Neurology

Volume - 2

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VASCULAR ANATOMY : CIRCLE OF WILLIS & ICA SYNDROME

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Vascular anatomy

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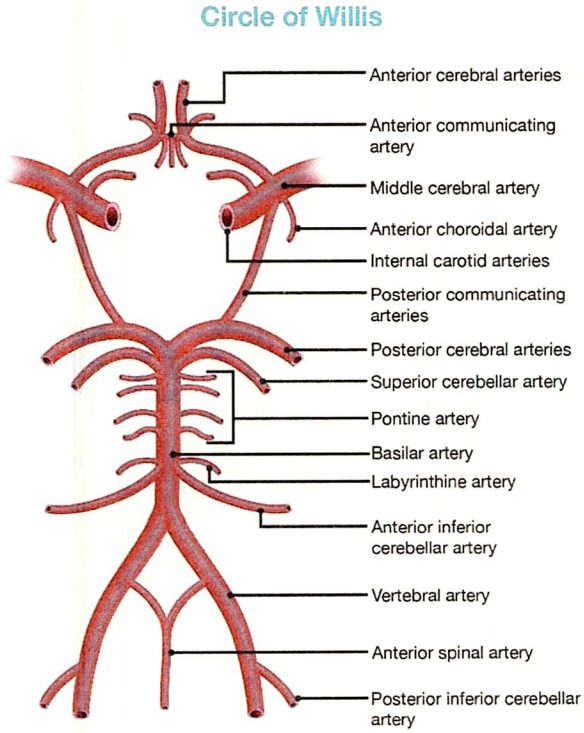
Stroke management is based mainly on Vascular images.
Angiographic imaging is very essential.

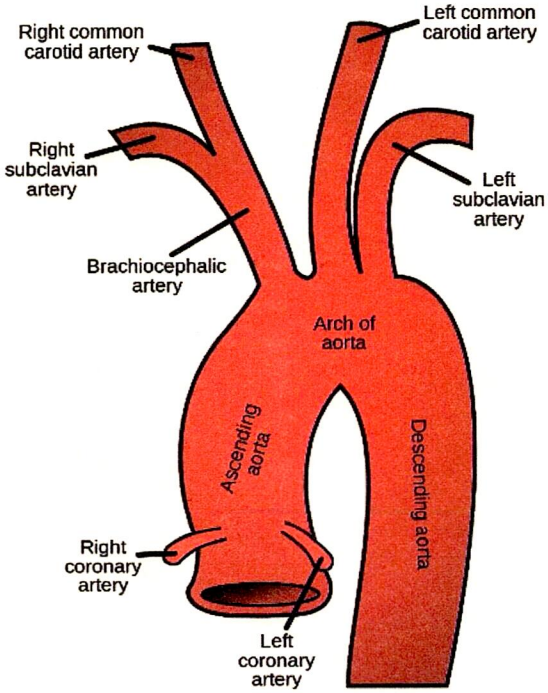
Circulation :

- 4 arteries 2 ICA and 2 vertebral arteries supply the brain :
  - Posterior circulation is contributed by vertebral arteries.
  - Anterior circulation is formed by the internal carotids.
- 2 ICA's originating from common carotid artery → Divides into MCA and anteriorly into ACA → ACA join together forming Acom.
- Pcom comes from ICA to supply the posterior circulation.

Common carotid artery :

- On the right side originates from brachiocephalic trunk whereas on left side it is direct branch of aortic arch.
- Hence a proximal embolus has predilection on left side due to its direct branching from aortic arch.





