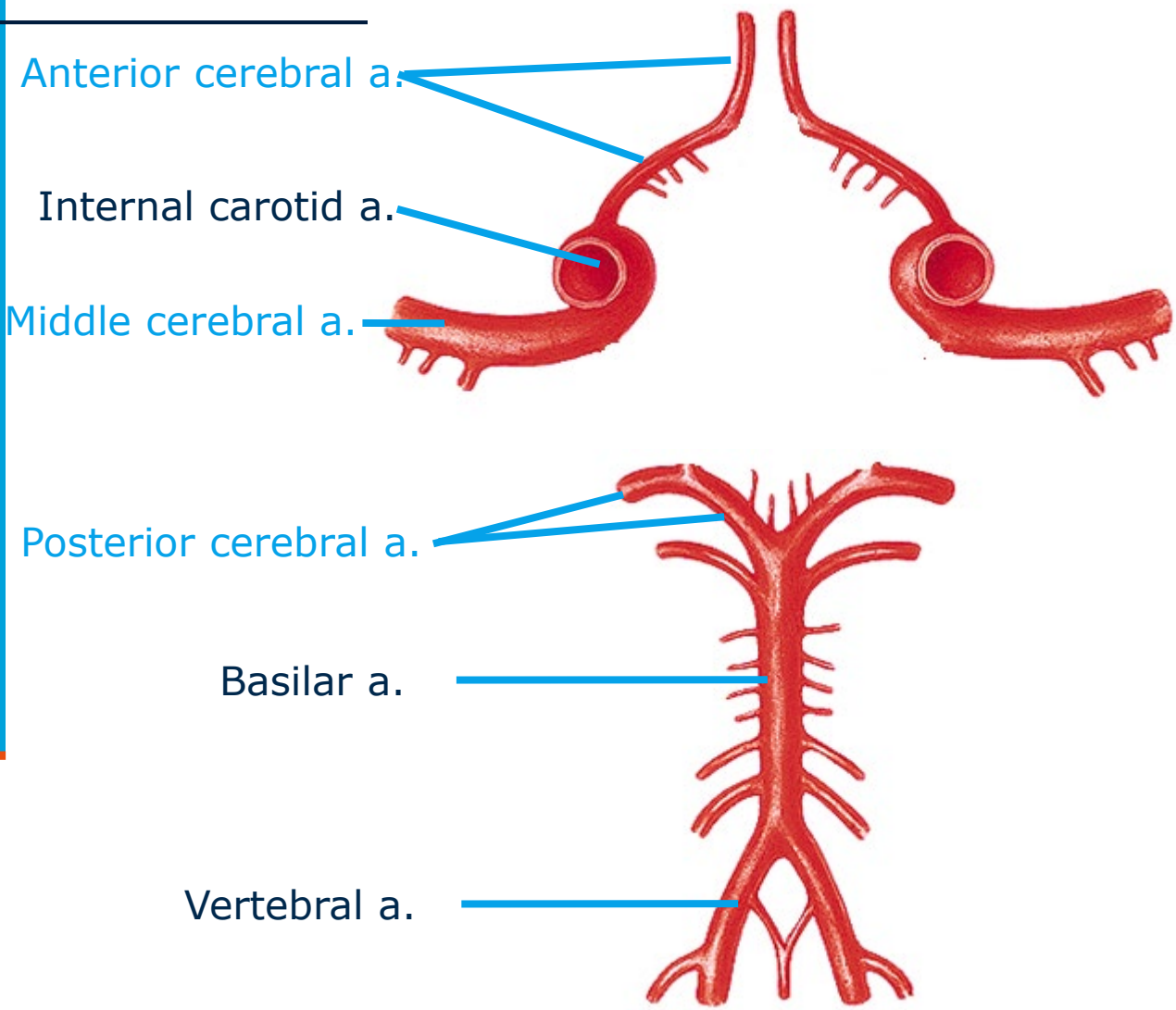
20%

Circle of Willis

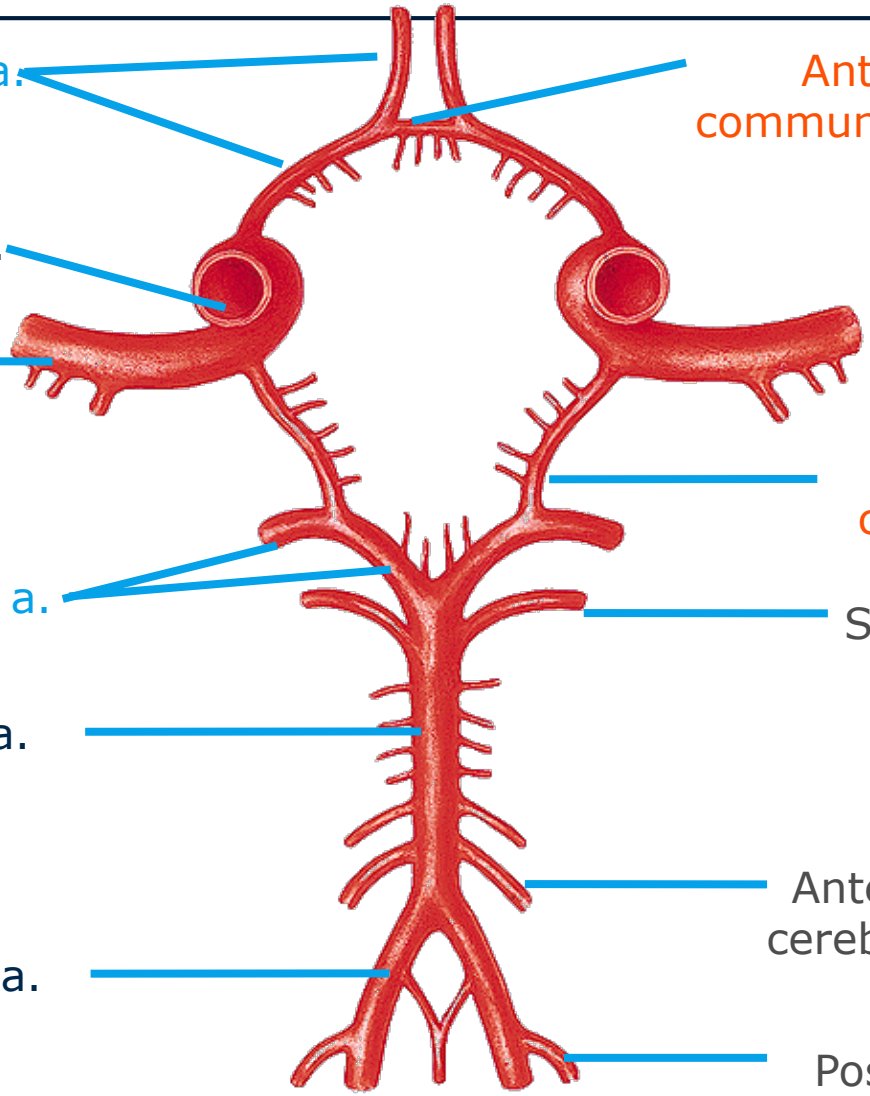




Circle of Willis



Circle of Willis



Anterior cerebral a.

Anterior communicating a.

Interbal carotid a.

Middle cerebral a.

Posterior communicating a.

Posterior cerebral a.

Superior cerebellar a.

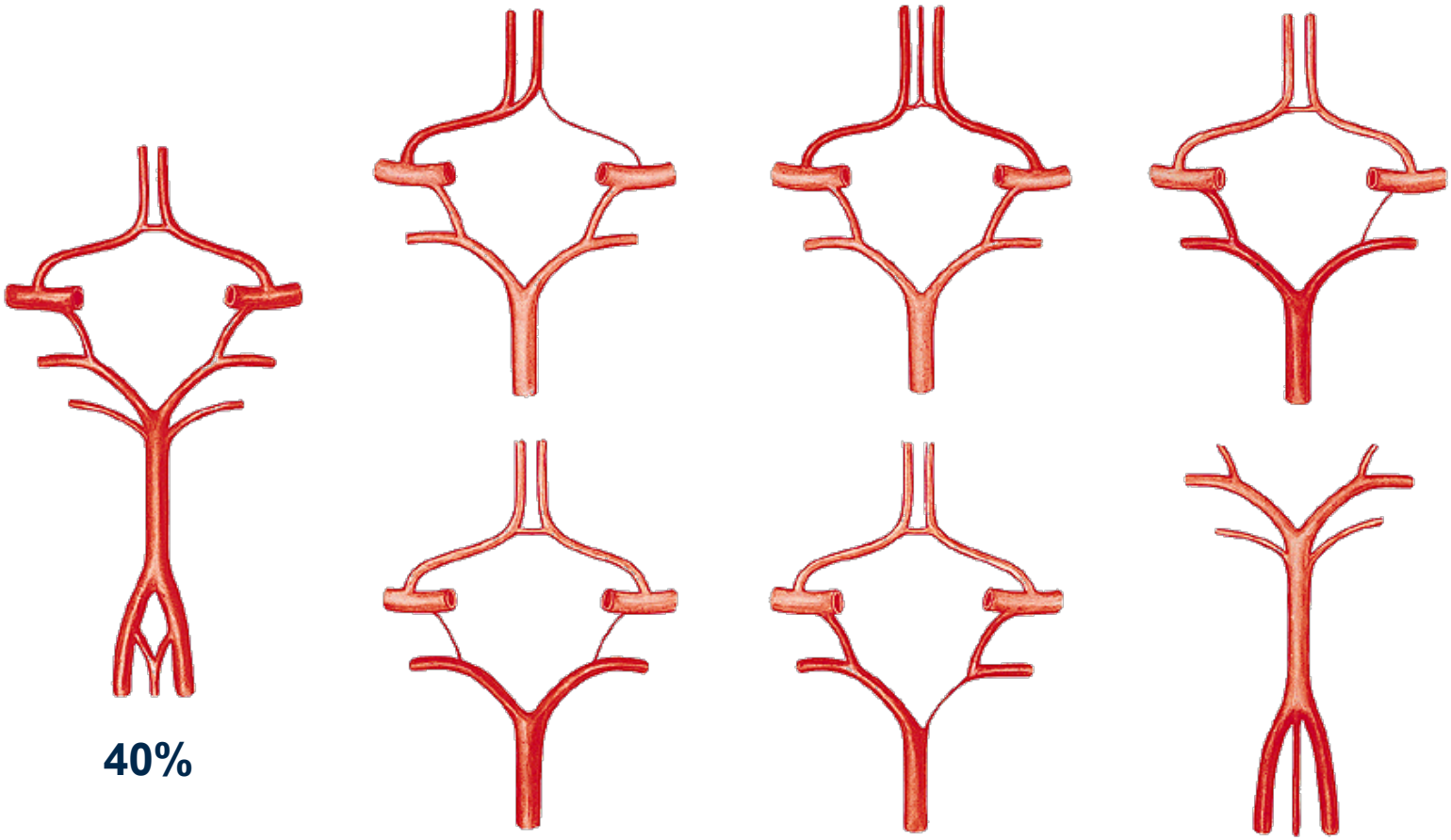
Basilar a.

Anterior inferior cerebellar a.(aica)

Vertebral a.

