

NEUROVASCULAR ANATOMY

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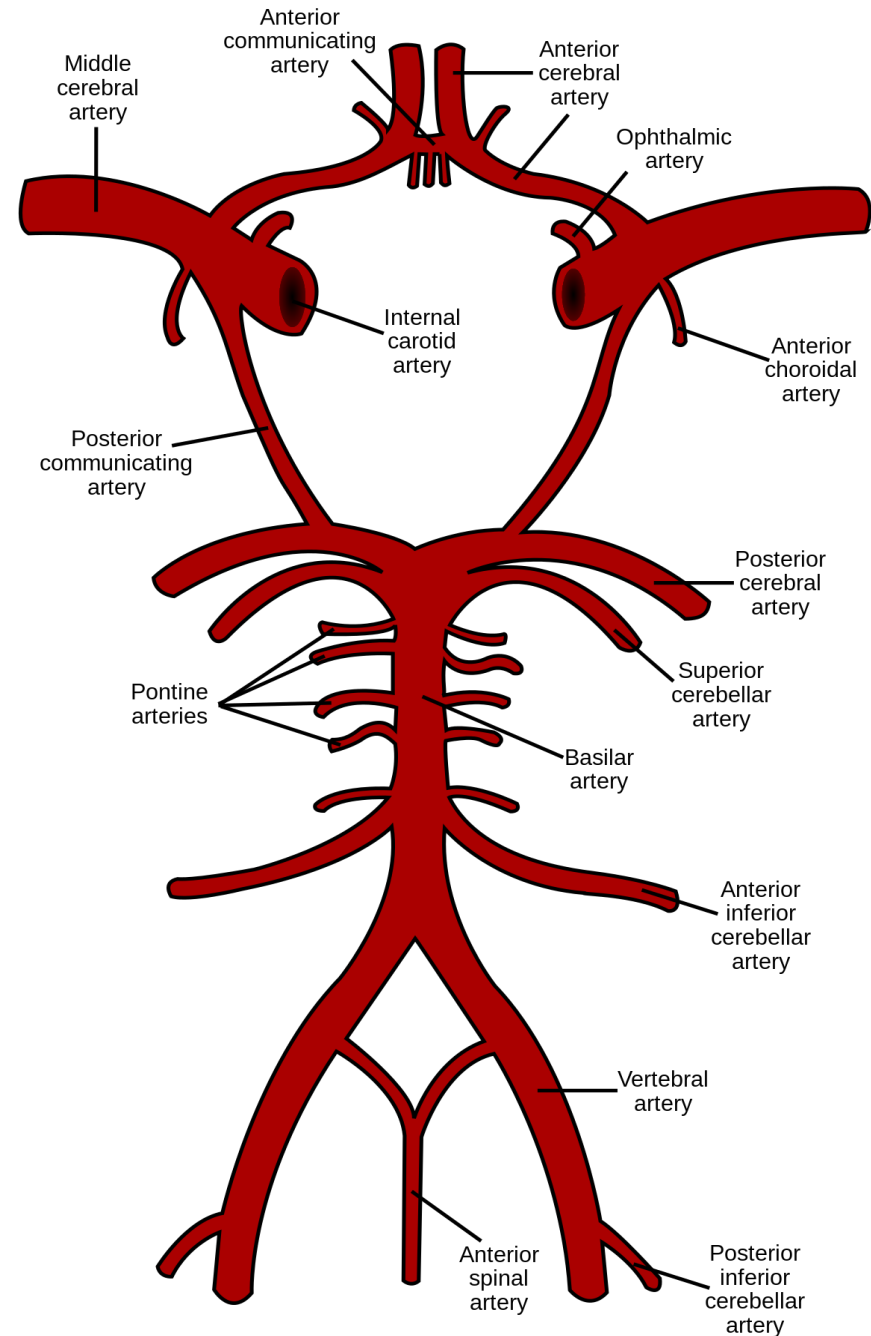
- While brain is 2% of total body mass ,it uses 50% of human body's glucose .
- brain receives 15-20% of the cardiac output.
- the normal average Cerebral blood flow is 50 ml/100gm /min.

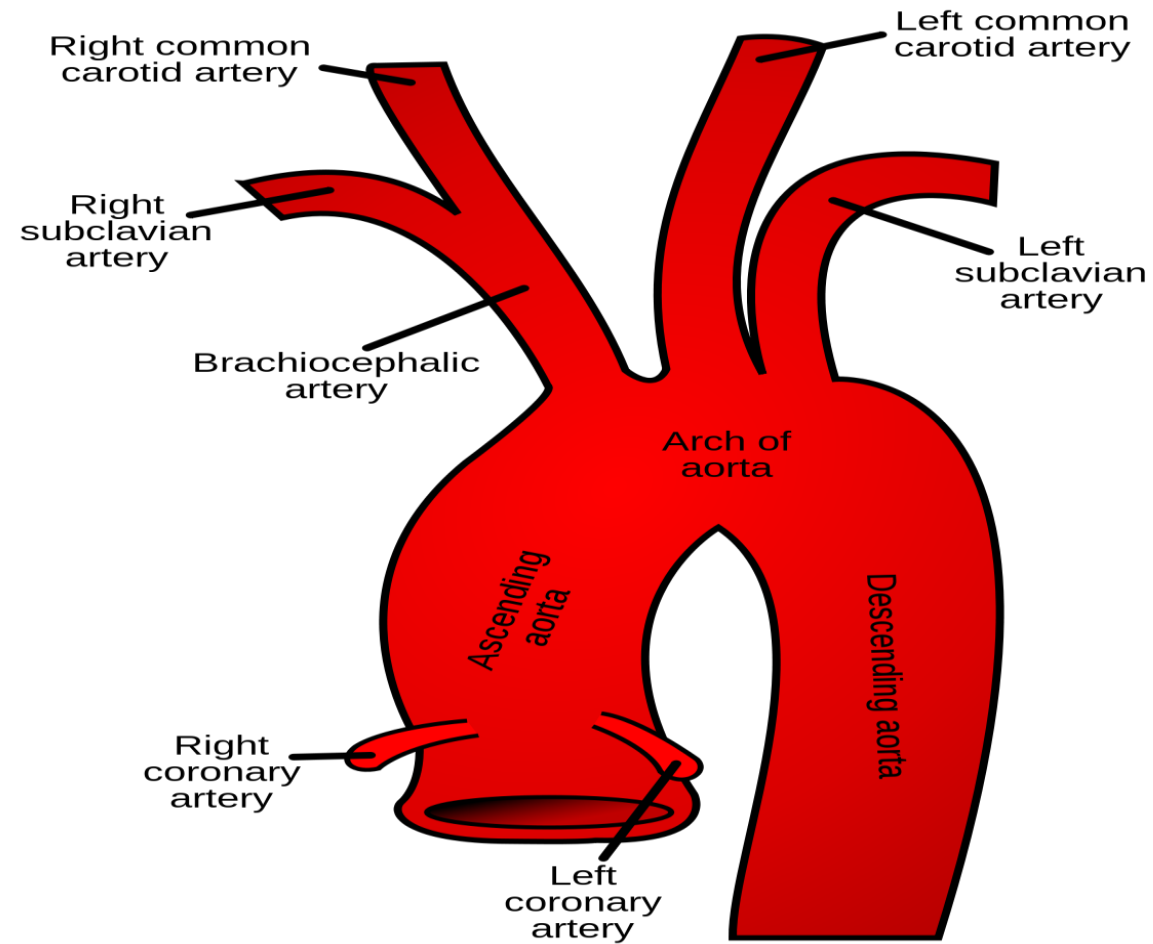
Two major sources of arterial blood provide this perfusion

1. Anterior circulation.....originates in internal carotid arteries
2. Posterior or vertebrobasilar circulation.....originates in vertebral arteries.

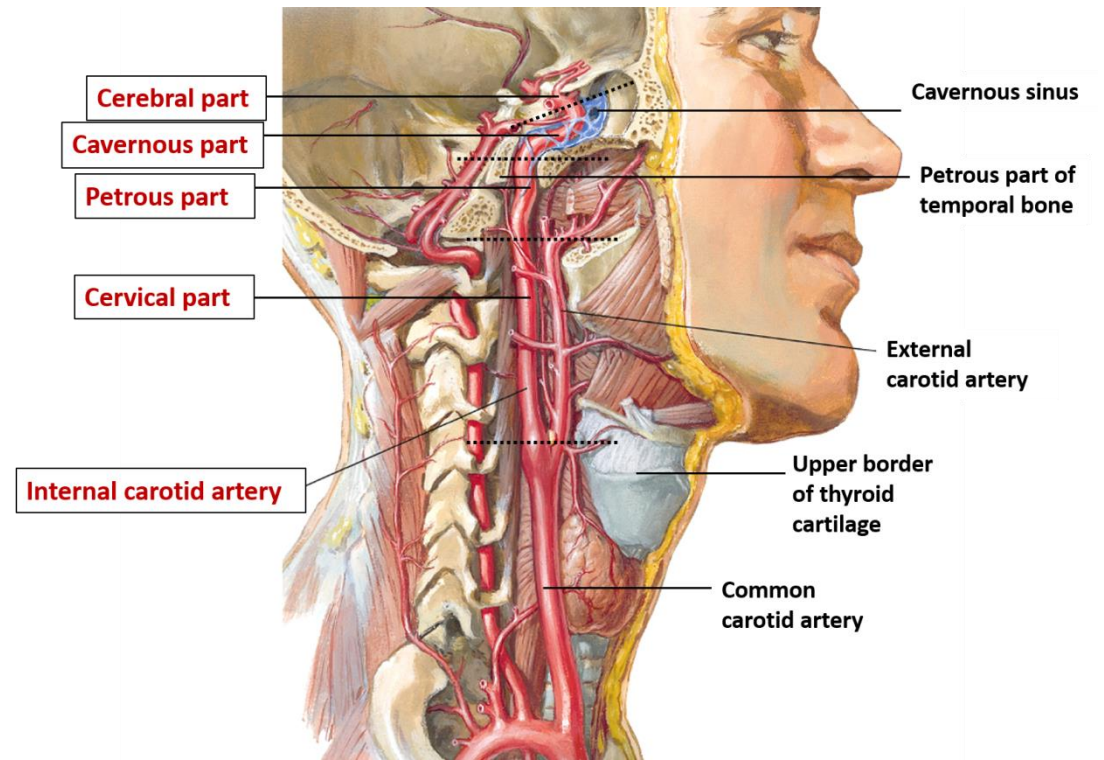
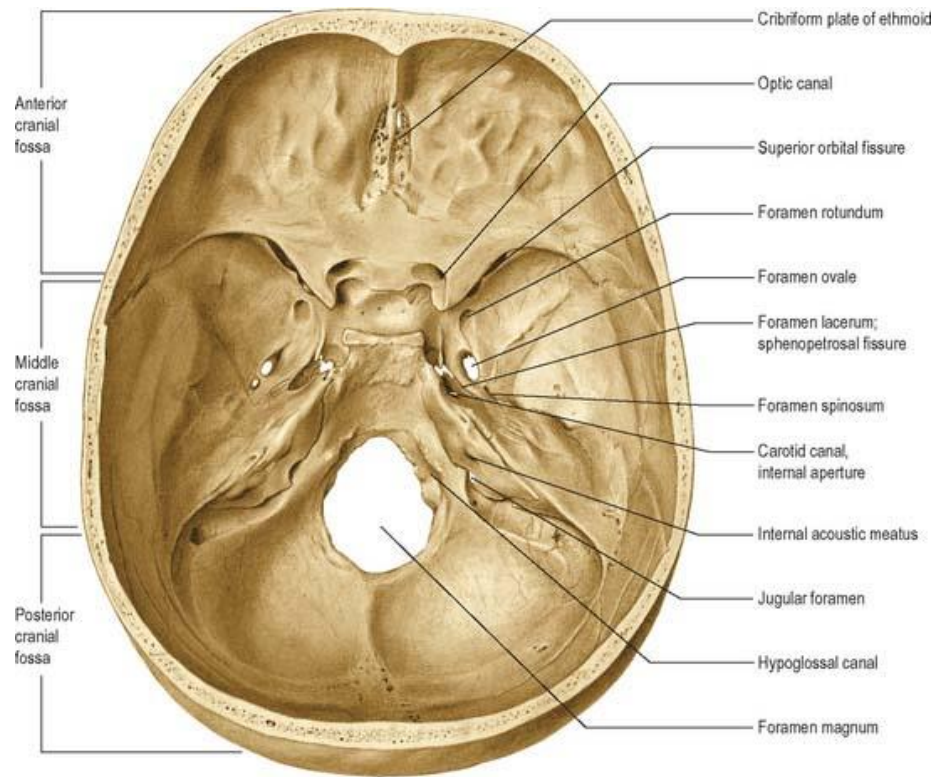
CIRCLE OF WILLIS

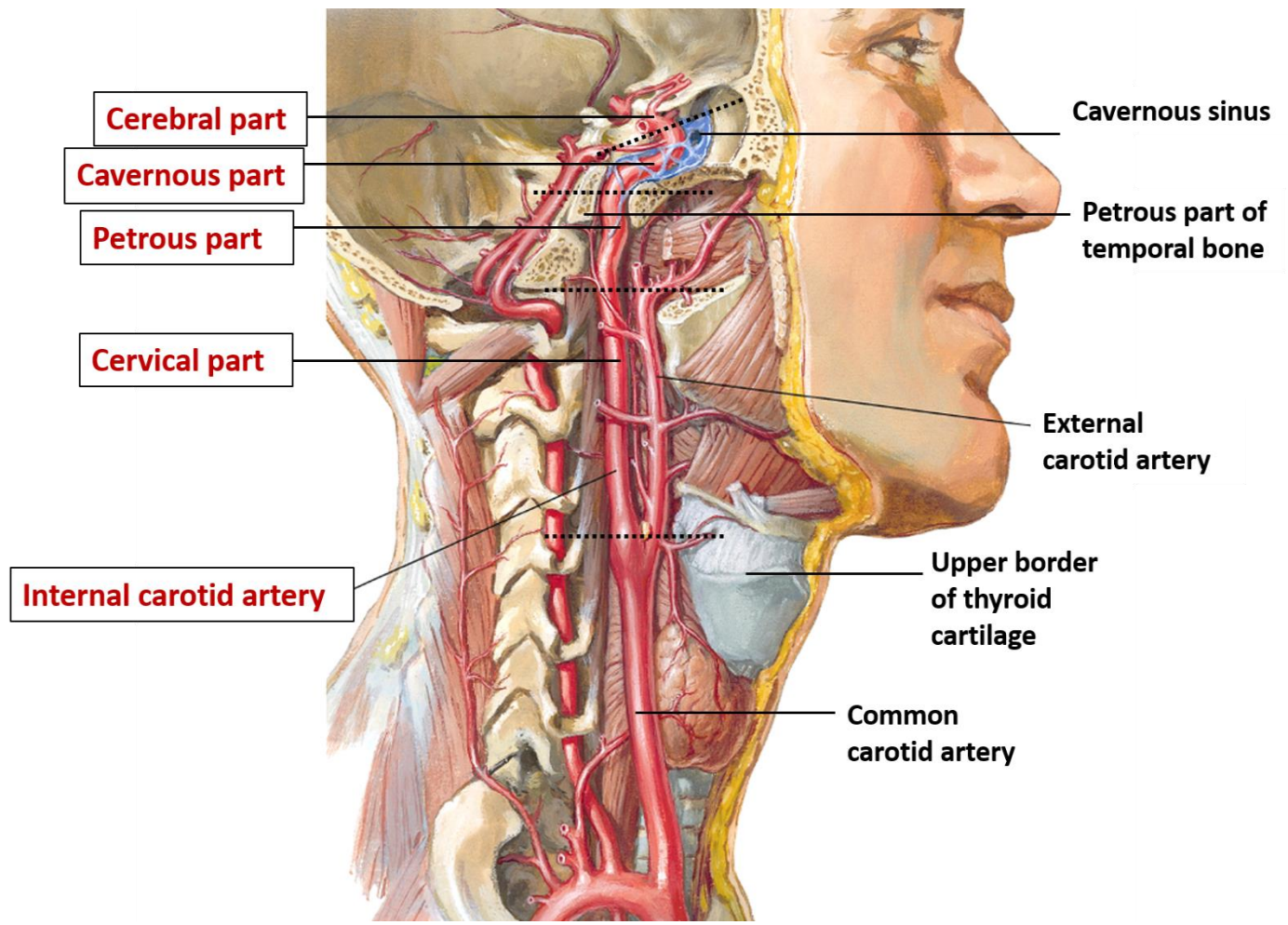
- It is formed at the base of the brain in the interpeduncular fossa.

