STROKE SYNDROMES

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34th Annual Board Review Course in Physical Medicine & Rehabilitation

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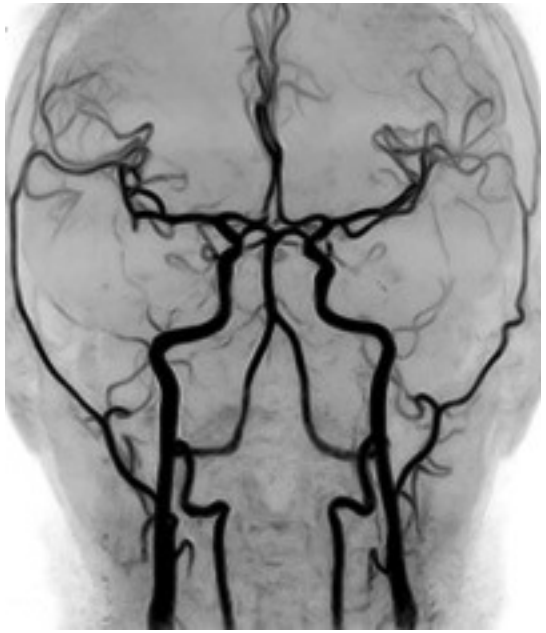
Overview

- Cerebrovascular Anatomy
- General Principles
- Large Vessel Syndromes
  - Anterior Circulation
  - Posterior Circulation
  - Watershed Syndromes
- Lacunar Syndromes