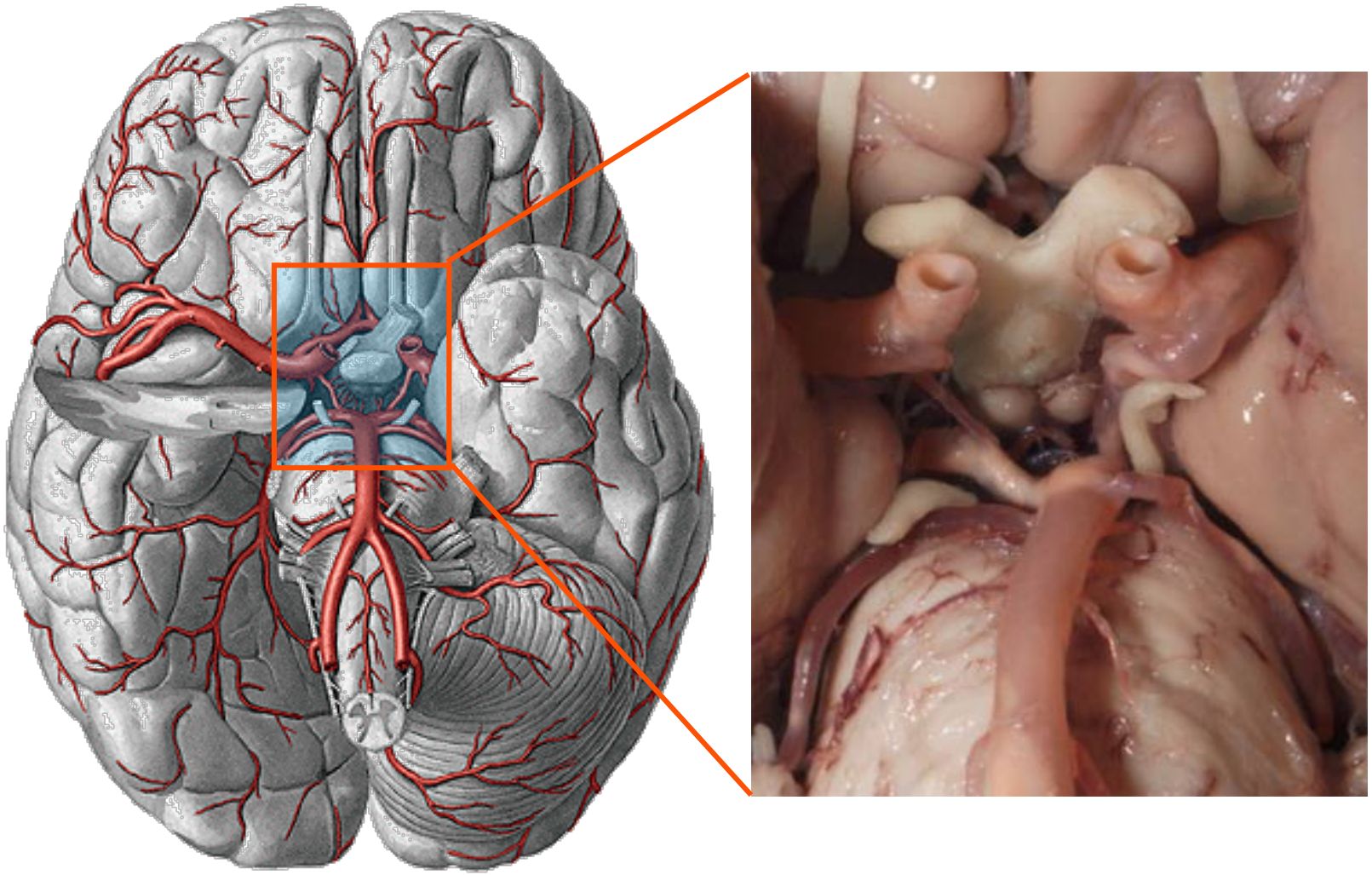
Posterior inferior cerebellar a. (pica)

