



WEBINAR SERIES

CEREBROVASCULAR DISEASE

May 22, 2019

BY: SARAH WEST, PH.D.



Learning Objectives

1. Learn causes and types of a stroke
2. Learn the main blood vessels in the brain where strokes can occur
3. Learn the different clinical presentations that can arise from different stroke locations



BASICS- TIAS

- Transient Ischemic Attacks (TIAs) or “mini strokes”
 - Original Definition: neurological deficit lasting less than 24 hrs., caused by temporary brain ischemia
- Typical Duration: 10 min, although imaging suggests can last longer and can produce permanent cell death
 - If it lasts longer than hour are usually small infarcts

BASICS- TIAS

- TIAs are usually warning sign of potentially larger ischemic injury
- 15% will have stroke within 3 mon., 50% of these happen within first 48hrs.
- CAUSES:
 - temporary embolism occlusion (then dissolves)
 - situ thrombi form on blood vessel wall
 - vasospasm leading to temporary narrowing of the blood vessel lumen
- R/O: focal seizures, migraine, episodes of hypoglycemia





BASICS- CVA

- Cerebrovascular Accidents (CVA) or stroke-
 - Is a loss of blood flow to the brain, which results in neuron death
- Types: ischemic or hemorrhagic
 - A) Hemorrhagic- rupture of a blood vessel in the brain, results in a sudden loss of blood flow to that area of the brain, only 13% of strokes
 - Intracerebral/Intraparenchymal or Subarachnoid (SAH)
 - B) Ischemic- inadequate blood supply, usually from a blockage, long enough to cause cell death

BASICS- ISCHEMIC STROKES

Types of Ischemic Strokes:

1) Embolic- piece of material (e.g. clot) forms in one place and travels to brain, lodge and occlude a blood vessel; occurs suddenly, maximum deficits at onset; can originate in heart (cardioembolic from A.Fib, MI, valvular disease), artery-to-artery (stenosis of arteries), artery dissection, atherosclerotic disease in aortic arch, patent foramen ovale (hole in heart), air/septic/fat/cholesterol emboli, endocarditis, disc emboli (cervical trauma), amniotic fluid emboli (childbirth), drugs/foreign objects

2) Thrombotic- blood clot forms locally on blood vessel wall usually at the site of an underlying atherosclerotic plaque causing occlusion, “stuttering course”

*Seen more in vascular dementia



BASICS- STROKE LOCATION

Locations:

1) **Large-vessel**- major blood vessels on brain's surface (e.g. MCA), usually emboli

2) **Small-vessel (aka Lacunar infarcts)**-small penetrating vessels, deep structures (e.g. basal ganglia, brainstem), usually caused by chronic hypertension

Cortical v. Subcortical Lesions

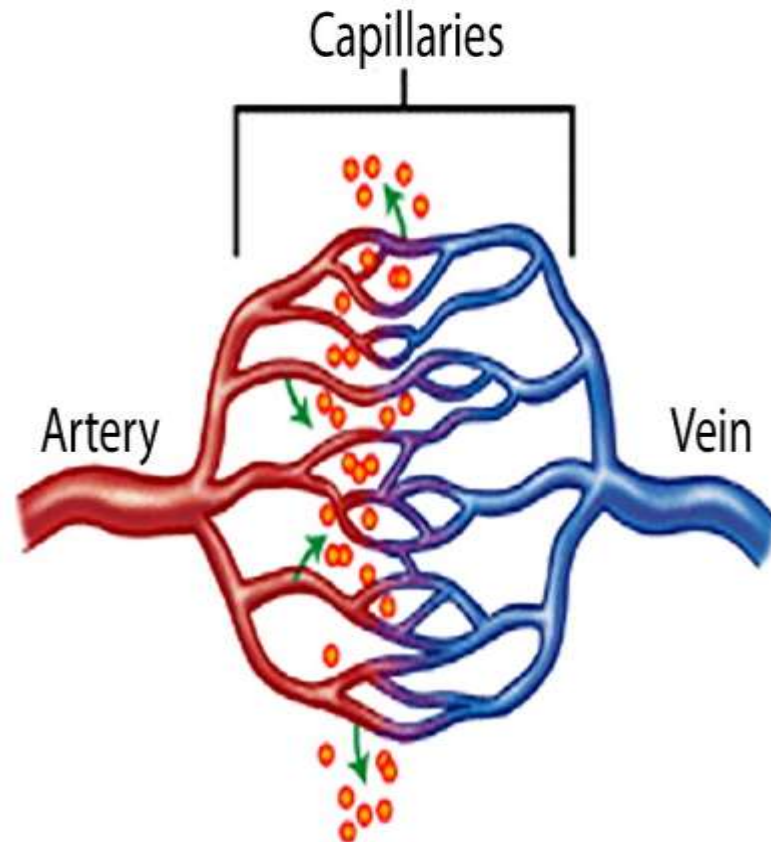
Treatment- Give TPA within 4.5 hours of onset, if miss window can give aspirin