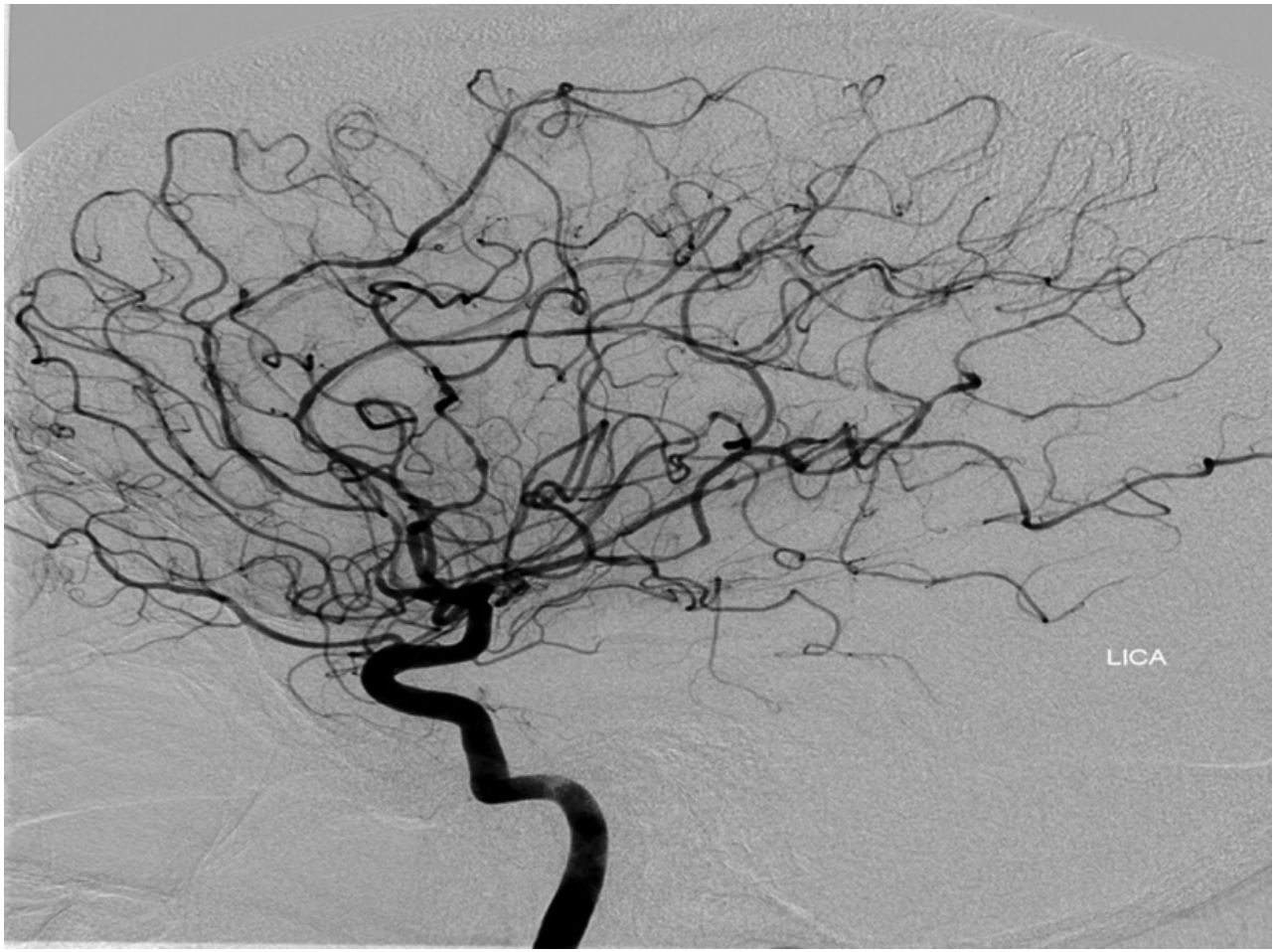
CEREBROVASCULAR ANATOMY

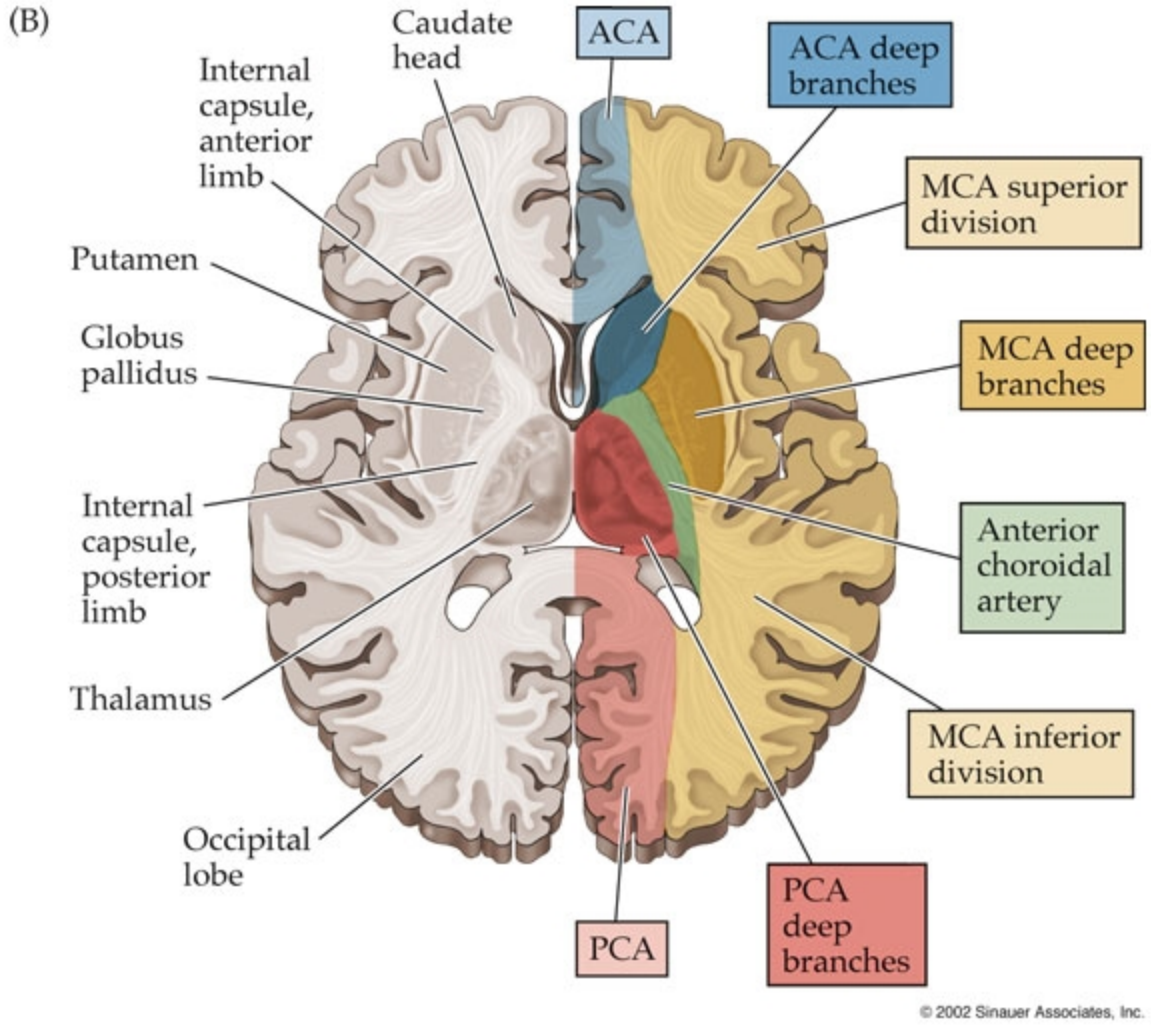
Axial

Coronal



Sagittal




(B)
Caudate head
ACA
ACA deep branches
Internal capsule, anterior limb
MCA superior division
Putamen
Globus pallidus
MCA deep branches
Internal capsule, posterior limb
Anterior choroidal artery
Thalamus
MCA inferior division
Occipital lobe
PCA
PCA deep branches
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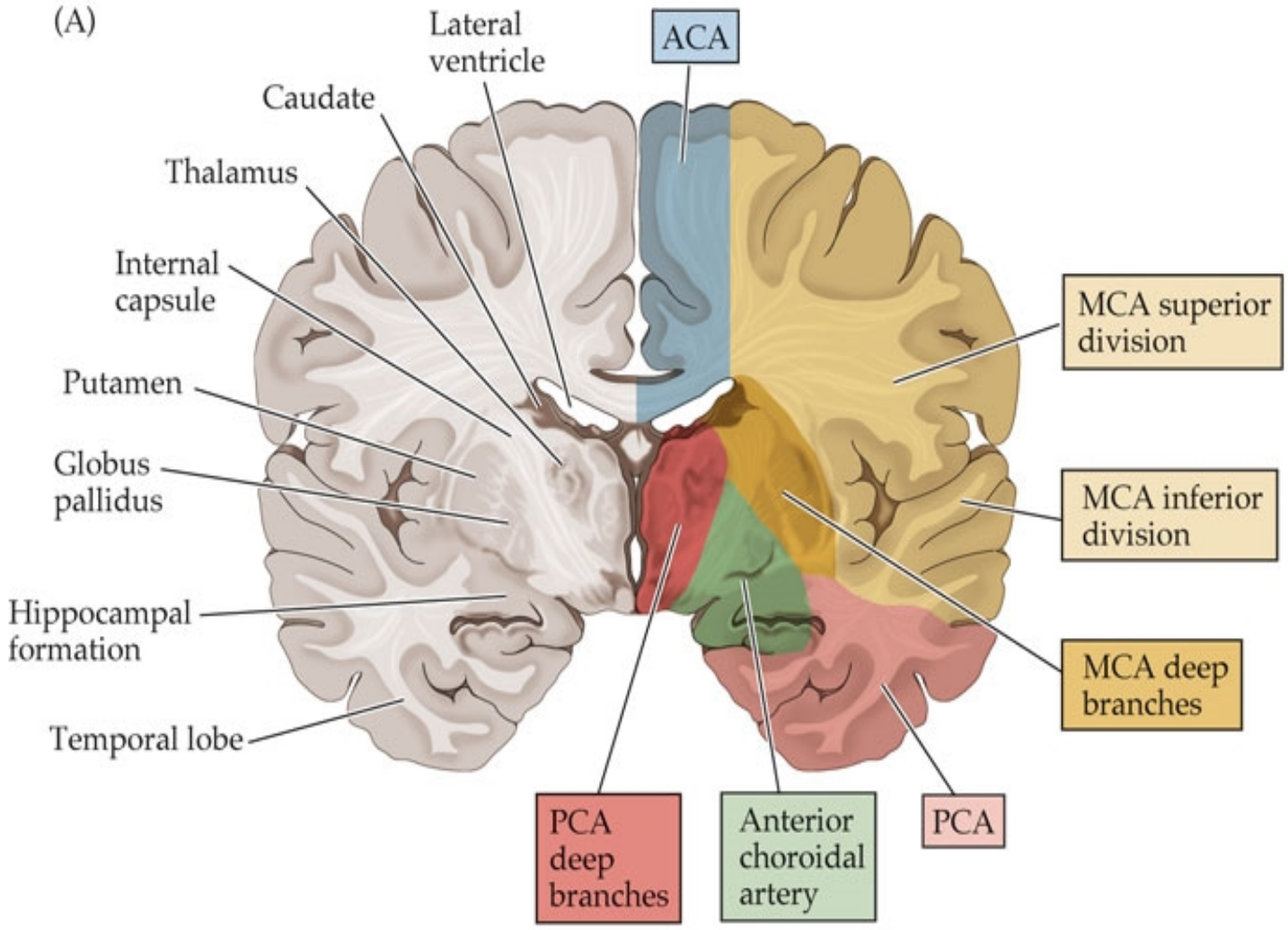

GENERAL PRINCIPLES

Stroke Type	Typical Features	Location	Mechanism
Large Vessel Thromboembolic (50%)	• Stuttering or progressive hours-days • Perfusion dependent • Often during sleep	• Carotid bifurcation • ICA siphon • Proximal M1 • Verterbral origin • Intracranial vertebral	• Atherosclerosis • Dissection • Radiation
Cardioembolic (25%)	• Sudden onset • Maximum at onset, improve quickly • Single or multiple vascular territories	Distal ICA M1/M2 Gray/white junction	• Atrial fibrillation • Mechanical valve • Recent MI • Dilated cardiomyopathy
Lacunar (10%)	• Sudden or gradual onset • Stuttering • Lack of cortical signs and symptoms	• Basal ganglia • Thalamus • Pons • Cerebellum	• Lipohyalinosis • HTN

Stroke Type	Typical Features	Location	Mechanism
Intraparenchymal Hemorrhage (10%)	• Progressive minutes-hours • Focal progressing to HA, N/V, somnolence, coma • Drugs, exertion, or other causes of HTN	• Basal ganglia • Thalamus • Pons • Cerebellum • Cortical	• HTN (Charcot-Bouchard aneurysm) • Cerebral amyloid angiopathy • AVM
Subarachnoid Hemorrhage (5%)	• Abrupt severe HA, neck pain, N/V, photophobia • focal neurological deficits less common • often have relevant family history	• Basal cisterns • Cerebral convexity	• Saccular aneurysm • CAA • AVM/DAVF

LARGE VESSEL SYNDROMES

Anterior Circulation Strokes

Question

- A 78 year old develops painless vision loss in his right eye that he describes as a curtain coming down, lasting for 15 minutes. Which test is most likely to diagnose the cause of his symptoms?
  a. Brain MRI
  b. Carotid duplex ultrasound
  c. Transthoracic echocardiogram
  d. 30 day cardiac rhythm monitor

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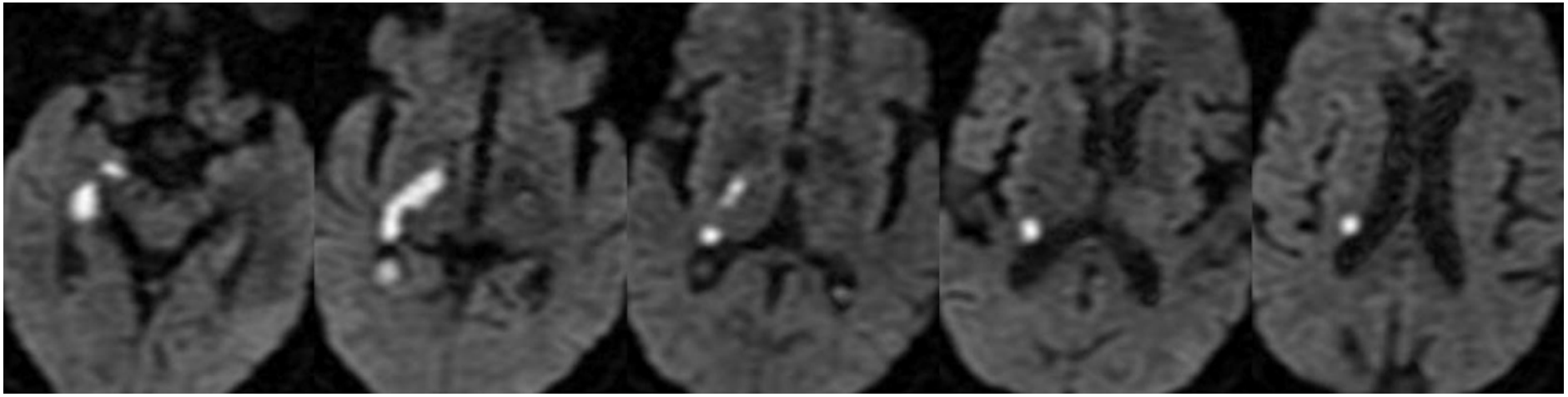
  d. 30 day cardiac rhythm monitor

Internal Carotid Artery

- Symptomatic stenosis
  - Hemodynamic: transient deficits with global hypoperfusion or increased demand
  - Embolic: amaurosis fugax, other TIA or strokes
  - Progressive cognitive decline
- Dissection
  - Headache, carotidynia
  - Horner's syndrome

Anterior Choroidal Artery



- Motor
  - Contralateral hemiparesis (posterior limb of internal capsule)
- Sensory
  - Contralateral hemianesthesia (VPM of thalamus)
- Vision
  - Homonymous hemianopia (LGN of thalamus)

Question

- A 76 year old with atrial fibrillation presents with reduced speech output, flat affect, and inability to walk. On exam she has minimal verbal output and cannot move either leg. What is the anatomic localization for her symptoms?
  a. Dominant inferior frontal lobe (Broca's area)
  b. Dominant posterior superior temporal lobe (Wernicke's area)
  c. Bilateral medial frontal lobes
  d. Cervical spinal cord