Aortic branches

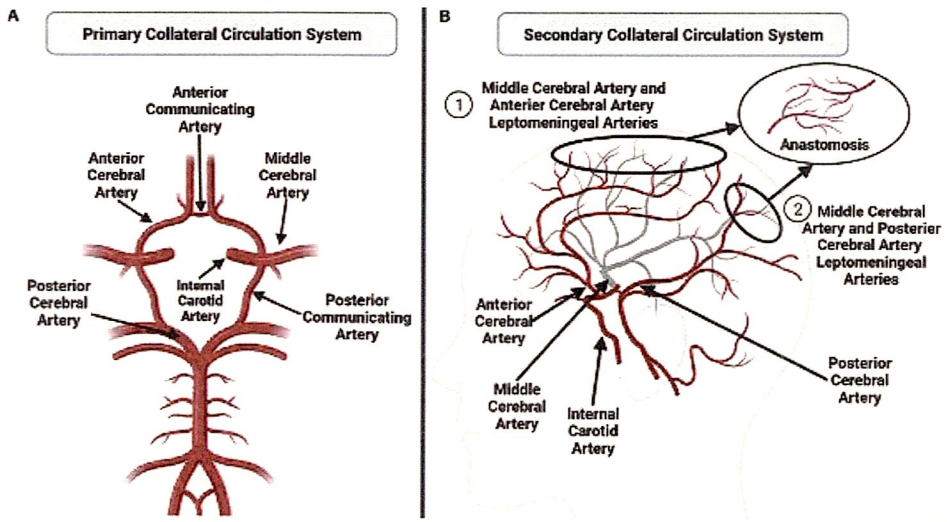
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Collateral circulation :

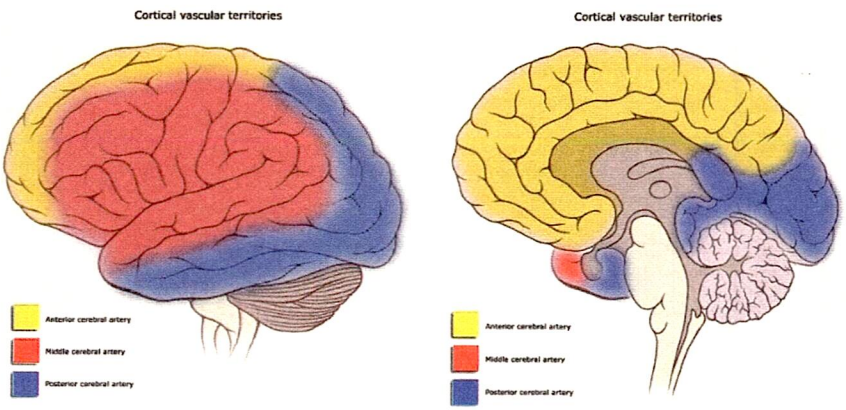
Any obstruction in the main arteries like ACA, there is communicating branches from the opposite side to form a collateral.

Types of collaterals :

i. Primary collaterals : Collaterals forming in circle of willis (Naturally present).
ii. Secondary collaterals :
   - Seen in case of pathological obstruction.
   - This can be evaluated by transcranial doppler.
   - Such reversal of blood flow happens in certain arteries and are called secondary collateral.
   - Eg : the ophthalmic artery or leptomeningeal artery flow is reversed in the presence of proximal occlusion.
iii. Tertiary collateral : These are newly developed vessels through angiogenesis.



Blood supply of brain :



Cortical vascular territories

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Anterior surface of brain.

- MCA supplies most of the lateral surface including the temporal pole.
- Whereas ACA supplies the upper lateral area (Stroke can cause lower limb weakness).
- The posterior cerebral artery supplies the occipital lobe and some part the temporal lobe.

Posterior surface of brain :

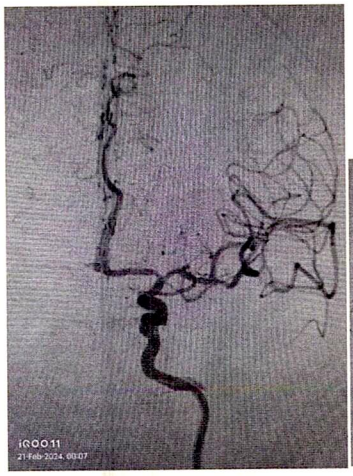
- Majority of the medial surface is supplied by ACA.
- PCA supplies the occipital area.
- Rostrum, genu, body and isthmus of the corpus calosum is supplied by the ACA except for the splenium which is supplied by the PCA.

Under surface of brain :

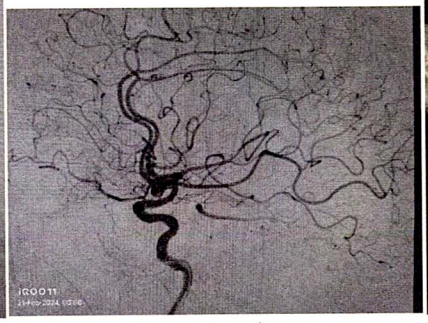
- Orbitofrontal cortex is supplied by the ACA.
- Interpeduncular fossa also is supplied by ACA.