CEREBRO-NEUROANATOMY

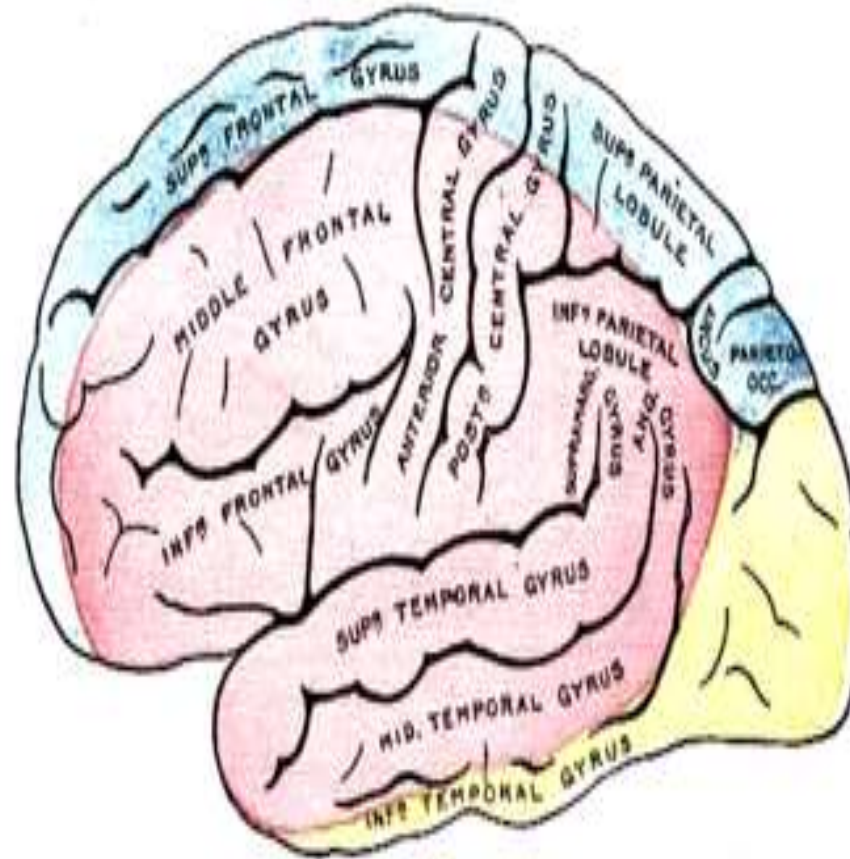
This picture illustrates the connection of the artery (red) to the arteriole (pinkish-purple) to the capillaries (purple)

Then from the capillaries to the venules (bluish-red) to the vein (blue)

Chronic hypertension and blockages (lacunes) occur in the capillaries



CEREBRO-NEUROANATOMY



*Please note all images were acquired online and citations are at the end of this slide deck



STROKE LOCATION

- Strokes can occur in many different areas of the brain
- Main arteries are: Middle Cerebral Artery, Anterior Cerebral Artery, and Posterior Cerebral Artery
- Can also occur in subcortical areas



