Neurology Perspective on Stroke for Rehabilitation Therapists

- Jeff Halladay, MD
- Neurologist

About presentation

- Asked to review some things about stroke
  - I have covered here 25 weeks at the time of presentation, starting in October 2024.
  - Presentation is 'best guess' on what might help
- Only called to rehab a few times.
  - Several of these were cases that are more complicated than we typically see at LMH
  - Large strokes (ICA, M1 MCA) or Hemorrhages (intraparenchemal, SAH, SDH)
  - Non-stroke pathology
- Majority of inpatient cases are small strokes at LMH

Goals

- Appreciate roles between neurology team members and different therapy team members
- Gain some appreciation for using neurologic anatomy for prognosis and treatment decisions
- Review less common shared cases seen on inpatient hospital and inpatient rehab floor

AI is sometimes right

Part 1: Stroke Overview

- The term "stroke" is used to describe a sudden loss of brain function caused by an interruption in blood flow to the brain. The name "stroke" reflects the sudden and impactful nature of this event, similar to a forceful strike.
- In ancient Greek, the word "apoplexy" was used to describe a stroke. This word comes from "apo," meaning "from," and "plexis," meaning "to strike." Over time, the term "stroke" evolved as a more common and descriptive term for this medical condition.

What is "Stroke Neurology"

- At large center, about half of time spent on hyperacute time window
  - Selecting patients for thrombolytics
  - Selecting patients for clot retrieval
  - Optimizing hospital treatment algorithms to minimize time to thrombolysis and time to re-cannulization
- Floor and ICU management
  - Managing SAH and vasospasm
  - Managing herniation and decision making in large strokes
  - Identifying mechanism and prevention strategies
- Conclusion: LMH is not representative of typical "Stroke Neurology"

Cases seen here are a subset of stroke

- We treat medium to small strokes here
  - Largest tends to be an M2 MCA
  - Most cases are small vessel or smaller embolic
- We transfer the larger events at risk for herniation and death
  - ICA strokes
  - M1 MCA strokes
  - Hemorrhagic Strokes
  - Subarachnoid Hemorrhage

Neurology at LMH: Classify the cause of the stroke

- Original TOAST classification is still used
  - Large artery atherosclerosis (carotid and vertebral and M1 MCA)
  - Cardioembolism
  - Small Vessel Occlusion (including Lacunar)
  - Stroke of Other Determined Etiology (ie meth, infection, etc)
  - Stroke of Undetermined Etiology (Cryptogenic)

Neurology at LMH: Prevent future stroke

- Most ischemic get antiplatelet
  - Now DAPT for 21 days for low NIHSS that have lower risk of hemorrhagic conversion
  - Aspirin vs clopidogrel has been debated for 30+ years
- Cardiombolic treated with anticoagulation
- Carotid normally treated with surgery and sometimes stent and sometimes medication
- Lower lipids
  - Benefit in JUPITER, HPS, SPARCL trials all 5-6%
  - Cholesterol is used to improve mechanical strength of animal cell membranes and muscles do not like blocking HMGCR
  - Normally see mitochondrial clustering at the membranes on biopsy, can improve with CoQ10

- Neurology often signs off at this point

Rehabilitation process takes over

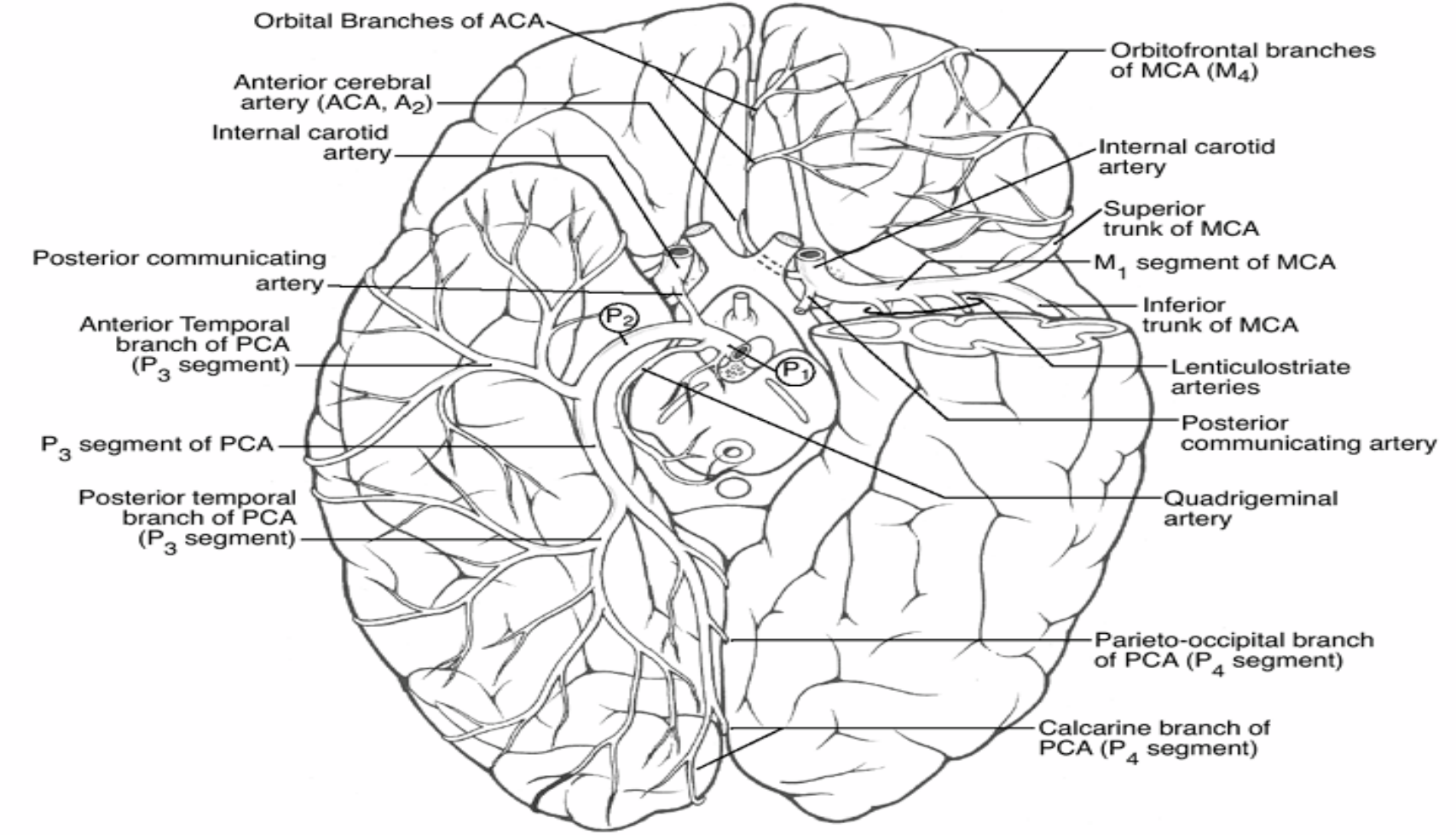
- Therapy largely takes over to improve deficits and independence
  - All goals for independence, motor improvement, nutrition, communication, etc
  - Management of common stroke complications like urinary retention, depression, etc
- Neurology in the background
  - Re-evaluate for unexpected clinical course
  - Follow up on risk factor workup
  - Address the 5-10% risk of post cortical stroke epilepsy peaking 5 years after stroke

"A neurologist can only help as part of a team with rehabilitation/ physiatry and surgery" - *Jeff Halladay, Neurologist*