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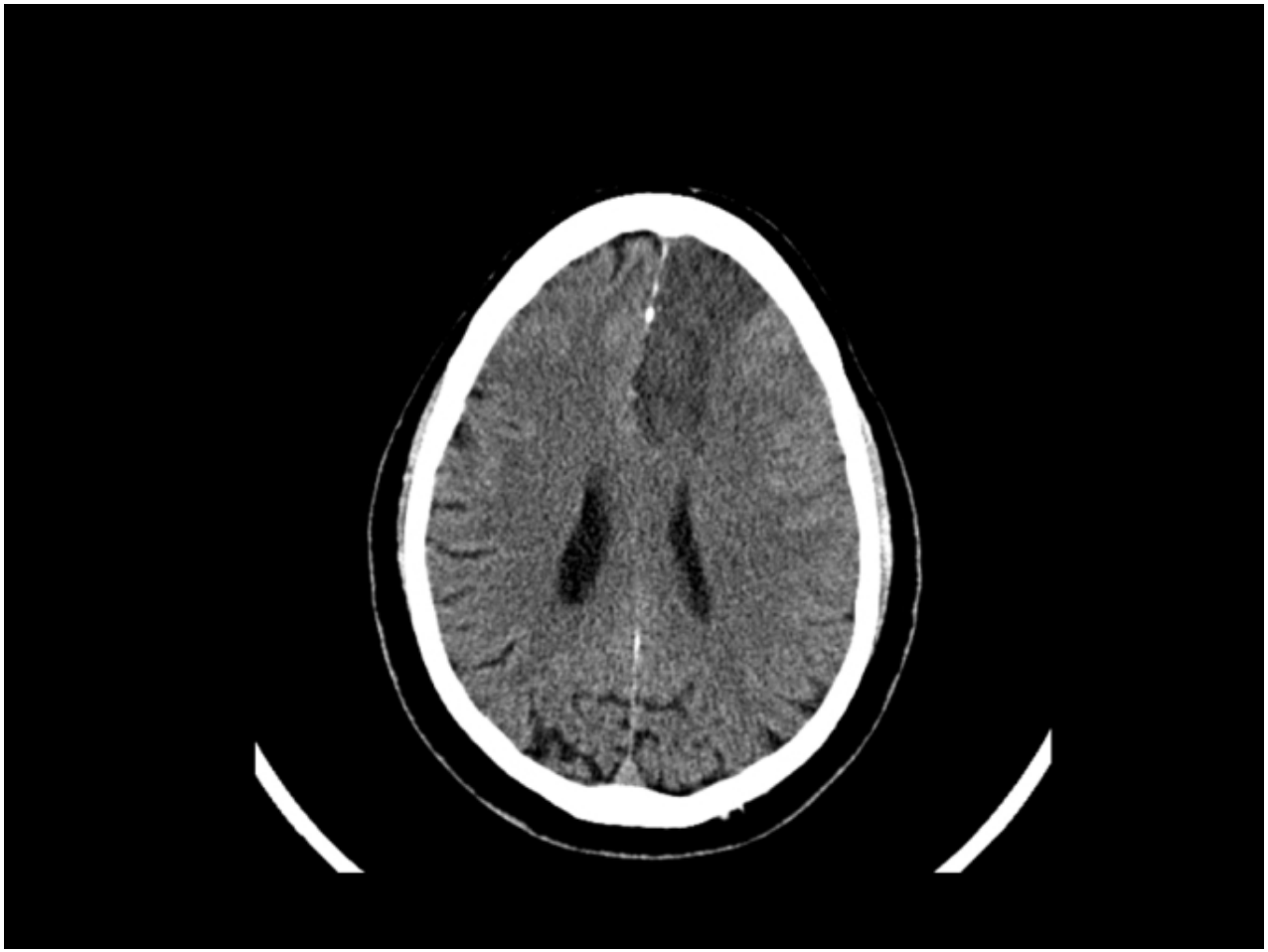
Anterior Cerebral Artery



- Motor
  - Contralateral leg weakness (distal>proximal)
  - may be bilateral
    - single A1
    - subfalcine herniation
- Sensory

- Cognitive/affective
  - Gait apraxia
  - Akinetic mutism/abulia
- Collosal disconnection syndromes
  - Left hand ideomotor apraxia, agraphia, tactile anomia
  - Left body part agnosia
  - Alien hand

Question

- A 67 year old presents with fluent, nonsensical speech with frequent paraphasic errors, neologisms, and right superior quadrant-anopia. Which vascular territory is involved?
  a. Right MCA inferior division
  b. Left ACA
  c. Left MCA superior division
  d. Left MCA inferior division

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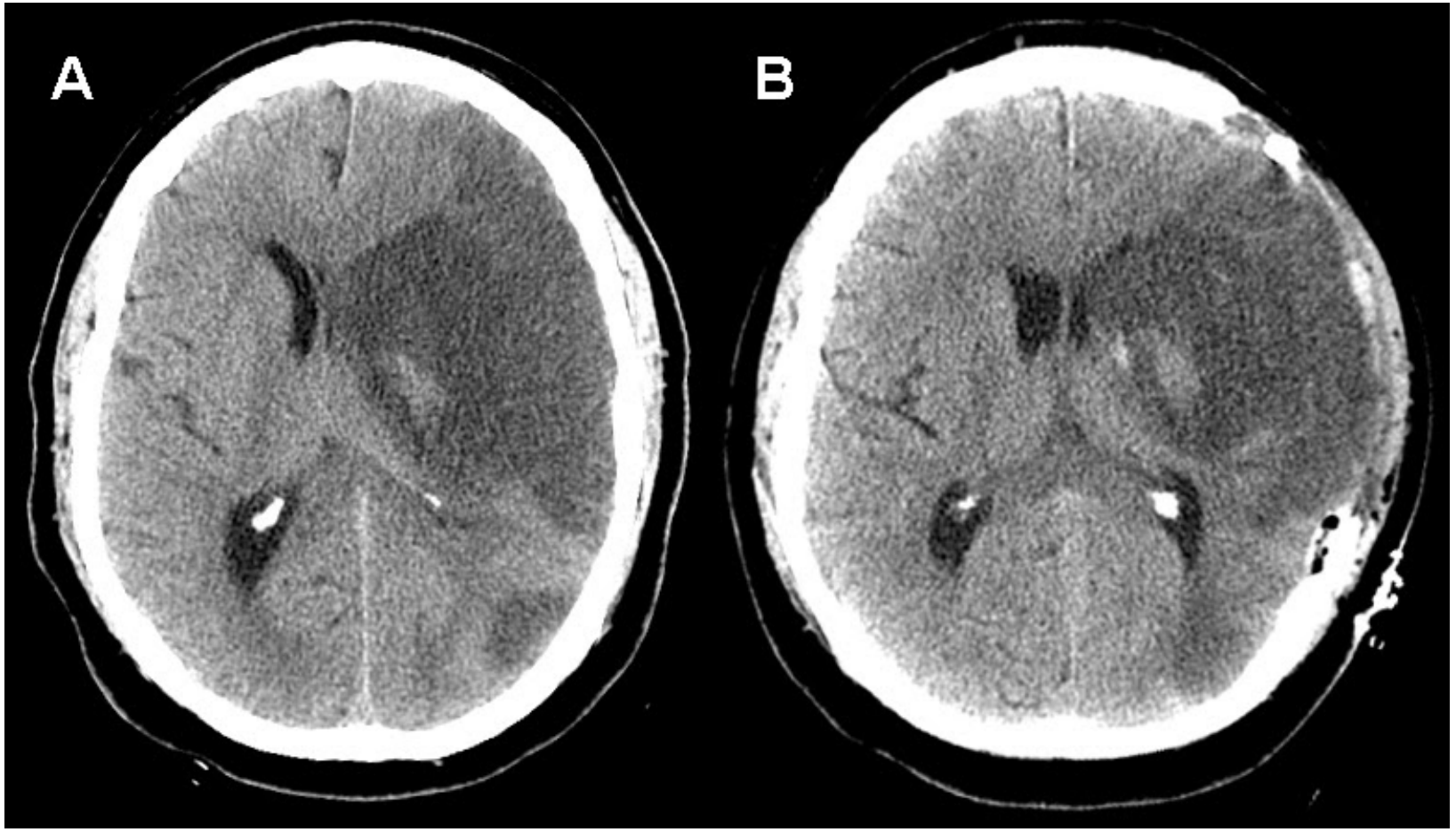
  a. Right MCA inferior division
  b. Left ACA
  c. Left MCA superior division
  d. Left MCA inferior division