MIDDLE CEREBRAL ARTERY

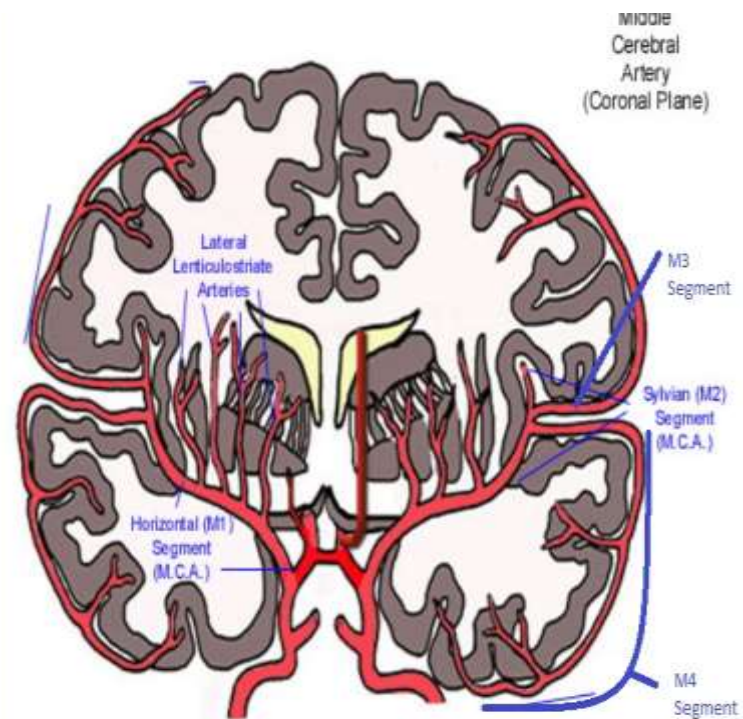
MCA stroke facts:

- 2/3 of all strokes, most common area affected by CVAs
- Usually stroke by embolism, carotids flow into MCAs
- MCA supplies: frontal, parietal, lateral temporal lobes, centrum ovale

MCA – THE SEGMENTS

4 Segments of MCA:

- M1 (spheroidal segment)- frontal and temporal lobes
- M2 (insular segment)- insula, most cortical arteries
- M3 (opercular)- ends at Sylvian fissure
- M4 (cortical)- blood to cortical surface





DEFICITS DUE TO MCA STROKE

- Hemiplegia, sensory deficits (usually more arms and face), apraxia
- Frontal involvement- coma, stupor, behavior-inappropriate, uncontrollable laughter, perseveration, apathy/abulia/akinetic mutism
- Neglect (typically more right hemisphere), visual field cuts (posterior), angular artery infarct- visual and optic problems, left/right confusion, trouble with reading and writing

DEFICITS DUE TO MCA STROKES

- Dom. Hem.- aphasia: global, Broca's, and Wernicke's; apraxia, alexia, agraphia, trouble naming objects, L/R confusion
- NDom. Hem.- confusion, denial of deficits, neglect, dysarthria, visuospatial problems, hallucinations/delusions, restless/agitation, sensory aprosody (trouble understand emotional speech), construction apraxia, asomatognosia (loss of awareness of part of the body), visuospatial problems
- Bilateral lesions in the temporal area can cause cortical deafness



ANTERIOR CEREBRAL ARTERY STROKE

- Arises from the internal carotid artery
- Supplies the medial surface of the frontal and parietal lobes, anterior corpus callosum, and other deep structures
- Five main branches, A1-A5
- Often have MCA infarct as well, rare to just have ACA infarct; can have vasospasm following rupture of ACoA (anterior communicating artery) aneurysm
- Ischemic stroke- cardiac emboli or thrombus from ICA





DEFICITS FROM AN ACA STROKE

DEFICITS:

- Motor: -paresis in legs more than upper body, rare in face
- Sensory: less common, may have trouble with proprioception in foot/leg
- Amotivation- ranging from apathy to mutism and severe lack of movement/talking, etc.
- Emotional lability, euphoria, restlessness, hyperactive, agitated, verbose, depressed (left-sided)
- Urinary incontinence