Circle of Willis: variants

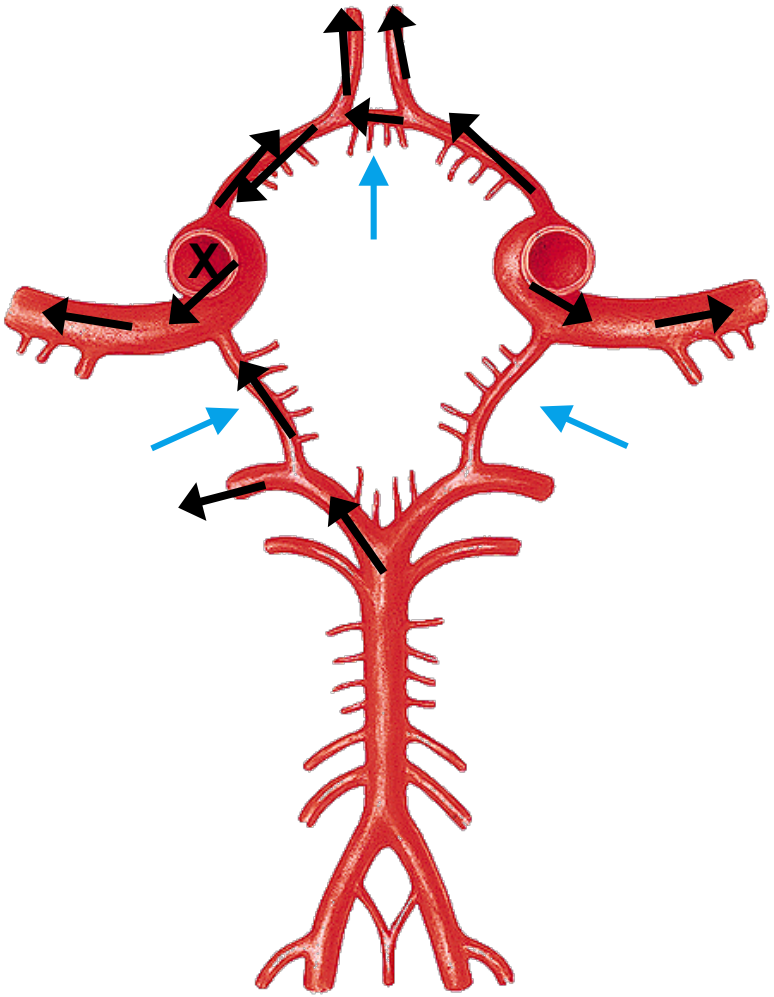


40%

Circle of Willis



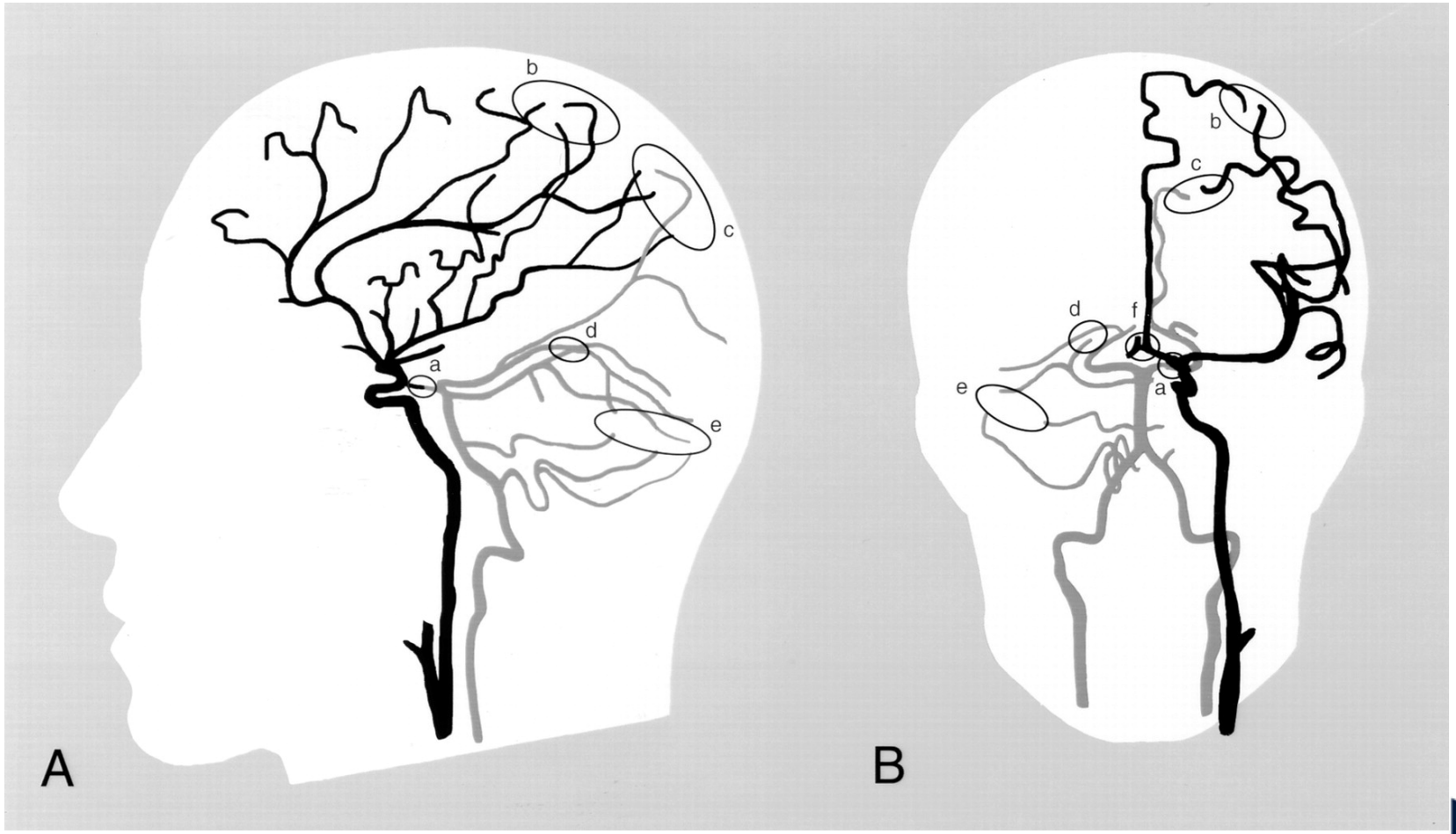
Collateral supply: circle of willis



- Carotid system left ↔ right
- Carotid ↔ Vertebrobasilar system

Collateral supply: anastomosis

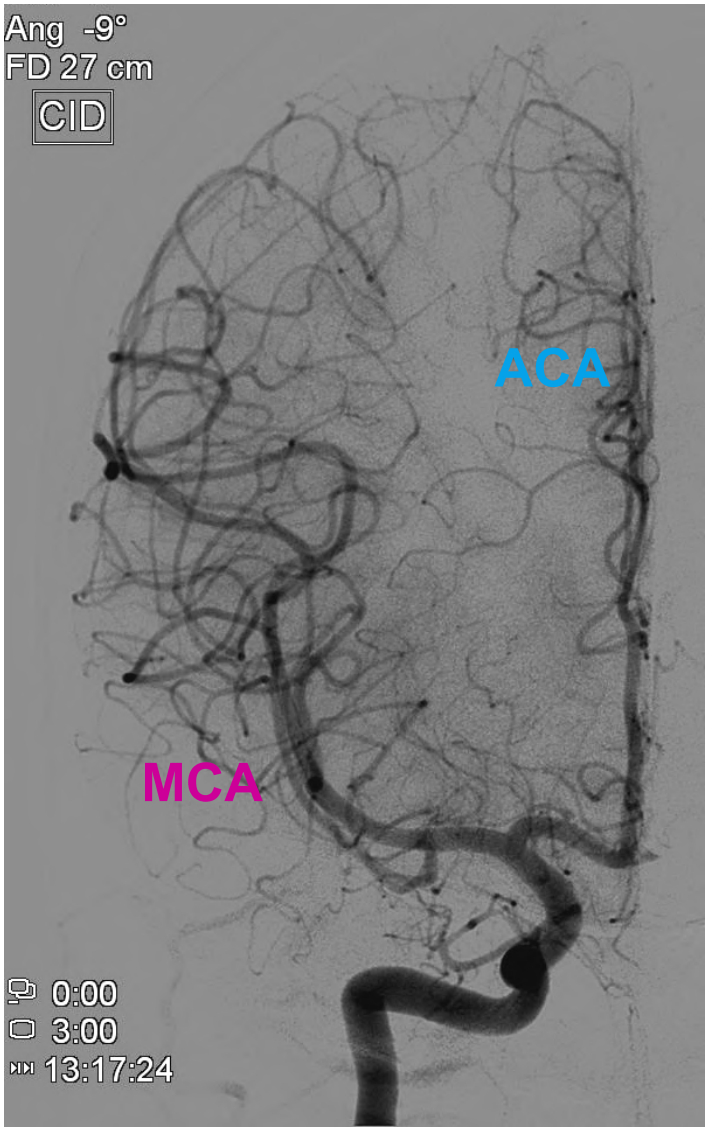
- ‘overlap’

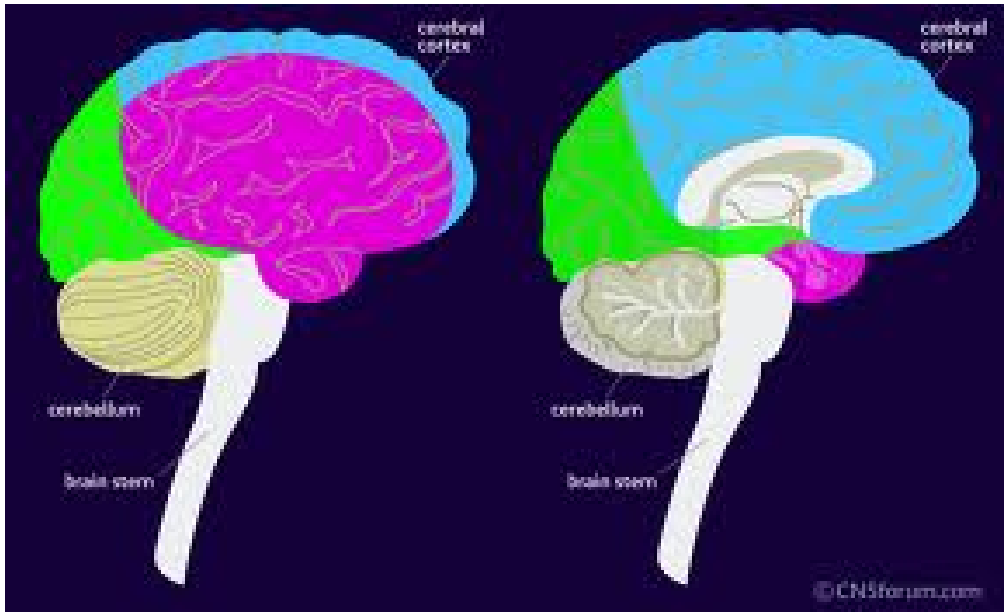


From vascular supply

to brain functions

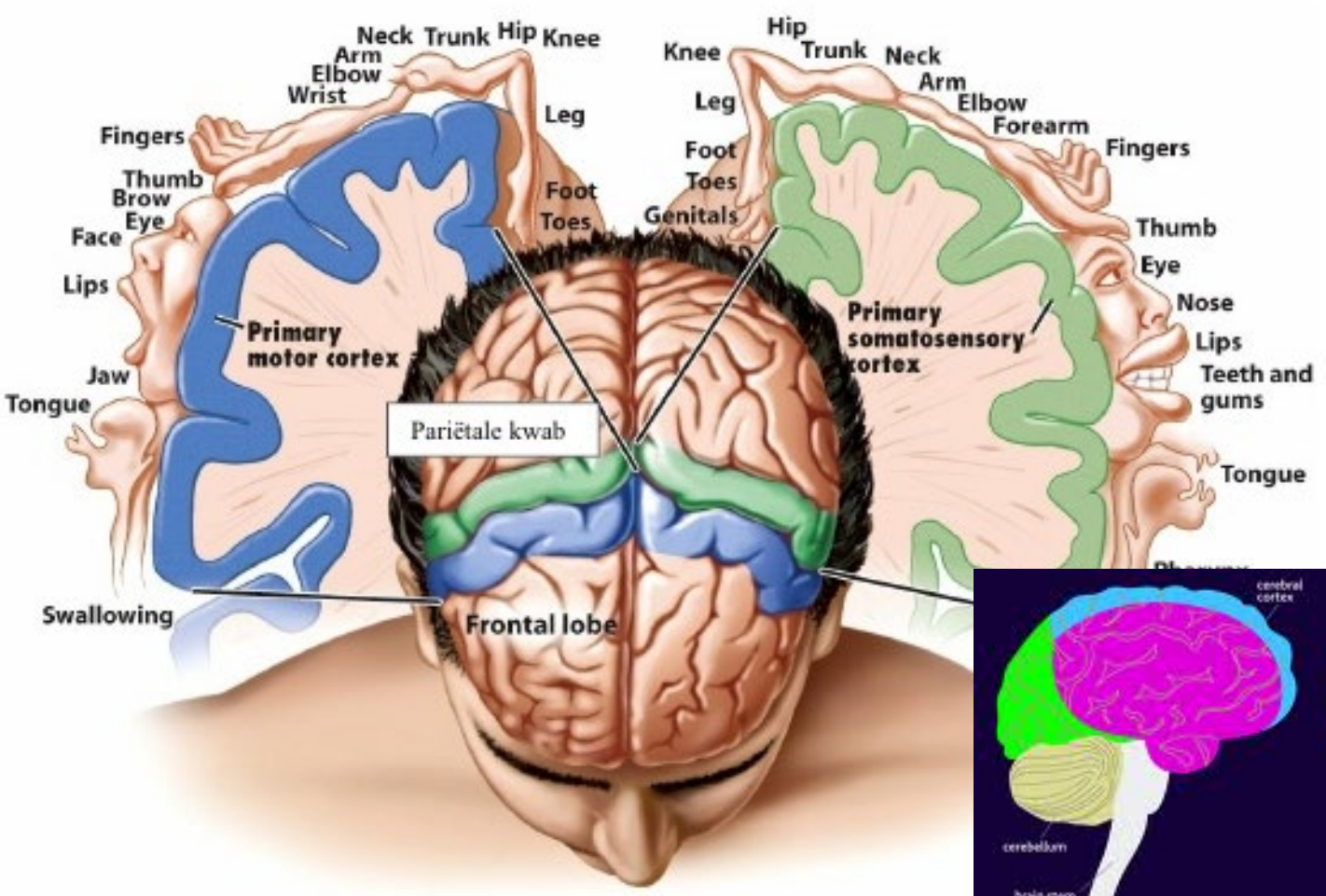
Middle and anterior cerebral artery

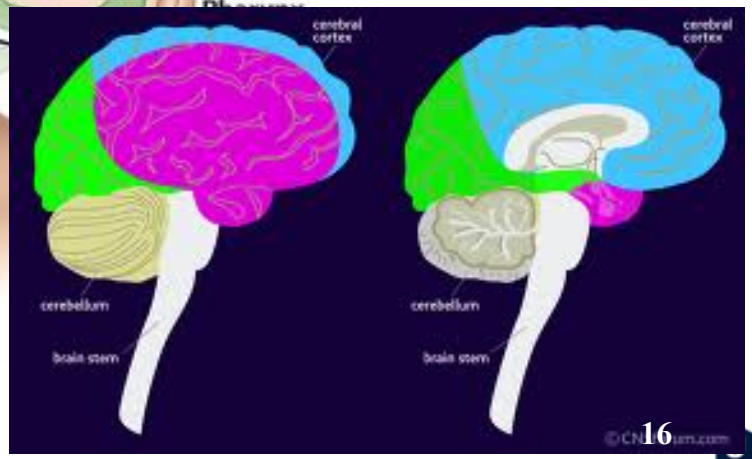


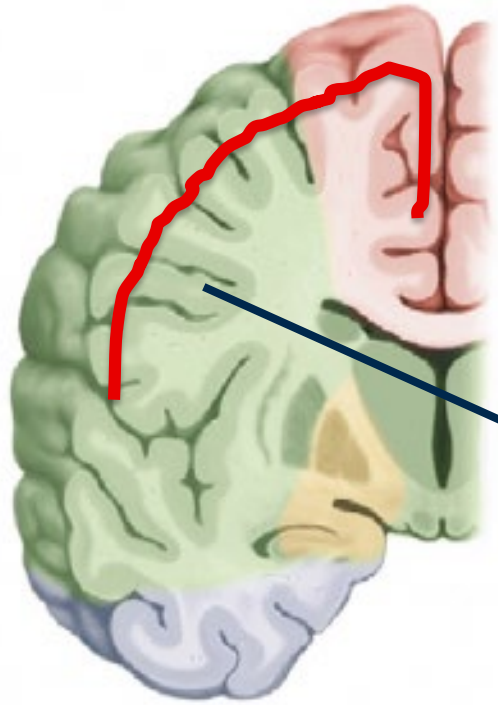


Side view

Frontal view


Neck
Trunk
Hip
Knee
Arm
Elbow
Wrist
Leg
Fingers
Thumb
Brow
Eye
Face
Lips
Jaw
Tongue
Foot
Toes
Primary motor cortex
Pariëtale kwab
Swallowing
Frontal lobe
Hip
Knee
Trunk
Neck
Arm
Elbow
Forearm
Fingers
Leg
Foot
Toes
Genitals
Thumb
Eye
Nose
Lips
Teeth and gums
Tongue
Primary somatosensory cortex