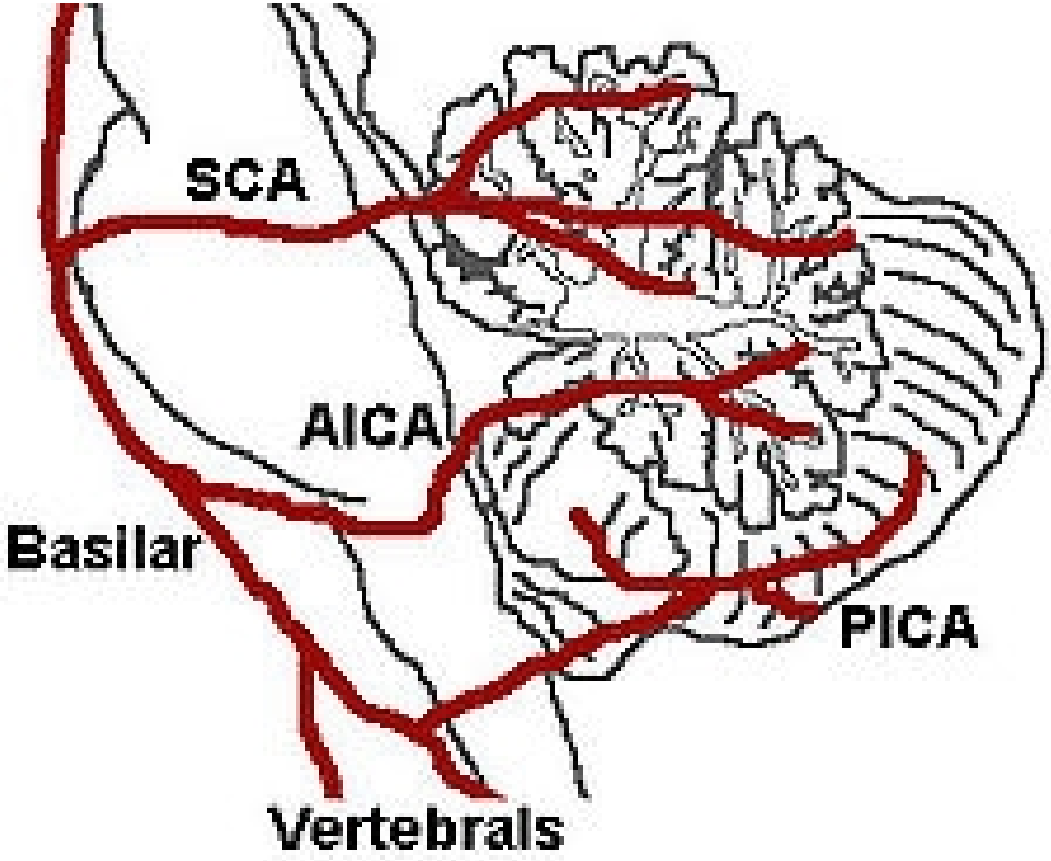
Middle Cerebral Artery

	Superior Division	Inferior Division
Motor	Contralateral face, arm>leg (Primary, secondary motor cortex)	
Sensory	Contralateral face, arm>leg (Somatosensory cortex)	
Vision		Homonymous hemianopia or quadrantanopia (Optic radiations)
Language	Expressive aphasia (dominant hemisphere, Broca's area)	Receptive aphasia (dominant hemisphere, Wernicke's area)
Prosody	Prosodic apraxia (non-dominant hemisphere)	Prosodic agnosia (non-dominant hemisphere)
Other	Hemineglect (non-dominant hemisphere)	Constructional apraxia (non-dominant hemisphere)

- Malignant MCA Stroke
  - Terminal ICA or M1 occlusion
  - Massive edema within 2-5 days leading to midline shift and uncal herniation
  - Early signs:
    - Decreased level of consciousness
    - Ipsilateral pupillary dilation
    - Ipsilateral hemiparesis
  - Decompressive hemicraniectomy increases likelihood of surviving with mRS≤4 if done within 48 hours


A
B

Posterior Circulation Strokes


SCA
AICA
Basilar
PICA
Vertebrals

Question

- A 73 year old presents with left sided facial numbness, right sided body numbness, ataxia on left finger to nose, and dysphagia. What additional finding is likely on exam?
  a. Left sided facial droop
  b. Right arm and leg weakness
  c. Left eye ptosis and miosis
  d. Inability to adduct right eye with left lateral gaze

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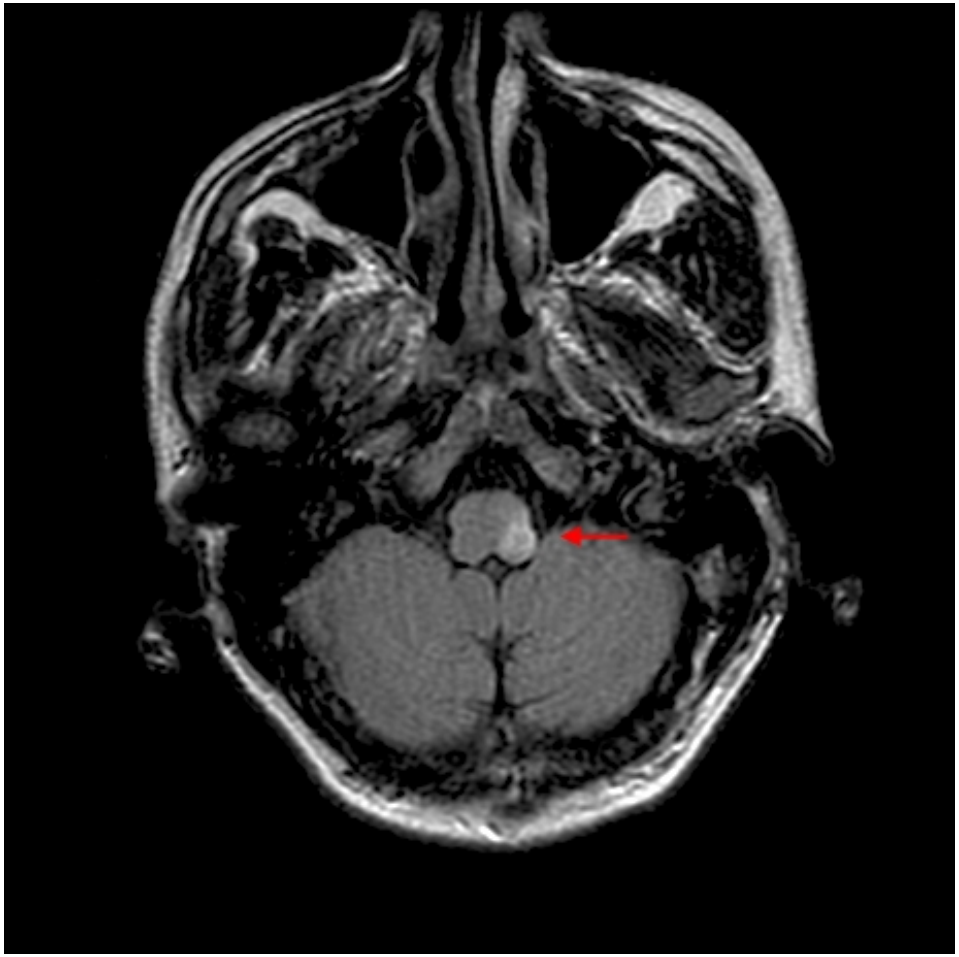
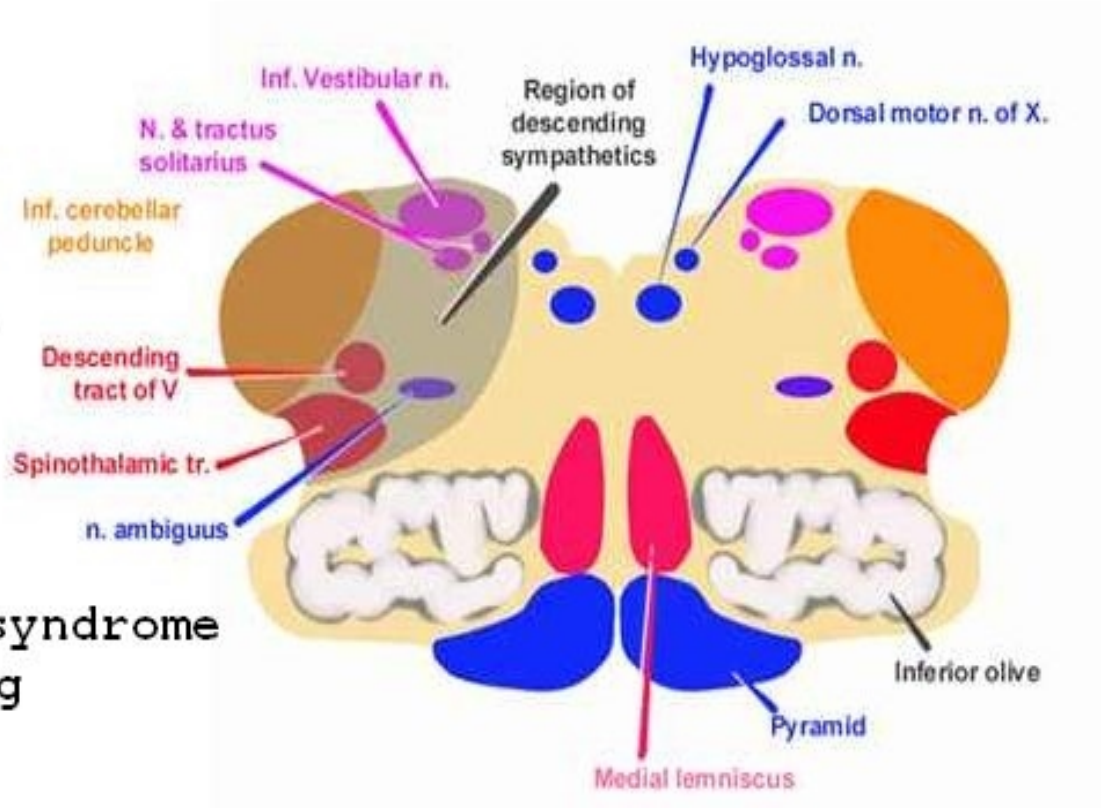
Lateral Medullary (Wallenberg) Syndrome



Lateral medullary syndrome of wallenberg



- Vestibulocerebellar
  - Vertigo (inferior vestibular nucleus)
  - Ipsilateral ataxia and hypotonia (inferior cerebellar peduncle)
  - Nystagmus, diplopia, ocular torsion
- Crossed sensory loss to pain and temperature
  - Ipsilateral face (descending spinal nucleus)
  - Contralateral body (spinothalamic tract)