On angiography image :

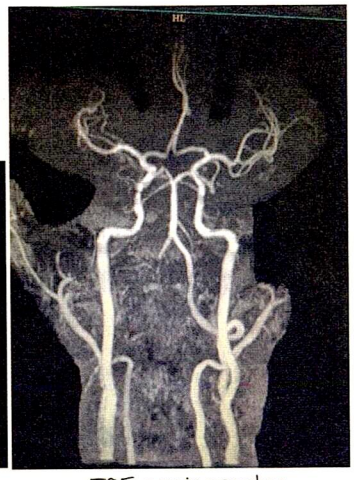
- ICA shows numerous tortuosities.
- ICA further divides into ACA and MCA.
- Azygous ACA where there is only 1 ACA which is dominant.
- ECA shows branching in the neck region.
- The vertebral arteries come to form the basilar artery further forming the posterior cerebral artery.



DSA anterior view



DSA lateral view



TOF angiography

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Anterior circulation syndromes

00:27:29

Anterior circulation syndromes :

- ICA syndrome.
- MCA syndromes.
- ACA syndromes.

ICA syndromes :

Case discussion : ICA occlusion.

- 64 year old smoker, having uncontrolled hypertension presented with h/o acute onset of visual loss of left eye, which improved in about 5 min. He also complains of headache, since last 3-4 months.
- O/E : BP → 190/100 mm Hg. Increased temporal artery pulsation on left side seen with cheek pulsation.
- Fundus → Hypertensive changes in right eye, reduced vessel calibre in left eye (Due to reverse blood flow in ophthalmic artery).
- TCD → Reversal of ophthalmic artery flow.

Note :

- Amaurosis fugax is the transient loss of vision in one of the eye due to TIA in the ICA.
- On ICA obstruction the blood is redirected to the ECA and hence shows temporal artery pulsations with angle, brow and check pulsation (ABC sign).



Chronic ICA occlusion with collateral formation



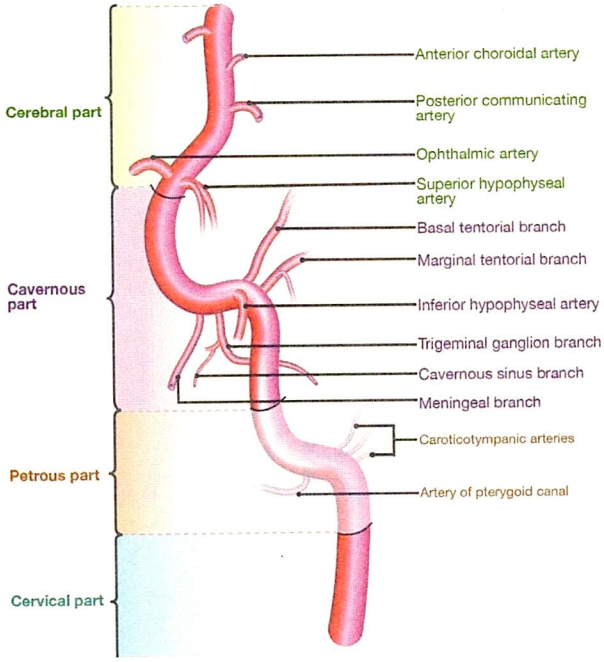
Before and after stent placement

Bouthillier classification :

- C1 → Cervical.
- C2 → Petrous.
- C3 → Lacerum.
- C4 → Cavernous.
- C5 → Clinoid.
- C6 → Ophthalmic.
- C7 → Communicating.

Mnemonic : Common Please Learn Carotid CLinical Organizing Classification .

Branches and parts of internal carotid artery



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Supraclinoid terminal branches of ICA : OPAAM .

- Ophthalmic.
- Posterior communicating.
- Anterior choroidal (Terminal branch).
- Anterior cerebral.
- middle cerebral arteries.

Note : Posterior choroidal is not from ICA, it is from the PCA.