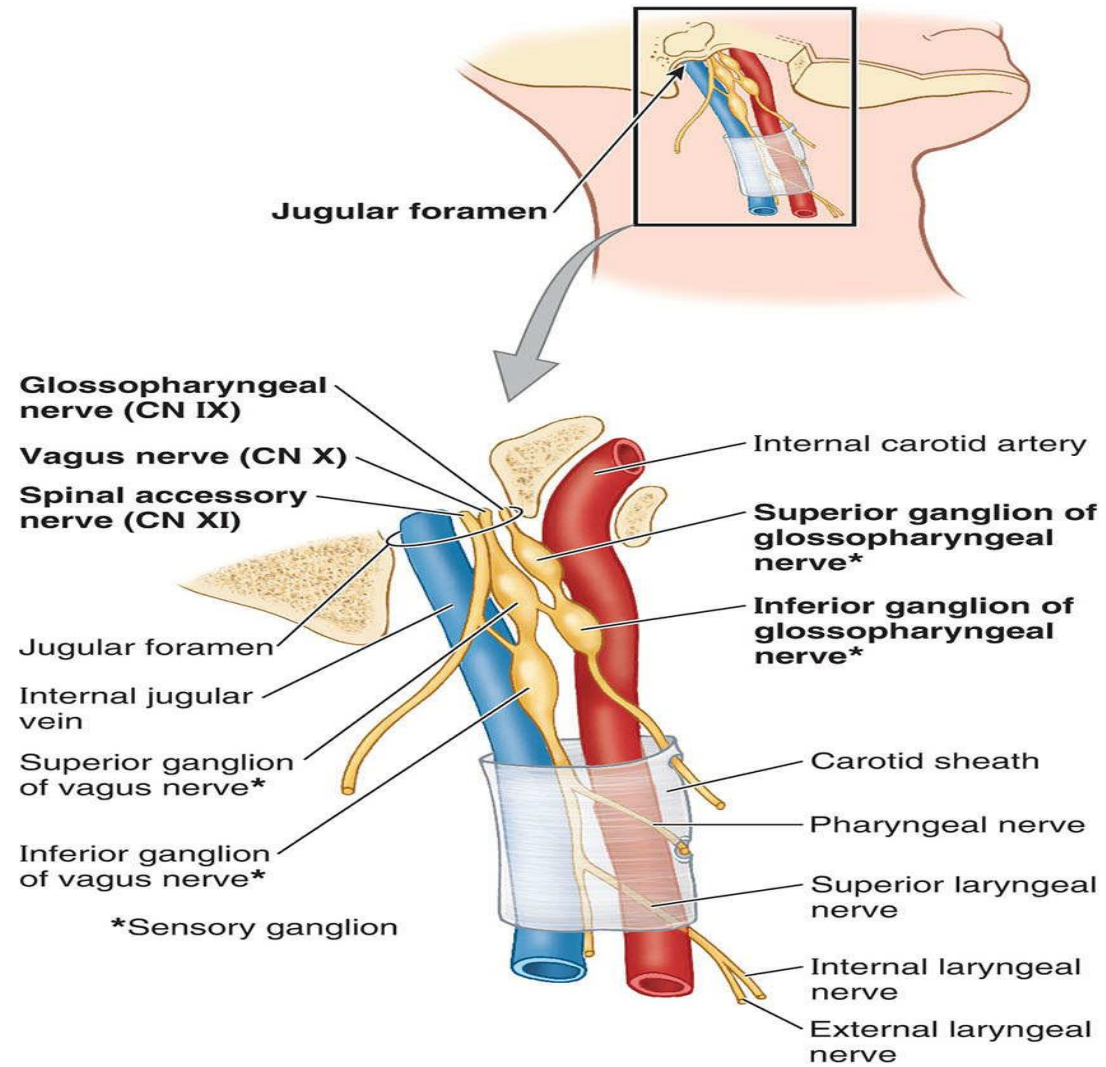




INTERNAL CAROTID ARTERY ...COURSE

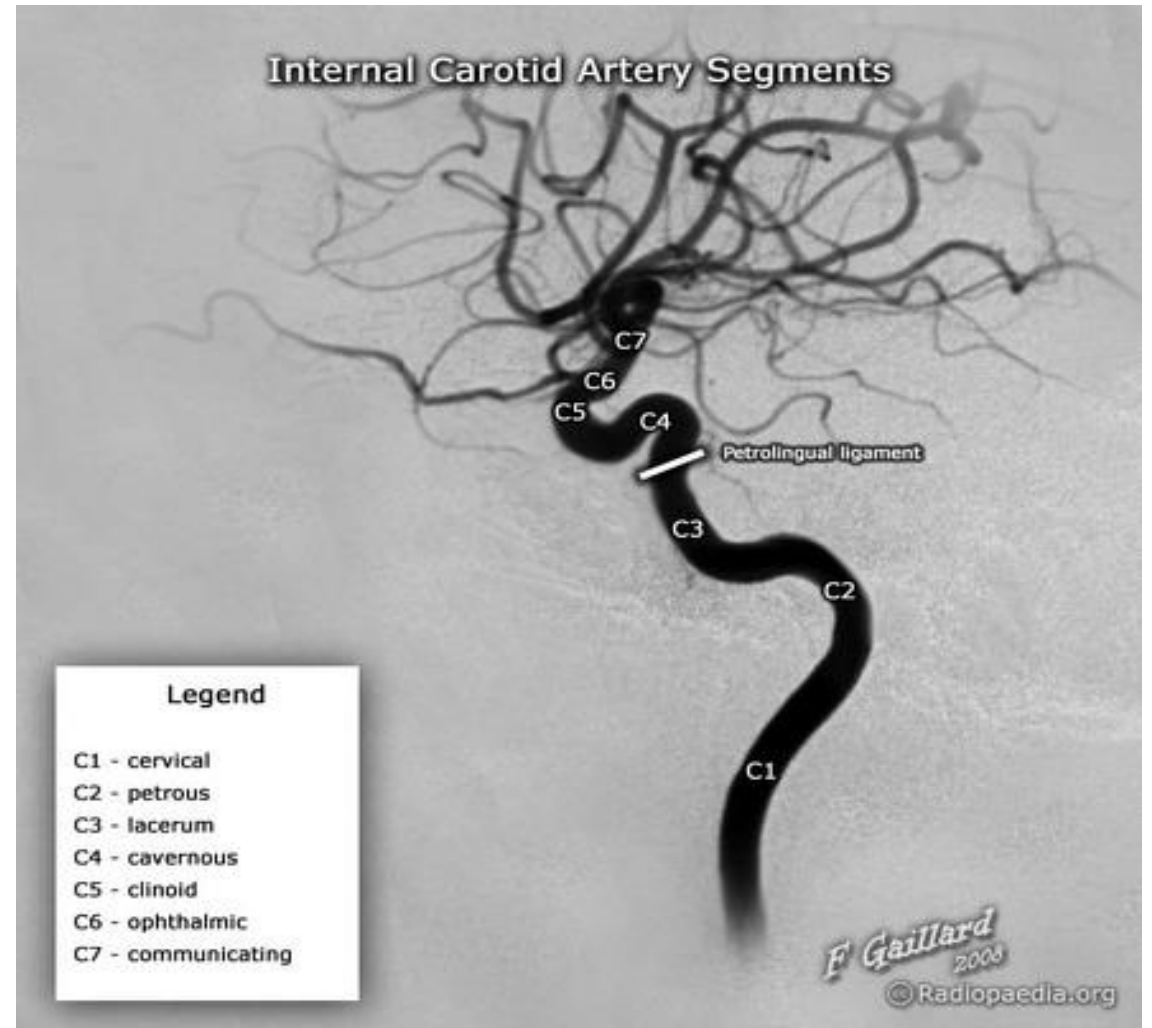






BOUTHILLIER CLASSIFICATION OF ICA

- C1...from bifurcation to carotid canal
- C2...from entrance to carotid canal to post. edge of foramen lacerum
branches....carotico tympanic artery
.....vidian artery
- C3...from post. edge of foramen lacerum to superior margin of petrolingual ligament
- C4...from sup. Margin of petrolingual ligament to proximal dural ring [ant clinoid process]



branches.....meningohypophyseal trunk

....inferolateral trunk

- C5...from prox dural ring to distal dural ring[cavernus sinus roof]
- C6...from distal dural ring to just proximal to the origin of post communicating artery

branches....ophthalmic artery

....superior hypophyseal trunk

- C7....from prox origin of posterior communicating artery to internal carotid artery bifurcation

branches....posterior communicating artery

.....anterior choroidal artery

.....ACA & MCA

BRANCHES OF ICA

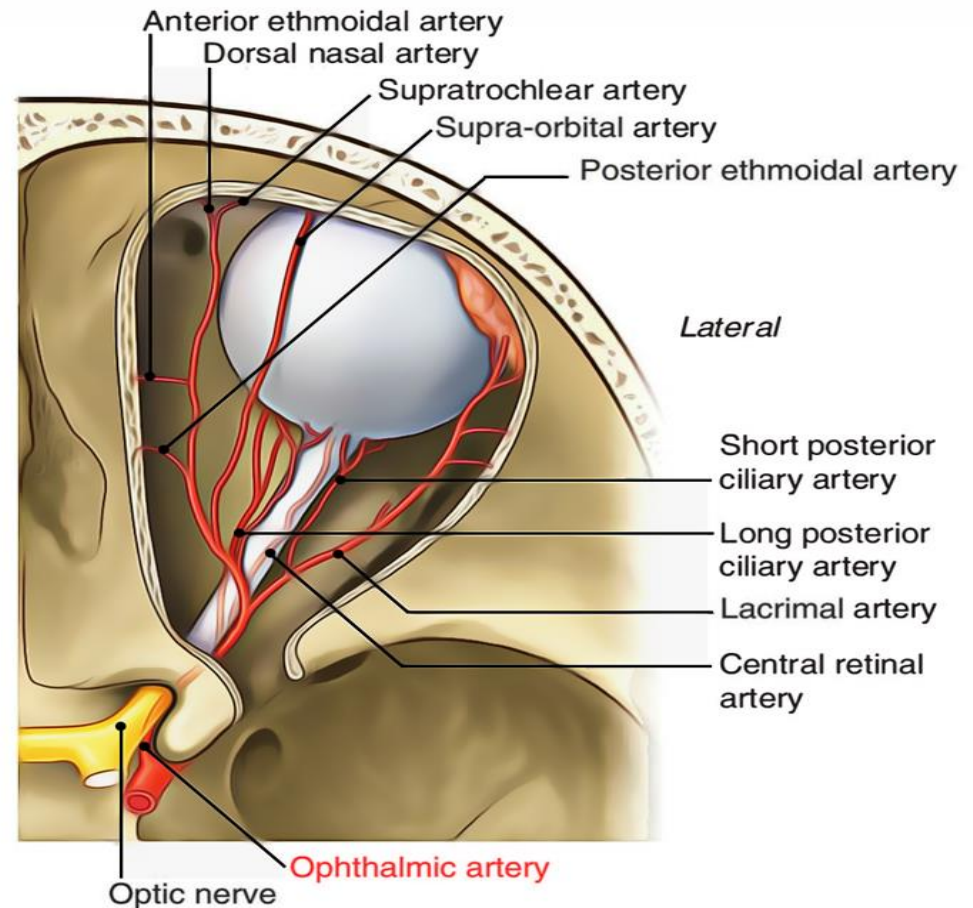
1. Ophthalmic artery

Supply....eye and other orbital structures

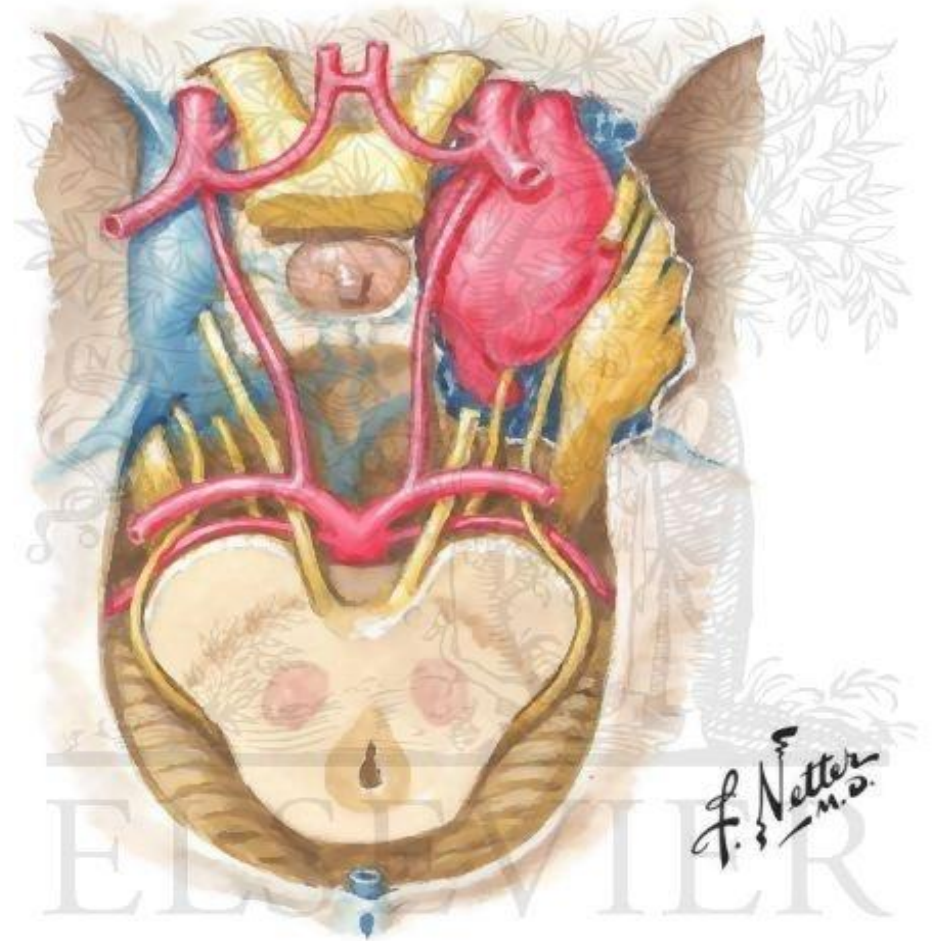
....frontal area of scalp

....ethmoid and frontal sinus

....dorsum of nose.



2. Posterior communicating artery.



3. Anterior choroidal artery...

Supply...posterior 2/3 of internal capsule

....optic tract and auditory radiations

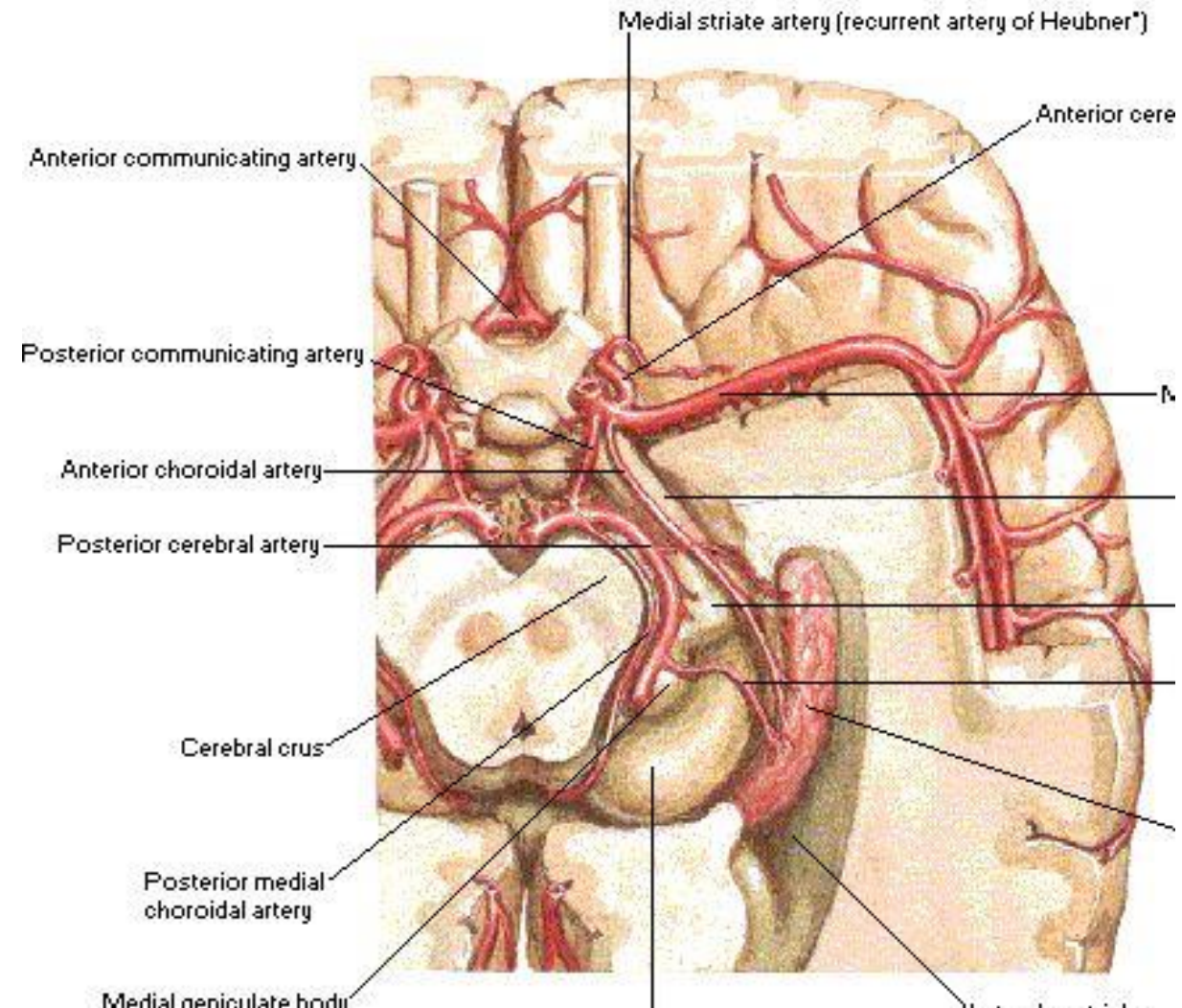
....lateral geniculate nucleus

....medial segment of globus pallidus

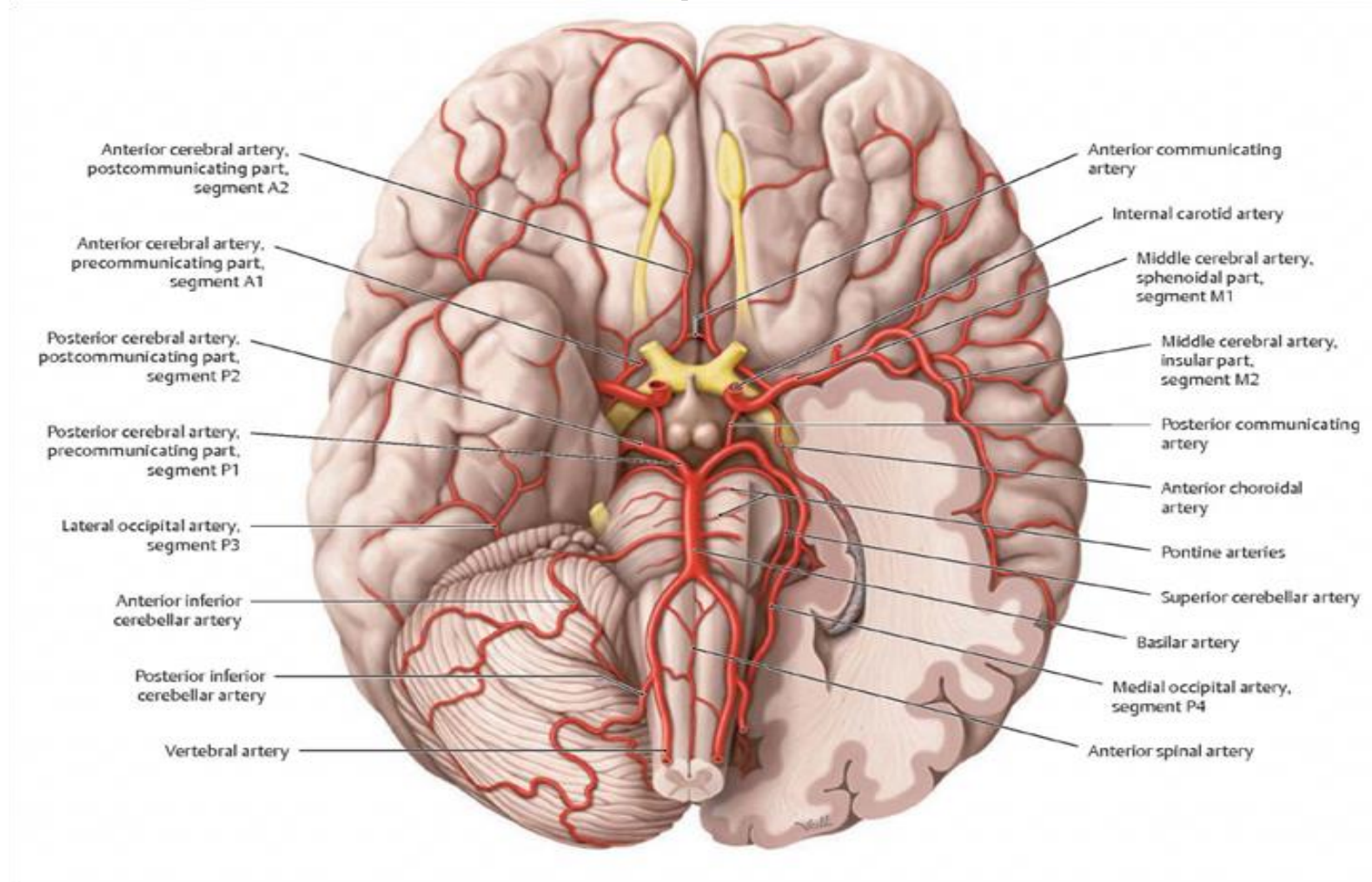
....tail of caudate nucleus

Superficial branches...uncus

hippocampus ...parts of amygdala and



4. Anterior cerebral artery



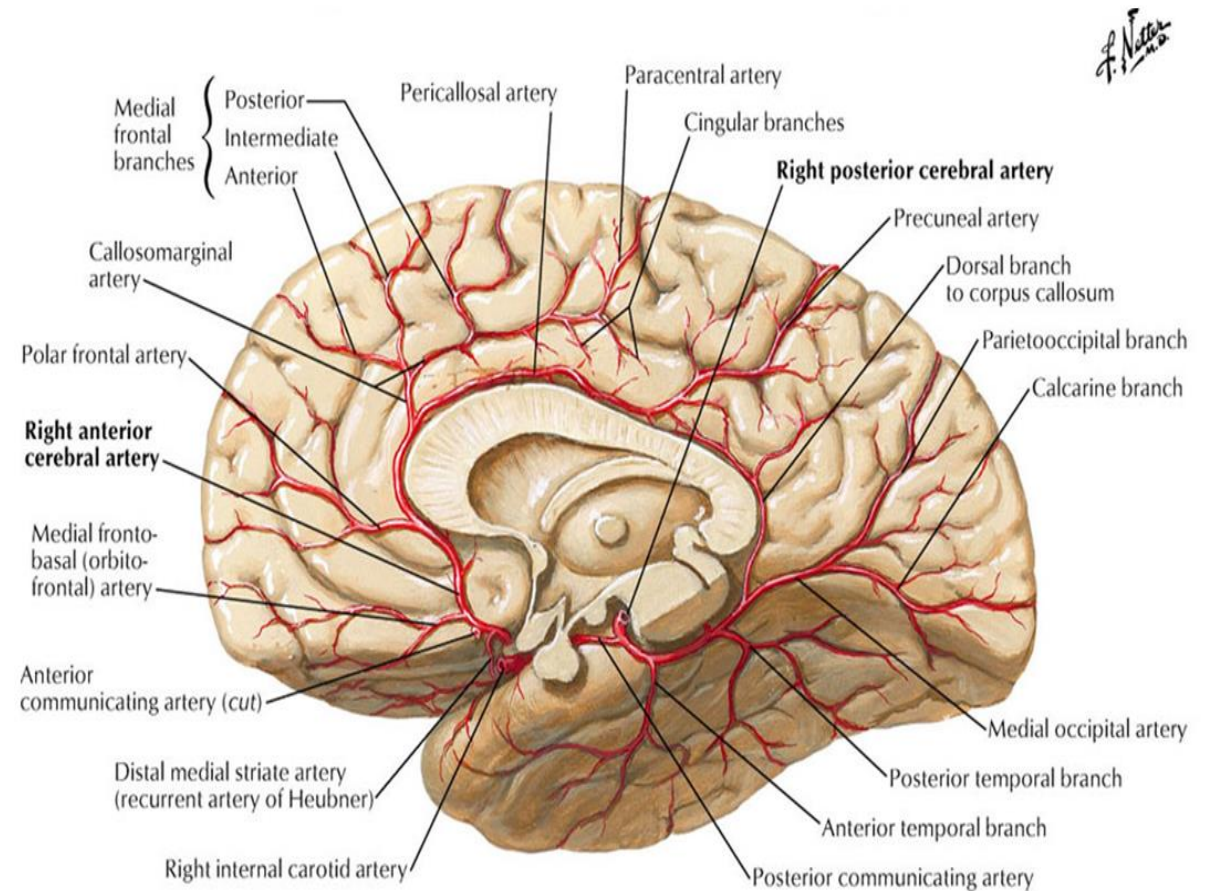
- Branches of ACA

A1...a.medial lenticulostriate artery

b.Anterior communicating artery

Supply...caudate nucleus,anterior limb of internal capsule,anterior hypothalamus,septum pellucidum,ant commissure,fornix.

