



# Imaging for Dementia

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# Objectives

1. Purpose of imaging for patients with cognitive complaints
2. A review of pertinent anatomy for image interpretation
3. Correlate clinical syndromes with their respective imaging

# Purpose of Clinical Imaging for Patients with Cognitive Complaints:

- **Primary purpose** of MRI is to **exclude** possible **structural** causes:
  - Tumors
  - Strokes (large vessel)
  - Subdural hematomas
  - Inflammatory processes (eg: infectious/autoimmune dz, etc..)
  - Normal Pressure Hydrocephalus (NPH) **Triad**: ↓ cognition, urinary incontinence, gait dist.
- **MRIs** can be helpful to increase or decrease our suspicion of a neurodegenerative disease, by showing **patterns of regional atrophy**, which often point to specific **underlying pathology**.
- If MRI is **equivocal**, we may consider functional imaging, such as an **FDG PET**, to look for **patterns of regional hypometabolism**.

**Ultimately, we are asking ourselves two questions:**

- *Does imaging correlate with our patients' clinical syndrome (and NP testing)?*
- *OR, do our findings support a psychiatric or metabolic cause of cognitive complaints?*

# Review of Pertinent Anatomy



**PRACTICE!**

# MRI Axial View

## Brain Stem (*inferior* → *superior*)

- A. Medulla oblongata
- B. Pons
- C. Midbrain (note: cerebral crus)

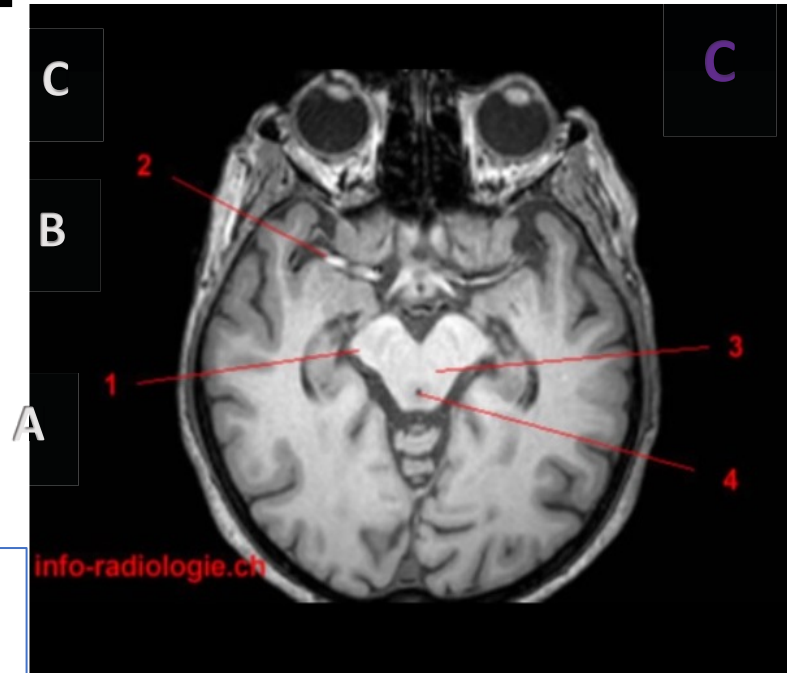
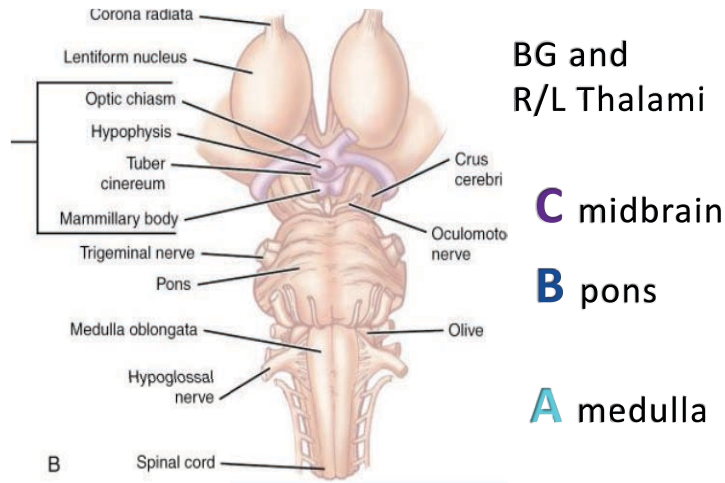
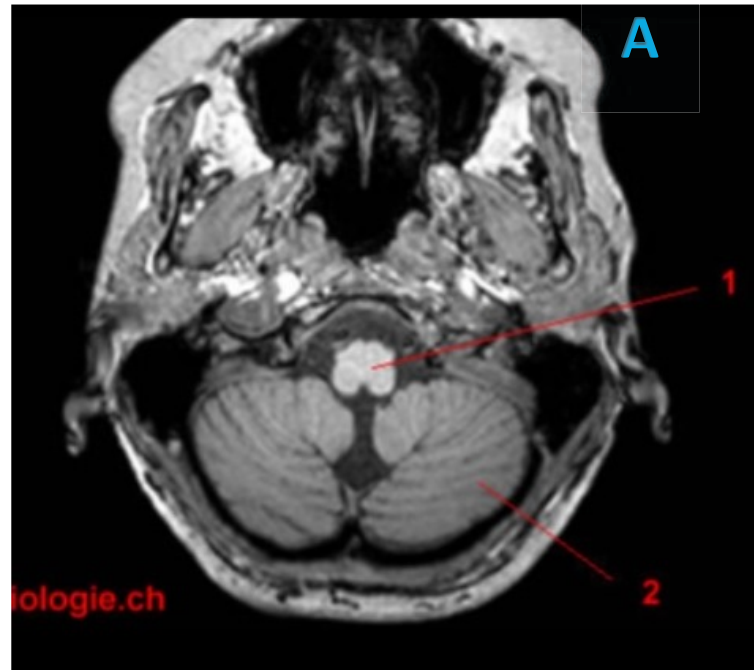
## Cerebellum