Part 2: Neurology approach to stroke

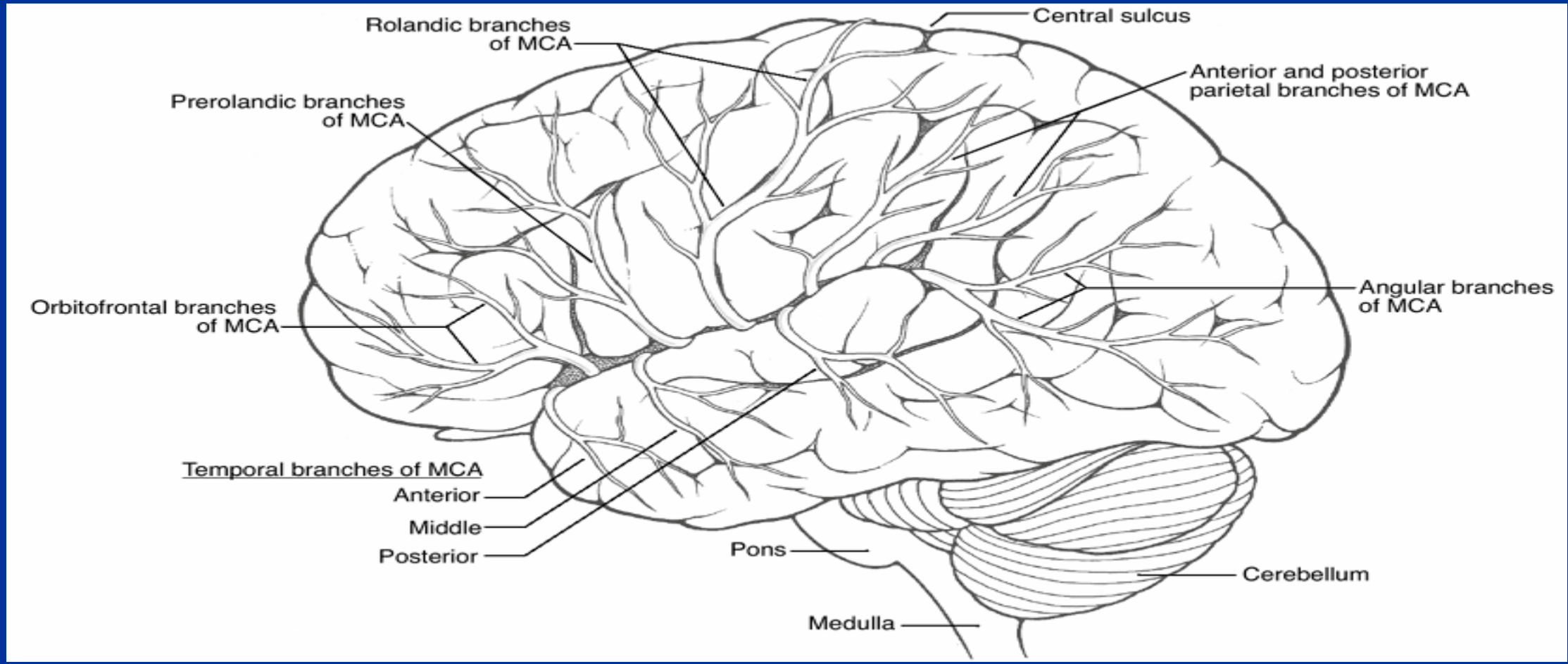
- Diagnosis based on joining anatomy (vascular and neuroanatomy) with mechanisms
  - "You need to be a good internist and know the anatomy before you can start being a neurologist" - Al Aksamit
- Will this helpful?
  - This team will need to tell me how you think, and we can stop and dialog at any point
  - "We are always smarter than any one of us" – Jim Albers, Neurologist