cerebral cortex
cerebellum
brain stem
cerebral cortex
cerebellum
brain stem

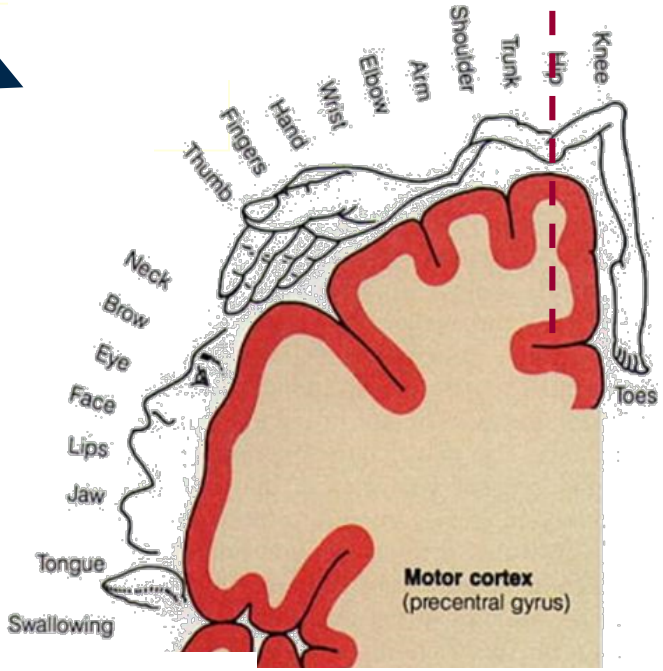


Anterior cerebral artery

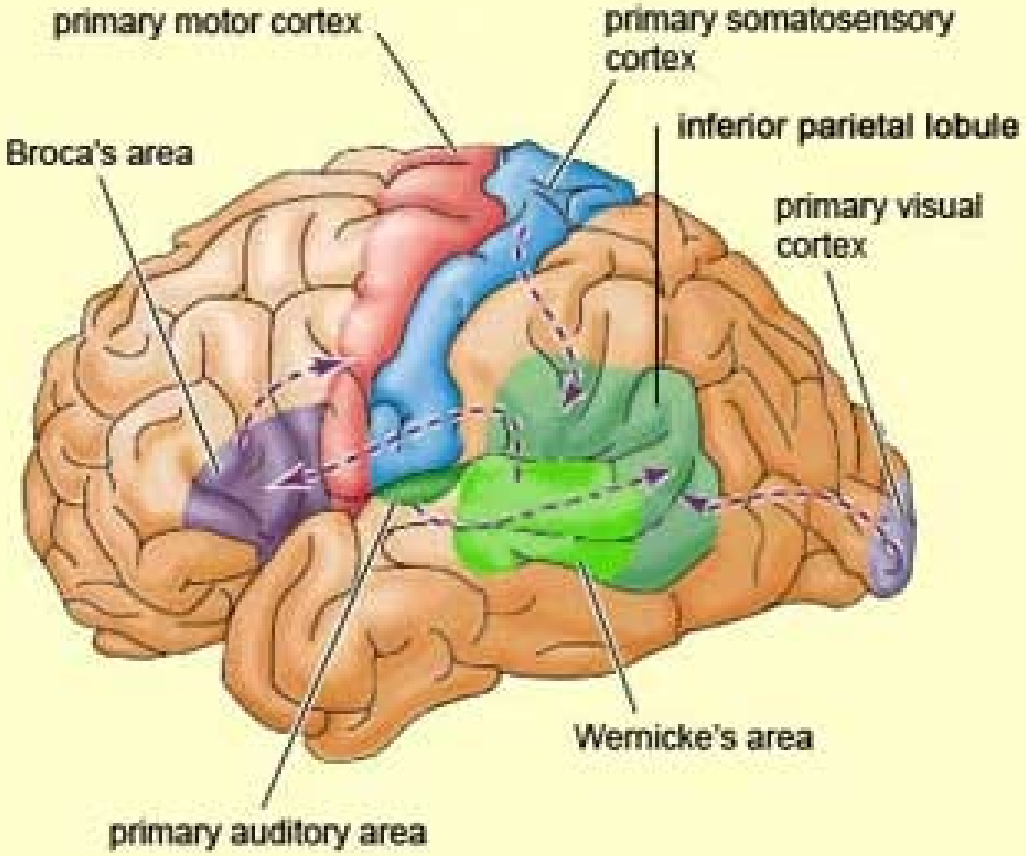
Medial cerebral artery

Posterior cerebral artery

m.c.a. ↔ a.c.a



Language



Broca and Wernicke area:

- In which lobe?
- On which side?
- In which vascular territory?

Posterior cerebral artery

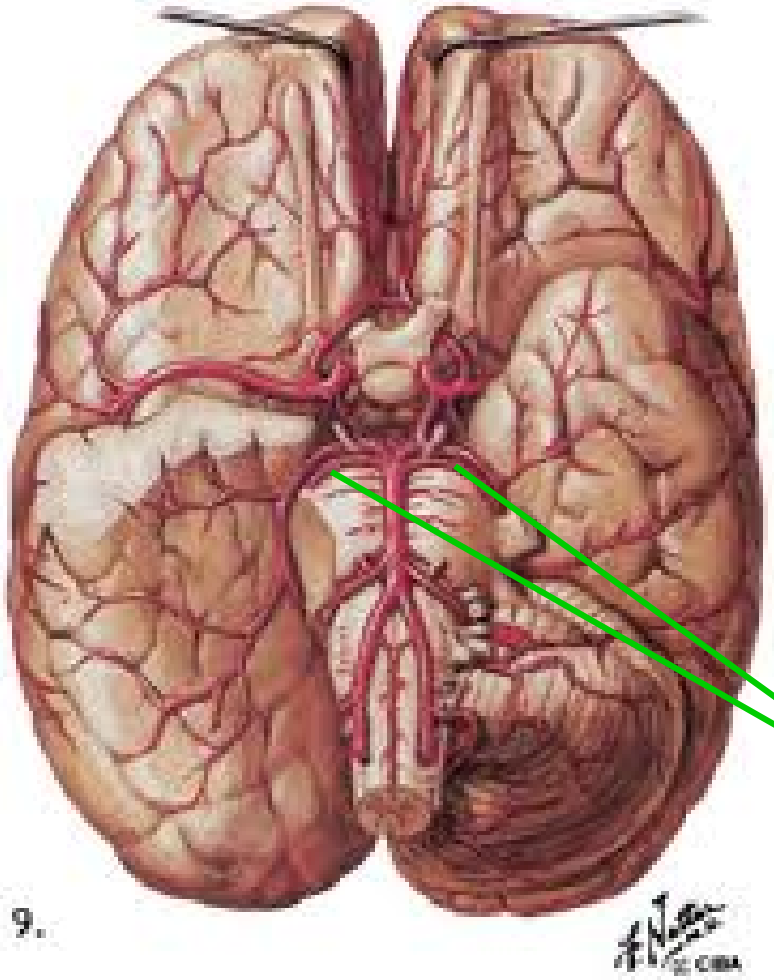
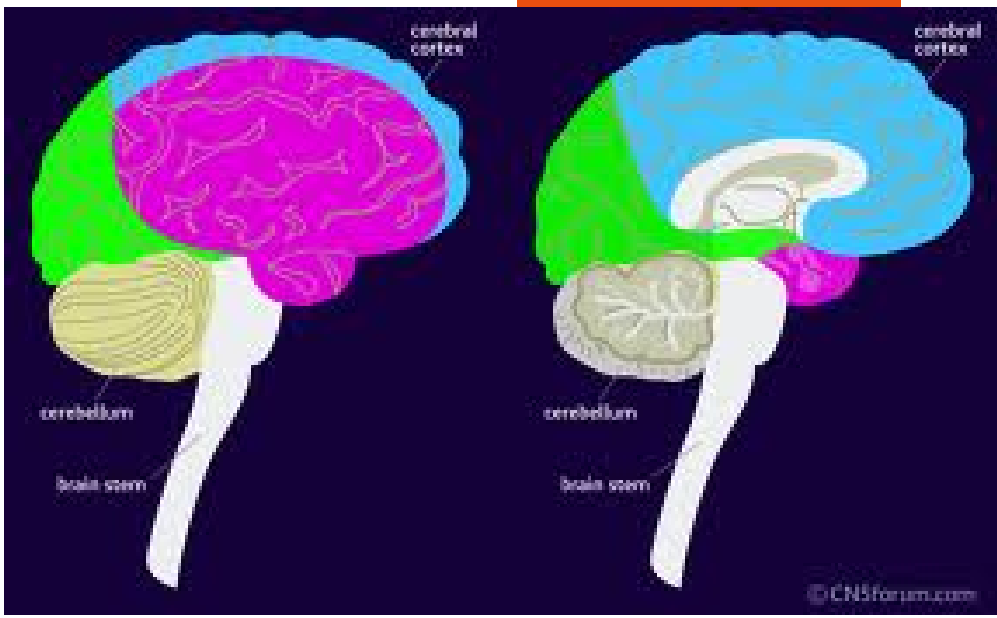
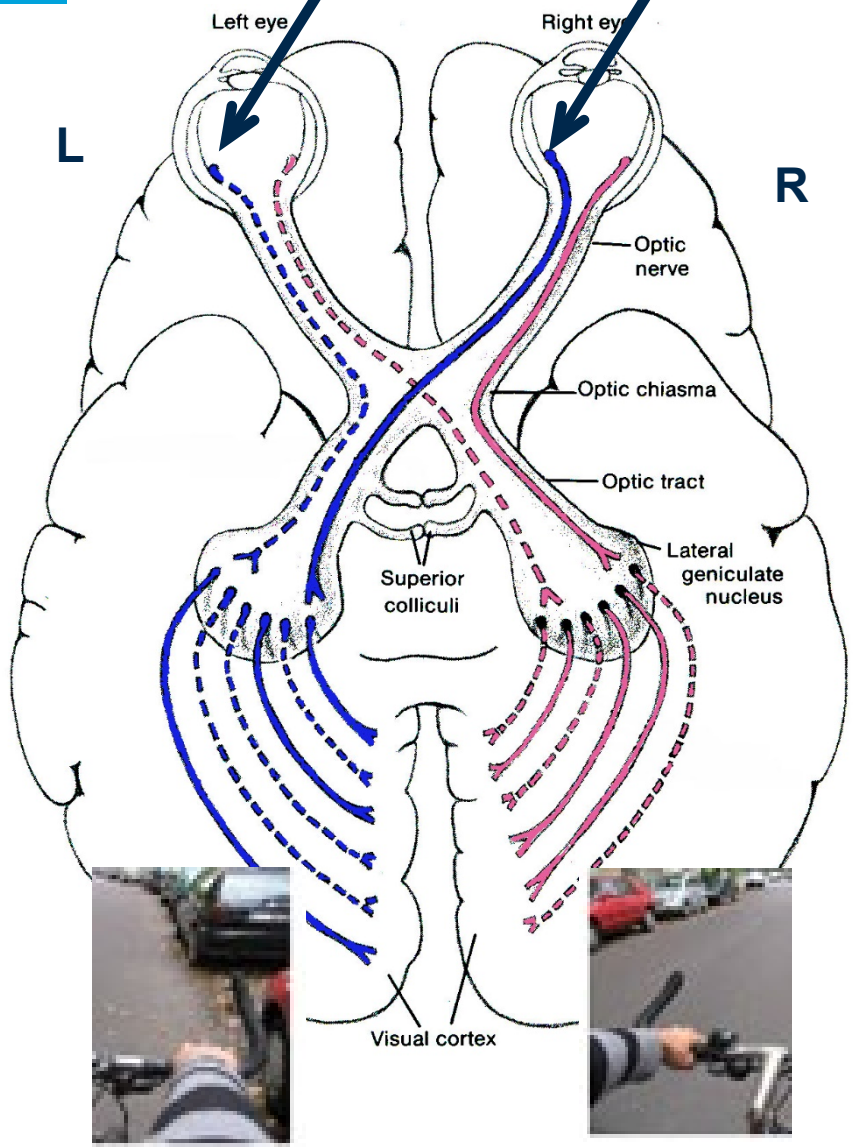


Figure 9.