## Temporal lobes

## Parietal lobes:

## Hints: (*always move inferior* → *superior*)

- At the level of the **medulla**, look at the **cerebellum**.
- At the level of the **Pons**, look at the **Poles (temporal and occipital)**.
- At the level of the **midbrain**, look at **hippocampi** and the **temporal horns**.
- at the level of the **midbrain**, look for the **parietal lobes** beginning to emerge.
- At the level of the **midbrain**, look for more of the **occipital lobes** to emerge.

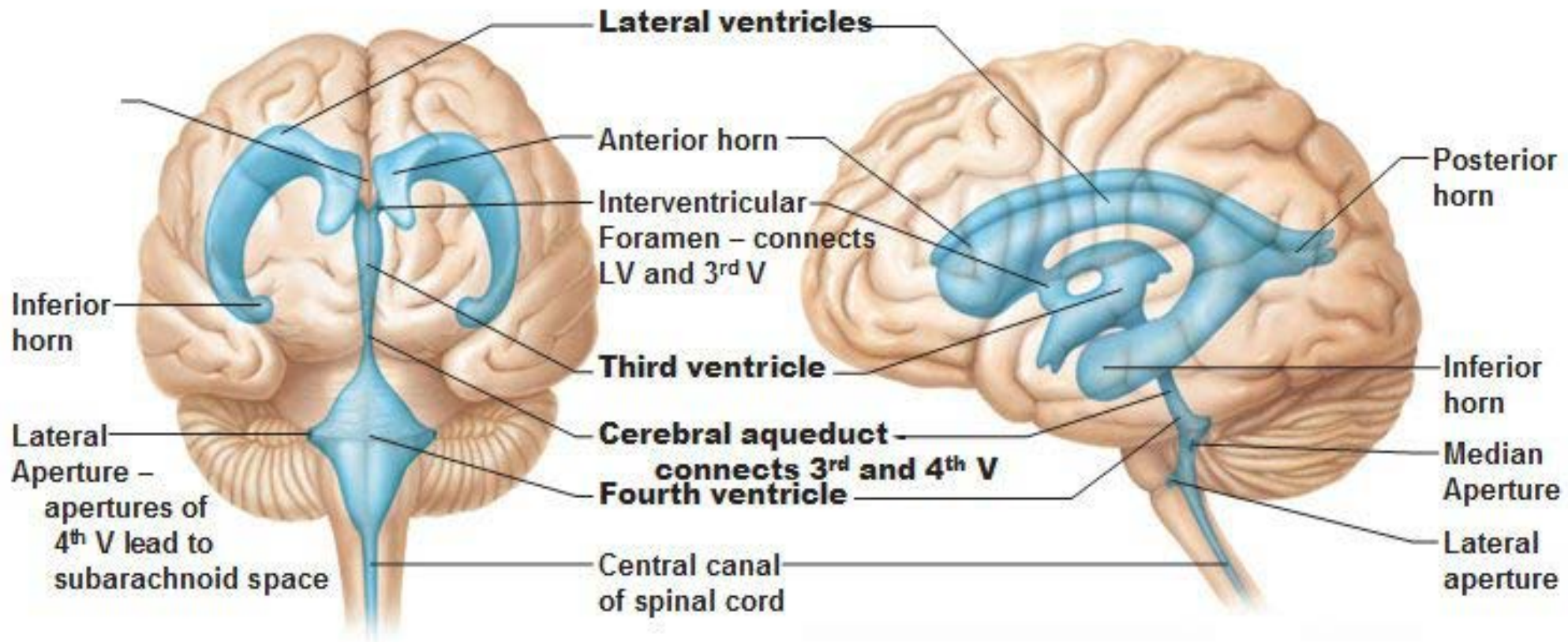


### Image Ref:

1. <https://testmyprep.com/subject/economy/new-and-emerging-theories-of-international-trade>
2. [http://w-radiology.com/atlas\\_brain\\_mri.php](http://w-radiology.com/atlas_brain_mri.php)

# Ventricles of the Brain

## Central part



- Lateral ventricles (paired)
- Third ventricle
- Fourth ventricle

- **Central part** of the lateral ventricles
- **Anterior horn** = **Frontal horn** (frontal lobe)
- **Posterior horn** = **Occipital horn** (occipital lobe)
- **Inferior horn** = **Temporal horn** (temporal lobe)
- **Atrium** = expansion at the **junction** of the **occipital** and **temporal horns**.