ICA syndromes characteristics :

- Shows recurrent TIA in one territory.
- Monocular acute blindness or amaurosis fugax.
- TIA associated with frequent unilateral headaches which are dull type of pain.
- Is associated with PVD or CAD.

Signs of ICA syndrome :

i. Neck :
   Bruit high pitched.

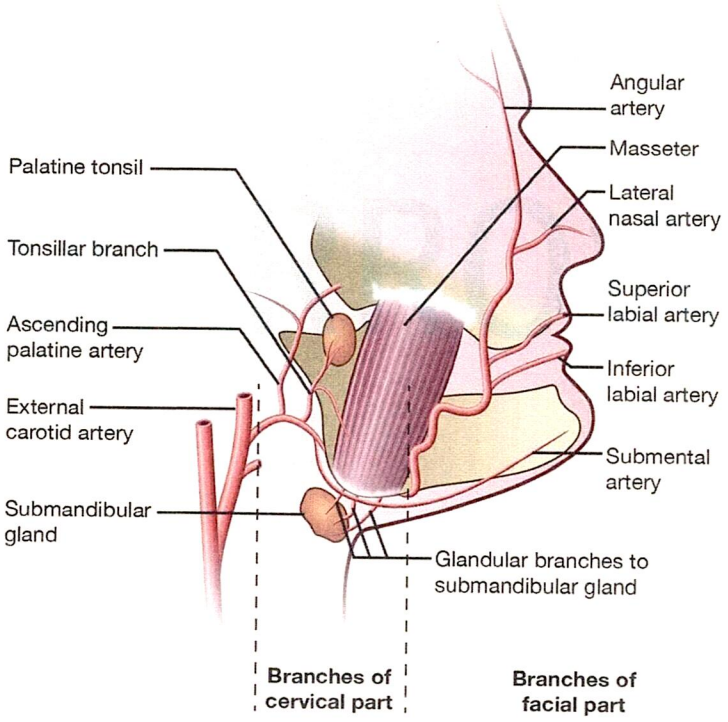
ii. Face :
   - Increase ABC (Ankle,brow, cheek) pulses.
   - Frontal artery sign.
   - Increased superficial temp artery pulse.

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iii. Retina :

- Reduced retinal artery pressure and calibre of retinal vessels.
- Retinal infarcts.
- Cholesterol crystal/platelet plug.

Facial artery



VASCULAR ANATOMY : ACA SYNDROME

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Vascular anatomy of ACA

00:01:02

Anterior cerebral artery (ACA) : Branch of internal carotid artery.
Both ACA are connected by anterior communicating artery (Acom).

Classification of ACA :

Anatomical :

- A1 : Segment prior to point of origin of Acom.
- A2 : Segment distal to point of origin of Acom.

Angiographic :

- A1 : Horizontal segment.
- A2 : Vertical segment.
- A3 : Segment parallel to corpus callosum.

Branches of ACA :

A1 segment :

- Medial lenticulostriate artery : Supplies lentiform nucleus, striatum, internal capsule.
- Recurrent artery of Heubner : Origin may vary.
  - From A1-A2 junction or A2 (90%).
  - From A1 segment (10%).

A2 segment :

- Recurrent artery of Heubner.
- Medial orbitofrontal artery : Supplies orbitofrontal cortex.
- Frontal polar artery.

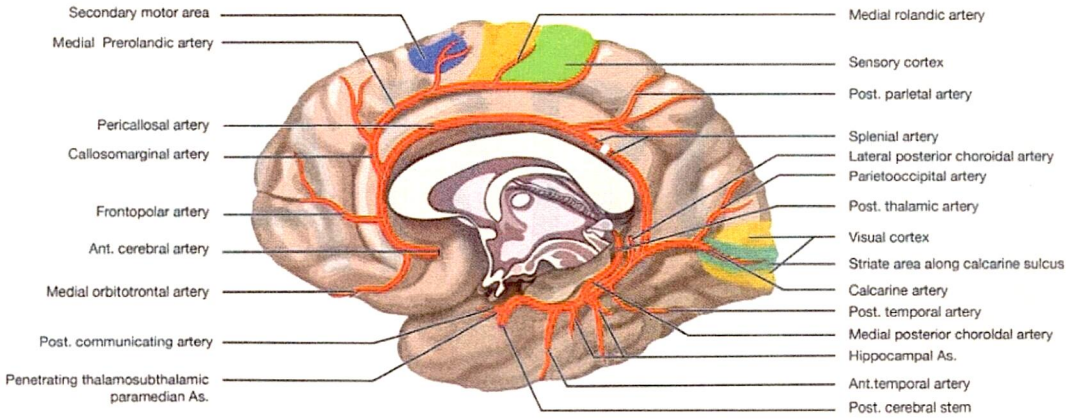
A3 segment :

- Pericallosal branch.
- Callosomarginal branch.