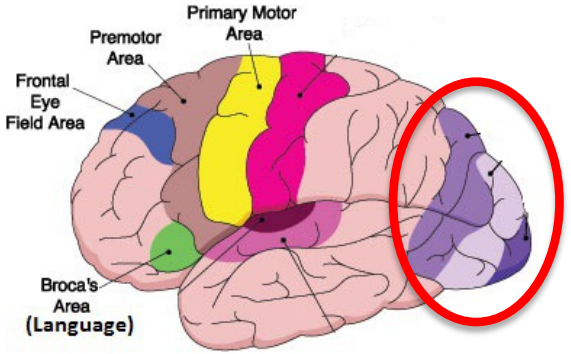


Occipital lobe: visual cortex

PCA



Visual tracts



Vertebral and basilar arteries

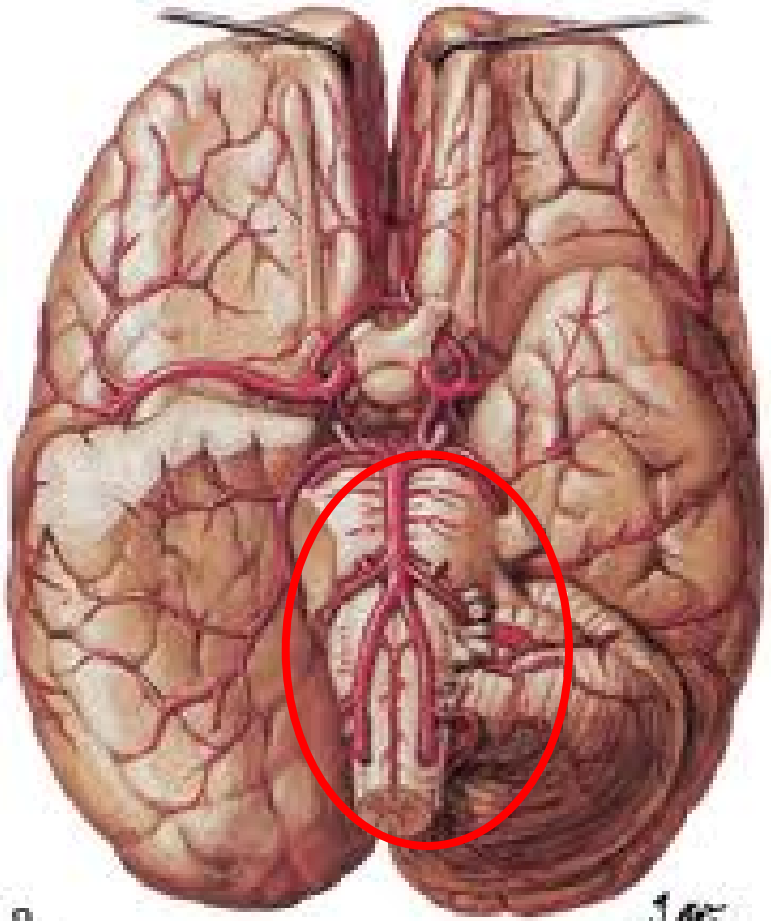
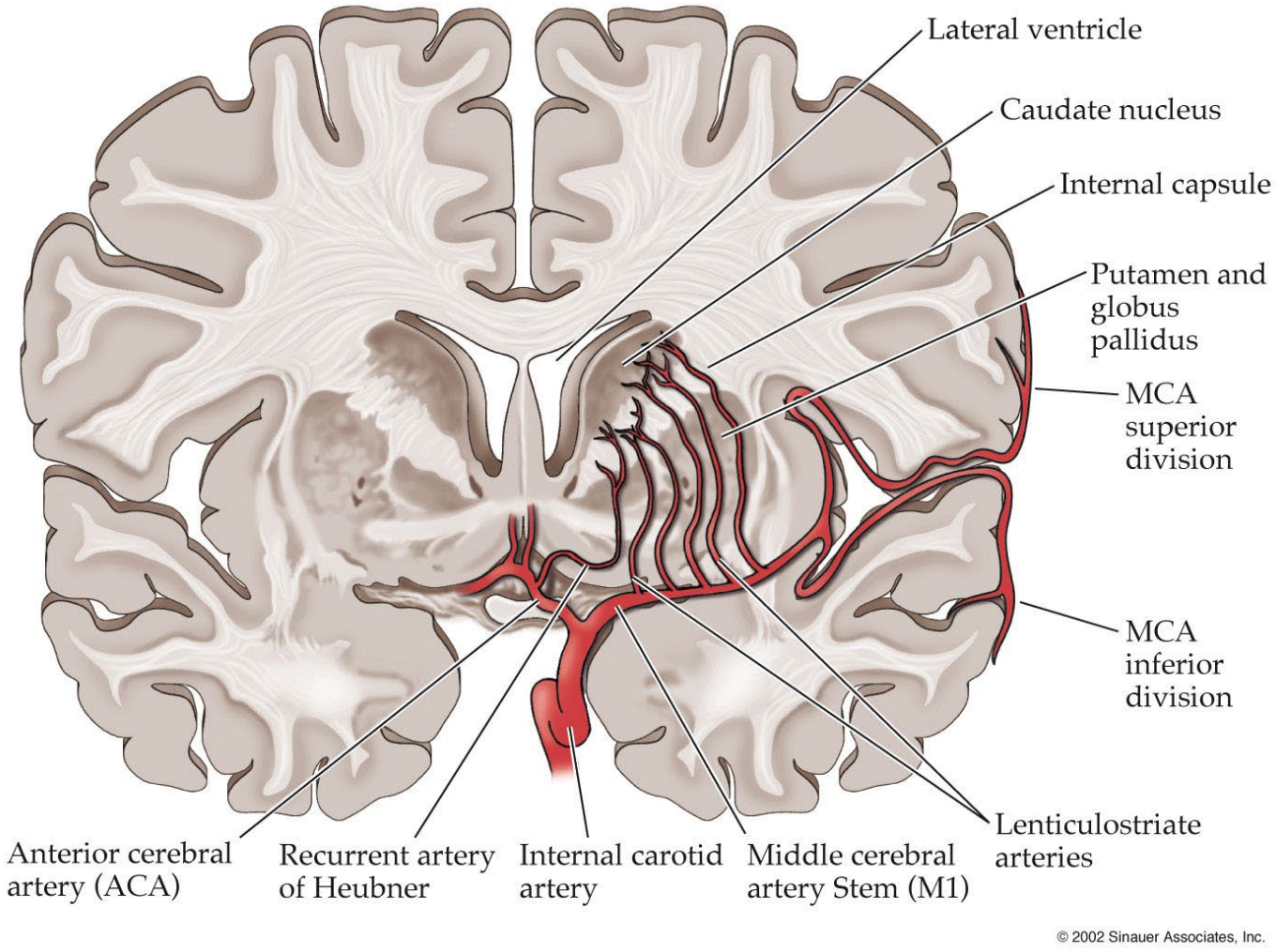


Figure 9.