A1 segment is associated with aneurysms.



*Note: Anterior parietal (postcentral sulcal) artery also occurs as separate anterior parietal and postcentral sulcal arteries.

A2...a.recurrent artery of Heubner
b.orbitofrontal artery
c.frontopolar artery

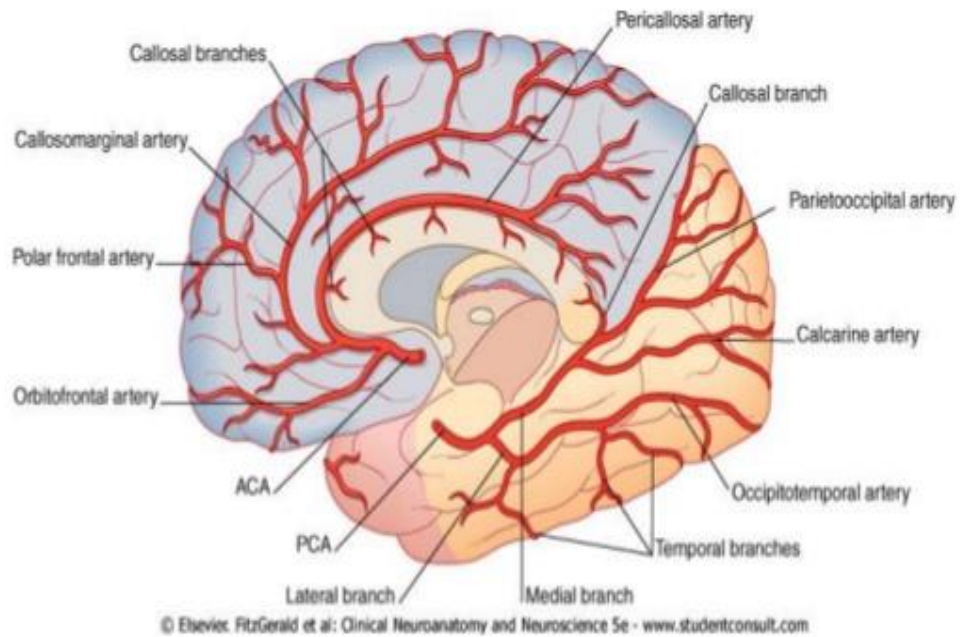
It then bifurcates into pericallosal and callosomarginal arteries

Supply....anterior portion of caudate nucleus
....internal capsule
.....inferior and inferomedial surface of frontal lobe

A3....[pericallosal]

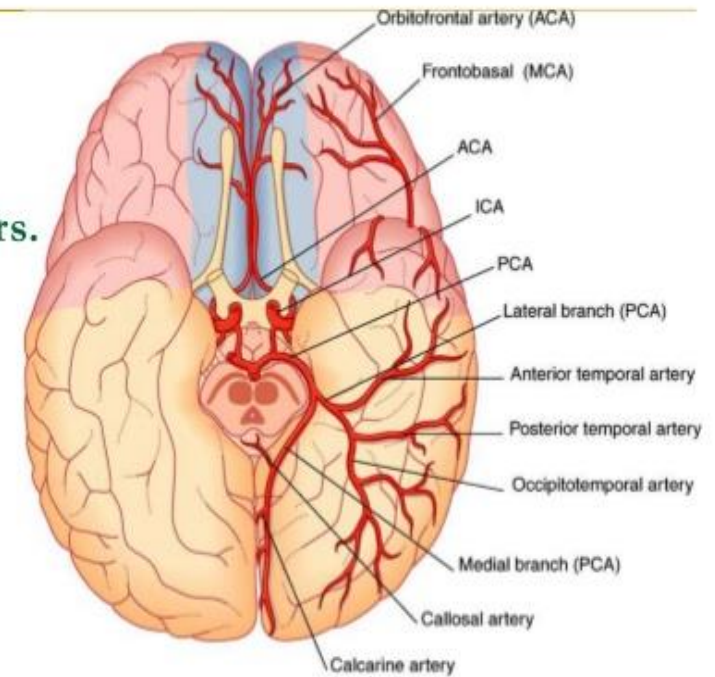
A4 & A5

Anterior Cerebral Artery: Cortical brs.

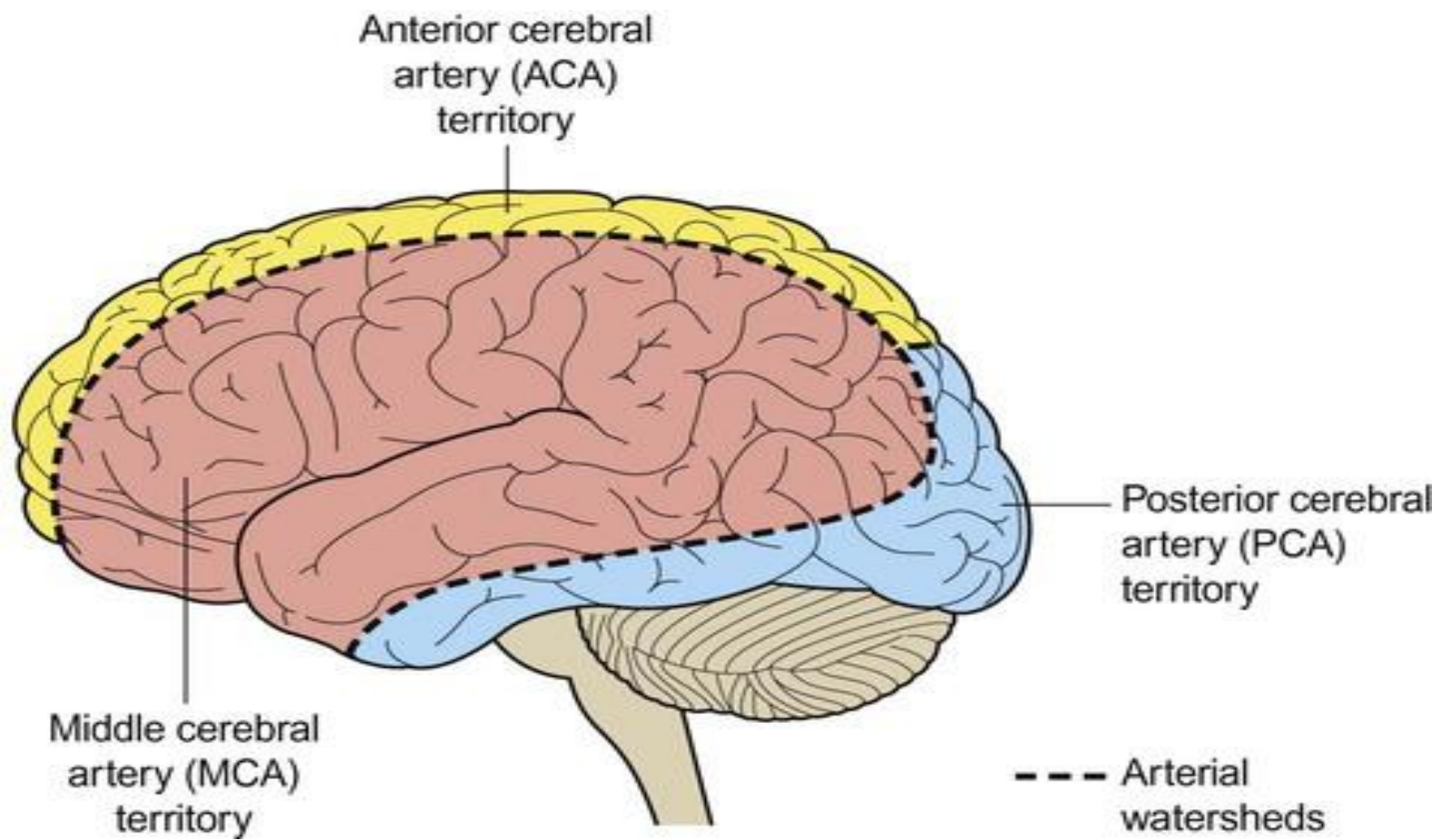


Medial view of the right hemisphere, showing the cortical branches and territories of the three cerebral arteries. ACA, PCA, anterior, posterior cerebral arteries.

Anterior Cerebral Artery: Cortical brs.



View from below the cerebral hemispheres, showing the cortical branches and territories of the three cerebral arteries. ACA, MCA, PCA, anterior, middle, posterior cerebral arteries; ICA, internal carotid artery.



Syndromes of ACA stroke

- **Uncommon in isolation.**
- Occur in patients with vasospasm after SAH caused by ACA or ACoM aneurysm.
- Otherwise percentage of ACA infarcts is < 3%



Deficit

1. Maximum disturbances occur when both arteries arise from one stem

.....paraplegia

.....urine incontinence

.....abulia

.....nonfluent aphasia

....personality changes

2. Contralateral weakness....lower extremity and to lesser extent the arm

3. Discriminative and proprioceptive sensory loss [primarily in lower extremity]

4. Anterior disconnection syndrome....left arm apraxia due to involvement of left corpus callosum {sympathetic apraxia}.

5. Infarction in basal branch....memory disturbance
anxiety and agitation

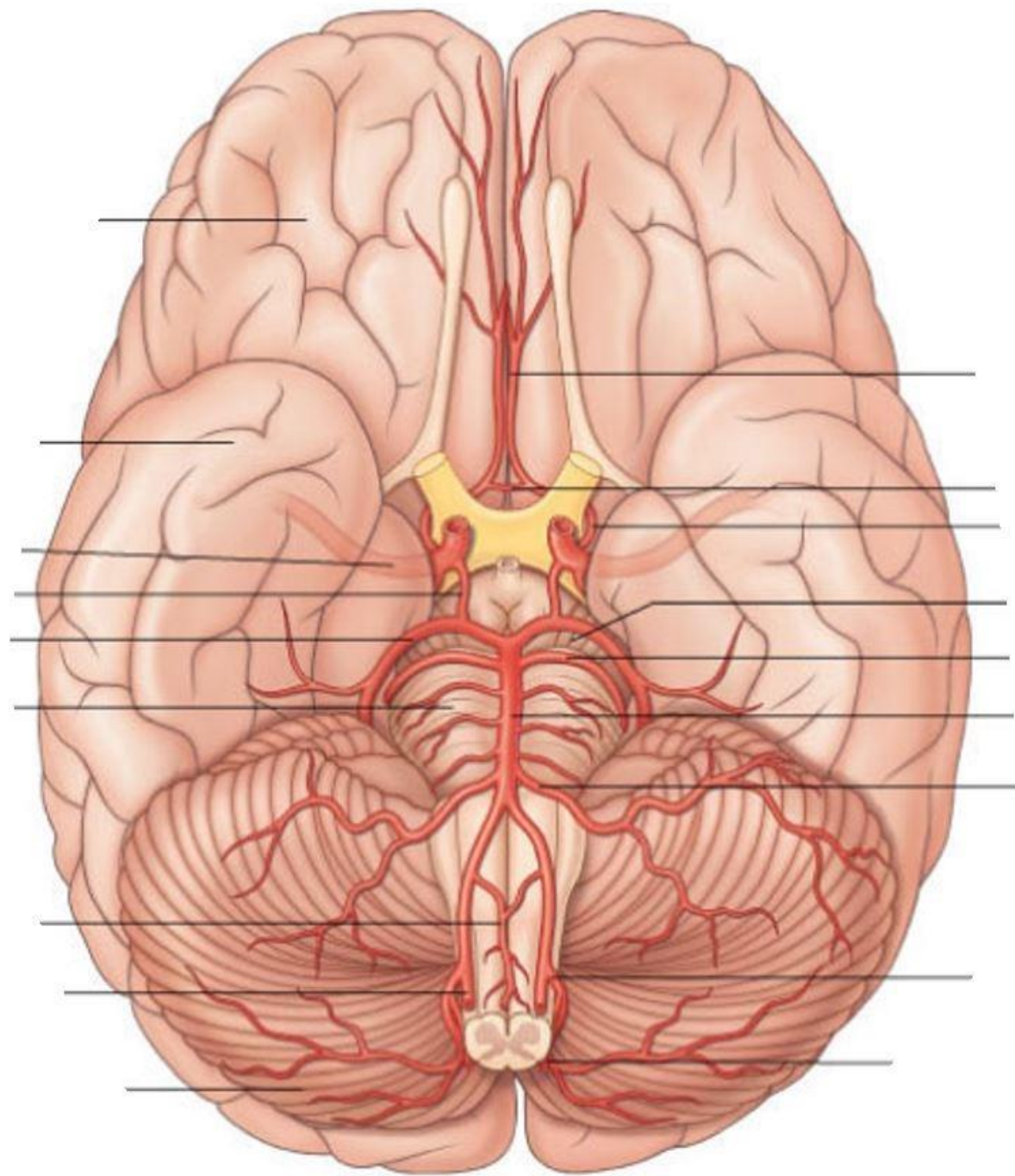
6. Infarction in medial lenticulostriate arteries[artery of hubner]

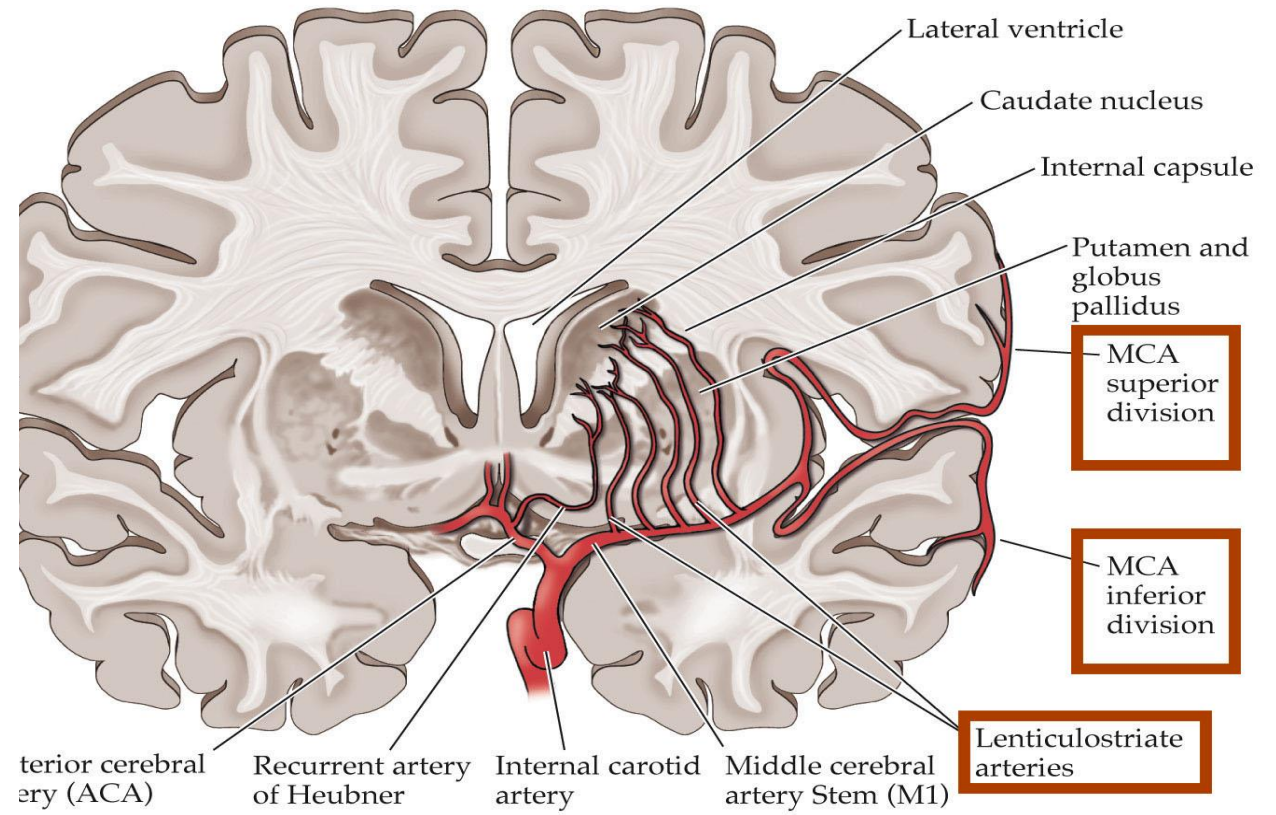
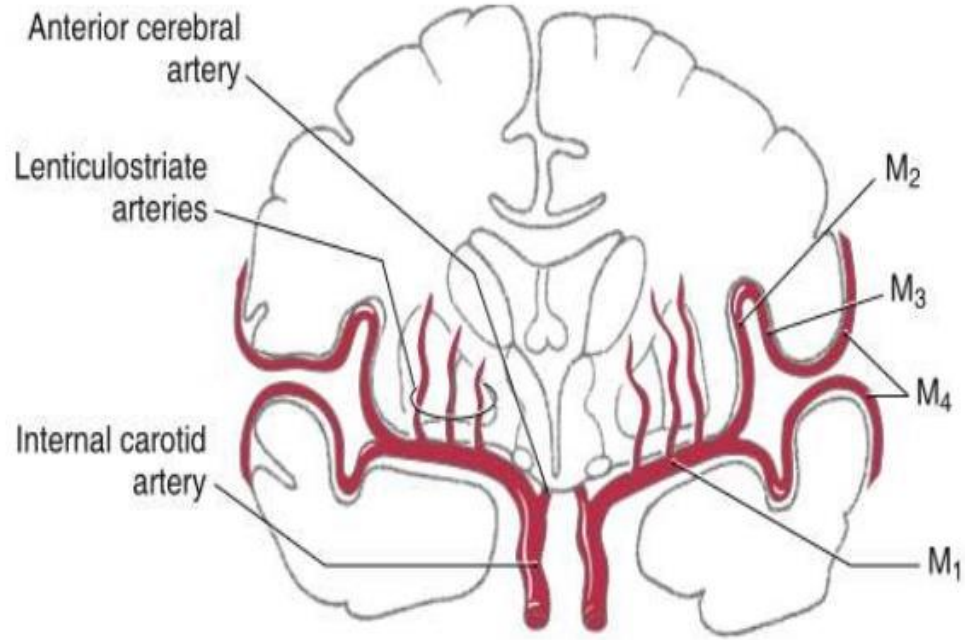
.....more profound weakness of face and arm without sensory loss due to involvement of anterior limb of internal capsule.