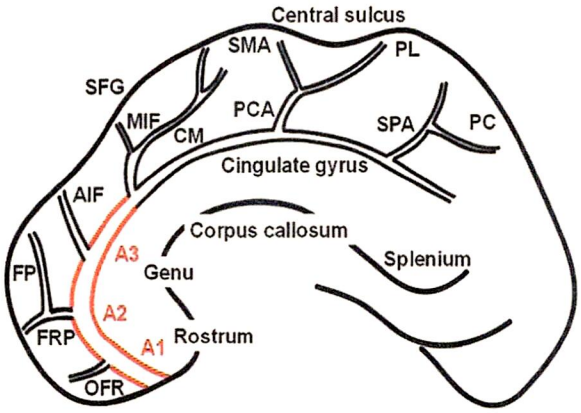
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Note :

Lateral lenticulostriate artery is a branch of middle cerebral artery (MCA).



Branches of ACA.



OFR = orbitofrontal; FRP: Frontopolar; FP: frontal pole; AIF: anterior internal frontal artery; SFG: superior frontal gyrus; MIF: middle internal frontal artery; CM: callosomaginal artery; PCA: paracentral artery; SMA: supplementary motor area; PL: paracentral lobule; SPA: superior parietal artery; PC: precuneus

Recurrent artery of Heubner :

- Originates predominantly from A2 ACA.
- Part of medial lenticulostriate artery.
- Areas supplied :
  - Anterior limb of internal capsule.
  - Caudate head and nucleus accumbens.
  - Medial part of globus pallidus.
  - Anterior hypothalamus.
  - Nucleus basalis/diagonal band of Brocca/uncinate fasciculus.

ACA syndromes

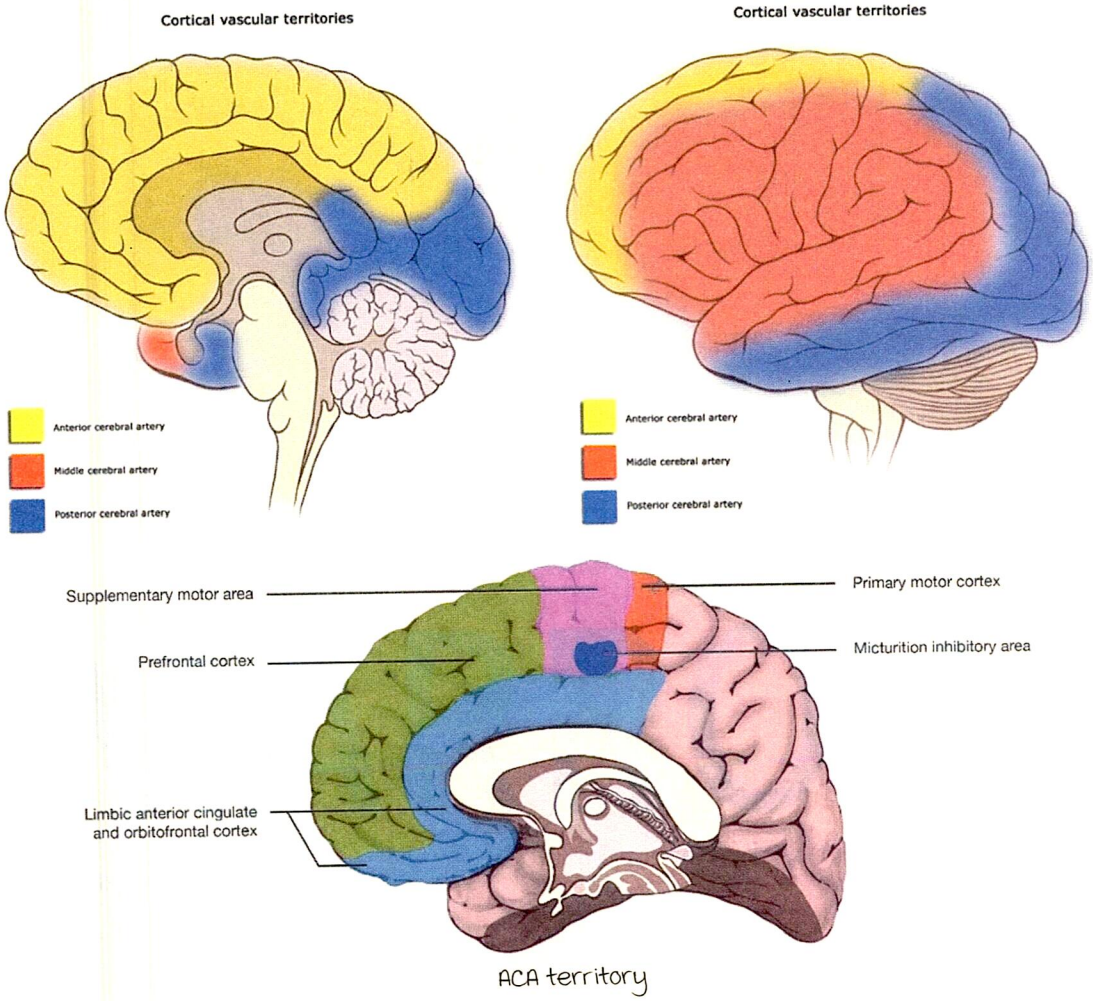
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Areas supplied by ACA :