Arterial Anatomy



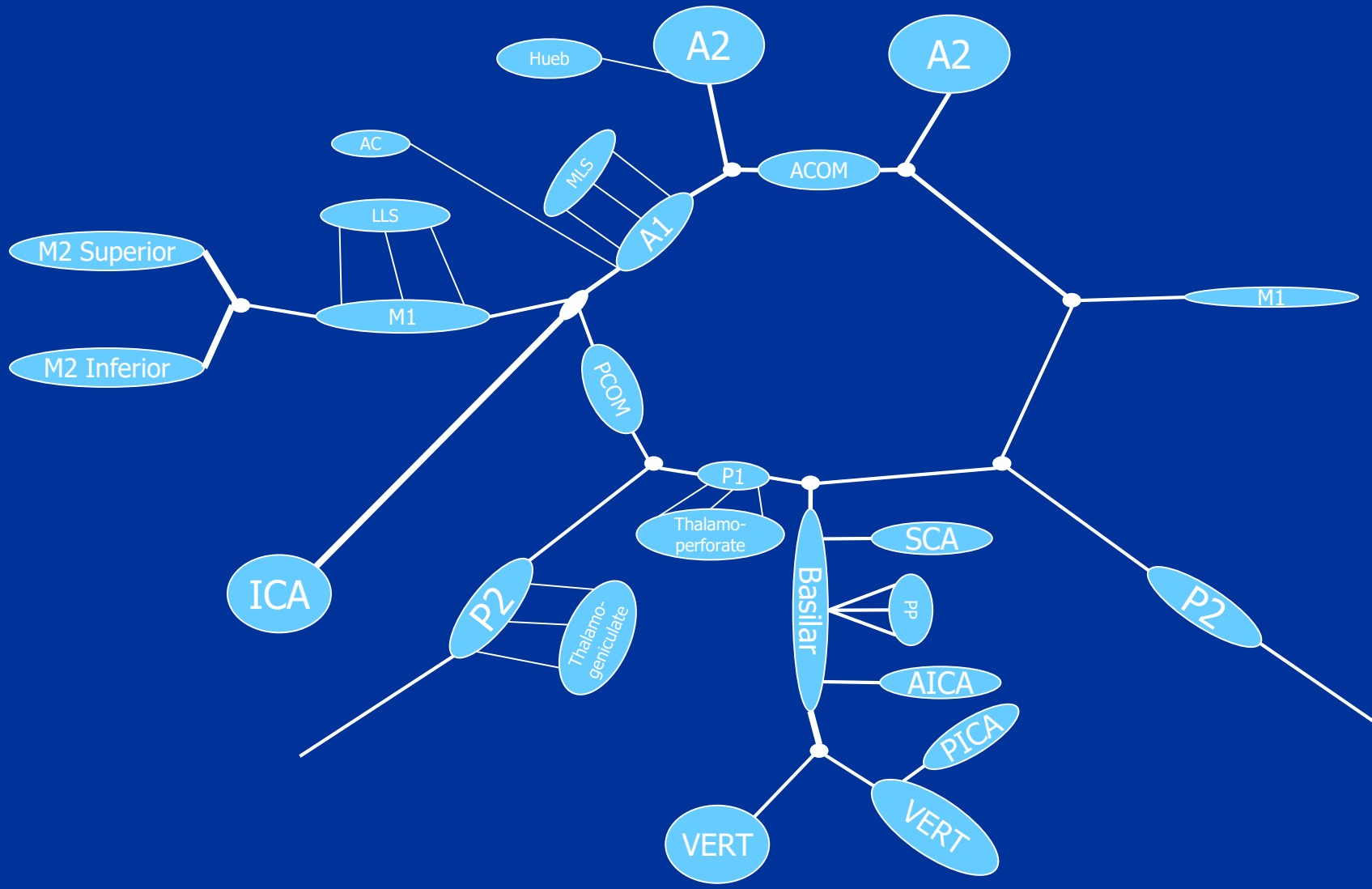
Haines, Neuroanatomy

Arterial Anatomy



Haines, Neuroanatomy

Schematic View of Arteries



To simplify, will focus on subset of vascular anatomy

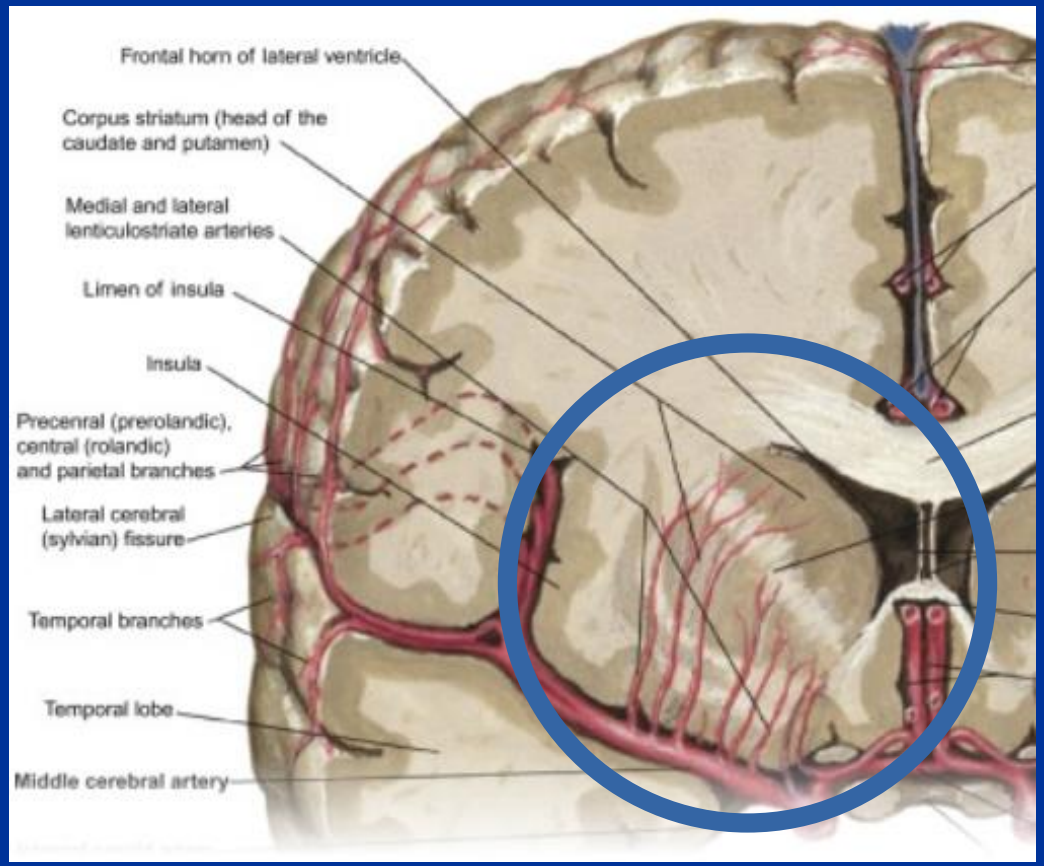
- Lacunar
- Superior large vessels (ACA, MCA, PCA)
- Skip:
  - Many sub-branches of large vessels
  - Cerebellar arteries
  - Less common ‘perforators’

“Classic” lacunar strokes

- Normally peak at onset but can be stuttering
- Common lacunar syndromes
  - Pure Motor Hemiparesis
  - Pure Sensory Stroke
  - Mixed motor and sensory
  - Ataxic hemiparesis
  - Clumsy Hand Dysarthria Syndrome

Lacunar Physiology

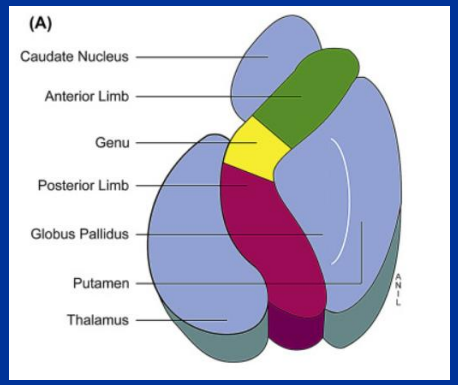
- Term coined by C Miller Fisher in 1965
- Tiny offshoots of larger arteries
- Variable number of lacunar vessels per person
- No smooth muscle to protect against hypertension

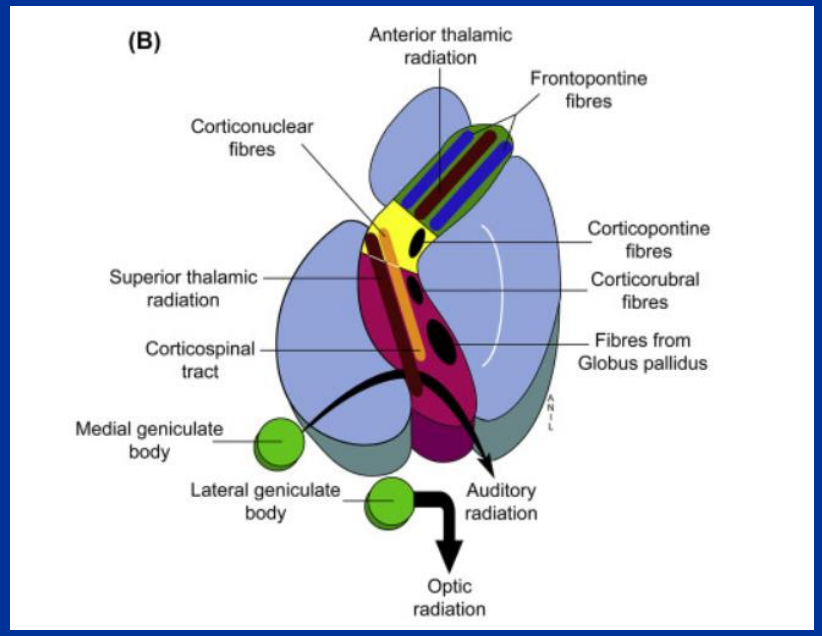


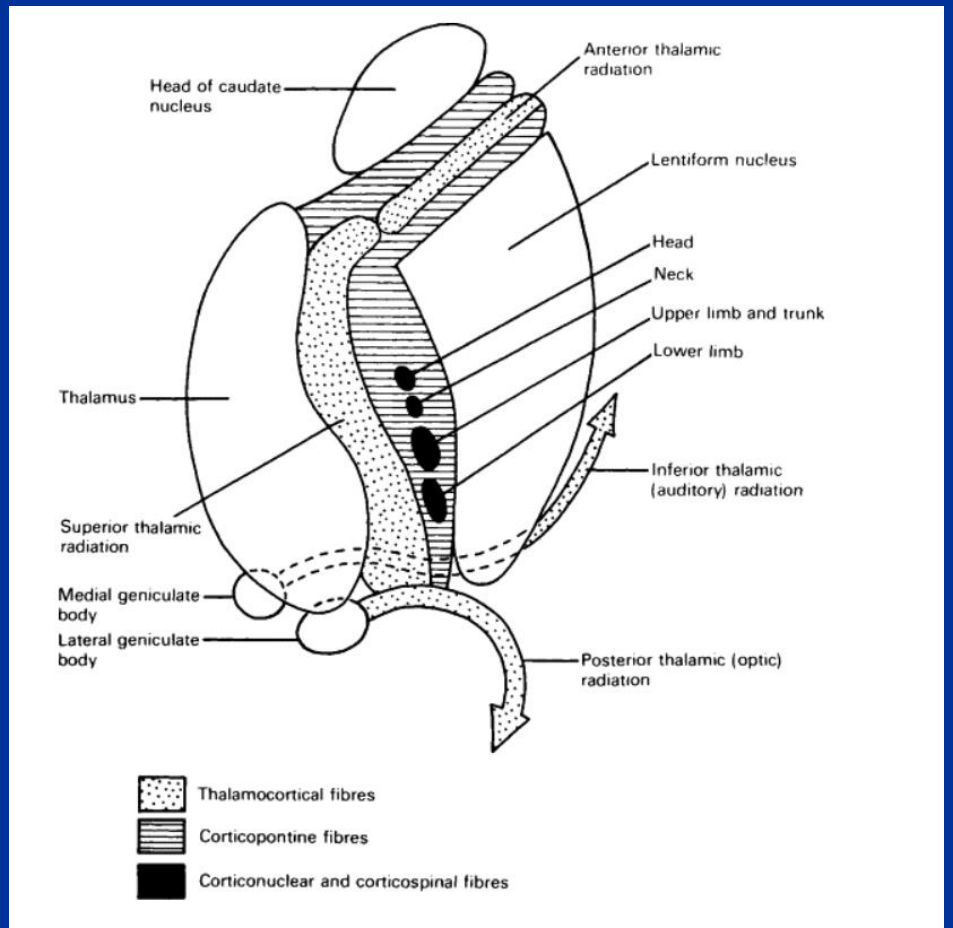
Lacunar syndrome: Pure Motor Hemiparesis