7. Contralateral grasp, sucking reflex, paratonic rigidity....medial surface of posterior frontal lobe.

8. Abulia...superiomedial lesion near corpus callosum

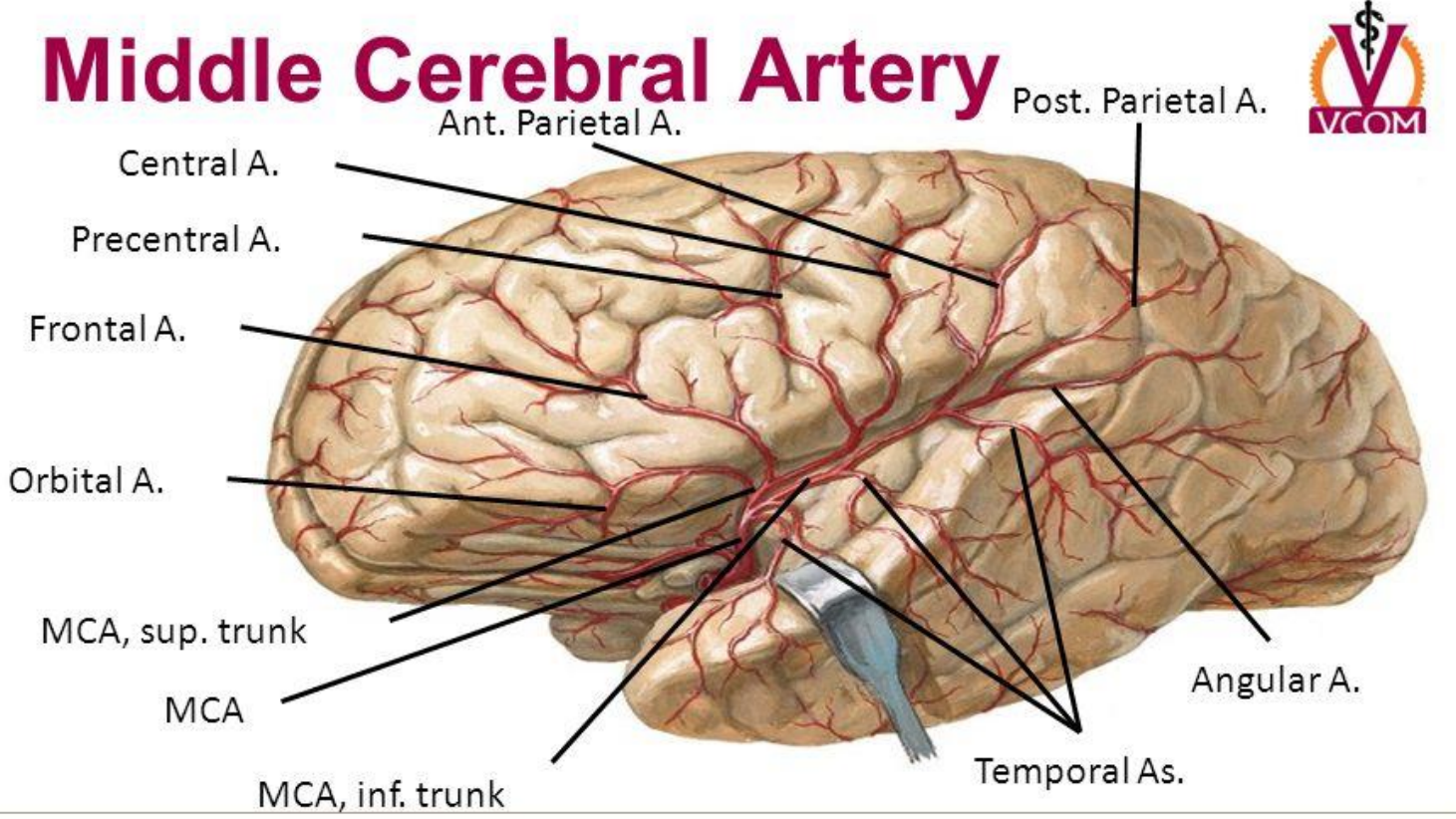
Middle cerebral artery course





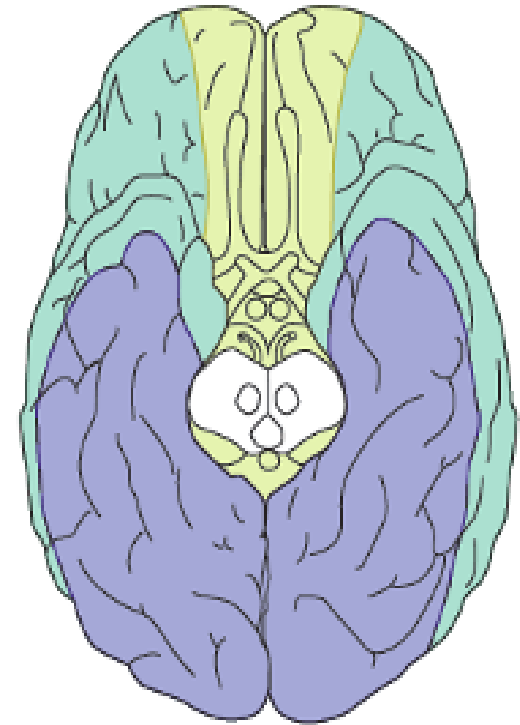
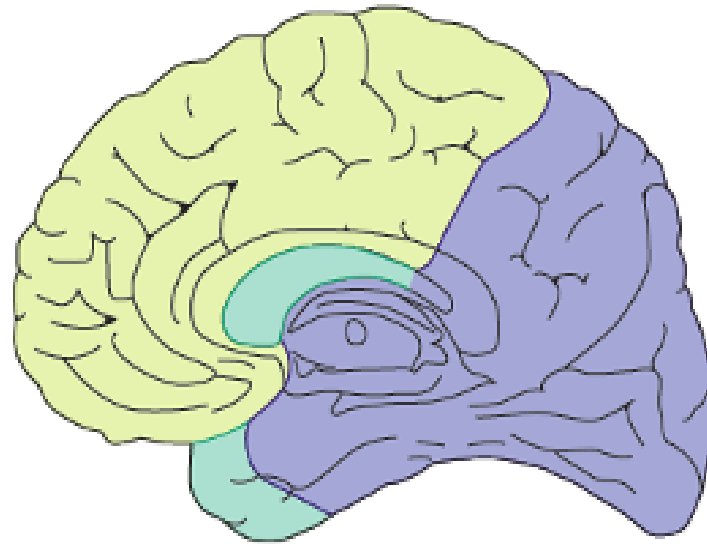
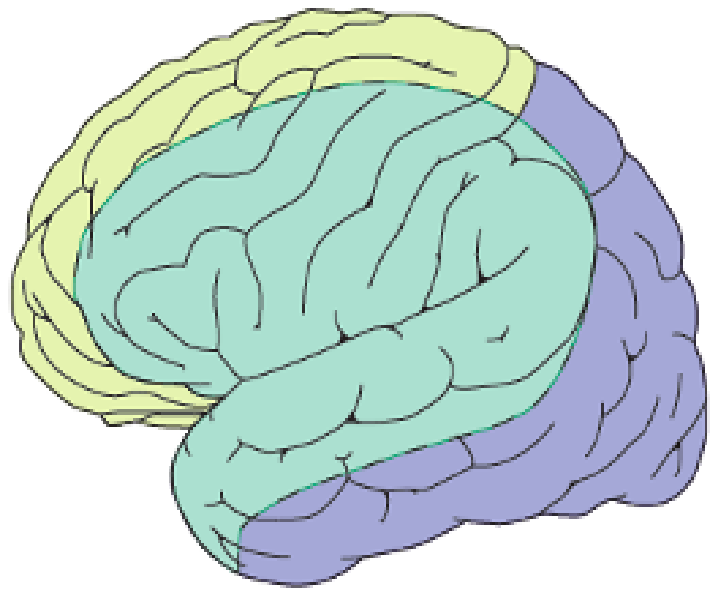
MCA.....BRANCHES

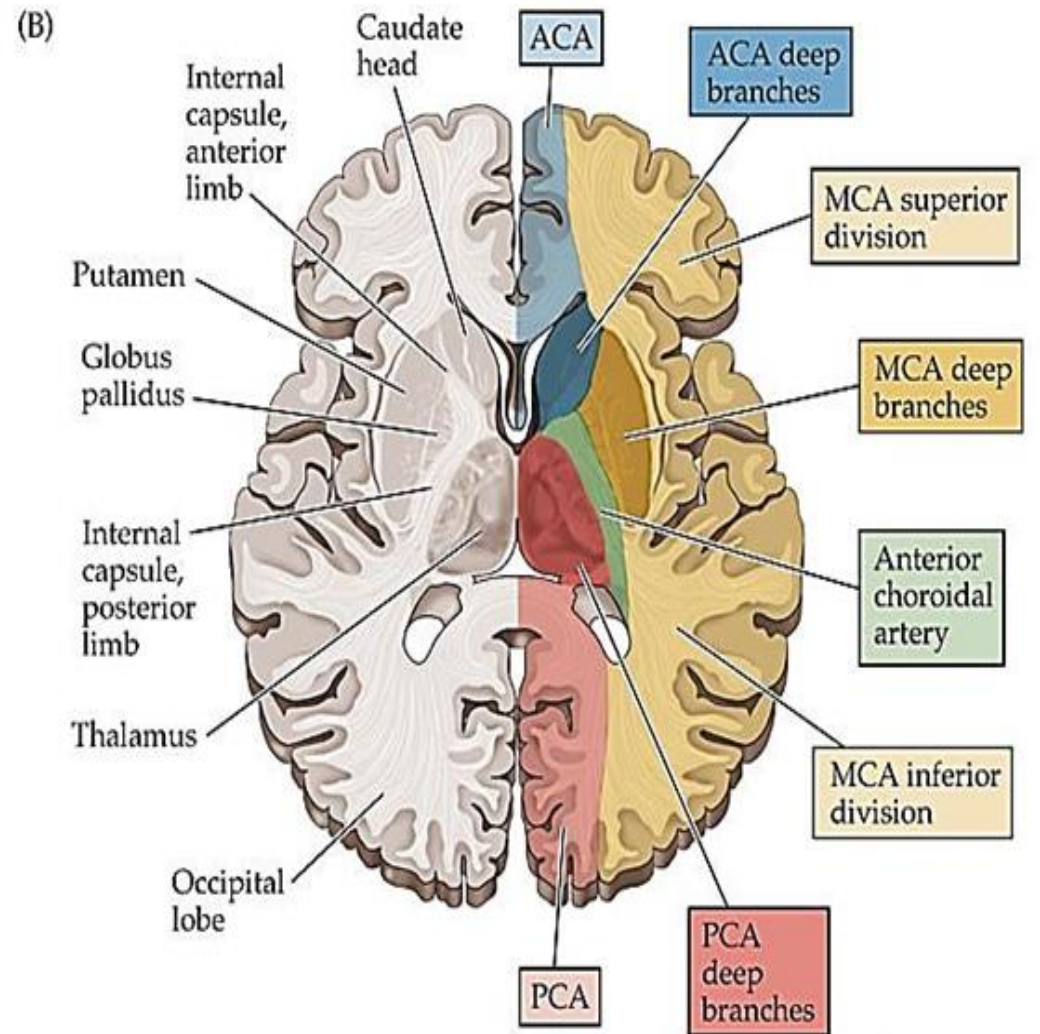
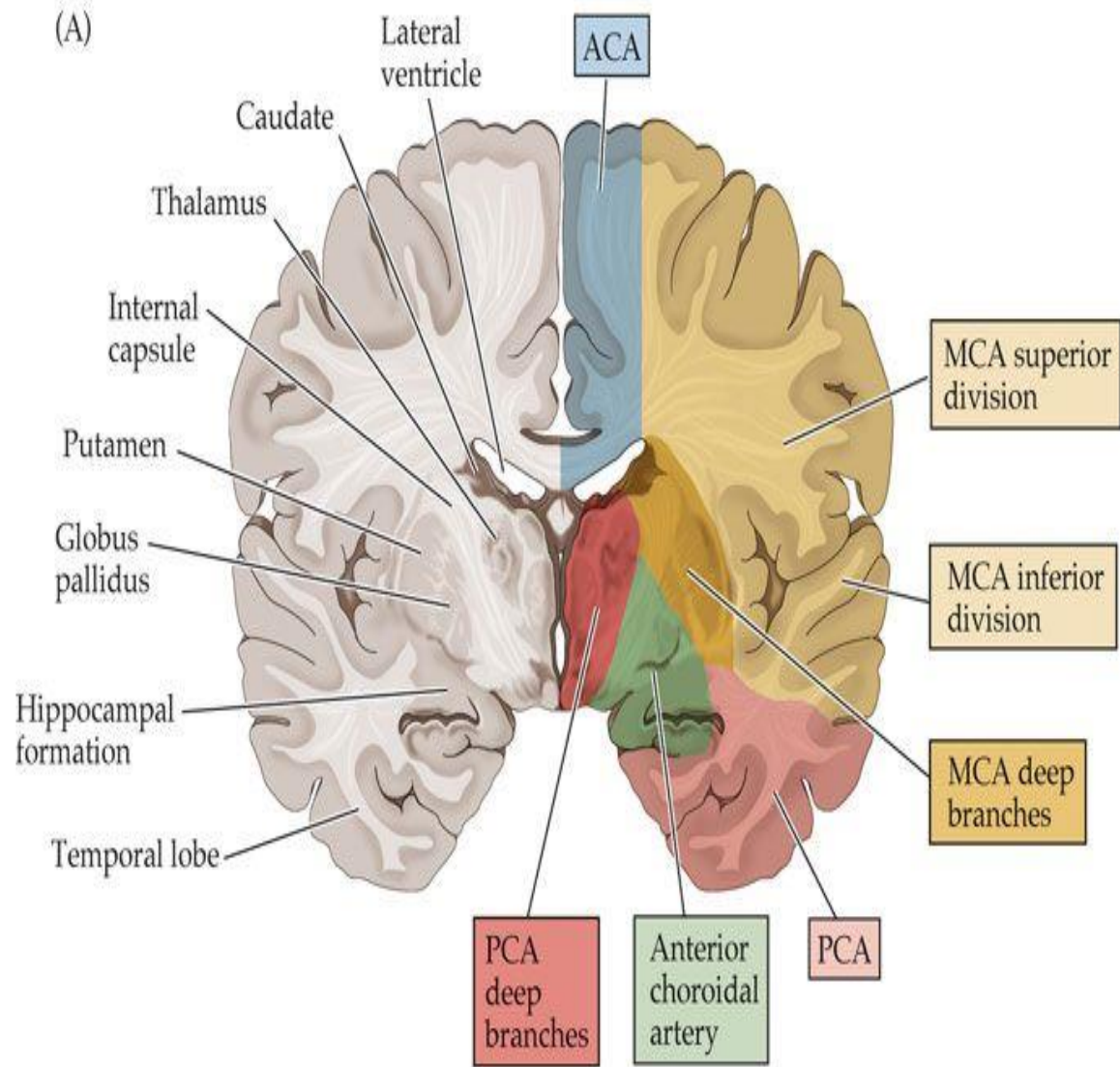
Middle Cerebral Artery

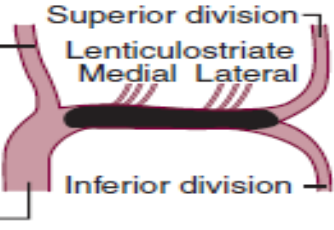

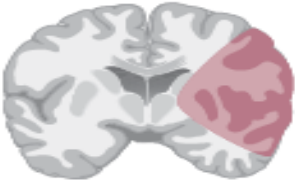
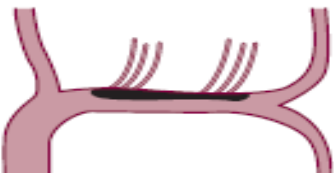

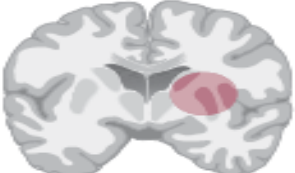
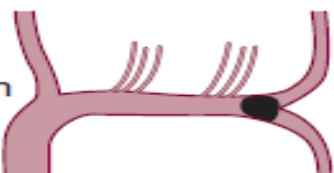
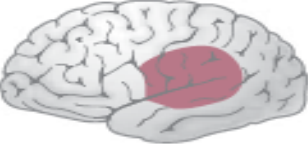

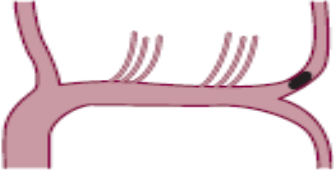


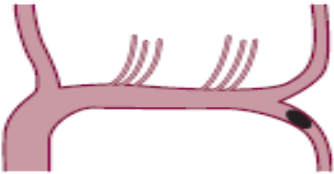

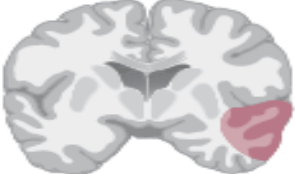


MCA...DISTRIBUTION

- Anterior cerebral artery (supplies anteromedial surface)
- Middle cerebral artery (supplies lateral surface)
- Posterior cerebral artery (supplies posterior and inferior surfaces)





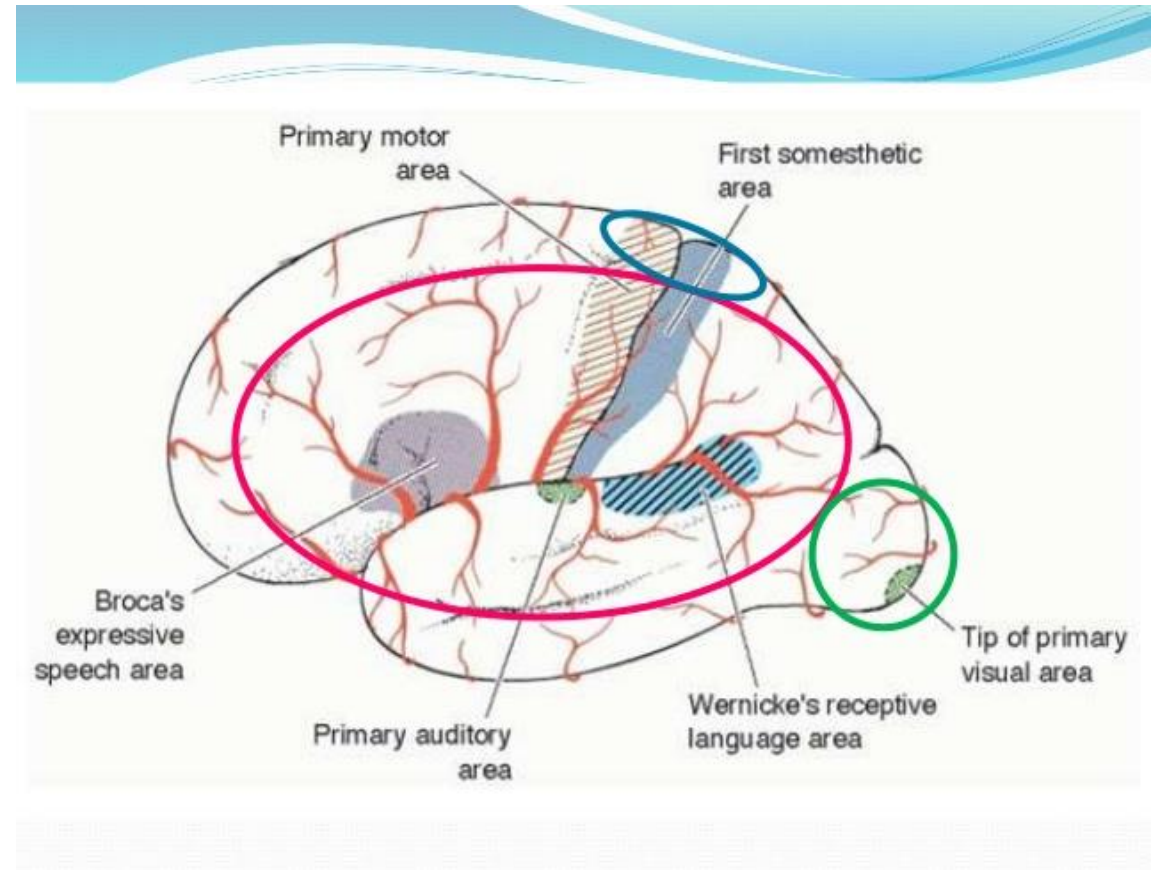
Lesion	Artery occluded	Infarct, surface	coronal section	Clinical manifestations
Entire territory Anterior cerebral Internal carotid	 <p>Superior division Lenticulostriate Medial Lateral Inferior division</p>			Contralateral gaze palsy, hemiplegia, hemisensory loss, spatial neglect, hemianopsia Global aphasia (if on left side) May lead to coma secondary to edema
Deep				Contralateral hemiplegia, hemisensory loss Transcortical motor and/or sensory aphasia (if on left side)
Parasyllvian				Contralateral weakness and sensory loss of face and hand Conduction aphasia, apraxia and Gerstmann syndrome (if on left side) Constructional dyspraxia (if on right side)
Superior division				Contralateral hemiplegia, hemisensory loss, gaze palsy, spatial neglect Broca's aphasia (if on left side)
Inferior division				Contralateral hemianopsia or upper quadrant anopsia Wernicke's aphasia (if on left side) Constructional dyspraxia (if on right side)

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MCAstem occlusion

- Contralateral hemiplegia...post limb of internal capsule
- Hemianestheisa
- Homonymous hemianopia...infarction of lateral geniculate body.
- Global aphasia
- Anosognosia ...with right sided lesions