- Bulbar muscle weakness
  - Ipsilateral palate, pharynx, larynx weakness → dysphonia, dysphagia, hiccups (nucleus ambiguus)
- Autonomic dysfunction
  - Ipsilateral Horner's syndrome (descending sympathetics)
- Respiratory dysfunction
  - Failure of automatic respiration during sleep (Ondine's curse, medullary reticular formation)

Question

- A 45 year old presents to the hospital with 3 days of neck pain, right hand incoordination after being involved in a motor vehicle accident. Overnight, she complains of a headache and nausea before becoming progressively more somnolent. What treatment is most likely to prevent further neurological worsening?
  a. Aspirin 325 mg
  b. Aggressive blood pressure reduction
  c. Decompressive hemicraniectomy
  d. Decompressive suboccipital craniectomy

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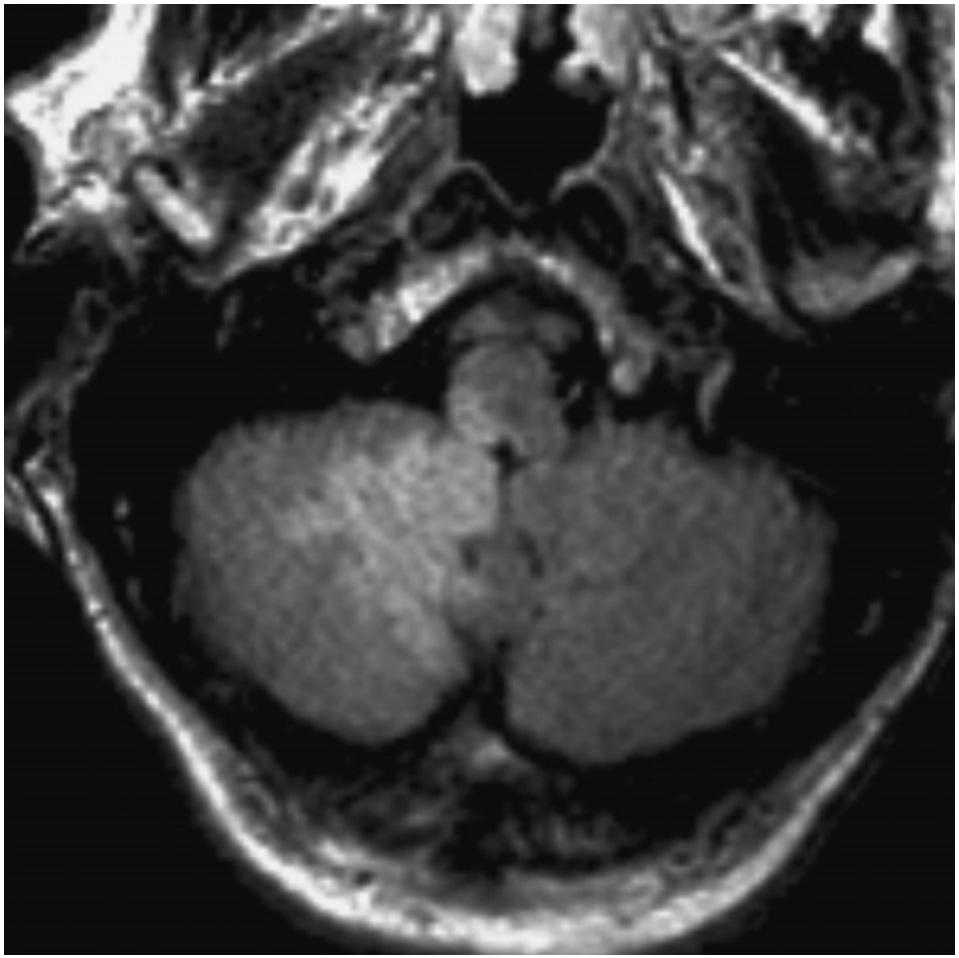
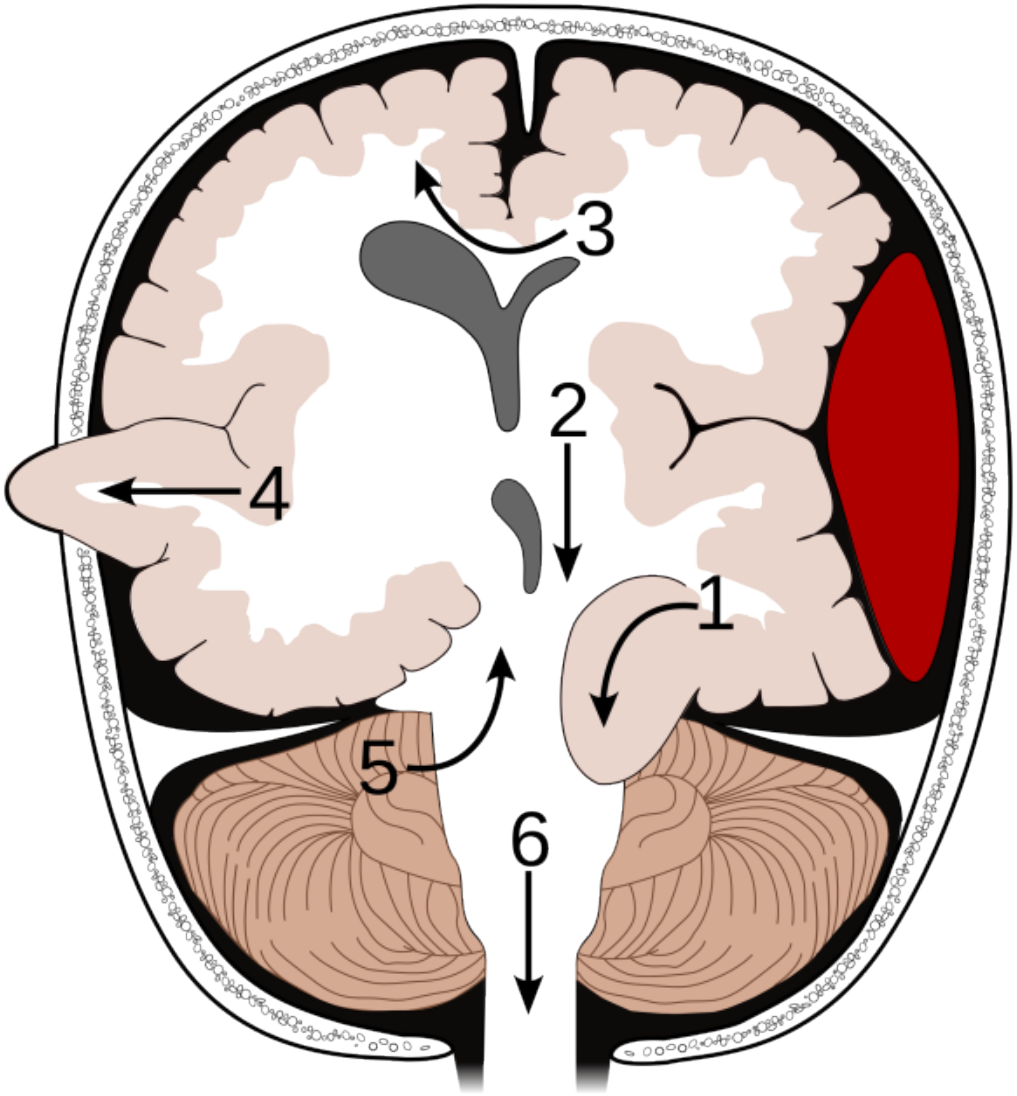
PICA Infarct