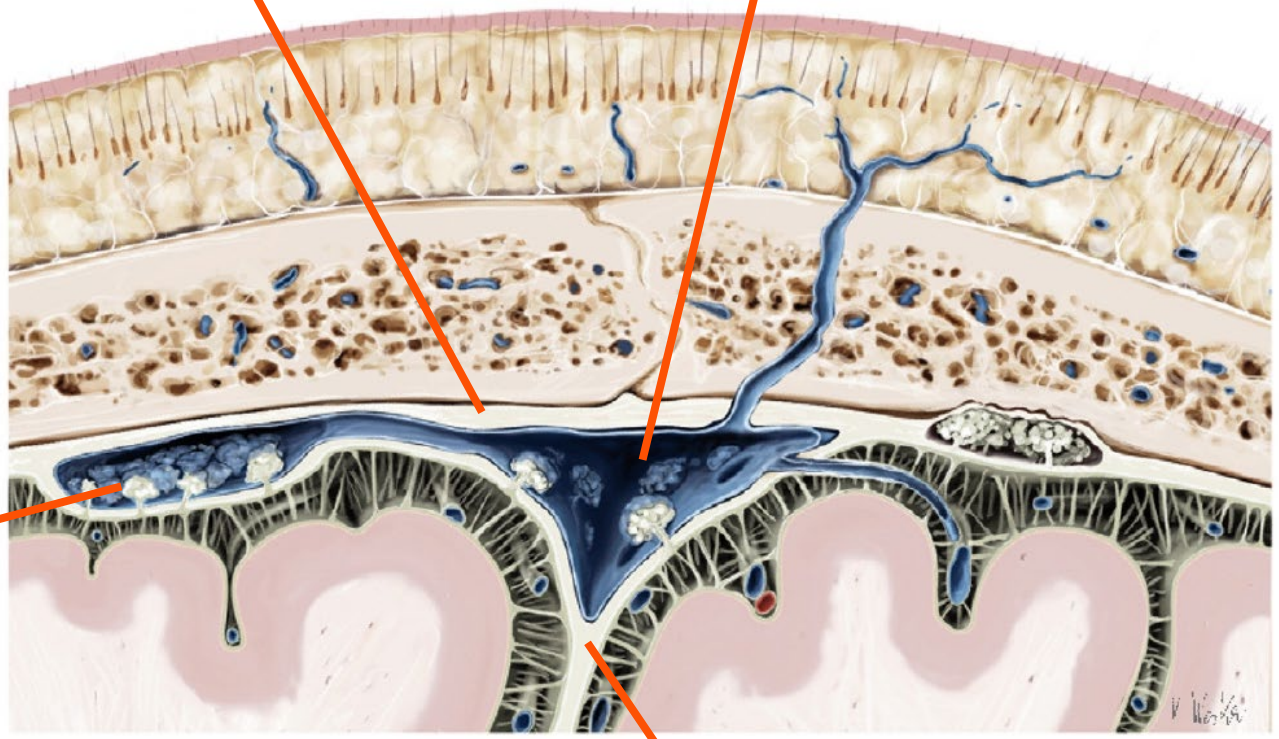
Brainstem
Cerebellum

Deep small vessels



End arteries, no collaterals

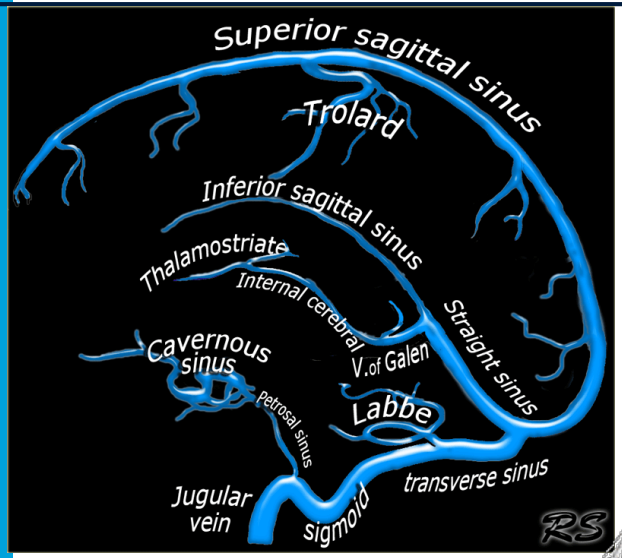
Venous system: sinuses



Sinus: venous channel within layers of dura

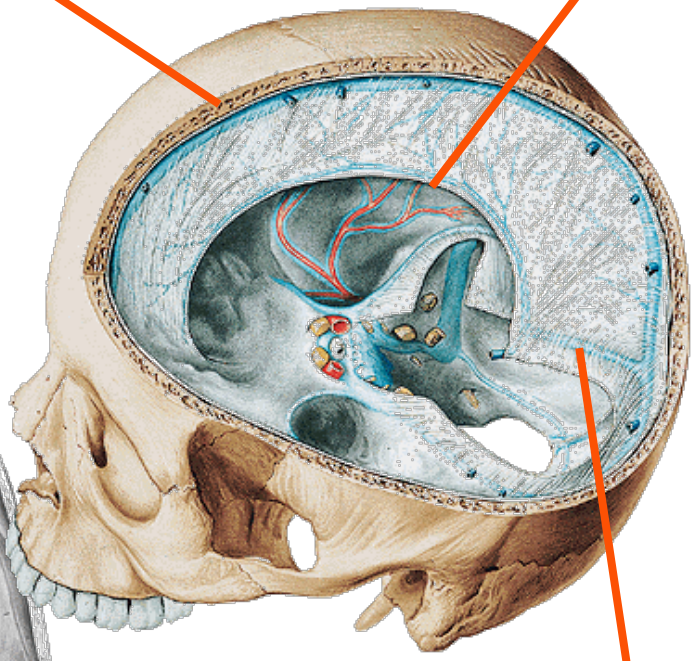
- Receives venous blood from cerebral veins
- Receives CSF through granulations

Venous system: sinuses

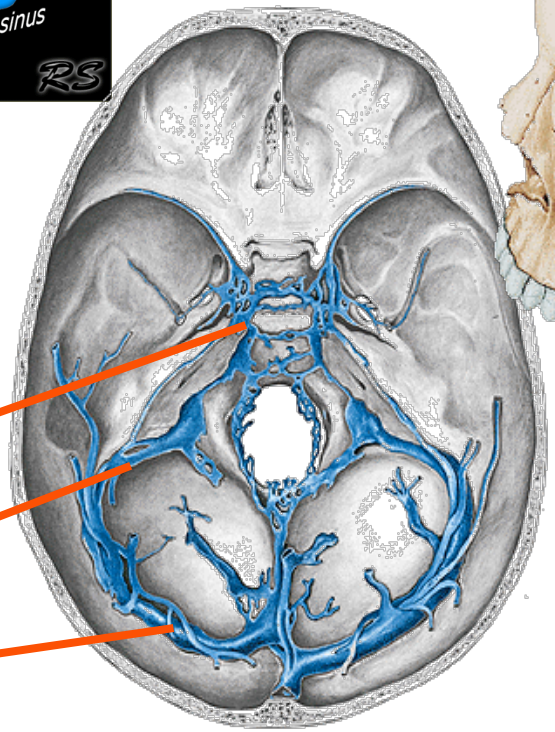


Superior sagittal sinus

Inferior sagittal sinus



sinus rectus



Sinus cavernosus

Sigmoid sinus

Transverse sinus

Venous system: sinuses

- Cerebral venes →

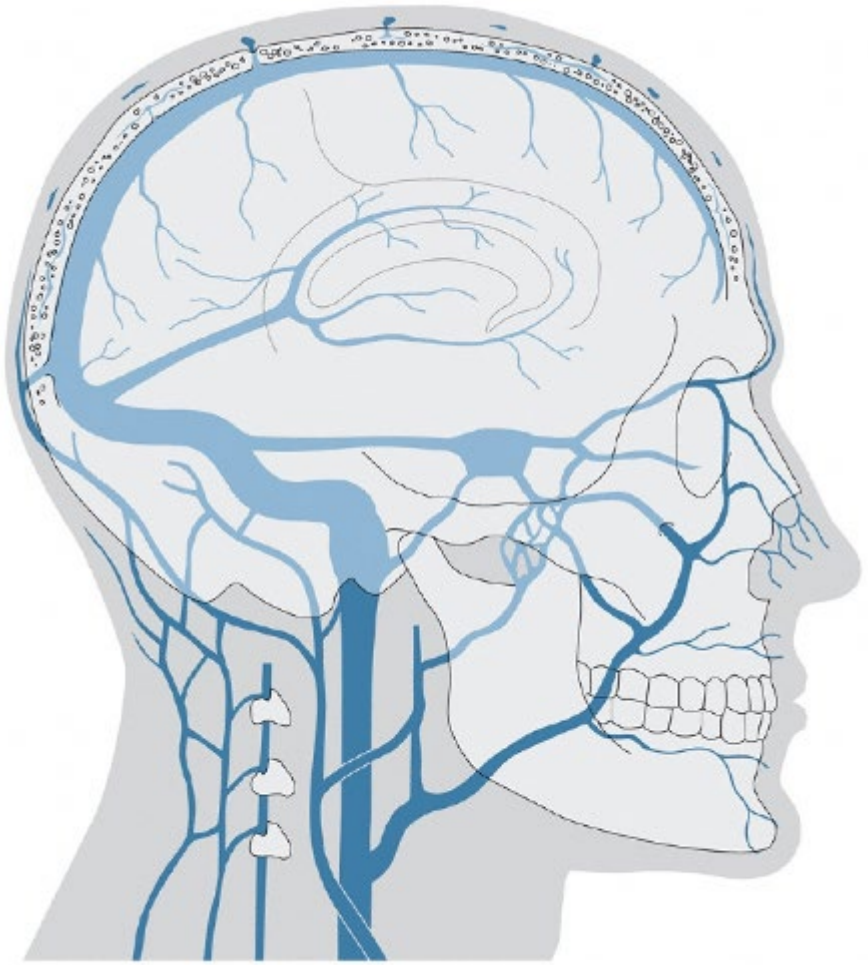
  sinus →

  internal jugular vene →

  brachiocephalic vene →

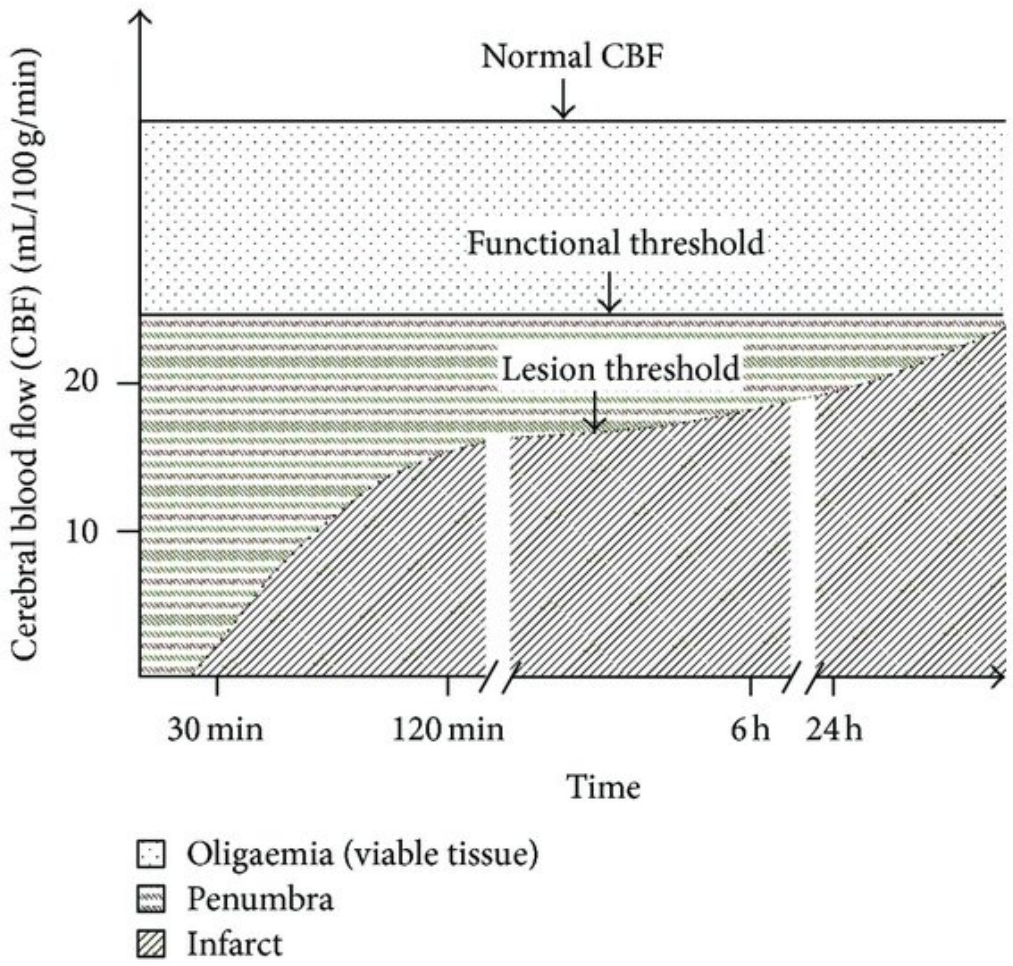
  superior vena cava →

  right atrium



When a clot forms:
Cerebral venous sinus thrombosis

Blood supply - When it goes wrong:



Ischemia =

insufficient blood supply leading to oxygen deficit in tissue and neuronal dysfunction

(CBF below critical threshold of 20-25 mL/100g/min)