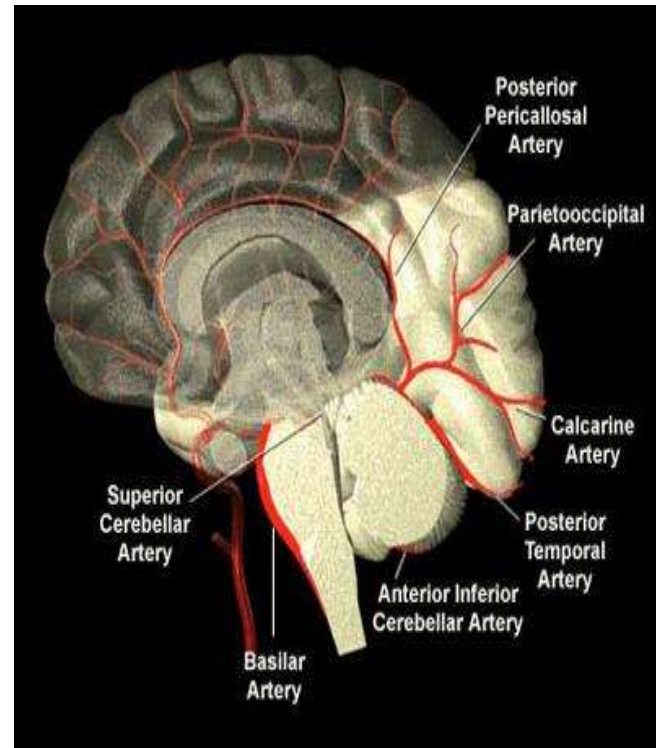
DEFICITS FROM AN ACA STROKE

Deficits continued:

- **Language:** transcortical aphasia (motor/sensory, initiation), mutism, whispering (not aphasia like MCA)
- Trouble with short-term memory, confabulation
- Pathological grasp phenomenon- closing one or more digits when touch palm of hand
- **Alien-hand sign:** feeling that the left hand does not belong to the person, motor perseveration (repeat motor movement because can't stop), compulsive manipulation of tools, voluntary behavior in one hand can cause involuntary behavior in the other

POSTERIOR CEREBRAL ARTERY

- PCA- supplies midbrain, thalamus, occipital lobes, temporal lobes, posterior parietal
 - Not going to see frontal signs (such as lack of insight)
- Separates from other strokes- no hemiparesis, can be clumsy or ataxia though



POSTERIOR CEREBRAL ARTERY STROKE

- DEFICITS: visual field cuts, higher order processing of visual info, gaze palsy, neglect (with right-sided stroke), sensory sx. (tingling/burning/etc), lethargy/stupor/coma, memory impairment, alexia without agraphia, impaired color naming, visual agnosia
- Cortical blindness- bilateral infarct to striate cortex, don't always admit what they can't see, can avoid bumping into objects/blink to visual threat
- Balint's syndrome- bilateral upper-bank posterior infarcts, poster PCA-MCA region, symptoms- disoriented to place, difficulty revisualizing locations, asimultagnosia (can't direct eyes for panoramic view), optic ataxia (can look at an object asked to look at), gaze apraxia
- Identify what objects are and where they are in space



WHITE MATTER STROKE

- Cause: hypertension, diabetes, or embolism (cardiac)
 - Hypertension & diabetes affect capillaries (smaller blood systems) → white matter, basal ganglia
- Deficits- sensory and motor problems, executive functioning problems, slowed processing speed

THALAMIC STROKE

Deep in the brain

Sensory relay station

Deficits: sensory, ataxia, jerky motor movements, fixed posture, can have impaired executive functioning and transient motor aphasia (especially left-sided lesions), amotivation/apathy, slight clumsiness, facial asymmetry, may have short-term memory loss, disorientation, aphasia, neglect, visual problems, visual hallucinations



BASAL GANGLIA STROKE

What is Basal Ganglia?

Most common site for spontaneous intracranial hemorrhage

Risk factors: hypertension, chronic alcoholism, MoyaMoya, cocaine use

Symptoms: impaired consciousness, aphasia, hemiparesis, conjugate gaze deviation, sensory deficits, neglect, motor deficits

CAUDATE NUCLEUS STROKE

Supplied by ACA and MCA

Part of basal ganglia, learning, movement

Major risk factors: hypertension, high cholesterol, diabetes, previous heart attack, cigarette smoking

Deficits: inattention, memory impairment, impaired executive functioning, restless/hyperactive or slowness, neglect, depression, speech: dysarthria, motor weakness

Types of deficits:

1. Apathetic
2. Disinhibited/impulsive
3. Affective symptoms with psychotic features

Good prognosis for recovery of function





MIDBRAIN STROKE

What is midbrain?