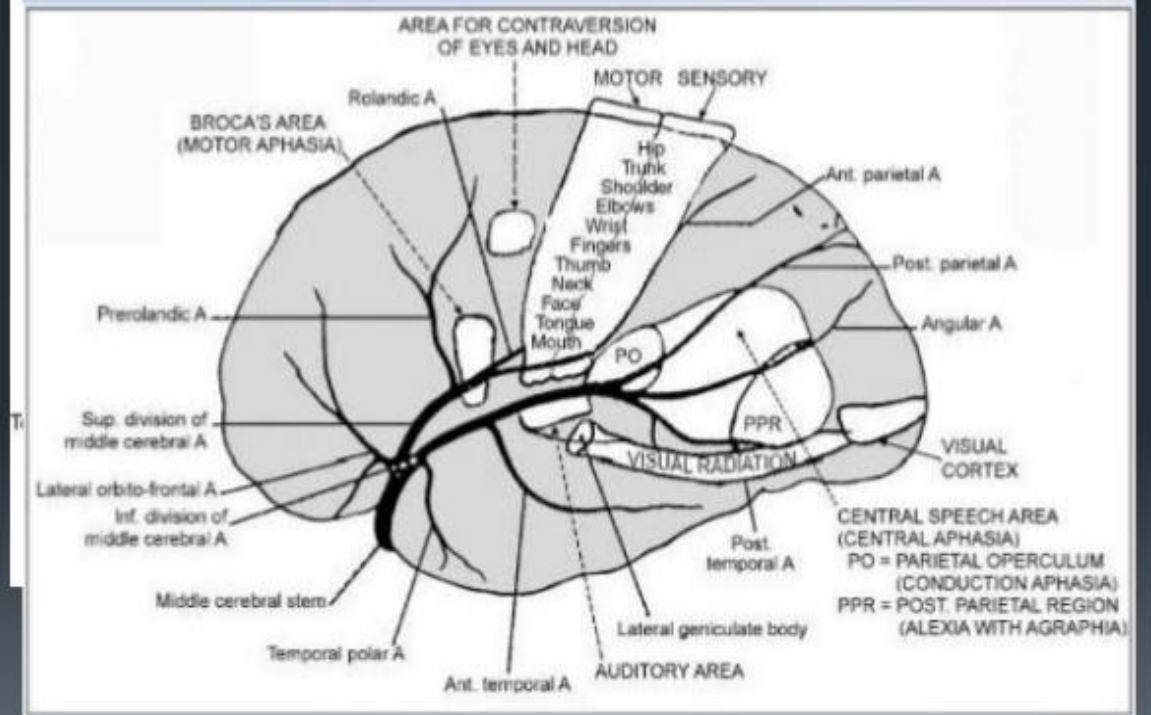




Superior division of MCA

- Sensorimotor deficit in contralateral face and arm and to lesser extent leg.
- Ipsilateral deviation of head and eyes.
- Initially global aphasia which changes to Broca's aphasia...left sided lesions

MIDDLE CEREBRAL ARTERY (MCA):



ASCENDING FRONTAL BRANCH

- motor weakness limited to face and arm.
- Broca's aphasia.{left sided lesion}

LEFT ROLANDIC BRANCH

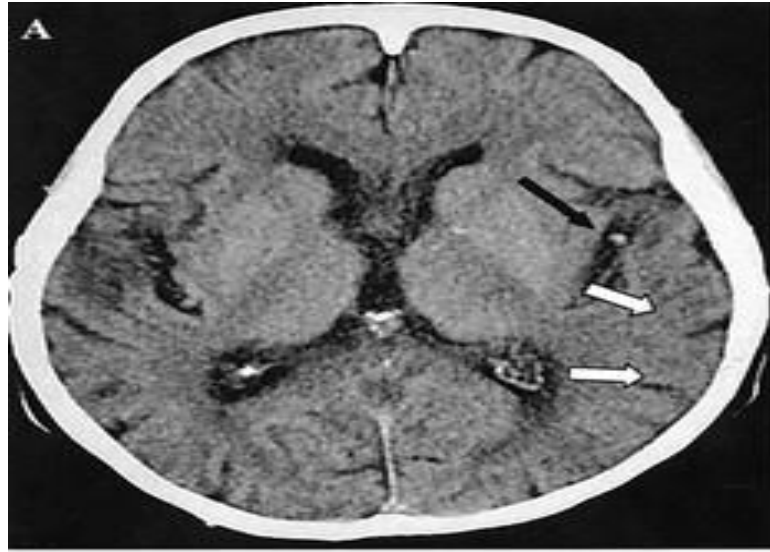
- Sensori motor weakness with severe dysarthria with little aphasia.

ASCENDING PARIETAL OR POSTERIOR BRANCHES OF SUPERIOR DIVISION

- No sensorimotor deficit but only conduction aphasia and ideomotor apraxia.

Inferior division of MCA

- Wernicke's aphasia....left sided lesions.
- Superior quadrantanopia or homonymous hemianopia
- Left visual neglect in right sided lesions



To summarize MCA strokes

- Paralysis of contralateral face & arm....somatic motor area
- Sensory impairment contralateral face & arm....somatosensory area for face and arm
- Motor speech disorder.....broca's area
- Gerstmann syndrome....parietal lobe dominant hemisphere
- Anosognosia, unilateral neglect....nondominant parietal lobe

- Homonymous hemianopia....optic radiation deep to temporal convolution
- Paralysis of conjugate eyes to opposite side....frontal convulsive eye field

ASPECT SCORE

- Alberta Stroke Programme Early CT Score

It has been recognized as a key selection criteria in updated AHA guidelines on management of acute stroke ,where endovascular therapy in patients with ASPECTS >6 is recommended

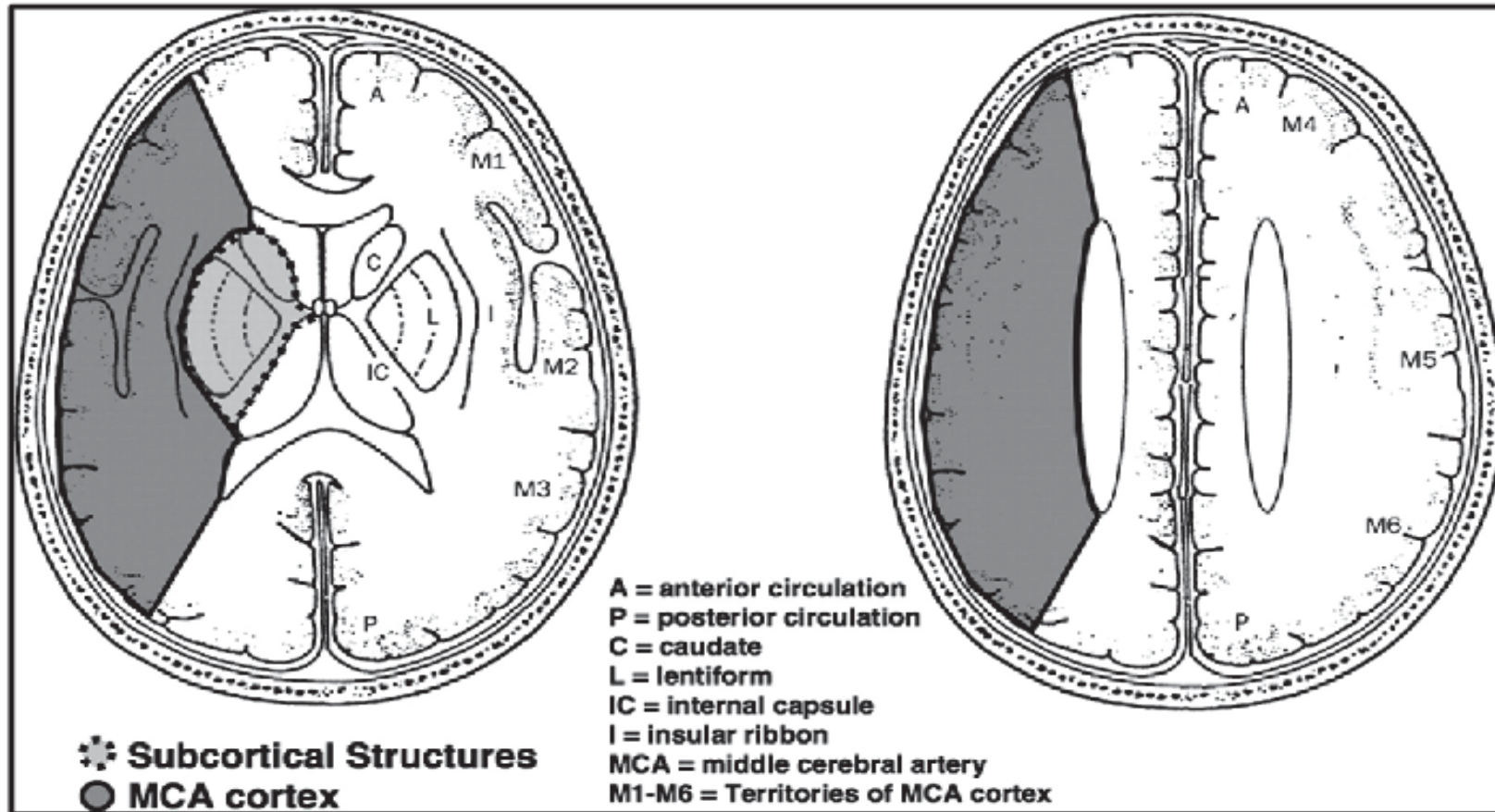
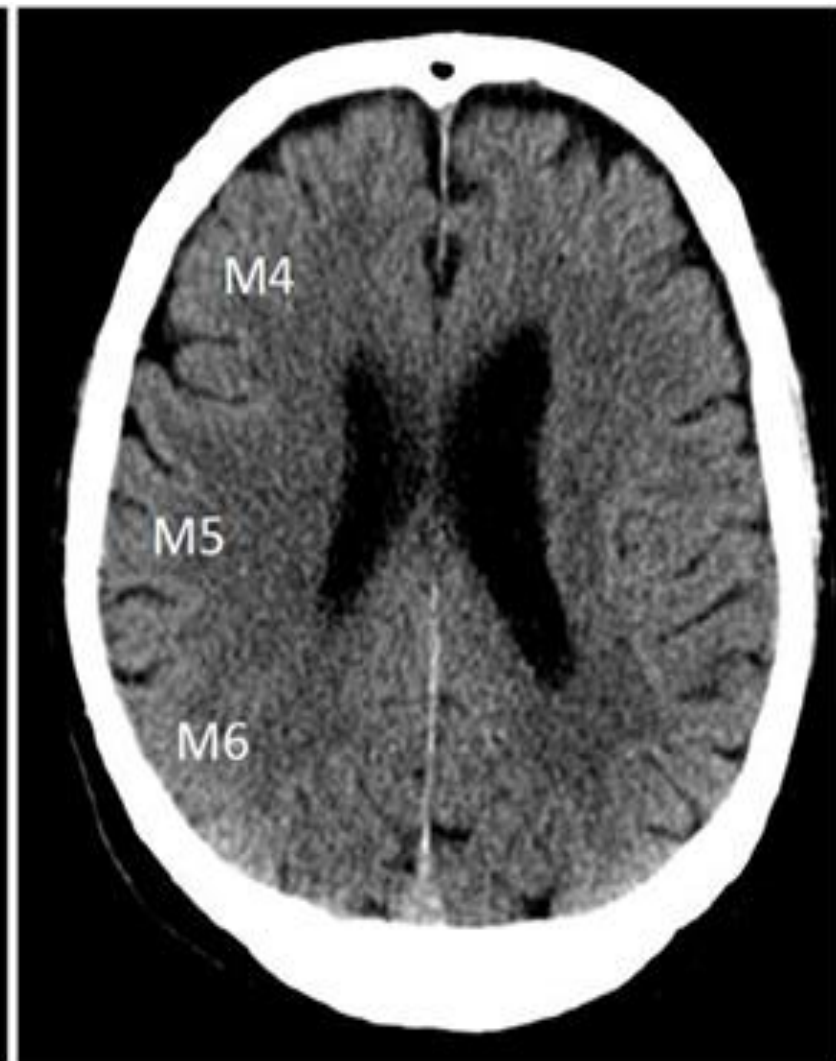
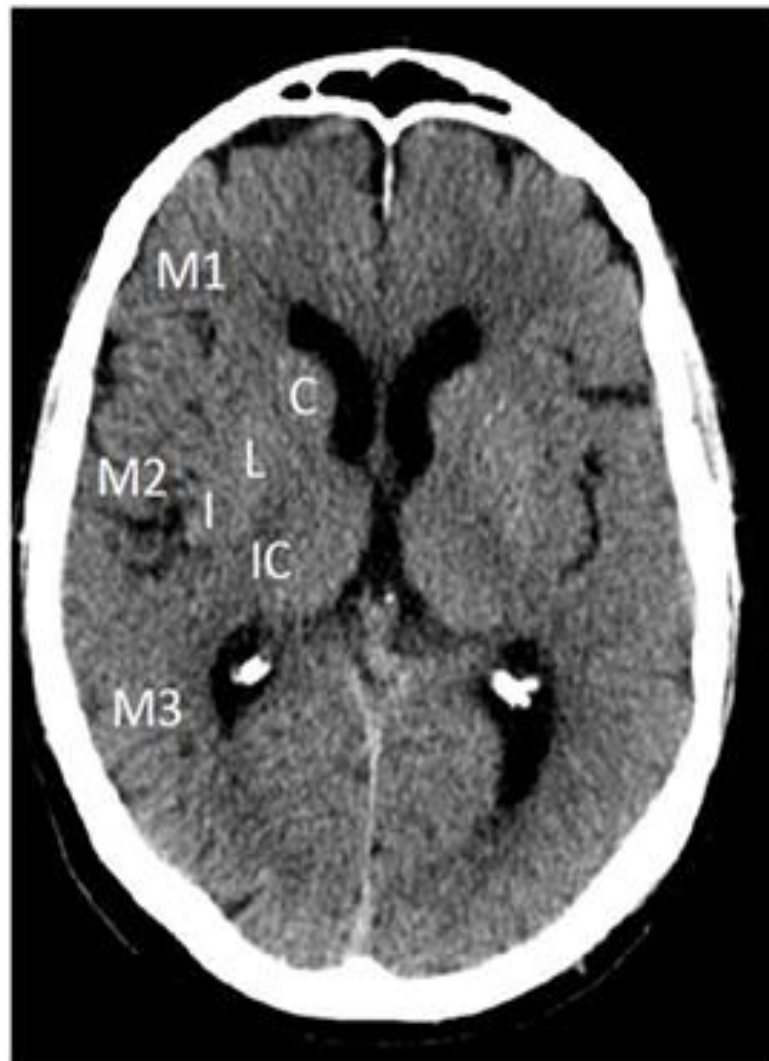


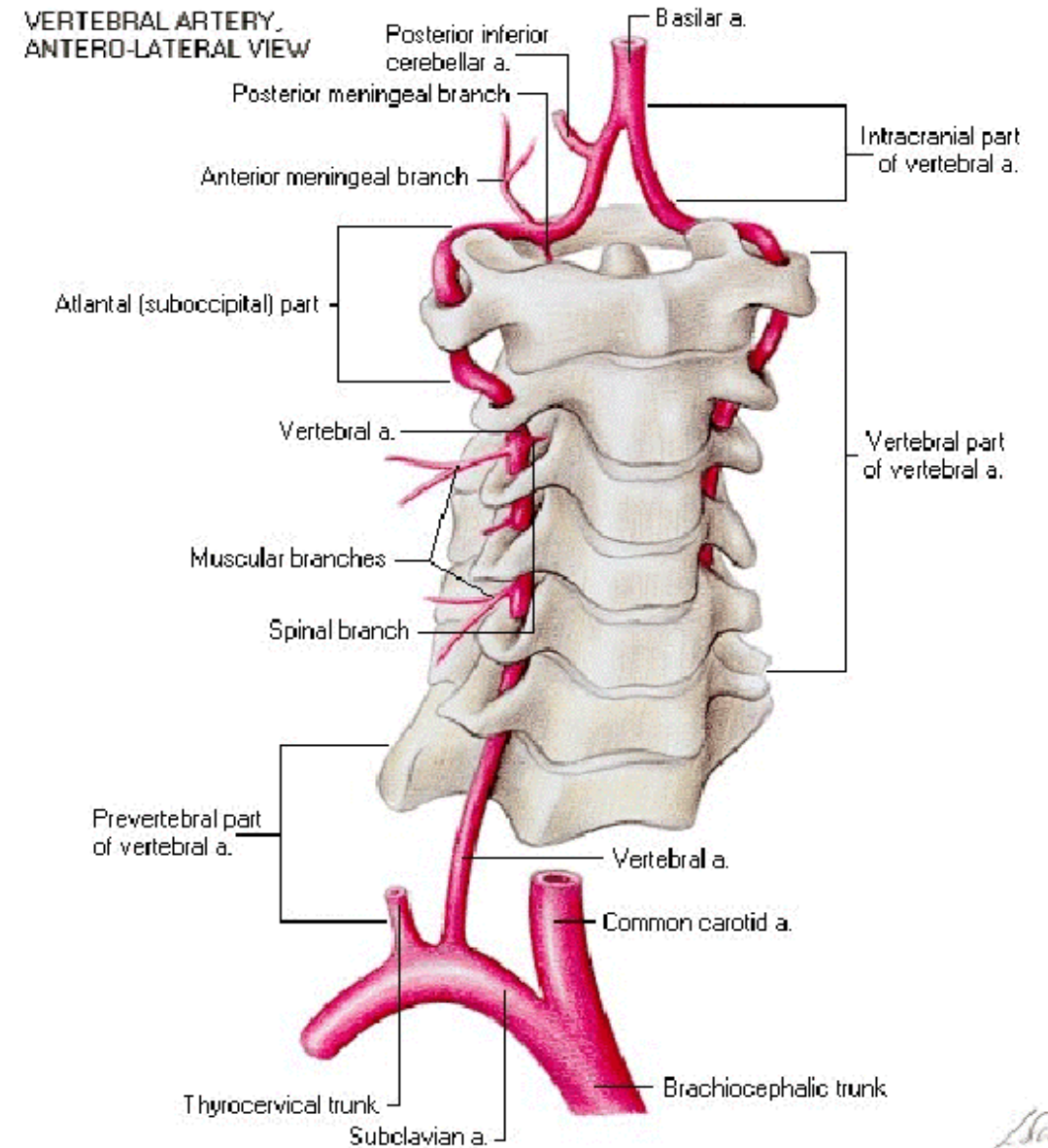
Fig. 1. ASPECTS regions (adapted from Barber et al [2]) (A) Anterior circulation; (P) Posterior circulation; (C) Nucleus Caudatus; (L) Nucleus Lentiformis; (IC) Internal Capsule; (I) Insular Ribbon; (M1) anterior MCA cortex; (M2) MCA cortex lateral to insular ribbon; (M3) posterior MCA cortex; (M4), (M5), and (M6) are anterior, lateral, and posterior MCA territories immediately superior to (M1), (M2), and (M3), rostral to basal ganglia.

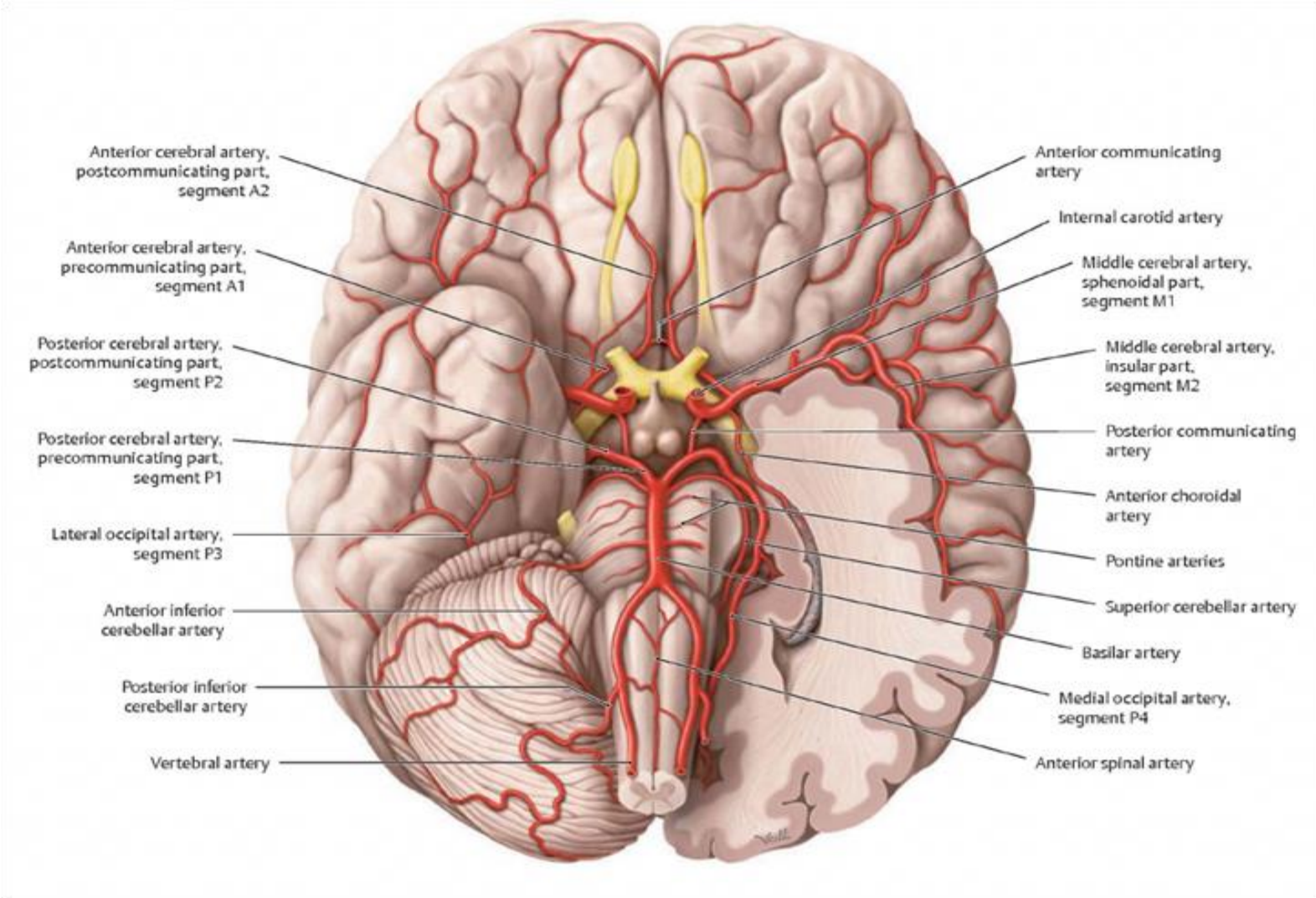


- When calculating ASPECT one point is subtracted for early ischemic change, such as focal swelling or parenchymal hypoattenuation, in each of 10 defined regions.
- Normal NCCT has ASPECT of 10 while diffuse ischemic changes throughout MCA territory gives a value of zero.