- Symptoms:
  - Contralateral weakness that usually affects face, upper & lower extremities
  - Dysarthria, dysphagia
  - No sensory or visual loss or cognitive impairments
- Localization:
  - Posterior limb internal capsule
  - Cerebral peduncle
  - Pons
  - Hemispheric white matter
- Therapy:
  - Often inpatient
  - PT
  - OT
  - SLT

Back to Anatomy: Millimeters Matter with Internal Capsule and Thalamus





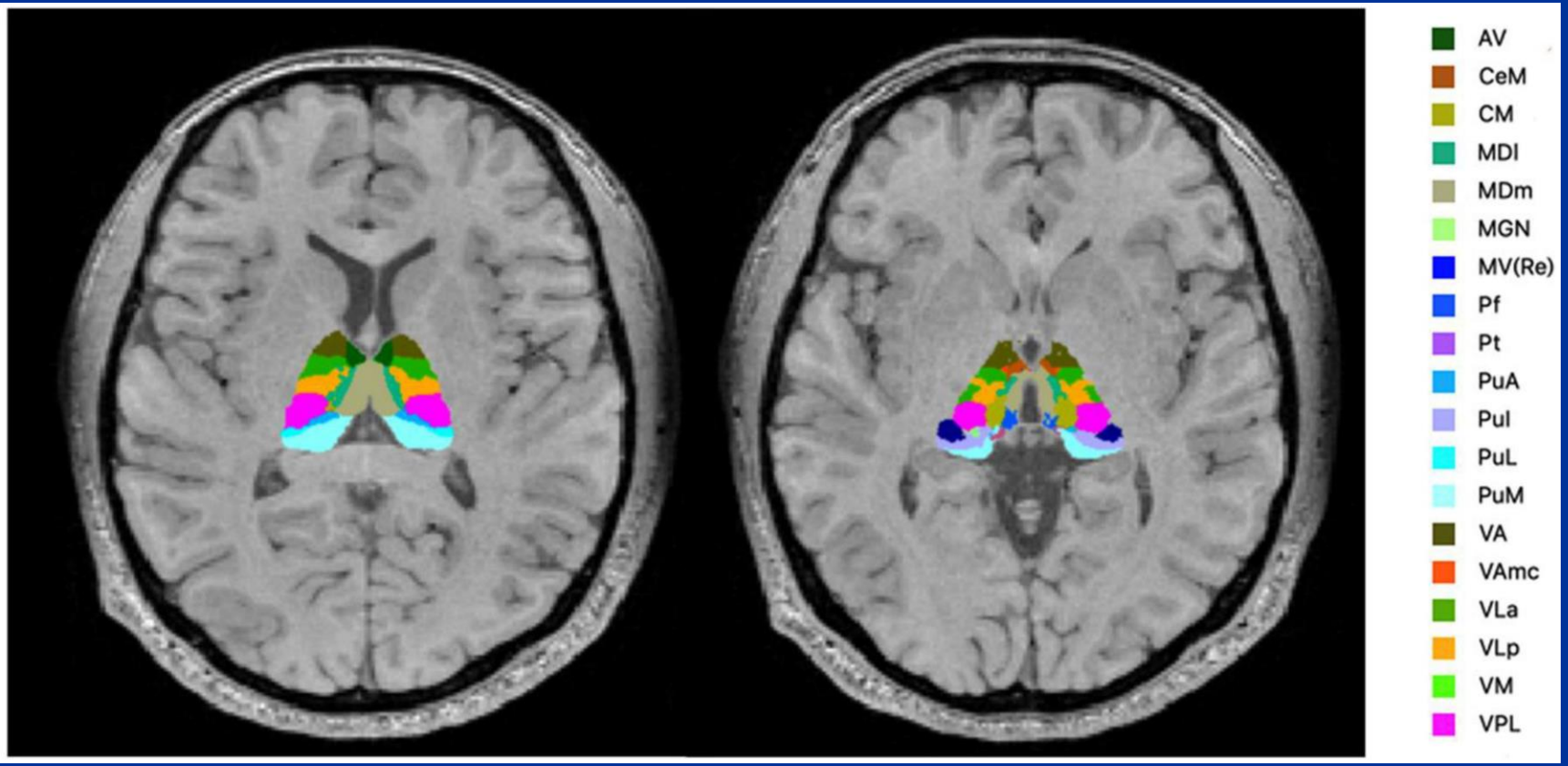


ScienceDirect

Lacunar syndrome: Pure Hemisensory Stroke

- Symptoms:
  - Contralateral sensory loss to all modalities that usually affects face, upper & lower extremities
  - No visual loss, motor loss, dysarthria, cognitive impairment
- Localization:
  - Ventral posterior thalamus
- Therapy:
  - Does well
  - Often home with some outpatient PT and OT

Back to Anatomy: Thalamic Anatomy



- Segmentation of the thalamic nuclei. The example of probabilistic segmentation *(not all segmentations are shown)*

Front. Psychiatry, 21 March 2023

The name of the thalamic nuclei depends on the many classification systems

- Prior slide appears to be Hirai and Jones classification
  - Proposed in 1989
  - Based on Nissl staining and acetylcholinesterase immunohistochemistry
- But historically, the Hassler system was based on functional changes lesions
  - So for Hassler the VIM nucleus maps roughly to the Hirai and Jones ventro-lateral posterior nucleus (VLP)
- Many atlases with different criteria for nuclei based on different stains, with different historical systems in Germany, US/UK, Japan.

- Easy to get lost and miss the point

How far down the rabbit hole of anatomy should therapists go?