Infarction =

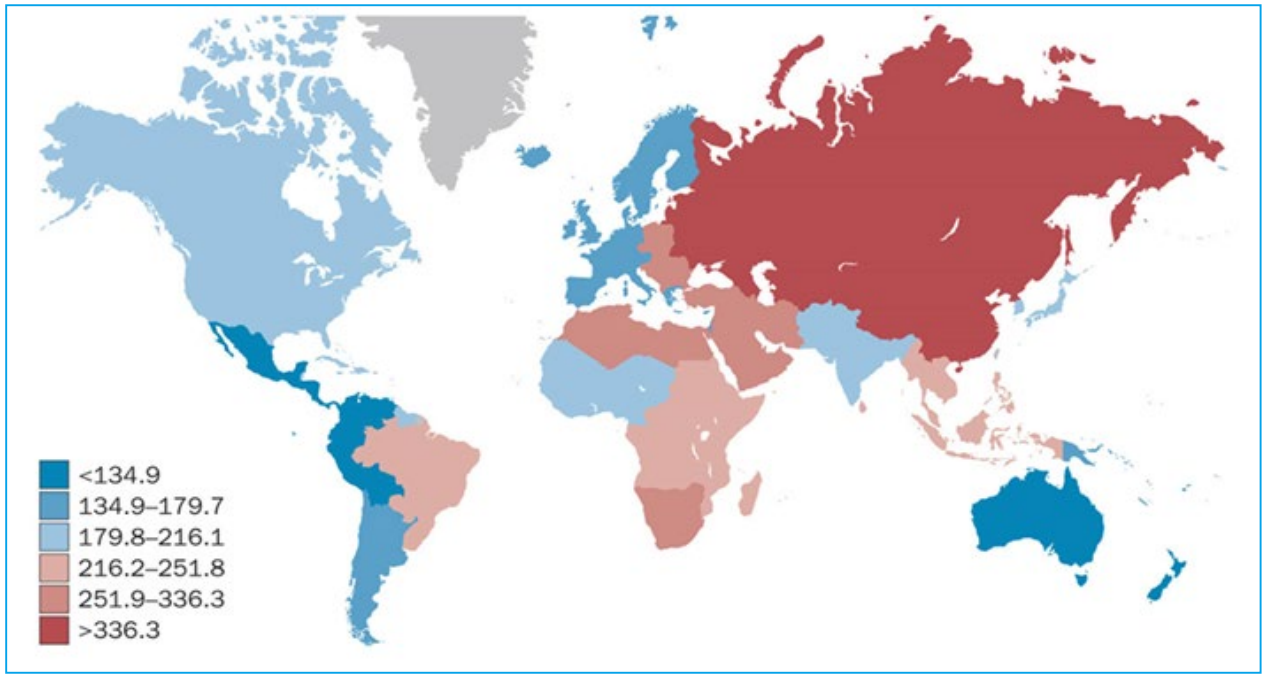
tissue death

Stroke

- Sudden interruption of arterial blood supply to the brain resulting in neurological deficits
  - Ischemic stroke : occlusion 80 %
  - Haemorrhagic stroke : rupture
    - Intracerebral 15 %
    - Subarachnoid 5 %

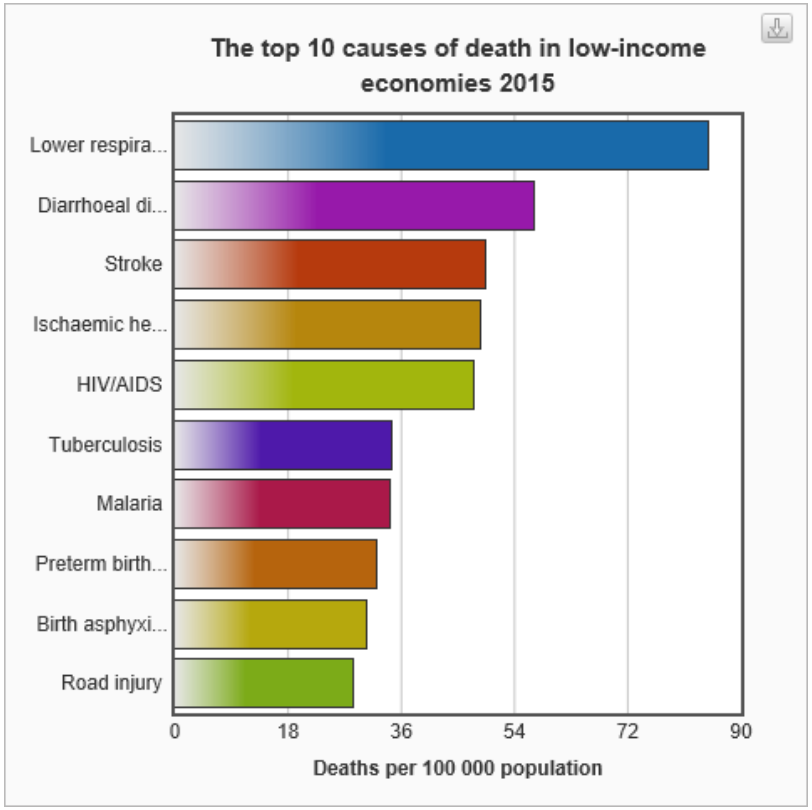
Stroke: impact

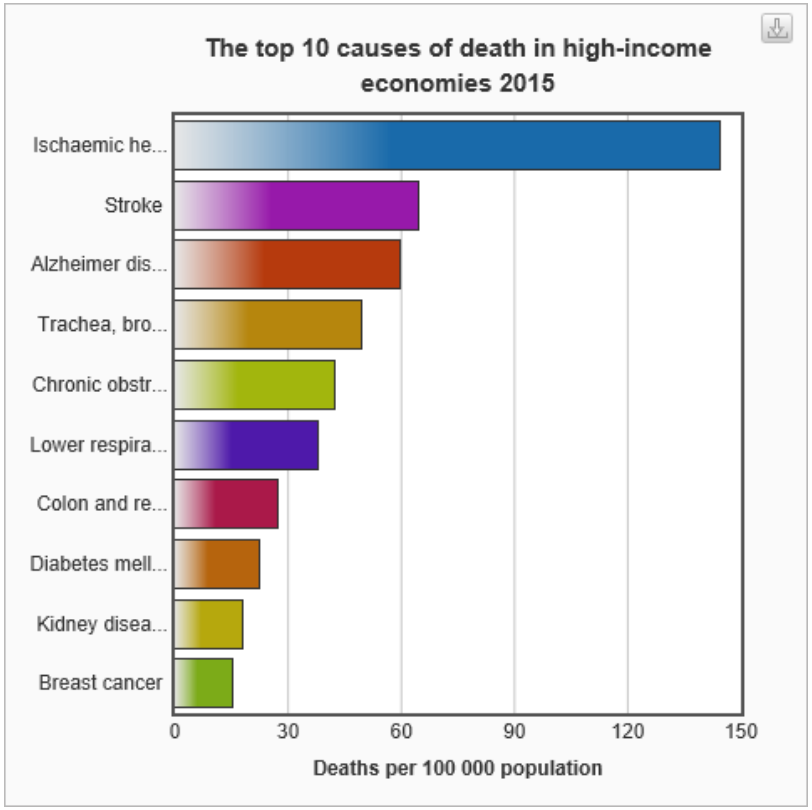
- Globally, 15 million strokes a year
- Leading cause of long term disability at older age



Age-standardized **stroke incidence** per 100.000 person-years for 2010

Stroke: impact





WHO

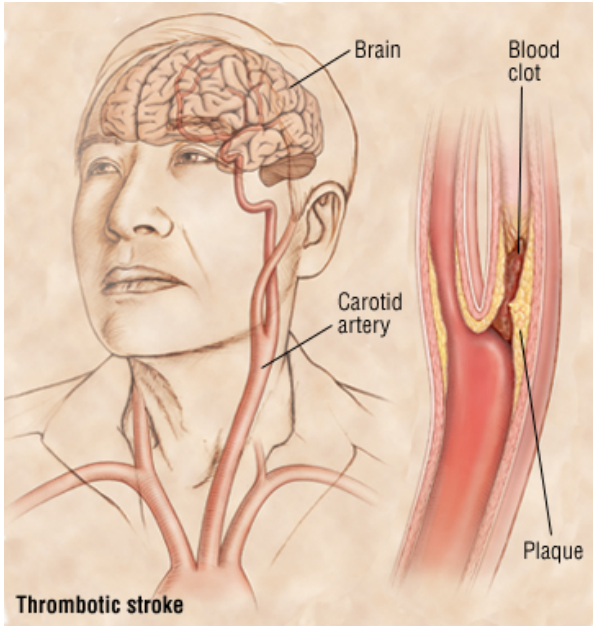
Ischemic stroke

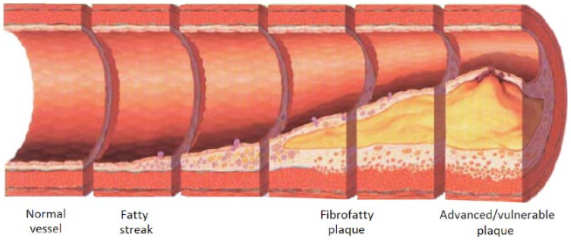
- Sudden signs of focal cerebral function loss
- Clinical signs depend on location of infarction