VERTEBRAL ARTERY

- V1...from its origin to vertebral transverse foramen C6 .
- V2...through the transverse foramen C6 –C1.
- V3....suboccipital part
- V4....intracranial part





Vertebral artery branches

- Meningeal branches....supply bone and dura in posterior cranial fossa.
- Anterior spinal artery
- Posterior spinal artery
- PICA
- Medullary arteries...distributed to medulla

PICA COURSE

PICA

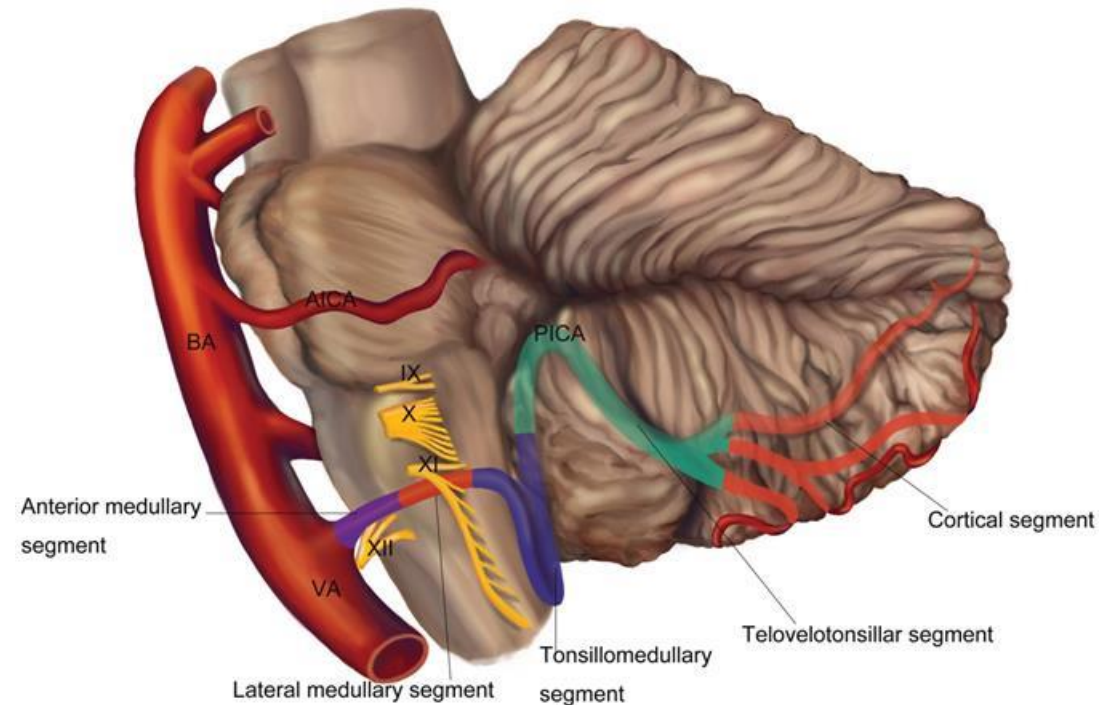
In 20% PICA arises from extracranial part

In 10% it arises from basilar artery.

SUPPLIES....medulla[dorsolateral region of medulla]

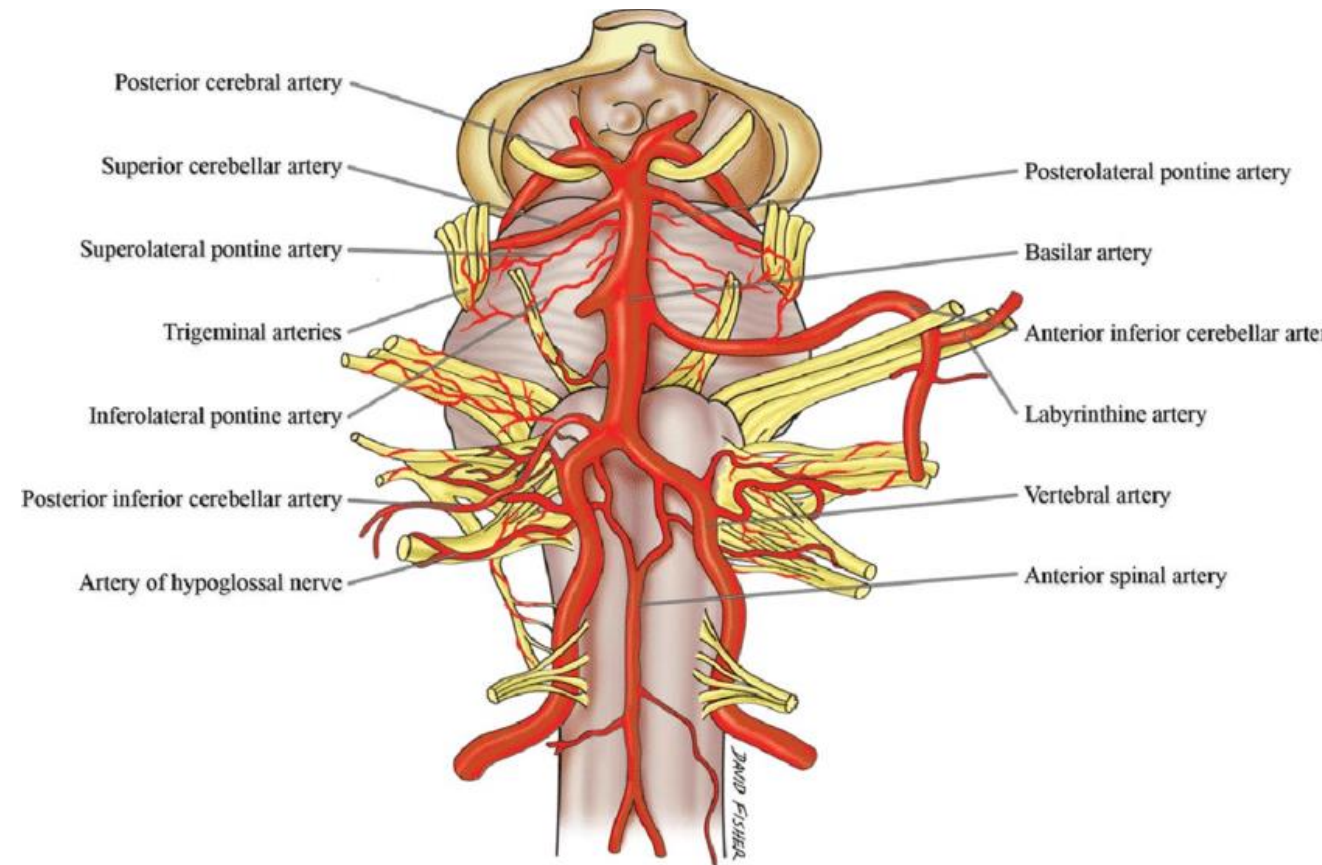
Cerebellum [ventral surface of cerebellar hemispheres]

Choroid plexus of 4th ventricle



BASILAR ARTERY COURSE BRANCHES...

- Small perforating arteries...paramedian circumferential to the pons
- AICA
- SCA.
- Labyrinthine artery.



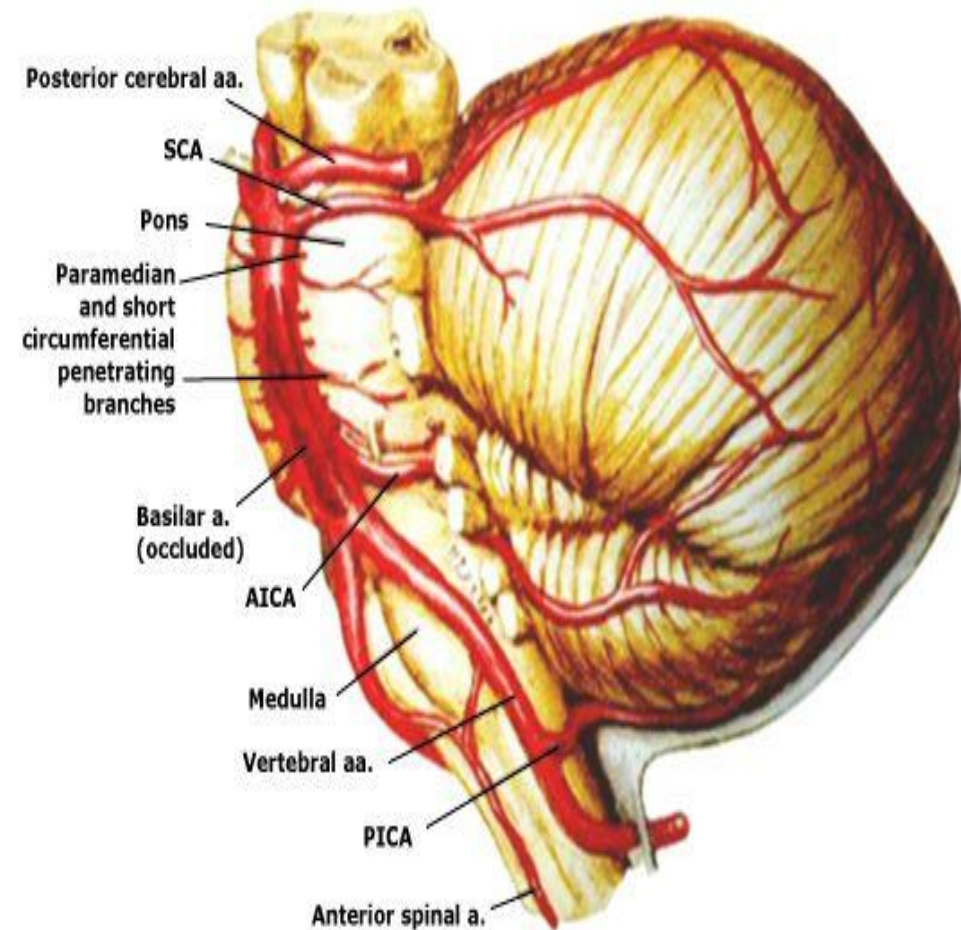
AICA COURSE

- Supplies...anterior and inferior surface of cerebellum

....middle cerebellar peduncle.

....inferiolateral portion of pons

....cranial nerves 7th & 8th



SCA

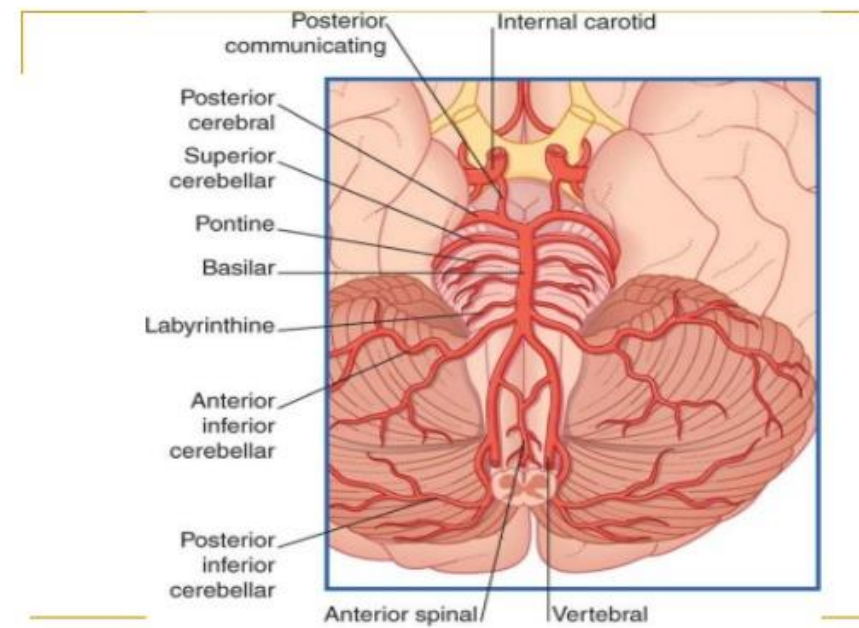
- SUPPLIES.....superior cerebellar peduncle
 -superior surface of cerebellum
 -deep nuclei embedded in cerebellar white matter
 -brainstem region

POSTERIOR CEREBRAL ARTERY

In 70% both PCA arise from the basilar artery

20% has its origin from ipsilateral ICA via PCoM {fetal origin PCA}

5% both arise from respective internal carotid arteries.



Arterial supply of hindbrain.

BRANCHES

1. Interpeduncular branches

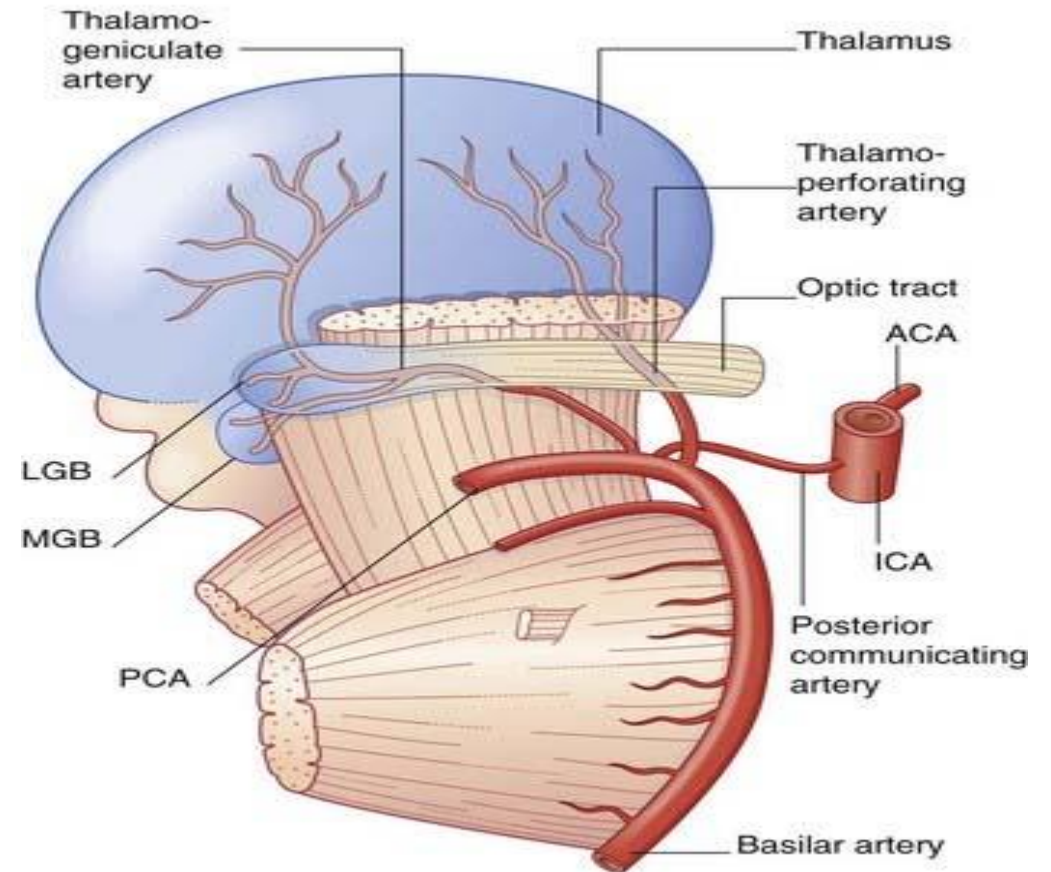
....red nucleus,

substantia nigra

medial parts of cerebral
peduncles

3rd & 4th nerve

reticular substance of upper
brainstem



2. Thalamoperforate arteries [paramedian thalamic arteries]

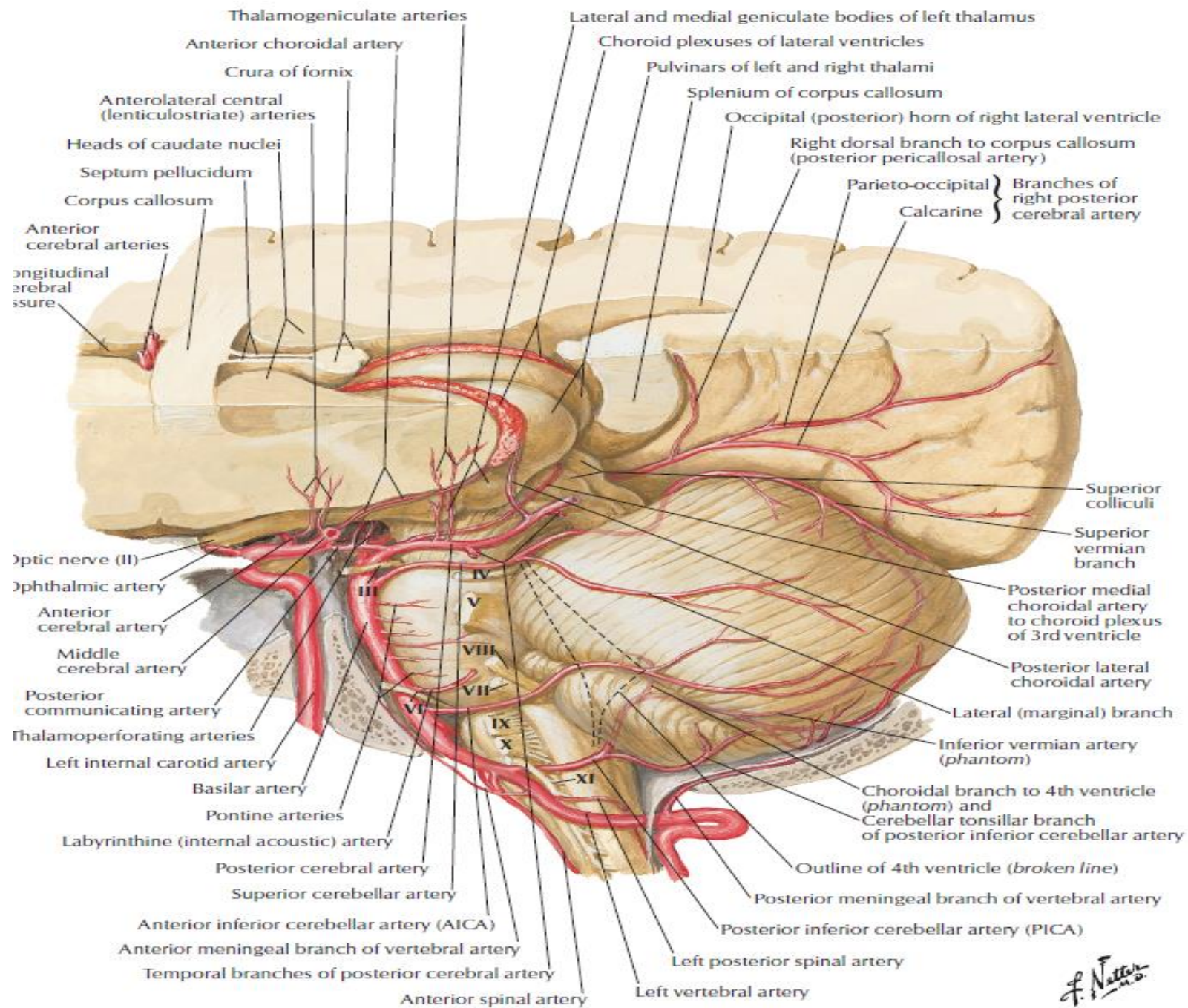
....thalamus [anterior, inferior and medial parts of thalamus]