- You probably figured out how in depth you need to go for what you do
- I would argue knowing a moderate amount helps
- In neurology, the need for anatomy can be deep
  - the prior slide starts to really matter when you program DBS placed in the 'VIM nucleus' and someone does not do well and you have to sort out why and which way to direct the field

Lacunar stroke: Mixed Motor / Sensory Stroke

- Symptoms:
  - Contralateral sensory loss to all modalities that usually affects face, upper & lower extremities
  - No visual loss, motor loss, dysarthria, cognitive impairment
- Localization:
  - Thalamus
  - Internal capsule
- Therapy:
  - Does well, especially if < 1 cm
  - Often inpatient
  - PT
  - OT
  - SLT

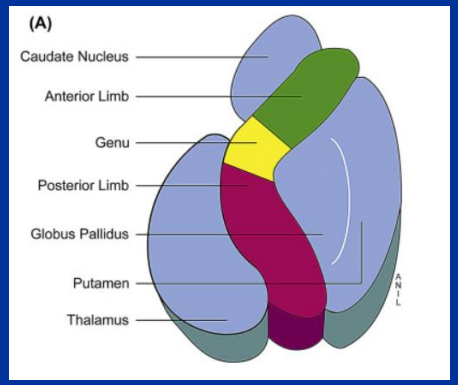
Lacunar stroke: Ataxic Hemiparesis

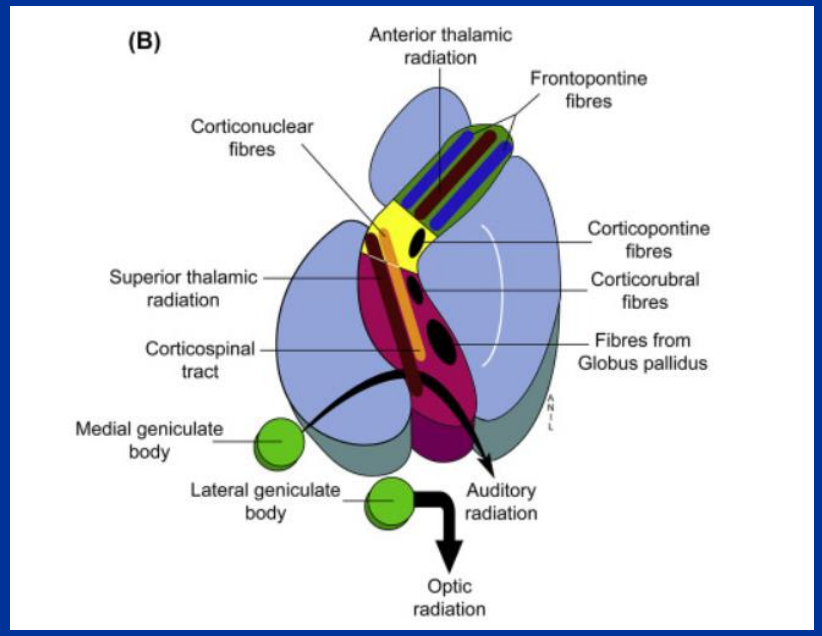
- Symptoms:
  - Contralateral weakness and ataxia
  - No visual loss or cognitive impairments
- Localization:
  - Basis Pontis (Base of Pons)
- Therapy:
  - Outcome based on density, but most do well
  - Often inpatient
  - PT
  - OT
  - SLT

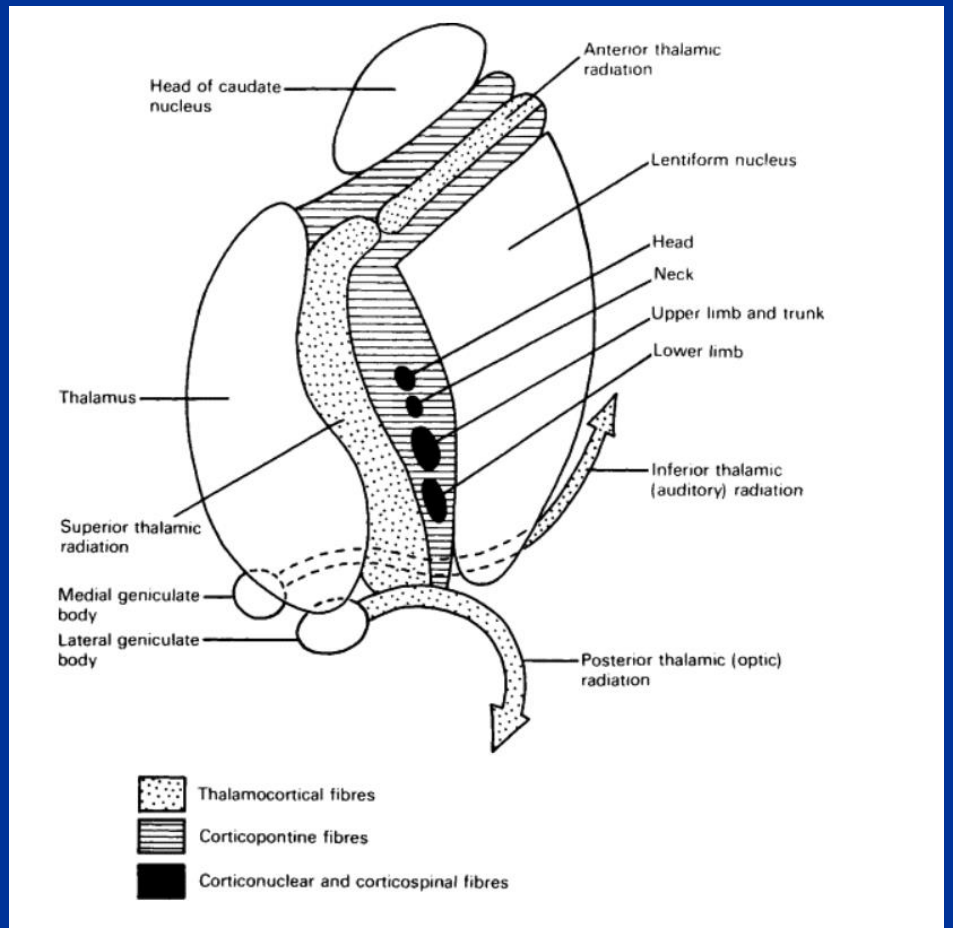
Lacunar stroke: Clumsy Hand Dysathria

- Symptoms:
  - Contralateral paresis and clumsiness of hand & arm
  - Dysarthria, dysphagia
  - Contralateral facial & tongue weakness
- Localization:
  - Genu of Internal Capsule
- Therapy:
  - Most do well
  - Have not seen enough to predict, but likely good
  - PT
  - OT
  - SLT

Back to Anatomy: Millimeters Matter with Internal Capsule and Thalamus







ScienceDirect

Last word on “lacunar syndromes”

Lacunar strokes and infarcts: A review

C. M. Fisher

- Charles Miller Fisher published a retrospective list in 1982
- It is impossible to memorize all the variables of lacunar artery variability but there are several common syndromes that help plan treatment

Table. Lacunar syndromes

1. Pure sensory stroke or TIAs
2. Pure motor hemiparesis
3. Ataxic hemiparesis
4. Dysarthria-clumsy hand syndrome
5. Modified PMH with “motor aphasia”
6. PMH sparing face
7. Mesencephalothalamic syndrome
8. Thalamic dementia
9. PMH with horizontal gaze palsy
10. PMH with crossed third-nerve palsy (Weber syndrome)
11. PMH with crossed sixth-nerve palsy
12. PMH with confusion
13. Cerebellar ataxia with crossed third-nerve palsy (Claude syndrome)
14. Sensorimotor stroke (thalamocapsular)
15. Hemiballism
16. Lower basilar branch syndrome—dizziness, diplopia, gaze palsy, dysarthria, cerebellar ataxia, trigeminal numbness
17. Lateral medullary syndrome
18. Lateral pontomedullary syndrome
19. Loss of memory (?)
20. Locked-in syndrome (bilateral PMH)
21. Miscellaneous:
    (a) Weakness of one leg with ease of falling
    (b) Pure dysarthria
    (c) Acute dystonia of thalamic origin