Ischemic stroke – 3 main causes

1. Large vessel disease

- Atherosclerosis



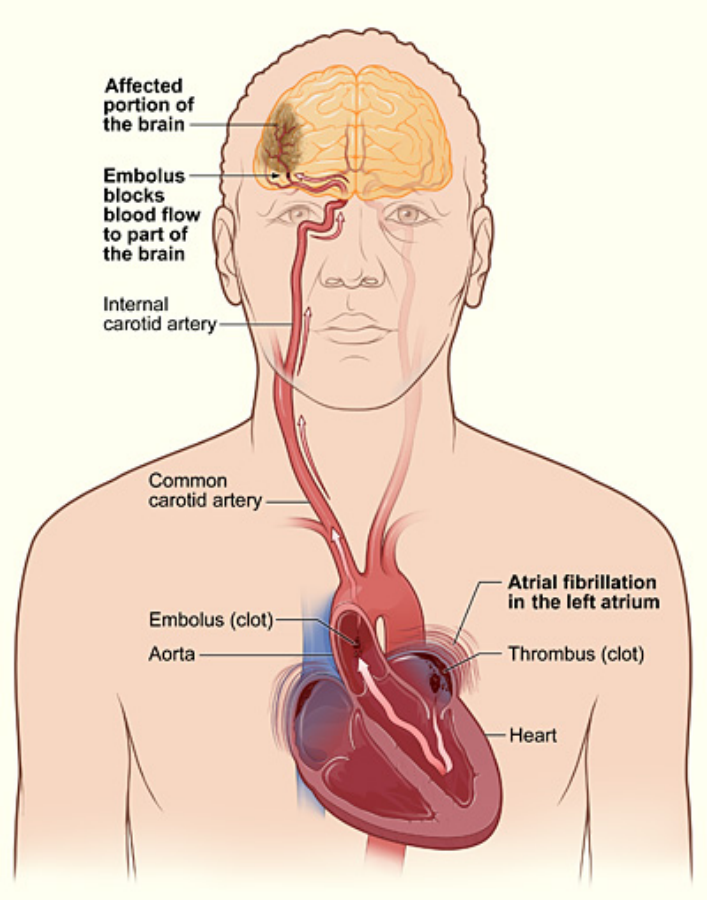


Atherosclerosis

Ischemic stroke – 3 main causes

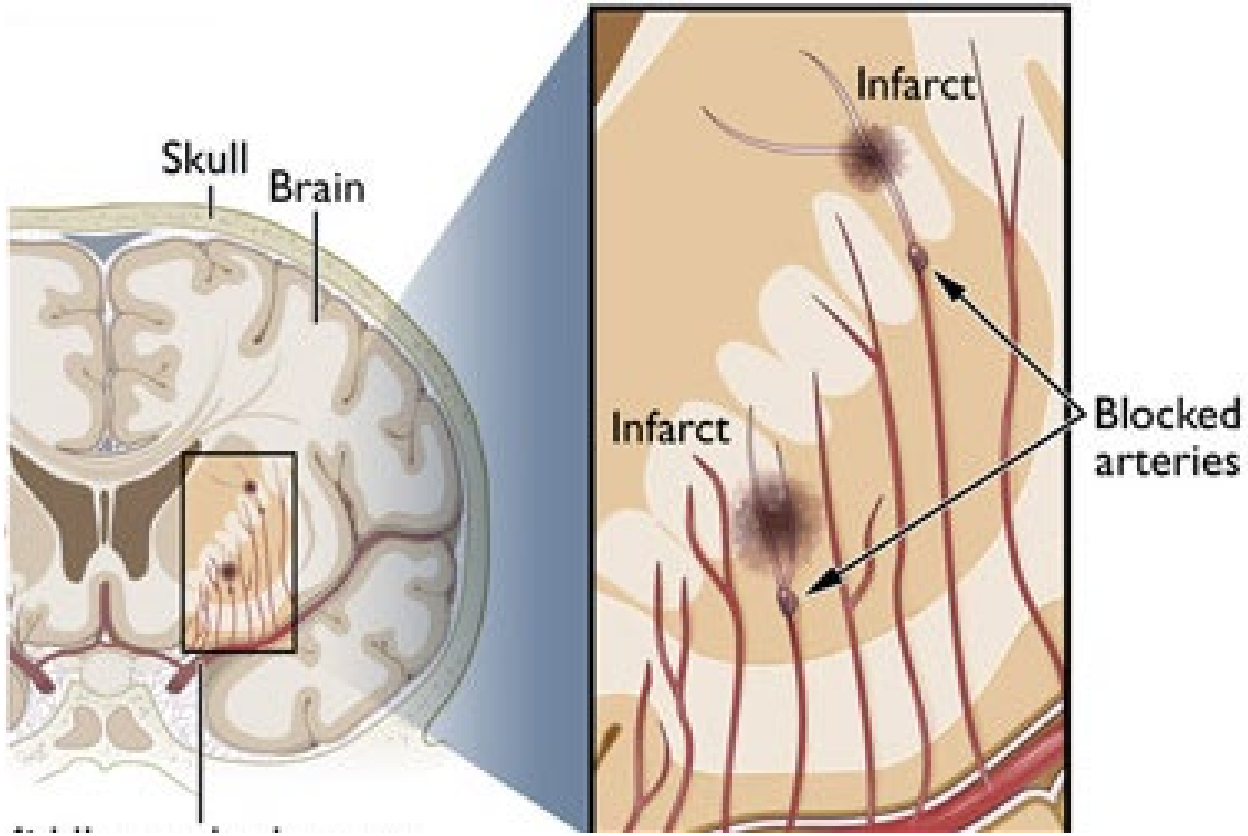
2. Cardiac embolism

- AF, prosthetic valve



Ischemic stroke – 3 main causes

3. Small vessel disease



Small vessel disease

Genetic factors

Risk factors
Age & Hypertension

Disturbance of NVU
Endothelial dysfunction

Increased BBB permeability
Hypoperfusion
Diminished CVR
Diminished PVS clearance
Microstructural damage
Inflammation

Structural brain abnormalities

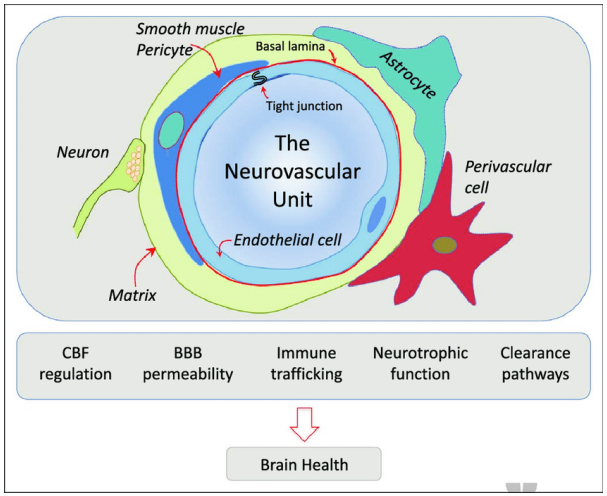
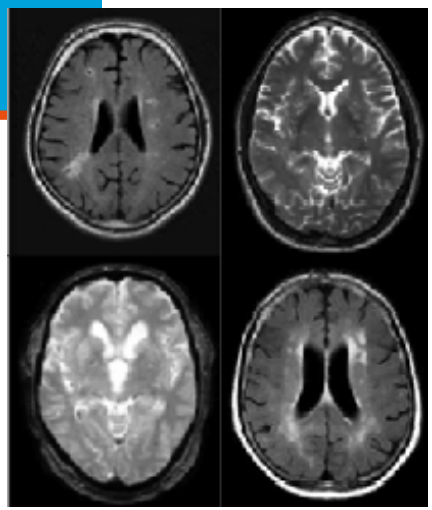


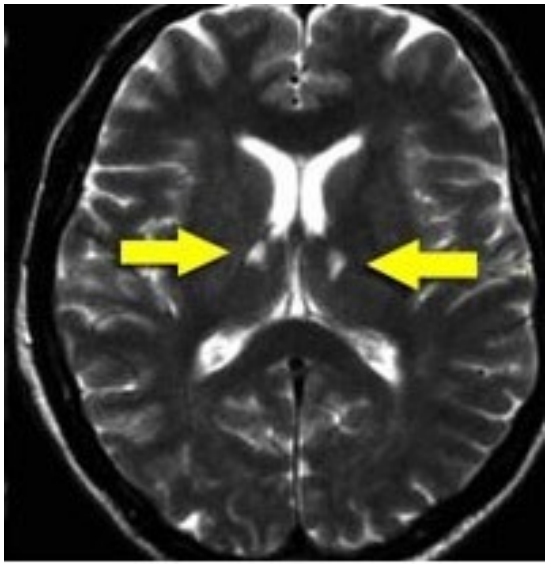
Figure: Gorelick 2017

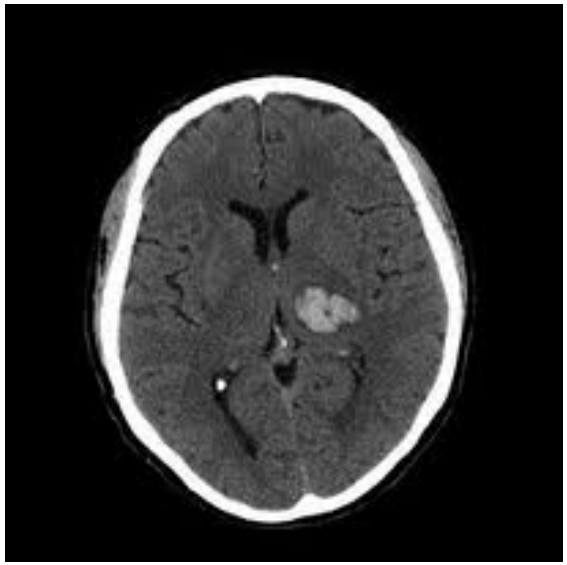


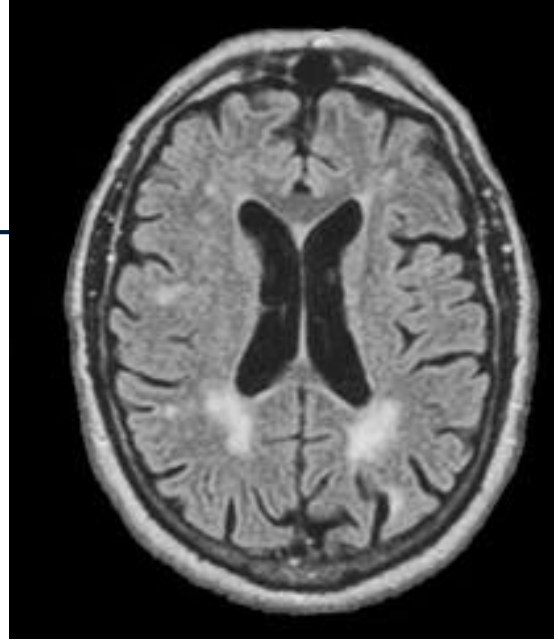
Clinical manifestations
- **Lacunar ischemic stroke**
- **Deep hemorrhagic stroke**
- **Cognitive impairment**

Small vessel disease

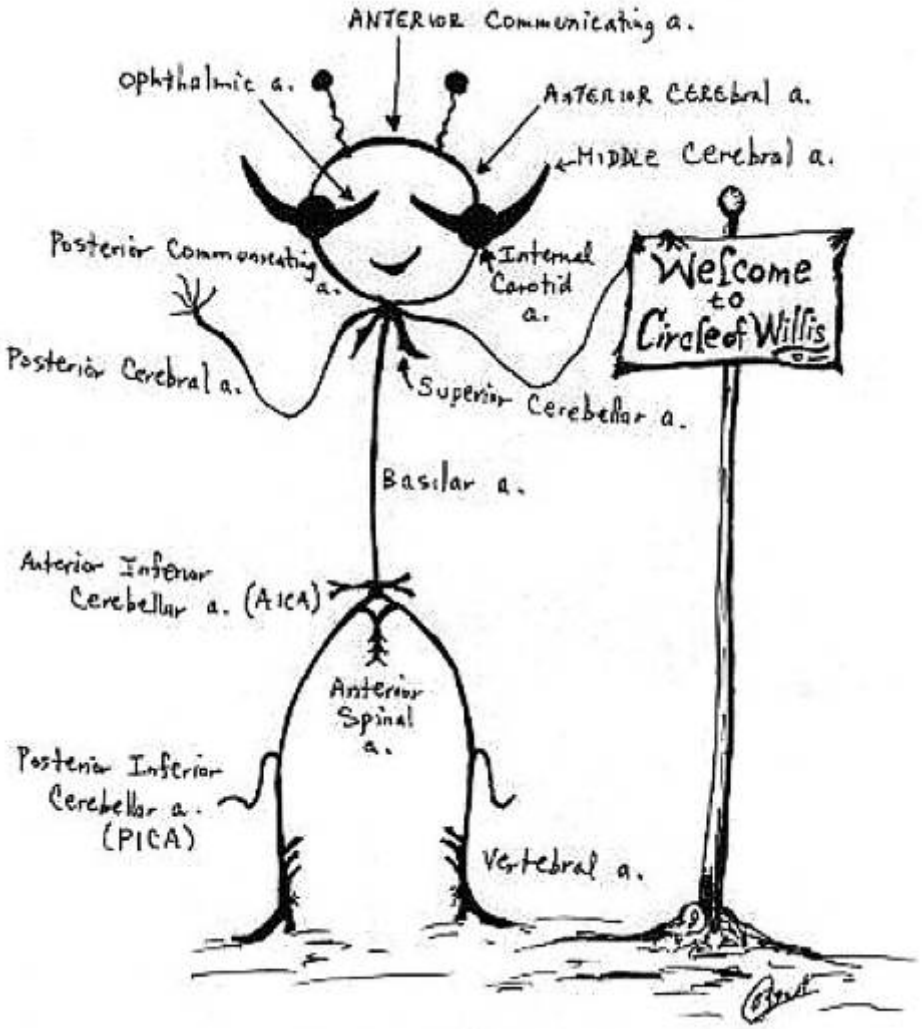
- Radiological:







Questions ?


ANTERIOR Communicating a.
Ophthalmic a.
ANTERIOR Cerebral a.
MIDDLE Cerebral a.
Posterior Communicating a.
Internal Carotid a.
Welcome to Circle of Willis
Posterior Cerebral a.
Superior Cerebellar a.
Basilar a.
Anterior Inferior Cerebellar a. (AICA)
Anterior Spinal a.
Posteria Inferior Cerebellar a. (PICA)
Vertebral a.