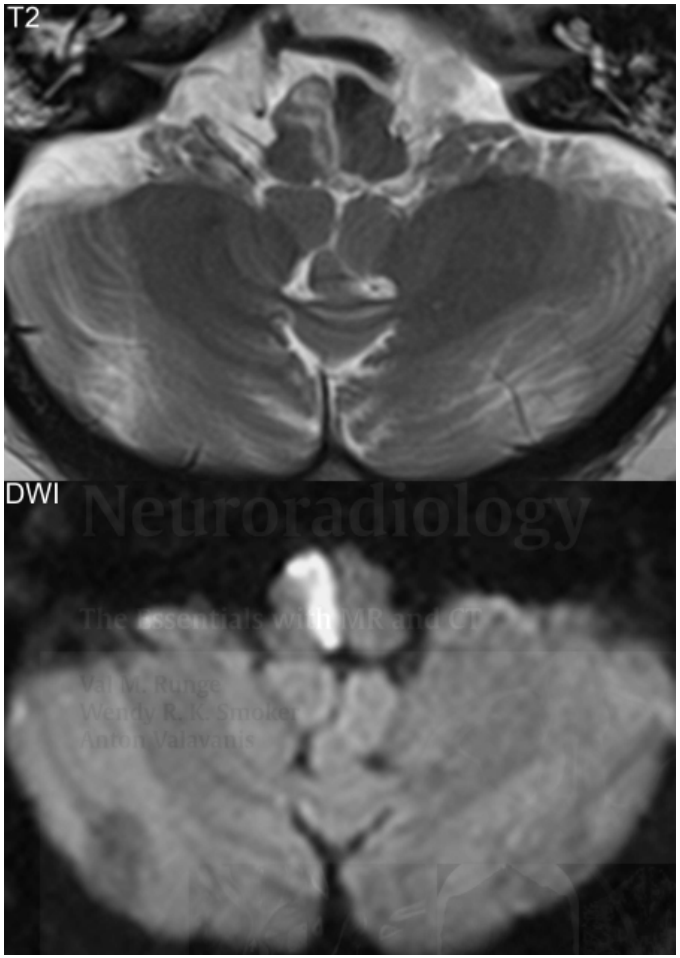


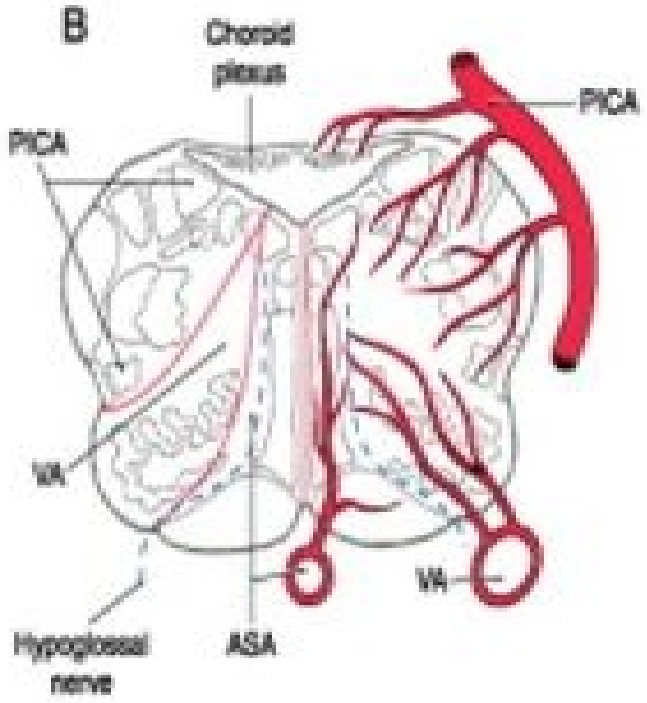
- May involve vermis, medial, or lateral inferior cerebellum
- 20% involve dorsolateral medulla
- Symptoms
  - Vertigo, dizziness, nystagmus
  - Nausea/vomiting, headache
  - Ipsilateral ataxia, truncal ataxia, truncal lateropulsion

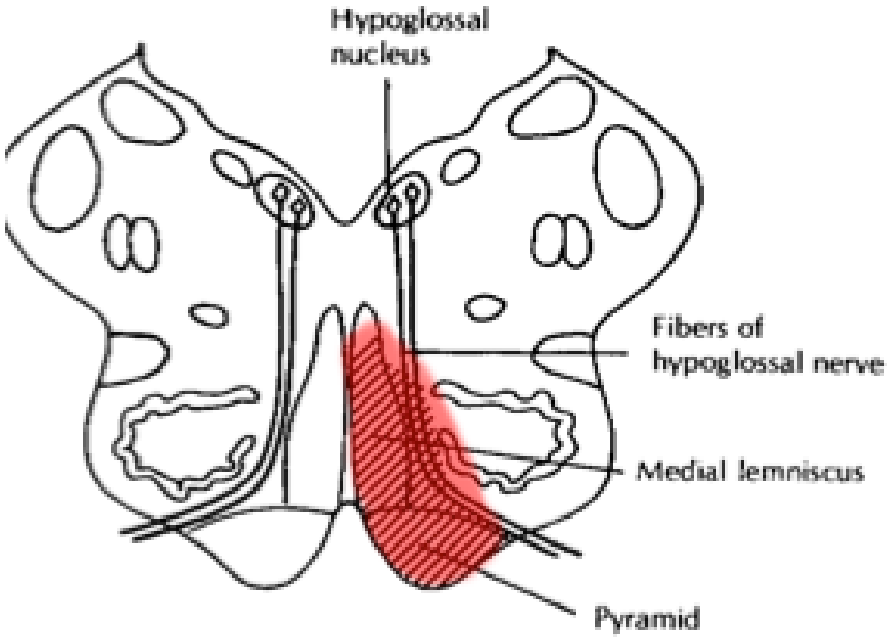
- Pseudotumoral cerebellar infarction
  - Seen in first 2-5 days after full territory PICA infarction
  - Headache, vomiting, somnolence → stupor and coma due to hydrocephalus, downward tonsillar, and upward central herniation
  - Early signs: vertical gaze palsy, bilateral Babinski
  - Requires suboccipital decompressive craniectomy


3
2
4
1
5
6

Medial Medullary (Dejerine) Syndrome




B
Choroid plexus
PICA
PICA
VA
VA
Hypoglossal nerve
ASA


Hypoglossal nucleus
Fibers of hypoglossal nerve
Medial lemniscus
Pyramid

- Contralateral hemiparesis (pyramidal tract)
- Contralateral loss of light touch, vibration, proprioception (medial lemniscus)
- Ipsilateral tongue weakness (hypoglossal fibers)

Question

- A 56 year old with refractory HTN presents with diplopia and left facial droop. On exam he is unable to abduct his left eye and has upper and lower left facial weakness. What is the most likely location of his stroke?
  a. Left dorsomedial pons
  b. Left lateral pons
  c. Left ventral pons
  d. Right ventral pons

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  c. Left ventral pons
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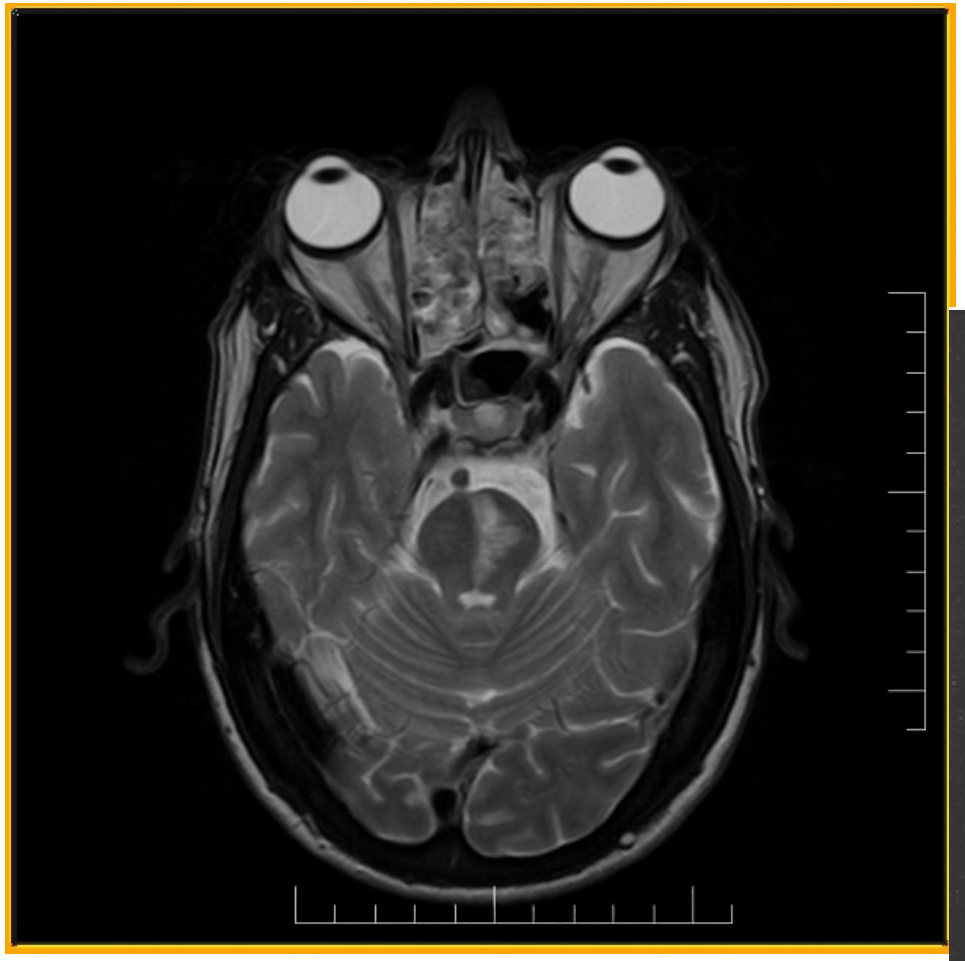
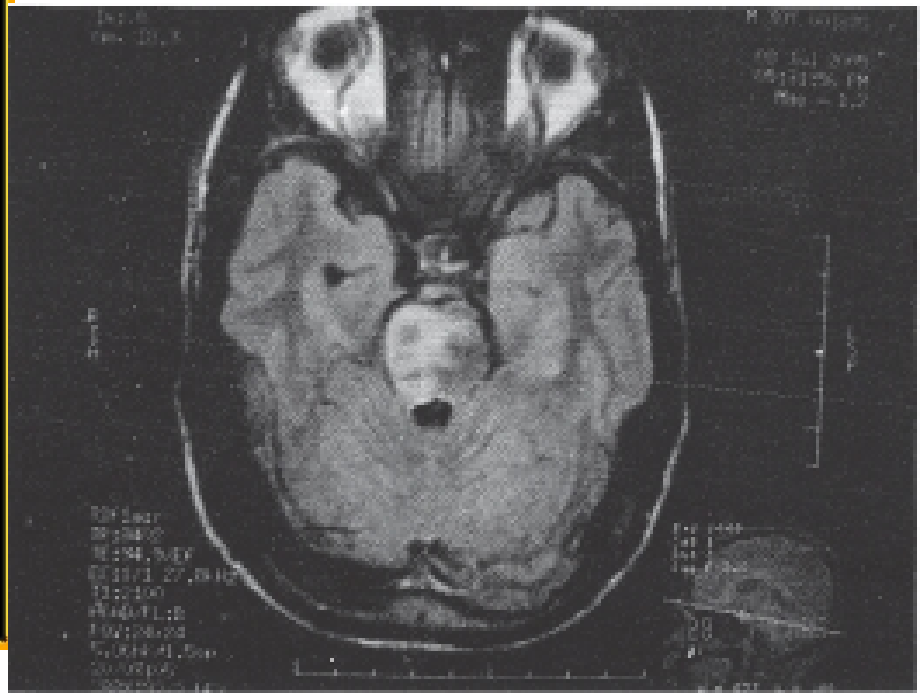
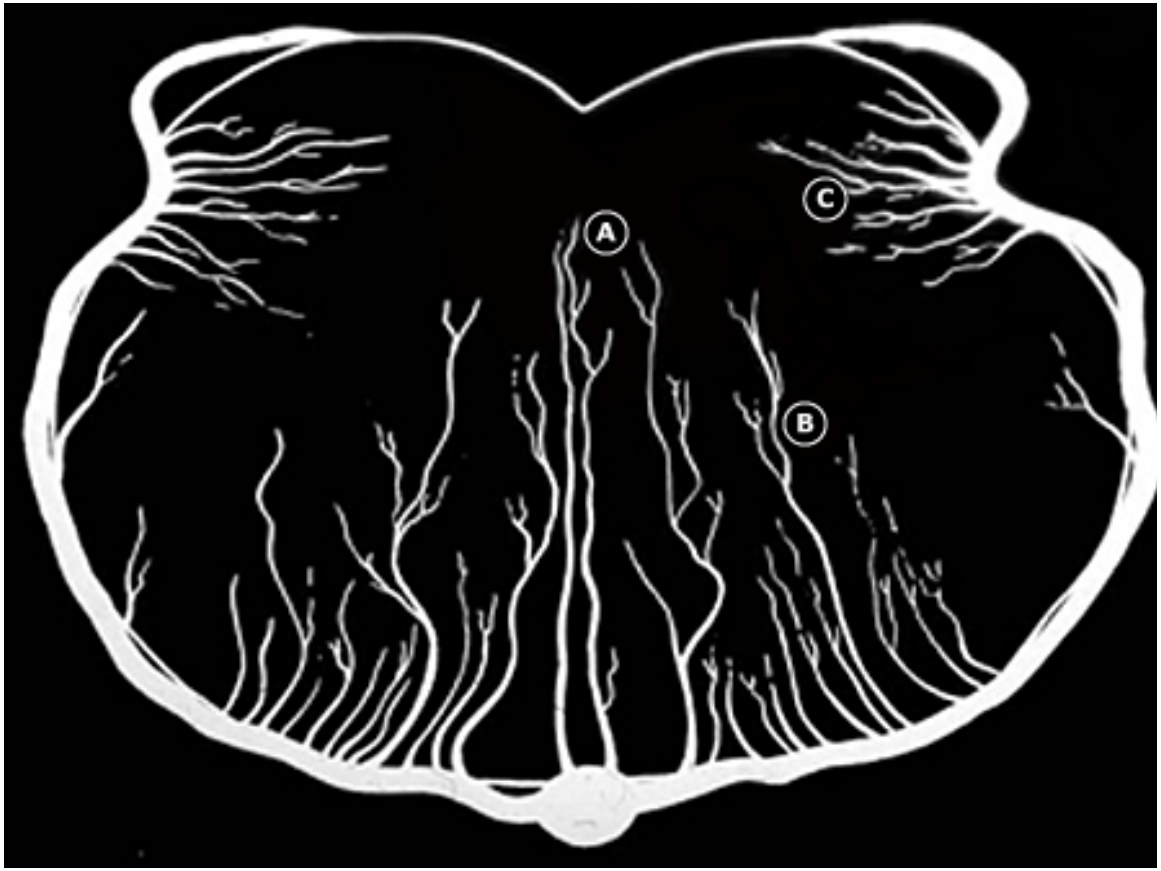
Basilar Artery Syndromes