Larger Artery Syndromes

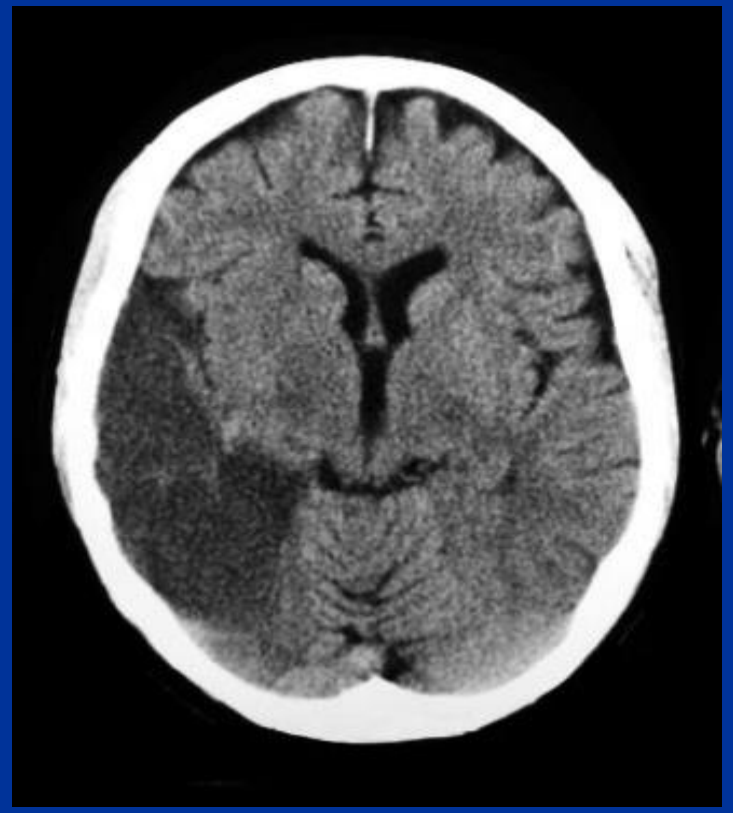
- Very common at larger centers – long length of stays and complicated decision making
- Larger strokes follow a different timeline
  - Swelling will peak between days 3-5 and then improve
  - More hemorrhagic conversion
- Cortical
  - Neuron dies – recovery requires using plasticity and not improvement of conduction block
  - More cognitive changes

65 year old with acute aphasia

MCA strokes

- Right MCA
  - Neglect
  - Hemianopsia
  - Hemiparesis
  - Cognitive Impairment
- Left MCA
  - Aphasia / mutism
  - Neglect
  - Hemianopsia
  - Hemiparesis
  - Cognitive impairment

A word on right inferior branch MCAs



- Please be on the lookout for isolated left hemisensory loss, neglect and visual field loss
- These are larger, will swell, and need to be treated from admission

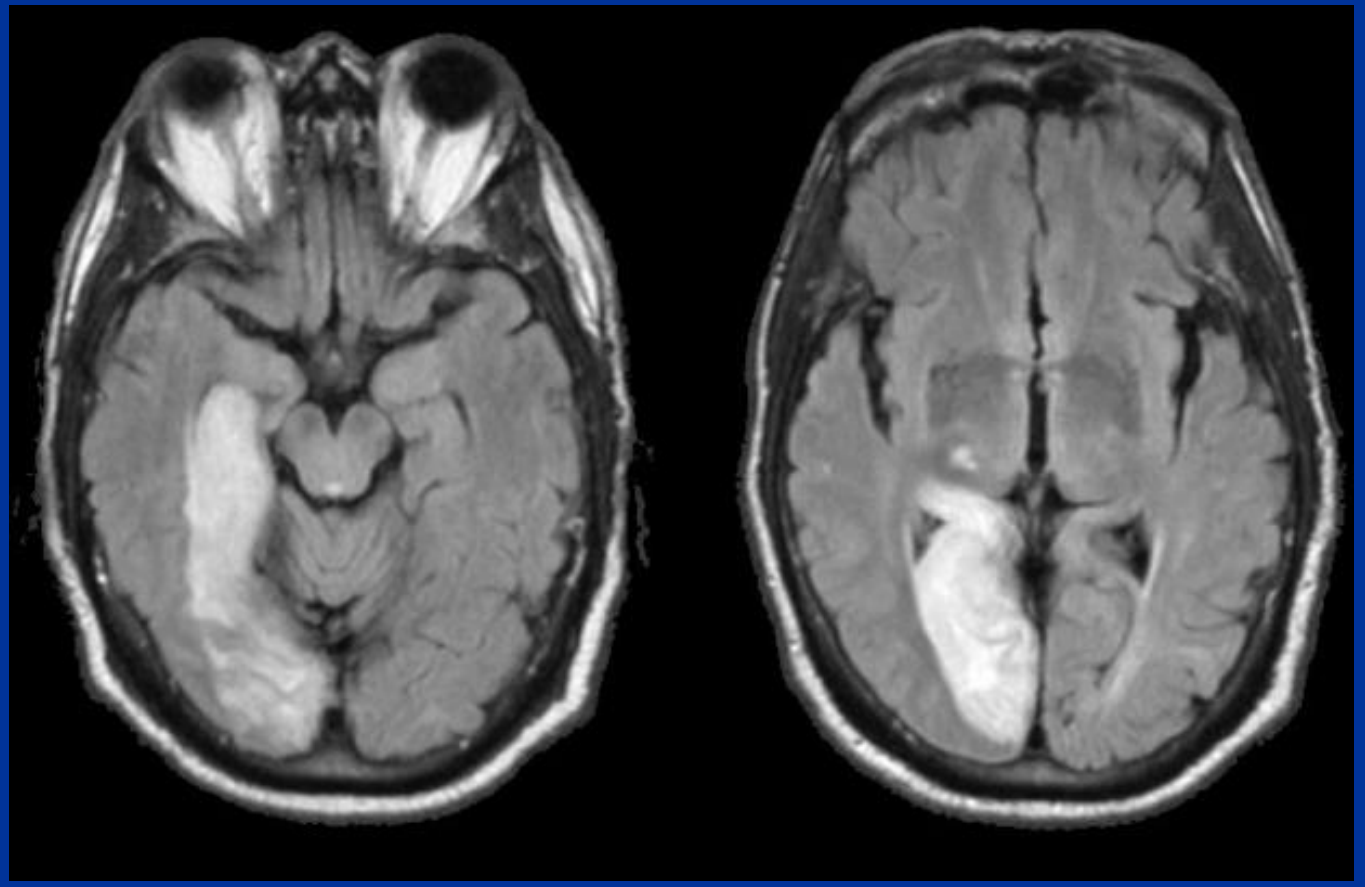
70 year old with left leg weakness and confusion

Radiopedia

ACA strokes

- Less common stroke type
  - Lower extremity weakness
  - Often some gait apraxia
  - Cognitive and behavioral changes

70 year old with left hemianopsia



Radiopedia

PCA strokes

- Posterior circulation
  - Proximal/P1 will affect thalamus from P1 lacunar vessels
  - Distal P2 cause the hemianopsia
- P2 or more distal branches with minimal thalamus are common
- Often outpatient therapy

Part 3: Case follow up

- Uncommon cases we saw together

I was called to the 4th floor for weakness, walked into the room, and saw someone who looked like this