3. Thalamogeniculate branches

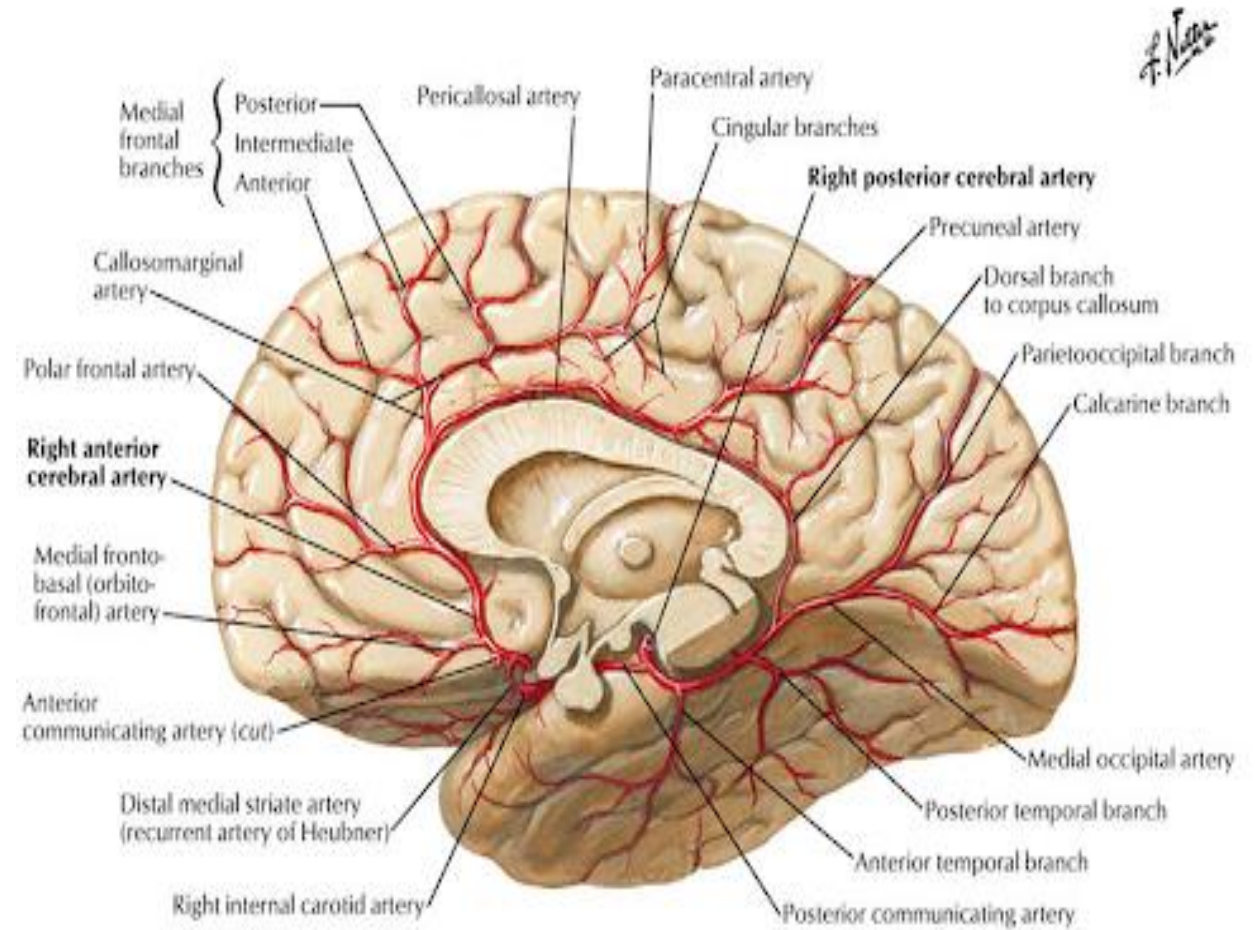
....lateral geniculate body and central & posterior parts of thalamus

4. Posterior choroidal branches

.....choroid plexus, posteriosuperior thalamus and part of hippocampus

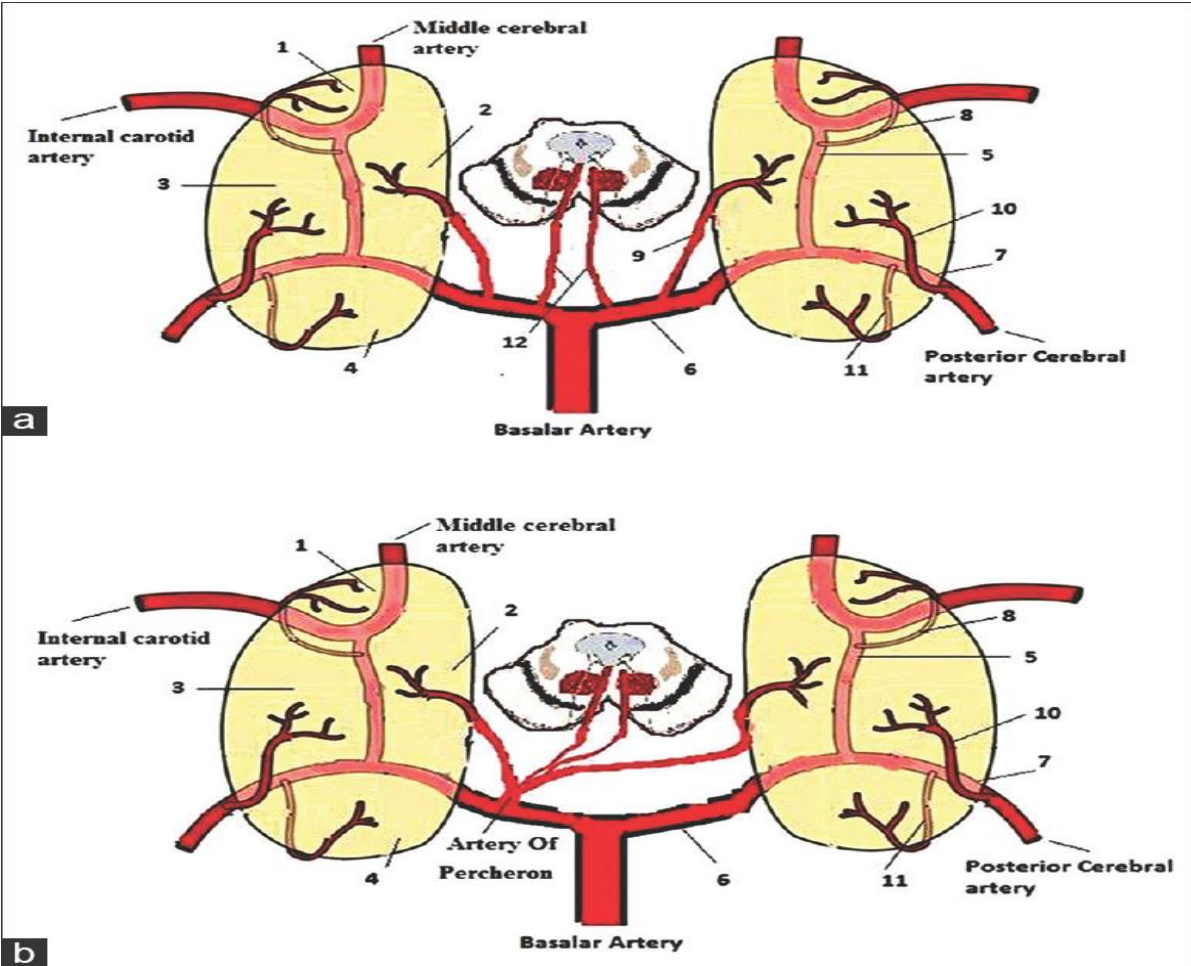


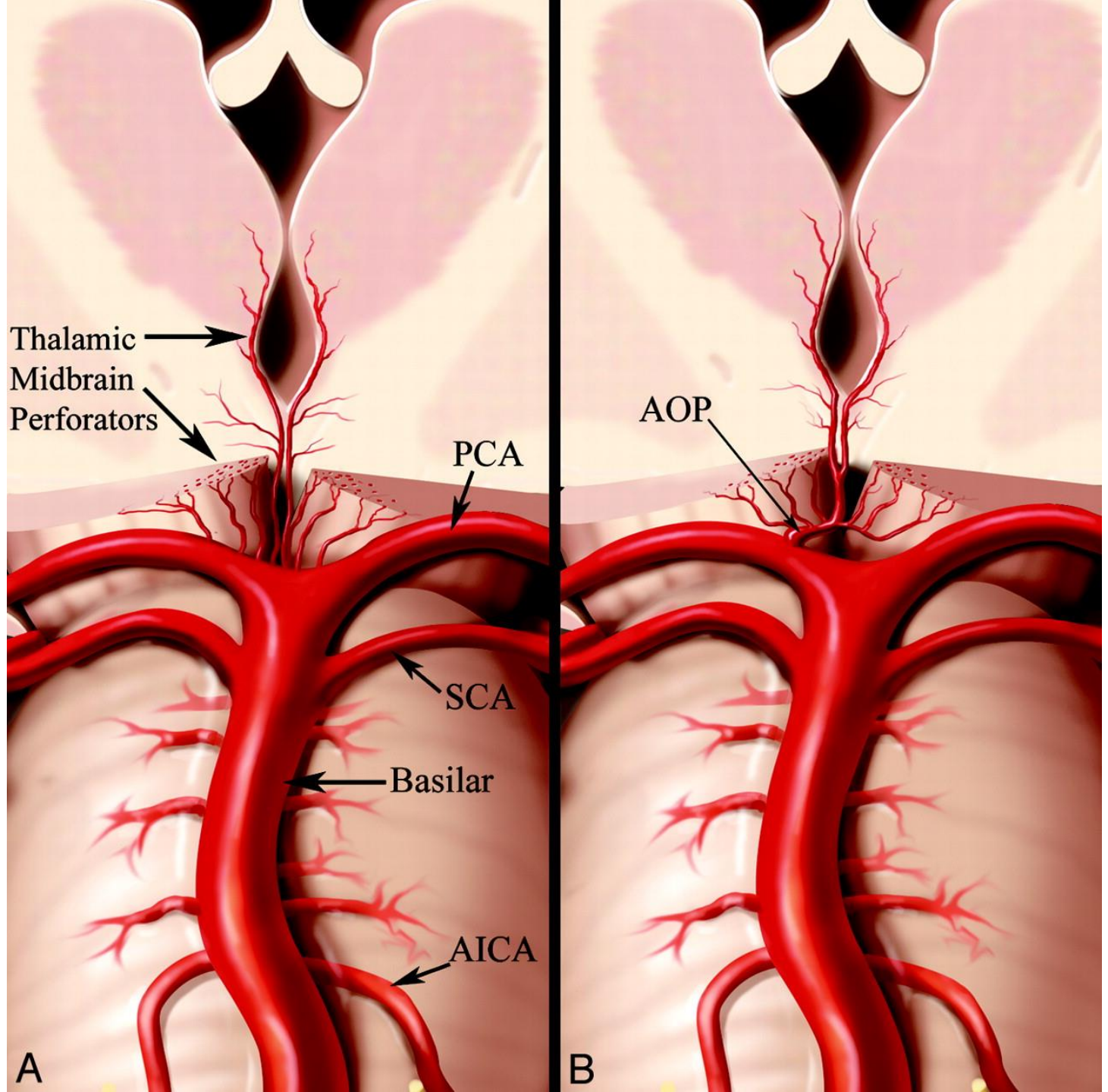
- 5.cortical branches
 - inferiomedial temporal lobes
 - ...medial occipital lobe

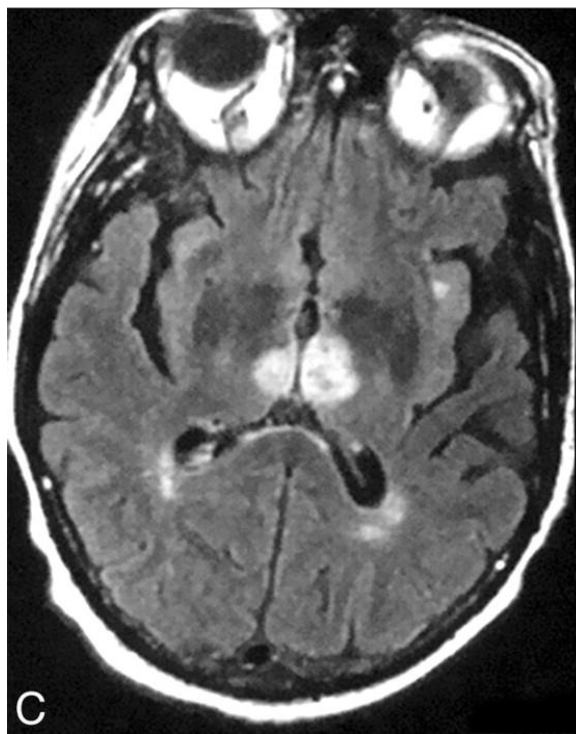
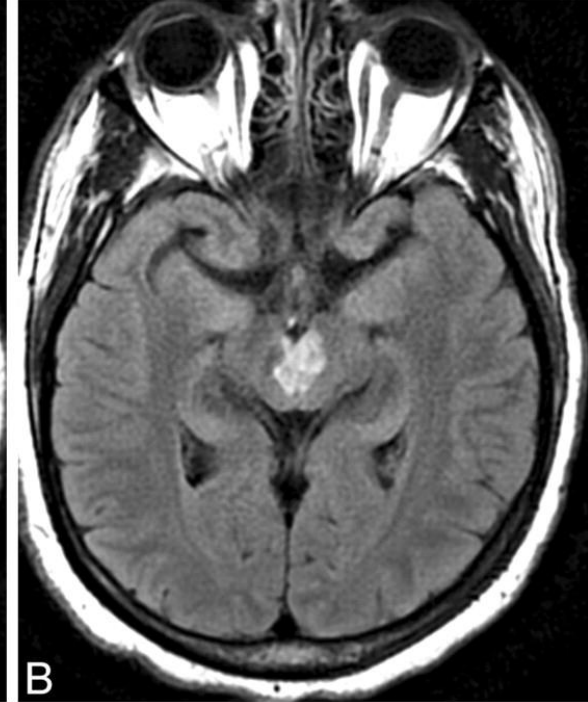
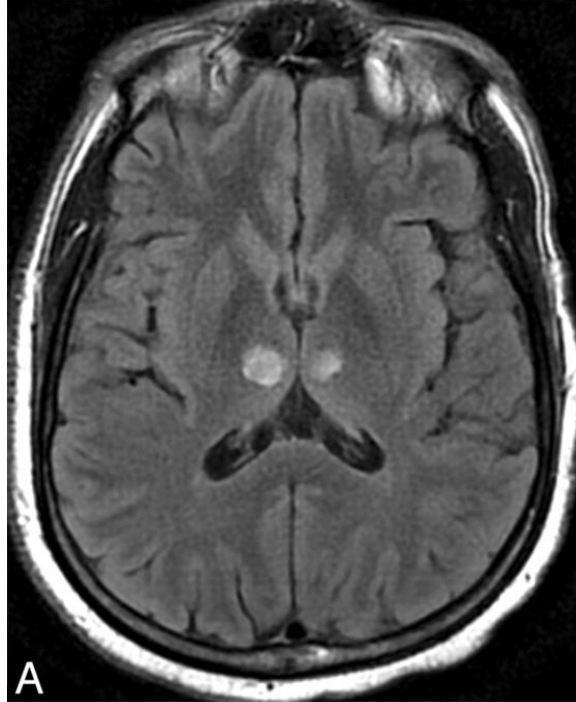


*Note: Anterior parietal (postcentral sulcal) artery also occurs as separate anterior parietal and postcentral sulcal arteries.

Artery of percheron







PCA strokes

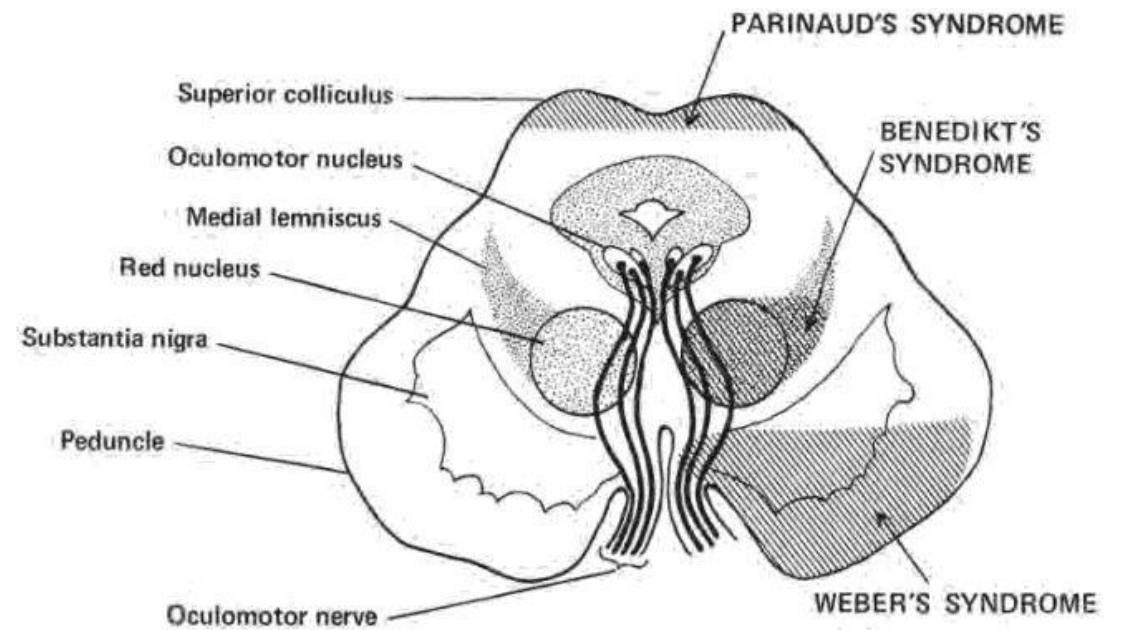
Proximal syndromes

1. Thalamic syndrome of Dejerine and Roussy....thalamogeniculate artery.

2. homonymous hemianopia...thalamogeniculate artery

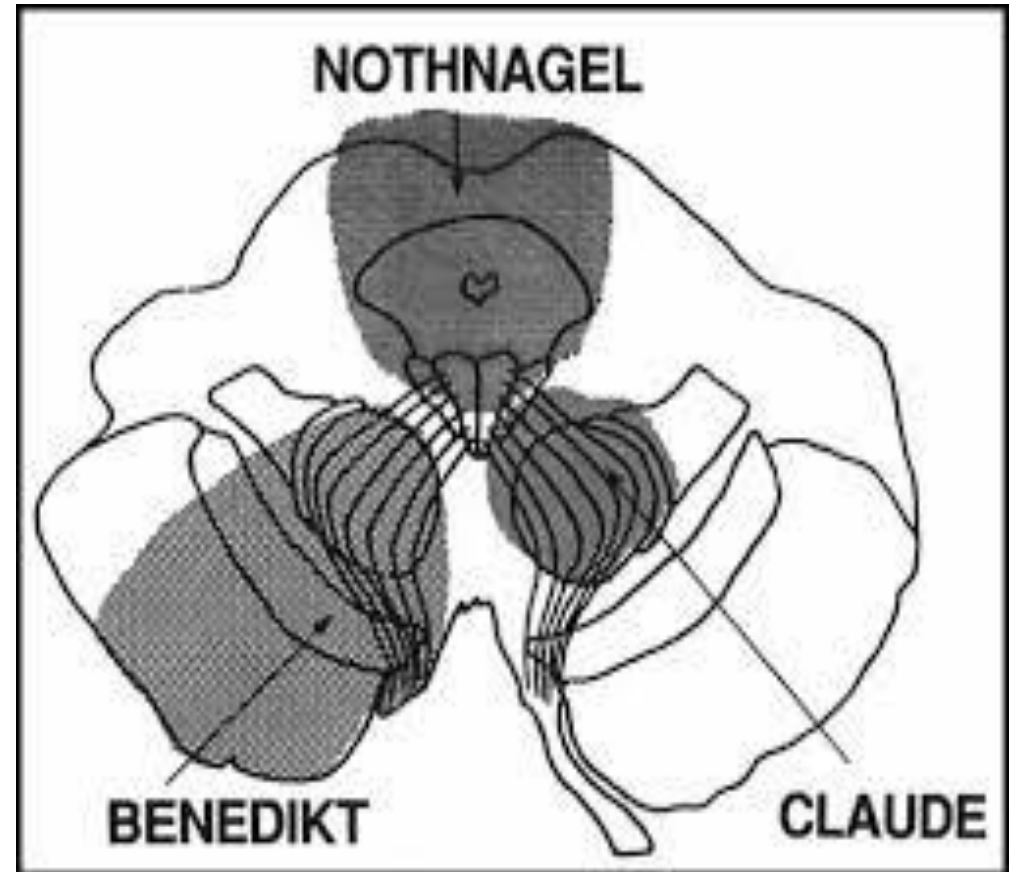
2. Central midbrain and subthalamic syndromes....occlusion of interpeduncular branches of PCA

1 weber syndrome....