A
B
C

- Pontine Syndromes
  - Inferior medial pontine syndrome (Foville)
  - Ventral pontine syndrome (Millard-Gubler, Raymond)
  - Lateral pontine syndrome (Marie-Foix)
  - Locked-in syndrome
- Midbrain Syndromes
  - Weber syndrome
  - Benedikt syndrome

- General rules:
  - Paramedian base contains descending motor tracts and crossing cerebellar tracts
  - Paramedian tegmentum contains oculomotor pathways
  - Lateral pons contains sensory and vestibular nuclei and tracts (relatively spared)

- Motor
  - Contralateral hemiparesis
  - Mild ipsilateral weakness, hyperreflexia, adventitial movements
- Bulbar
  - Facial weakness, dyasarthria, dysphagia, dysphonia
  - Often bilateral
  - Palatal myoclonus
  - Pseudobulbar affect
- Severe bilateral corticospinal and corticobulbar involvement results in “locked-in” syndrome

- Oculomotor
  - Horizontal gaze palsies (Lateral, INO, one-and-a-half syndrome)
  - Skew deviation, ocular bobbing
  - Pinpoint pupils
- Sensory
  - Not common, but may involve contralateral loss of light touch, vibration, and proprioception (medial lemniscus)

Top of the Basilar

- Embolic occlusion of rostral basilar artery causing ischemia of midbrain, thalami, temporal, and occipital lobes

- Oculomotor/Pupillary (Parinaud syndrome)
  - Vertical gaze palsy, setting sun sign
  - Convergence-retraction nystagmus
  - Mid position fixed pupils
- Altered mentation
  - Hypersomnolence, abulia
  - Peduncular hallucinations
  - Anterograde or retrograde amnesia

Question

- A 65 year old presents with vision difficulty and numbness in his left arm and leg. Exam shows a left homonymous hemianopia. Which additional finding might be expected on exam?
  a. Left hemiparesis
  b. Difficulty recognizing familiar faces
  c. Inability to read with preserved writing
  d. Difficulty with calculations

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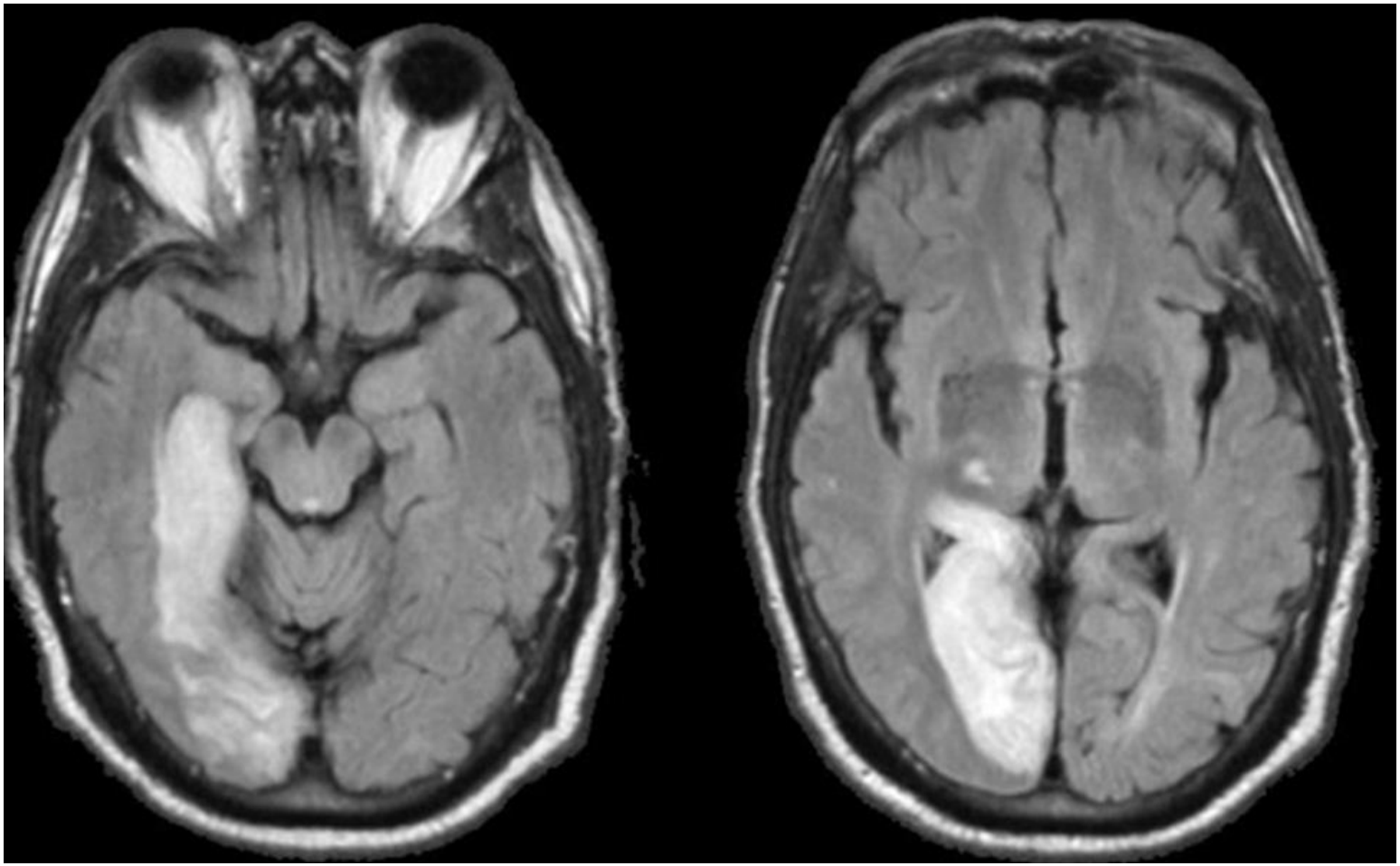
PCA Infarct