Acta Neuropathologica 2021

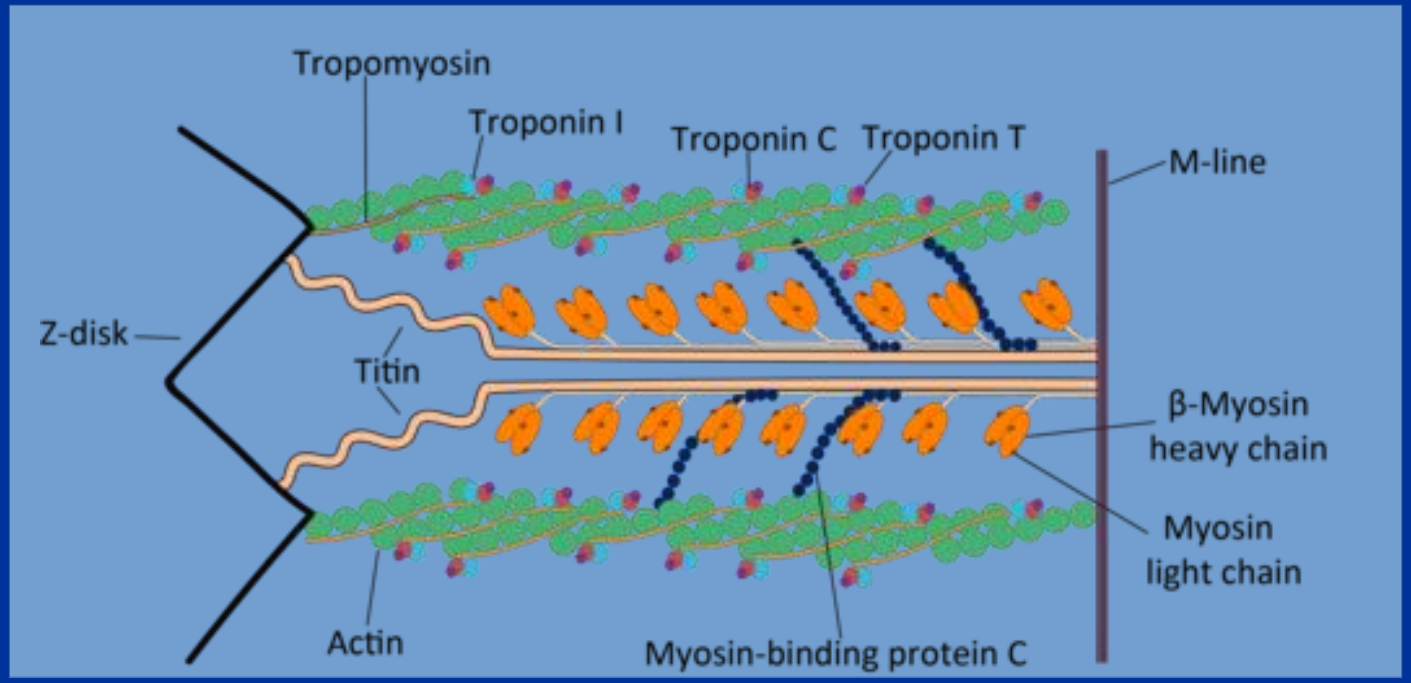
Congenital Myopathies

- Congenital Myopathy
  - Genetics came back as TPM3
  - Normally these show up on biopsy, which he did have at age 3
    - Nemaline Rod
    - Congenital Fiber type disproportion

Acta Neuropathologica 2021

Congential Myopathies

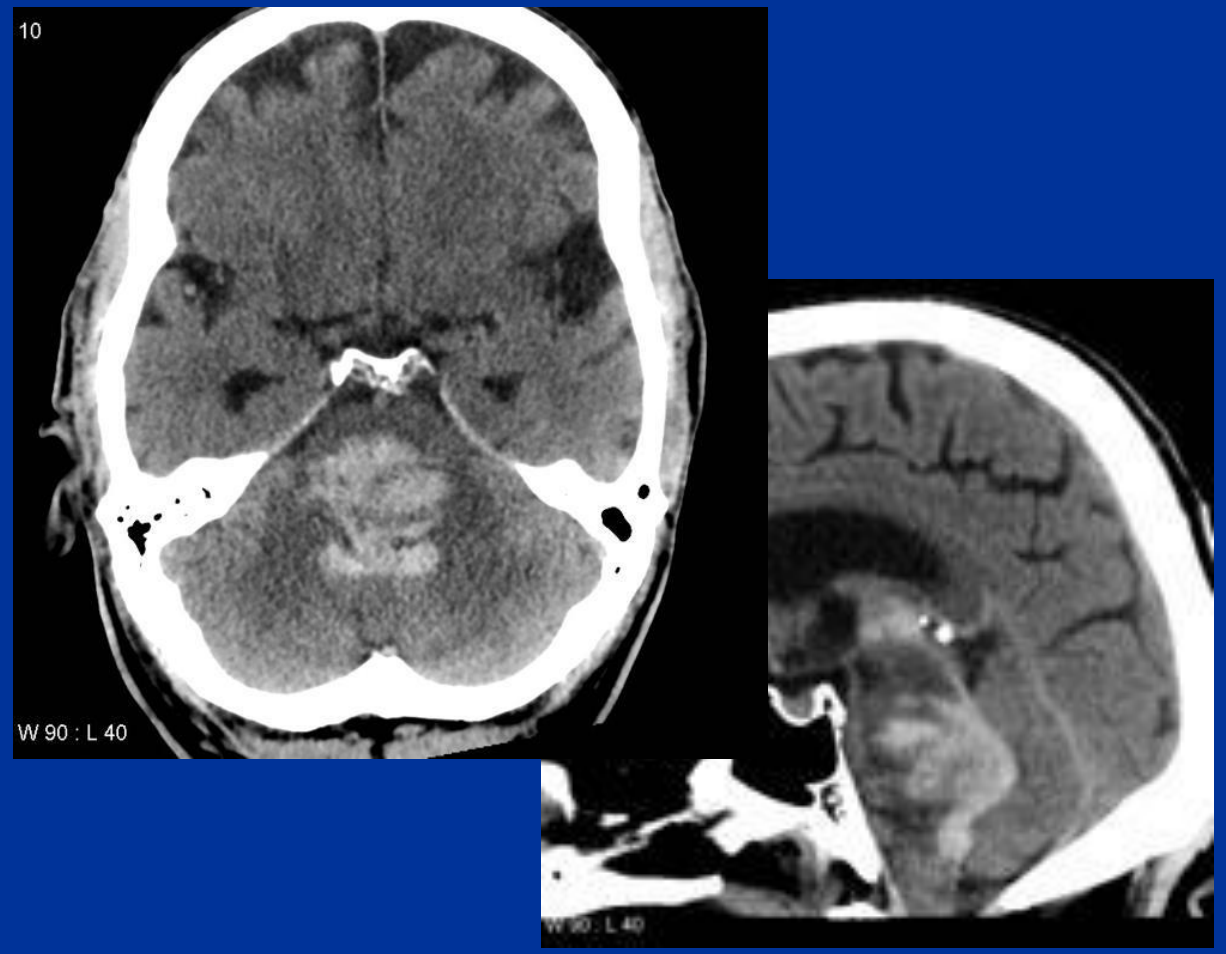
- TPM3
  - Slow muscle alpha (α)-tropomyosin
  - Found only in Type 1 muscle fibers
- Rare cases of heart disease
- No change in therapy, except realizing limitations
- He is doing well