- Superior 2 cm strip of lateral surface of cerebral hemisphere.
- Motor homonculus respresenting the lower limbs : Parasagittal area.
- Paracentral lobule : Control of micturition.
- Cingulate gyrus : Energization of brain.
- Orbitofrontal cortex.
- Anterior part of corpus callosum.

Classical features of ACA syndromes :

- C/L crural monoparesis : Lower limb weakness.
- Behavioral abnormalities.
- Apathy, abulia.
- Incontinence.
- Callosal apraxia/anterior disconnection syndrome.
- Transcortical motor aphasia.



ACA territory

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A1 segment occlusion :

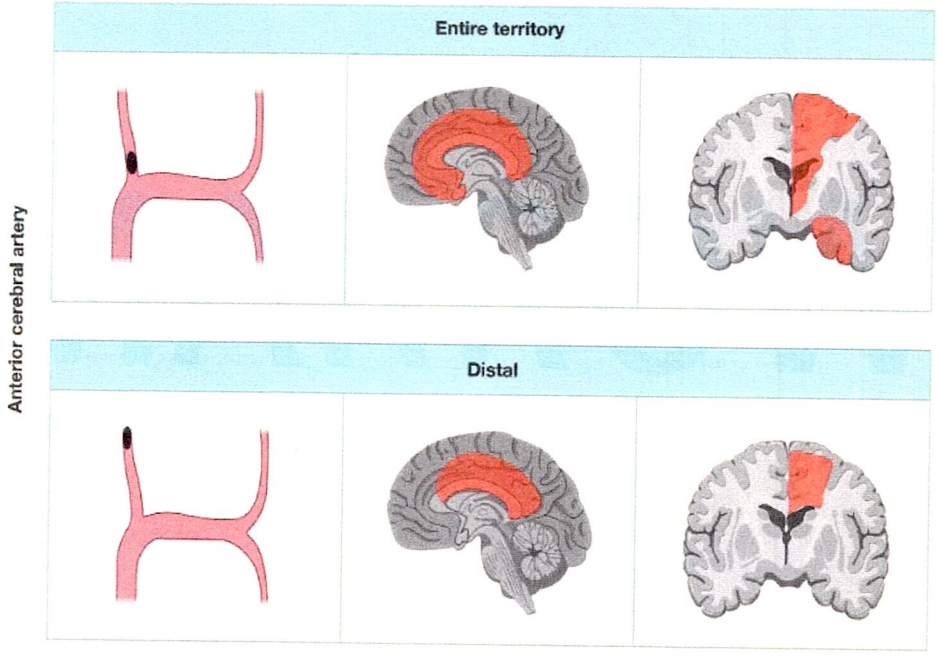
Classical presentation is not seen due to Acom.