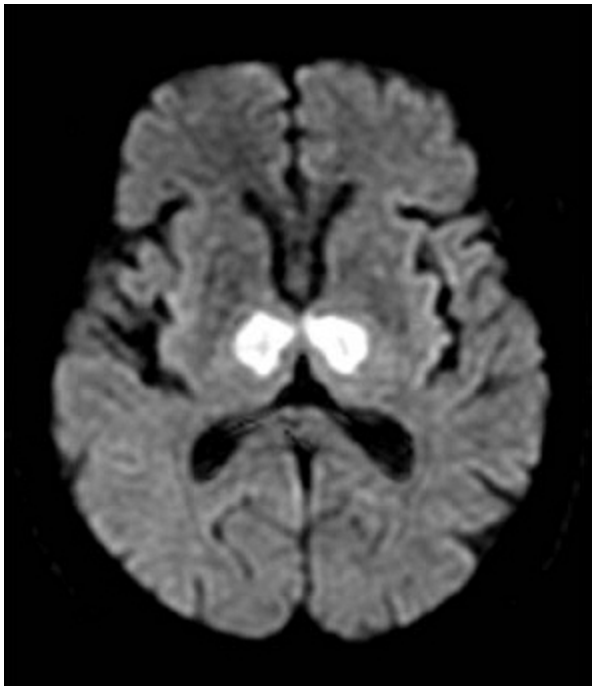
- Vision loss
  - Contralateral hemianopia
  - Macular sparing
- Sensory
  - Contralateral paresthesias, anesthesia
  - Delayed neuropathic pain (Dejerine-Roussy)

- Left PCA Stroke
  - Alexia without agraphia (left occipital lobe + splenium of corpus collosum)
  - Gerstmann syndrome (acalculia, agraphia, finger agnosia, right-left confusion)
- Right PCA Stroke
  - Prosopagnosia
  - Visual neglect
  - Visuospatial disorientation

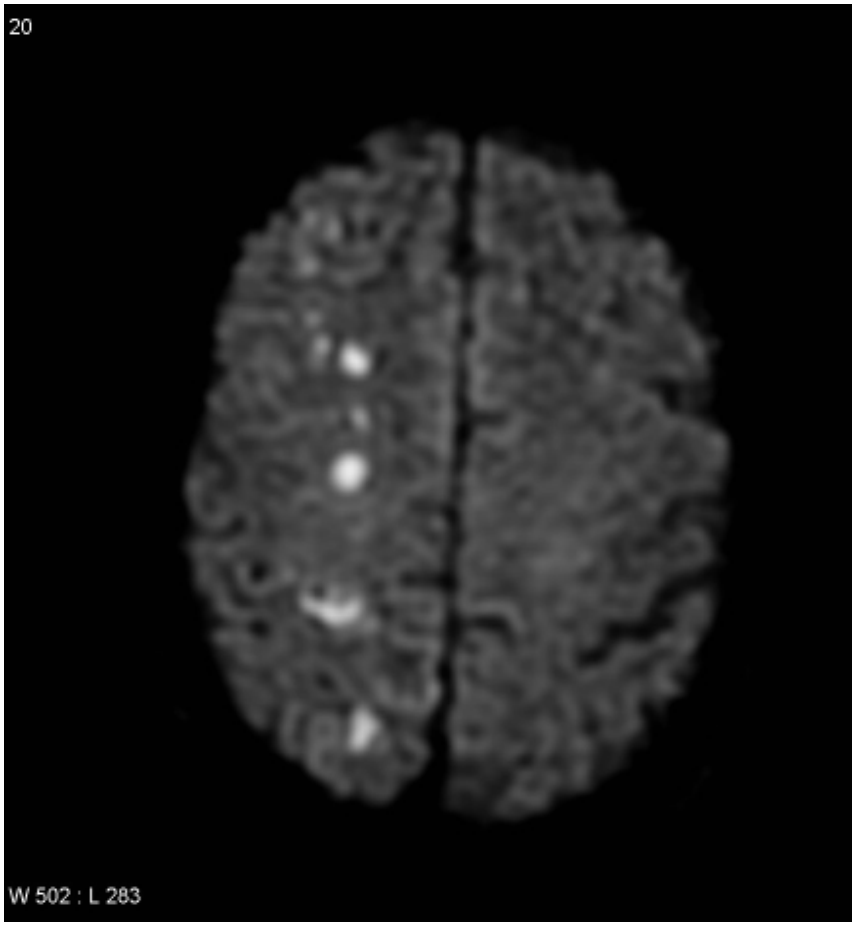
- Bilateral PCA strokes
  - Balint syndrome (optic ataxia, ocular apraxia, asimultagnosia)
  - Anton syndrome (denial of cortical blindness, visual hallucinations)

Bonus

- Artery of Percheron
  - Single thalamic perforator arising from one PCA
  - Occlusion results in bilateral thalamic infarcts
  - Hypersomnolence, language, and memory disturbance



Watershed Syndromes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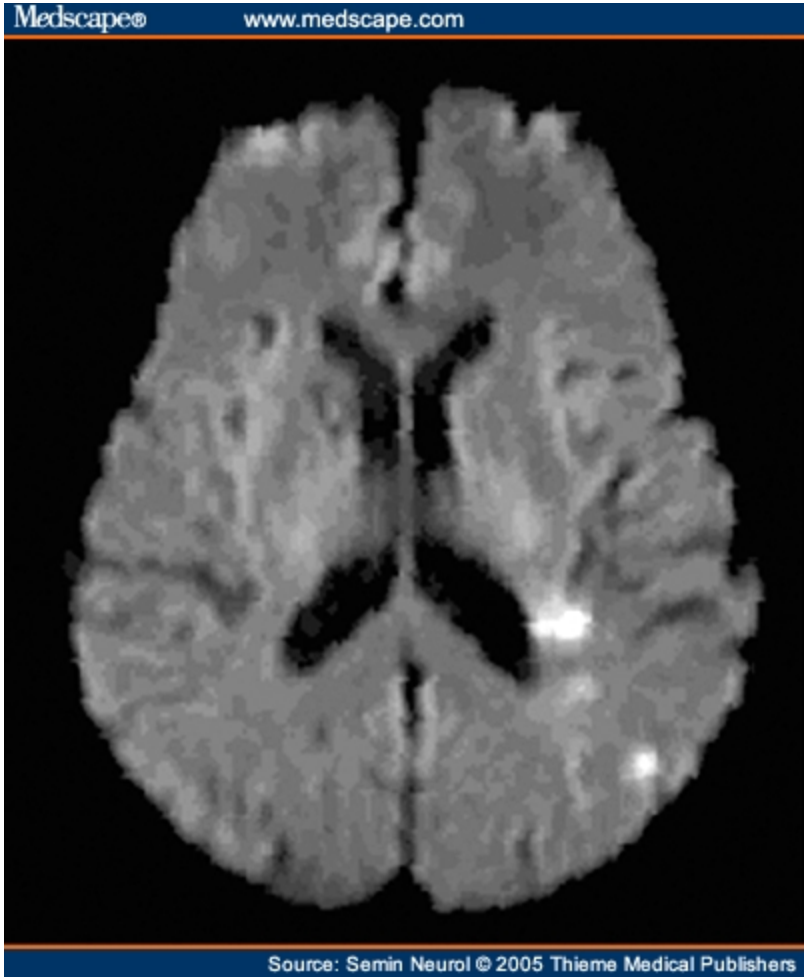
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- Inadequate perfusion of areas at the border between two vascular territories
  - ACA-MCA, PCA-MCA
  - Symmetric or asymmetric
  - Cortical and subcortical regions
- Low cardiac output states: shock, heart failure, arrhythmia
- Large vessel stenosis: atherosclerosis, dissection, vasospasm

- Bilateral visual loss (optic radiations)
- Stupor
- Proximal arm and leg weakness sparing the face hands and feet (man-in-a-barrel)

LACUNAR SYNDROMES

- Lipohyalinosis of small, penetrating vessels
  - Artery of Heubner
  - Lenticulostriate
  - Thalamoperforant
  - Basilar perforators
- Progressive or stuttering course over hours to days
- Lack of cortical signs (aphasia, agnosia, apraxia, anopia, neglect)

- Pure motor hemiparesis (~50%)
  - Weakness of face, arm, and leg
  - Capsular warning syndrome
  - Internal capsule, corona radiata, pons
- Sensorimotor (15-20%)
  - Weakness and numbness of face, arm, and leg
  - Posterolateral thalamus and internal capsule
- Pure sensory (~15%)
  - Numbness of face, arm, and leg
  - Thalamus, corona radiata

- Ataxic hemiparesis (~10%)
  - Ipsilateral weakness and ataxia
  - May have dysarthria, nystagmus, gait deviation
  - Internal capsule or pons
- Clumsy hand-dysarthria (~5%)
  - Facial weakness, dysarthria, dysphagia, slight weakness and clumsiness of one hand
  - Pons

- Questions?