Wikipedia

Called to 4th floor for severe dizziness

- Bilateral facial palsies
- Palatal weakness
- Severe vertigo
- Vomiting

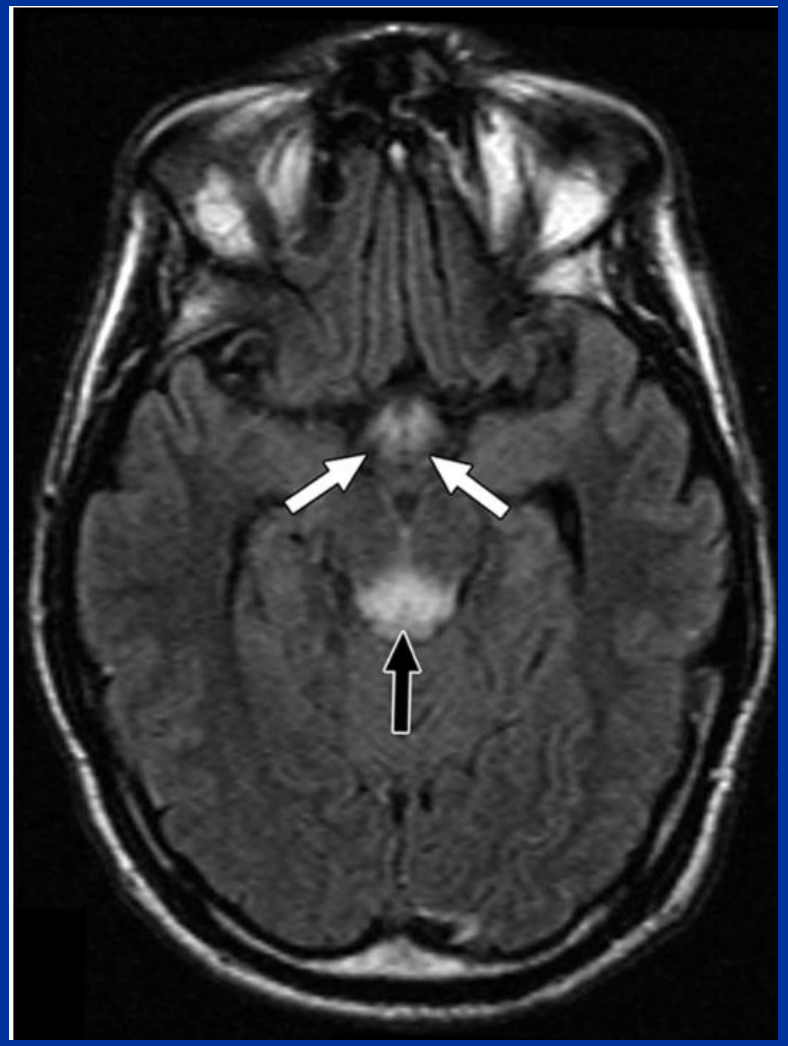


Radiopedia

Brainstem hemorrhage

- Why some anatomy matters: Patient was transitioned to an outpatient team in nursing who decided to try vestibular therapy.
- This made her much worse, they called, I wrote orders for them to stop and be gentle
- Once that was stopped her vomiting got better again
- Was having picnics with husband at last check in

Hospital Consult for Encephalopathy

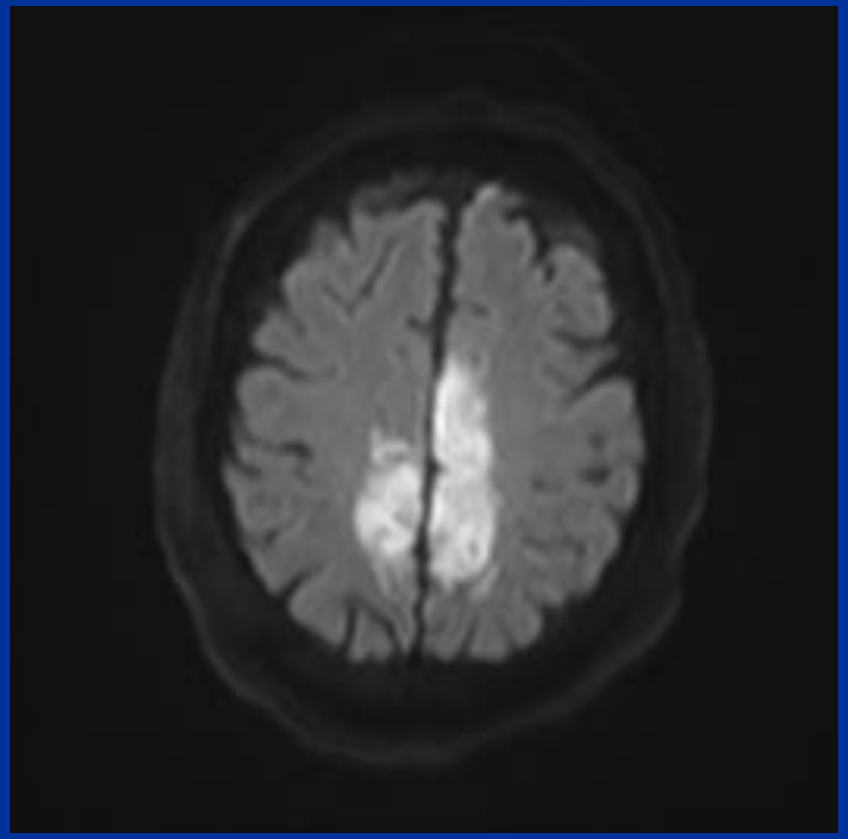


- Over 20 years I saw this MRI 2 times
- But in the last year, I saw it another 2 times

- Wernicke's Encephalopathy (Severe)

Radiopedia

Hospital Consult for Bilateral Symptoms



- Week of unexplained progressive leg weakness
- Right arm and leg plegia (complete)
- Left leg weakness
- Frontal ptosis

- Sometimes people have anatatomic variants

Wrap Up – Neurology Perspective on Stroke for Therapists

- Stroke for LMH inpatients is a subset of stroke neurology
- Many strokes have predictable therapy needs (80/20) and outcomes, based on size and location/anatomy
  - A few lacunar syndromes
  - Most common large artery syndromes
- Neurology perspective: strike a balance between knowing anatomy and pattern matching
  - Don't do vestibular therapy on brainstem strokes
  - Don't deep dive into thalamic anatomy atlases

Did I leave too much time?

Tired of Slums and MoCA? Try Kokmen

Name_____ MC#_____ Date_____

KOKMEN SHORT TEST OF MENTAL STATUS

Subtest	Ideal Score
Orientation (Name, address, building, city, state, day [of the month or the week], month, year)	8
Attention (up to seven digits forward)	7
Learning (apple, Mr. Johnson, charity, tunnel) number of trials for acquisition _____	4
Calculation (5x13, 65-7, 58÷2, 29+11)	4
Abstraction (orange-banana, horse-dog, table-bookcase)	3
Construction (draw a clock showing quarter after eleven, copy a cube)	4
Information (president, first president, number of weeks/year, and definition of an island)	4
Recall	4
Total Score*	38 Total

- Kokmen E, Naessens JM, Offord KP. A short test of mental status: description and preliminary results. Mayo Clin Proc 1987;62(4):281-288.
- Kokmen E, Smith GE, Petersen RC, Tangalos E, Ivnik RC. The short test of mental status. Correlations with standardized psychometric testing. Arch Neurol 1991;48(7):725-728.

Frank Jones Story- 1980s

- "I have a friend, Frank Jones, whose feet are so big that he has to put his pants on by pulling them over his head."
- 'Can he do it?' If patients correctly answer 'No,' they are then asked to explain 'Why not?"'
- If they see humor/ absurdity they 'git it', if then understand logic they 'get it'
  - Type I: Normal – they git and get it
  - Type II: Delirium – they git but don't get it
  - Type III: Dementia – they don't git or get it
  - Type IV: Depression – They get but don't git it