Deficits- oculomotor palsies, motor involvement, akinetic mutism, disorientation, memory disturbance, sensory symptoms, visual hallucinations (rare), hearing/taste change

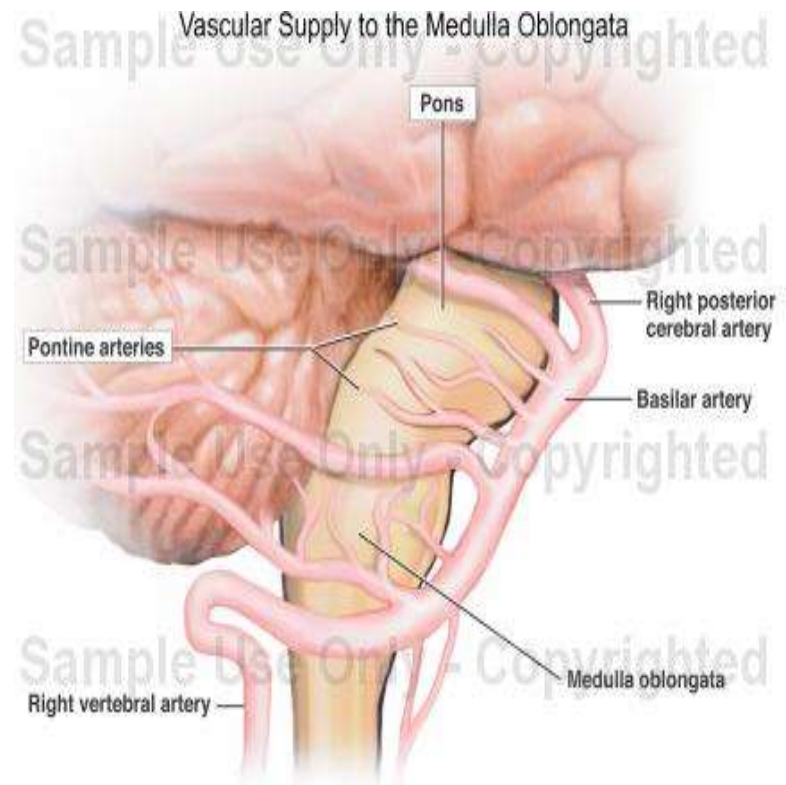
Can have midbrain Locked-in Syndrome

PONTINE STROKE

Most common cause:

Small Artery Disease
and Microembolism

Projections from
prefrontal cortex,
parietal region, and
temporal region



PONTINE STROKE

Deficits: hemiplegia, ataxic hemiparesis, dysarthria/facial paresis, transient dizziness, diplopia, gaze abnormalities, nystagmus, dysphagia, can have deficits in smooth pursuit of visual saccades, tonic limb spasms, cranial nerve palsies

Dysarthria/clumsy hand syndrome: (common presentation in pontine stroke)

dysarthria, clumsiness characterized by dysmetria (lack of coordinated movement), dysdiadochokinesia (inability to perform rapid alternating movements), ataxia

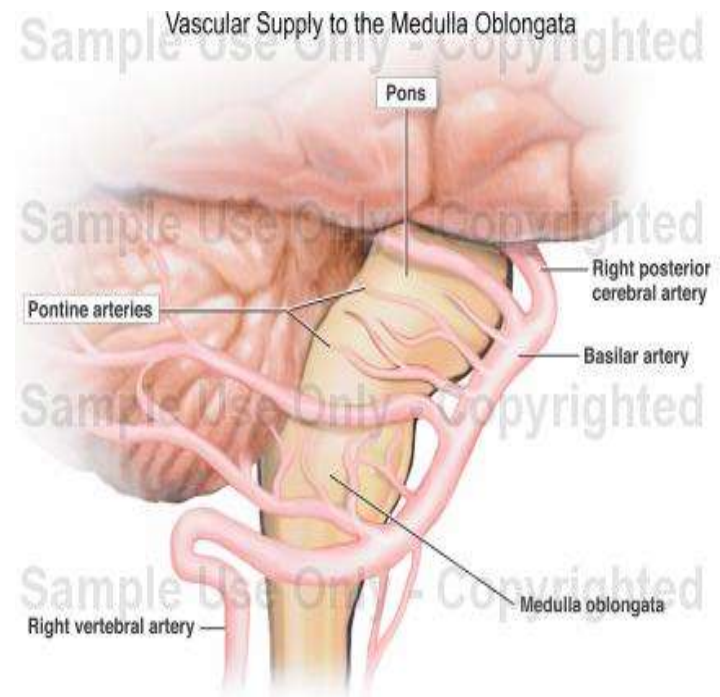
Hemorrhages: altered consciousness, visual hallucinations, respiratory problems, quadriplegia, cranial nerve palsy, pinpoint pupils, gaze paresis, autonomic dysfunction; poor prognosis, can be Locked-in (may still have vertical eye movement which is controlled by midbrain)



MEDULLARY STROKE

What Medulla does?