Medial lenticulostriate artery involvement : Weakness (+).

Distal A2 segment occlusion :

- C/L crural monoparesis.
- Transcortical aphasia.
- Left limb apraxia/callosal apraxia.

ACA syndrome



Man in barrel syndrome :

Etiologies :

- ACA-MCA watershed area involvement.
- Bibrachial MND.
- Bilateral brachial plexus involvement.
- Central cord syndrome.

Features :

- Significant weakness of bilateral upper limbs.
- Lower limbs are spared.

VASCULAR ANATOMY : MCA SYNDROME

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Classification

00:04:39

Majority of MCA disease are embolic.
Hyperacute : mainly of vascular etiology.
TIA are less frequent in MCA disease than ICA disease.

Classification :

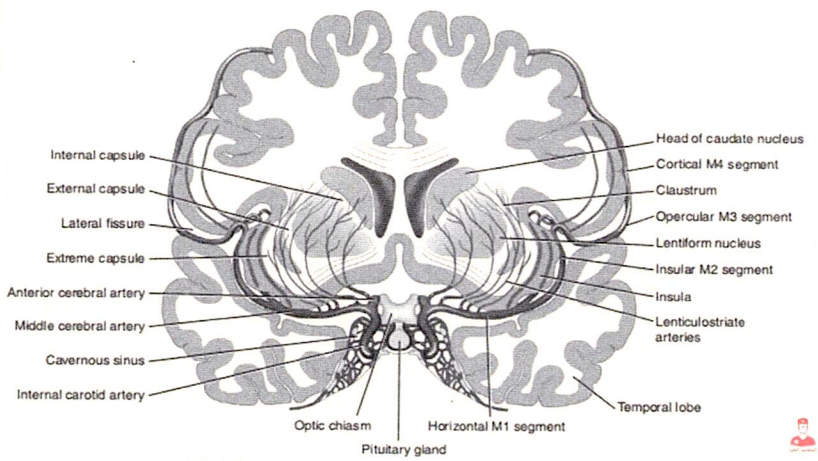
Anatomic classification :

- M1 segment : Horizontal segment that gives off perforating branches to the internal capsule, lenticulostriate branches.
- M2 segment : Divides into superior and inferior division.

Angiographic classification :

Significance in localisation of the thrombus.

- M1 segment : Horizontal segment. } Amenable to
- M2 segment : Goes around the insula. } intervention.
- M3 segment : Part of the MCA inside the sylvian fissure. } Amenable to
- M4 segment : Cortical branches. } thrombolysis.



Angiographic classification

Note :

- Angiographic classification is used for treatment decisions.
- M1, M2 can be treated with thrombectomy.
- M3, M4 can only be treated by thrombolysis.

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MCA syndromes

00:13:45

Classical presentation :

MCA supplies mostly the frontoparietal and temporal area.

Important structures involved :

- Motor cortex : Produces C/L hemiplegia.
- Primary sensory area involvement : Hemisensory loss.
- Eyefield : I/L gaze palsy.
- If it is an irritable lesion (Post seizure, abscess etc), C/L gaze palsy.
- Optic tract fibres : Hemianopia.

Dominant side involvement :

i. Language involvement/aphasia :
   - Broca's aphasia : Superior division involvement.
   - Wernicke's aphasia : Inferior division involvement.
   - Conduction aphasia.
   - Angular gyrus involvement : Cause alexia with agraphia.

ii. Classical apraxia.

iii. Gerstmann syndrome :
   - Dominant parietal lesion.
   - Left inferior parietal lobule and deep white matter.
   - Left angular gyrus involvement :
     - Finger agnosia.
     - Right-left confusion.
     - Acalculia.
     - Dysgraphia.

Non dominant MCA syndrome :

- Language abnormality : Prosody.
- Constructional apraxia.
- Dressing apraxia.
- Anosognosia : Denial of deficit.
- Sometimes frontal involvement can also occur leading to delirium, delusions, hallucinations, and emotional instability.
- Hemineglect.