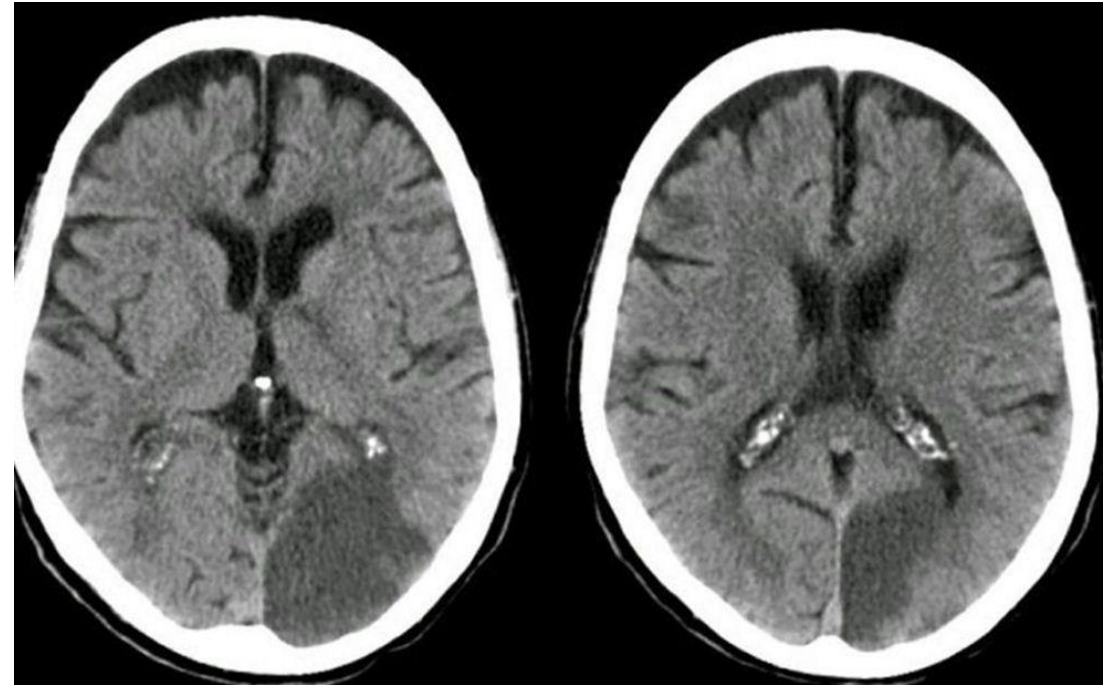


2. Claude's syndrome

3. Benedikt syndrome



- Homonymous hemianopia....calcarine cortex or optic radiation
- Cortical blindness....bilateral occipital lobe
- Alexia without agraphia,color anomia...dominant calcarine cortex and posterior part of corpus callosum



- Memory defect....inferomedial temporal lobes bilaterally
- Topographic disorientation and prosopagnosia....nondominant calcarine and lingual gyri
- Simultagnosia...dominant visual cortex
- Visual hallucinations...calcarine cortex

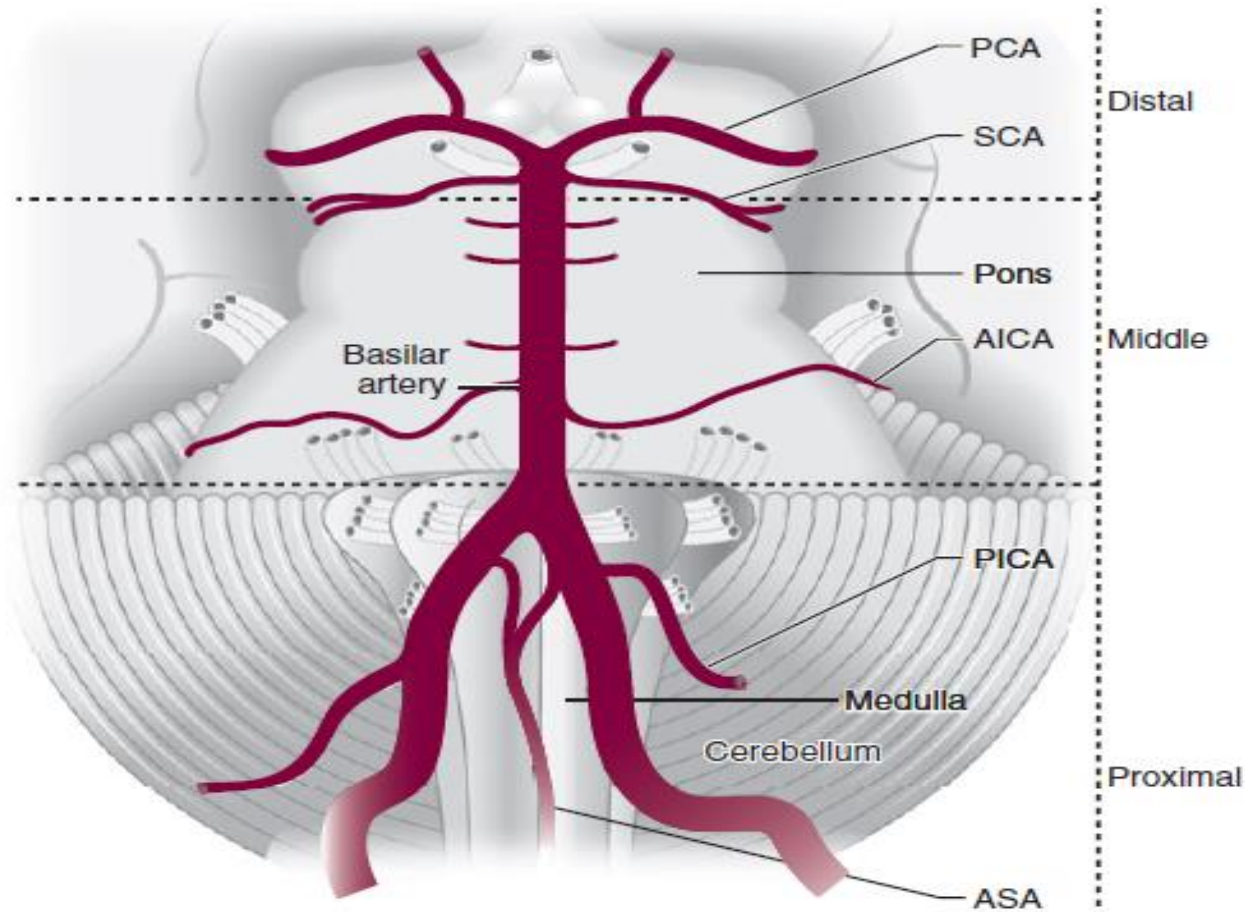


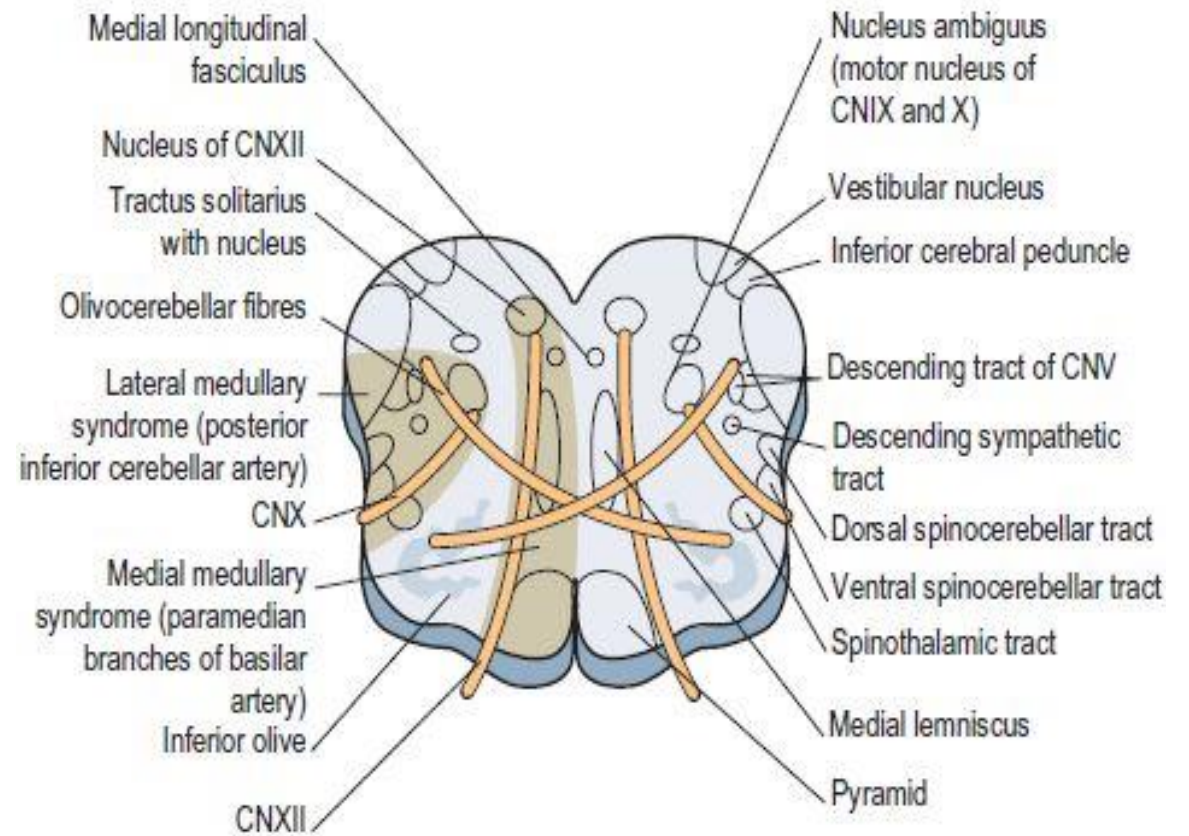
Figure 8.28 Sketch of base of the brain showing the intracranial vertebral and basilar arteries and their respective branches. The brain regions are divided into proximal, middle, and distal intracranial territories. AICA, anterior inferior cerebellar artery; ASA, anterior spinal artery; PCA, posterior cerebral artery; PICA, posterior inferior cerebellar artery; SCA, superior cerebellar artery.

LATERAL MEDULLARY SYNDROME OF WALLEMBERG

due to occlusion of any of the five vessels...vertebral

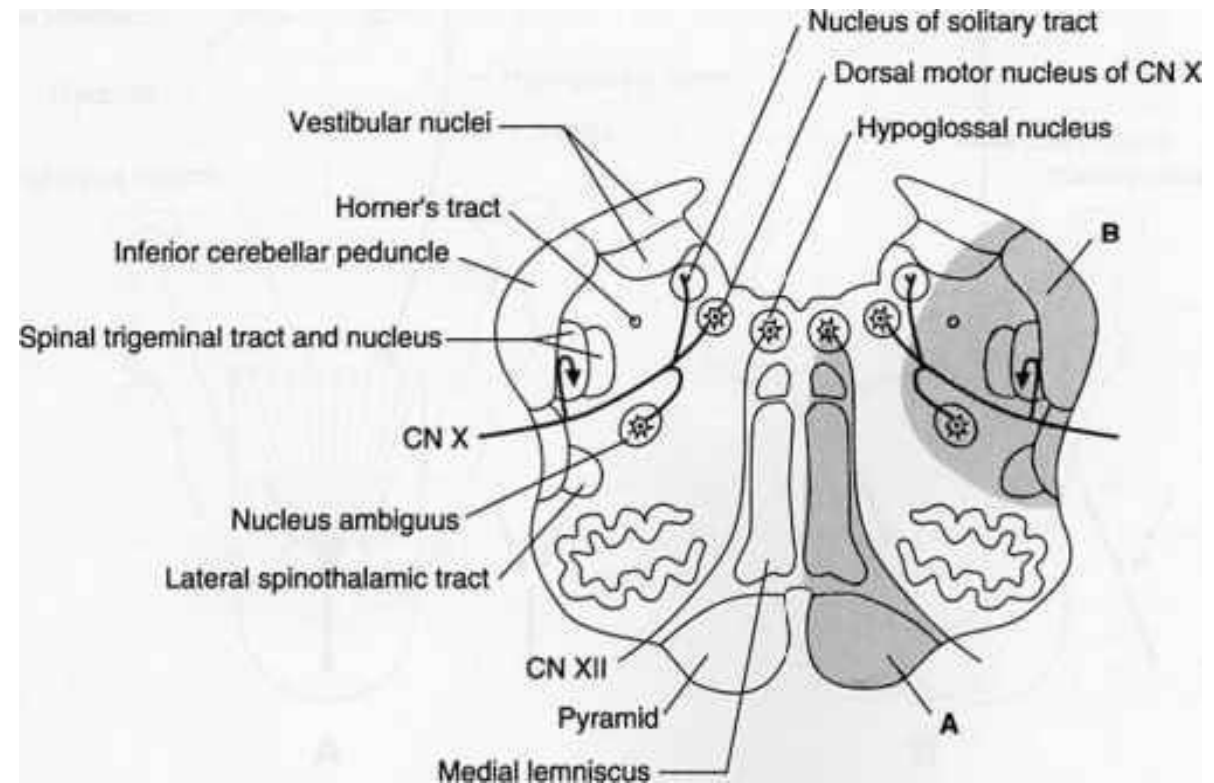
....PICA

....superior, middle or inferior lateral medullary arteries



MEDIAL MEDULLARY SYNDROME

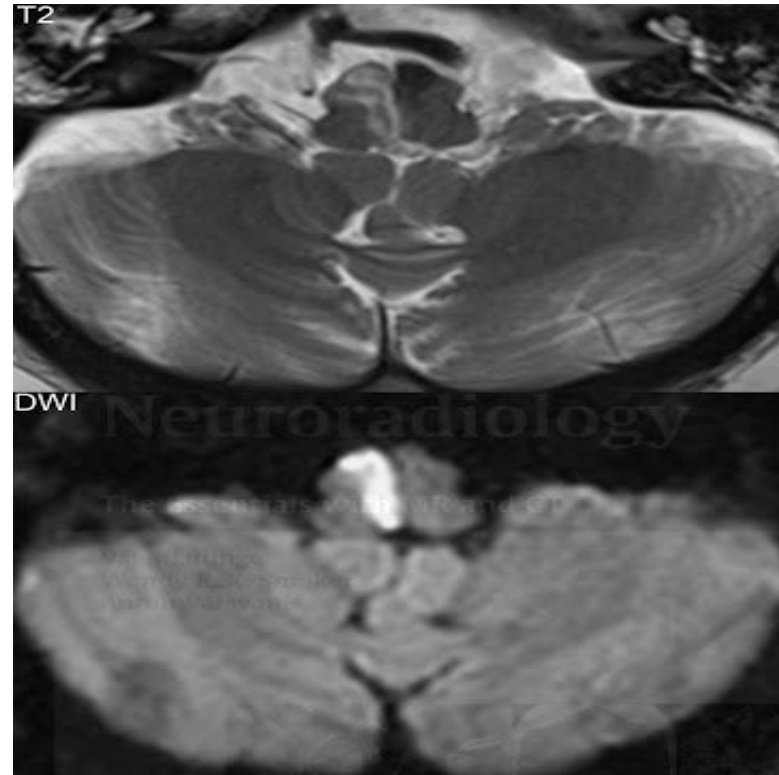
Due to occlusion of vertebral or branch of vertebral or basilar artery.



Lateral medullary syndrome



Medial medullary syndrome



LATERAL SUPERIOR PONTINE SYNDROME {syndrome of superior cerebellar artery}

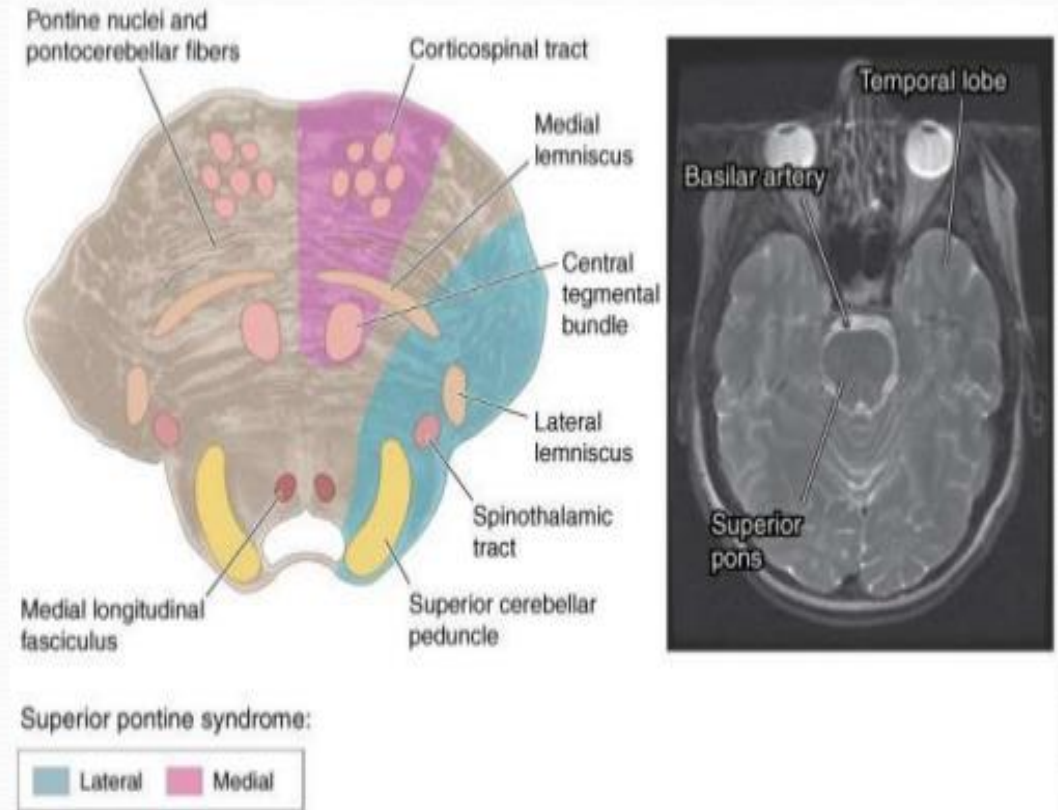
On the side of lesion

- Ataxia of limbs and gait
- Dizziness, nausea and vomiting
- Horizontal nystagmus
- Paralysis of conjugate gaze
- Horner's syndrome

Opp side

- Impaired pain and thermal sensation
- Impaired touch vibration and position sense

Superior pontine syndrome

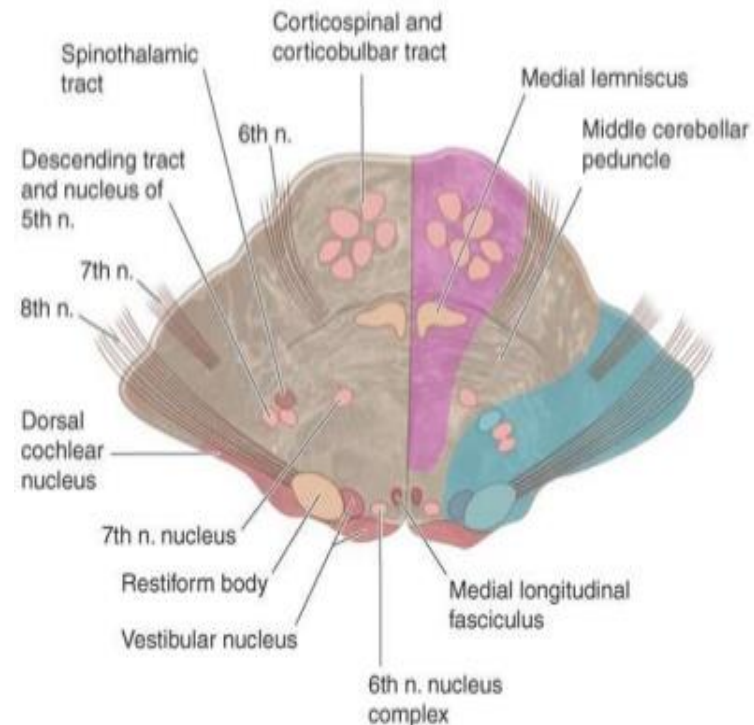


LATERAL INFERIOR PONTINE SYNDROME[occlusion of AICA]

On the side of lesion

- Vertigo,nystagmus,nausea, Vomiting.....vestibular nerve or nucleus
- Facial paralysis...7th nerve
- Paralysis of conjugate gaze....centre for conjugate gaze

INFERIOR PONTINE SYNDROMES:



Inferior pontine syndrome:



Source: Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J: Harrison's Principles of Internal Medicine, 18th Edition: www.accessmedicine.com Copyright © The McGraw-Hill Companies, Inc. All rights reserved.

- Deafness and tinnitus...8th nerve
- Ataxia...middle cerebellar peduncle and cerebellar hemisphere
- Impaired sensation over face...descending nucleus ant tract o 5th nerve

on side opposite lesion

Impaired pain and thermal sensation over one half of body...spinothalamic tract