Symptoms: headache, vertigo, nausea/vomiting, gait instability/ataxia, nystagmus, loss of sensation perception, respiratory changes (particularly when sleeping), dysphagia, later hiccups



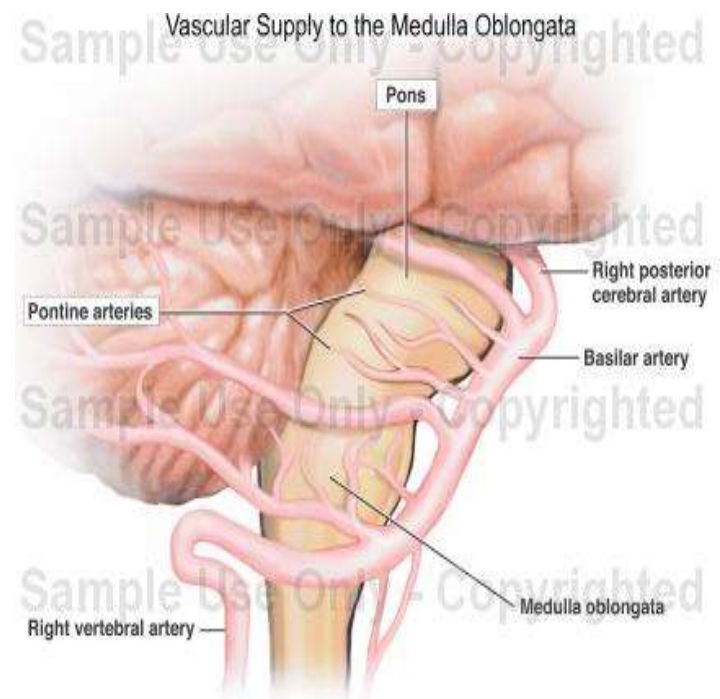
CEREBELLAR STROKE

What is cerebellum?

Symptoms: vertigo/dizziness, vomiting, limb/gait ataxia, headache, dysarthria, trouble sensing pain and temperature, eye movement abnormalities/nystagmus

Cerebellar Cognitive Affective Syndrome (CCAS):

Impairment in executive functioning, visuospatial, visual memory, language (dysprosody, agrammatism, mild anomia), personality change (blunted affect or disinhibition, inappropriate behavior) affect-depression





STROKE TREATMENT

- Acute warning signs of a stroke: slurred speech, weakness on one side of the body, unilateral facial droop/asymmetric smile, alteration in consciousness
- Go to hospital immediately
- Head CT
- If blockage, there are medications and interventions to reduce damage, small window (up to 3-4.5 hours), act fast



STROKE TREATMENT

- Hospital stay and treatment will vary- depending on stroke severity
- Inpatient Rehabilitation
- Subacute Rehabilitation
- Outpatient Rehabilitation



FOLLOW-UP CARE

- Follow-up with physicians (neurologist, physiatrist)
- PT, OT, ST, recreational therapy, cognitive therapy
- Neuropsychologists/Psychologists
- Nurses
- Dietician/Nutritionist
- Housing and supportive care in home





REFERENCES

Blumenfeld, H. (2010) *Neuroanatomy through Clinical Cases*. Sunderland, MA: Sinauer Associates, Inc.

Caplan, L.R. & van Gijn, J. (2012) *Stroke Syndromes, 3rd Ed.* New York, NY: Cambridge University Press

Images:

Blood Vessels: Curehht <https://curehht.org/understanding-hht/what-is-hht/medical-summary/normal-blood-vessel-formation/>

Middle Cerebral Artery: Wikipedia https://en.wikipedia.org/wiki/Middle_cerebral_artery

MCA segments: Lumen Loyola University of Chicago

<http://www.meddean.luc.edu/lumen/meded/neuro/neurovasc/navigation/mca.htm>

Centrum Semiovale: Normal Myelination MRI Atlas <https://www.myelinationmriatlas.com/3-months.html>

Anterior Cerebral Artery: Wikipedia https://en.wikipedia.org/wiki/Anterior_cerebral_artery

Posterior Cerebral Artery: The Internet Stroke Center

<http://www.strokecenter.org/professionals/brain-anatomy/blood-vessels-of-the-brain/>