# Hippocampus, Temporal horn, Thalamus, GB, Collateral sulcus, and Calcarine fissure

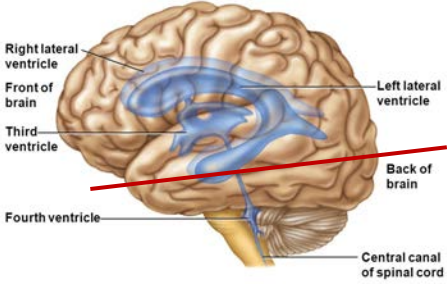


Fig. 5-4a, p. 139

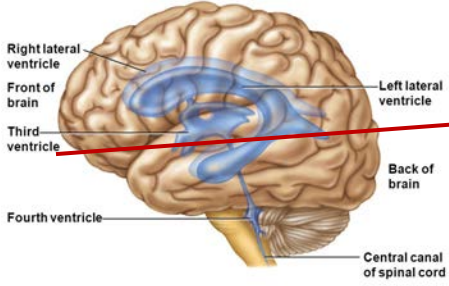


Fig. 5-4a, p. 139

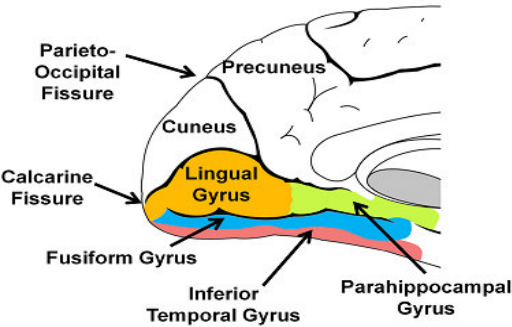
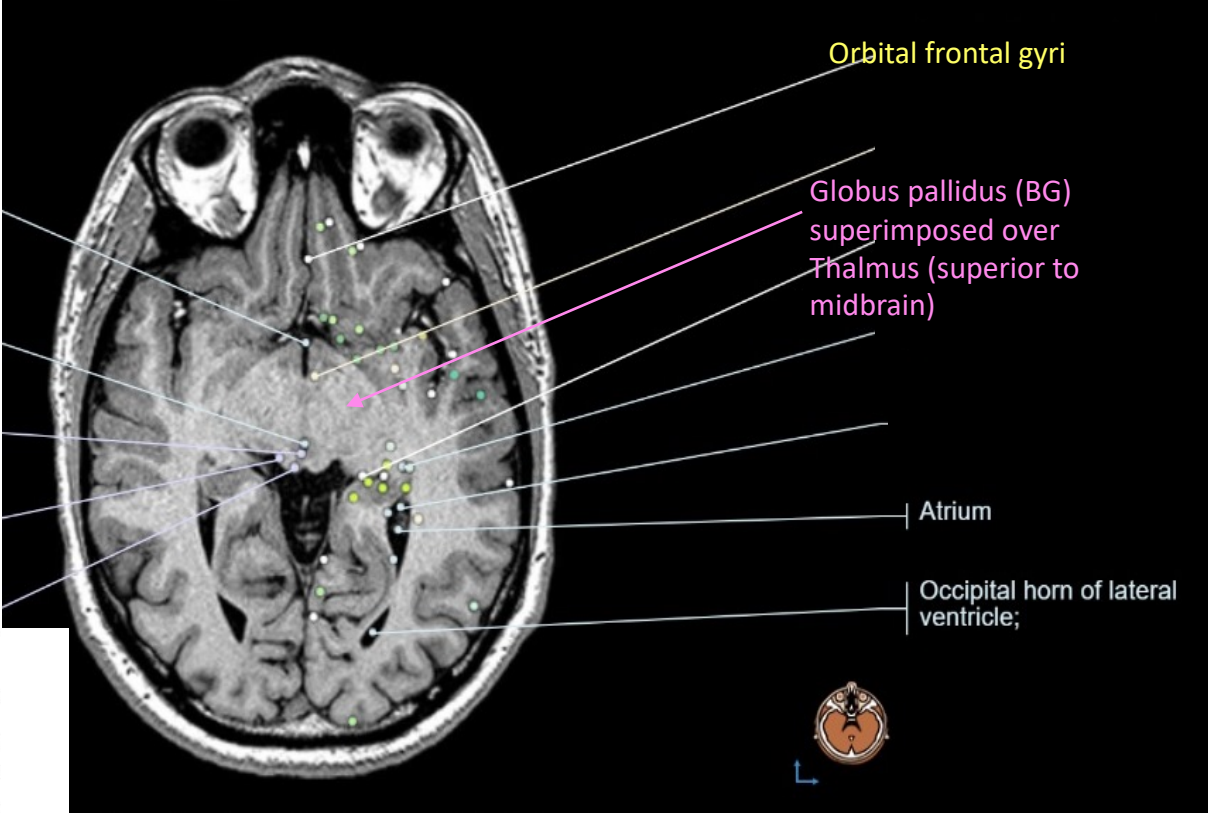
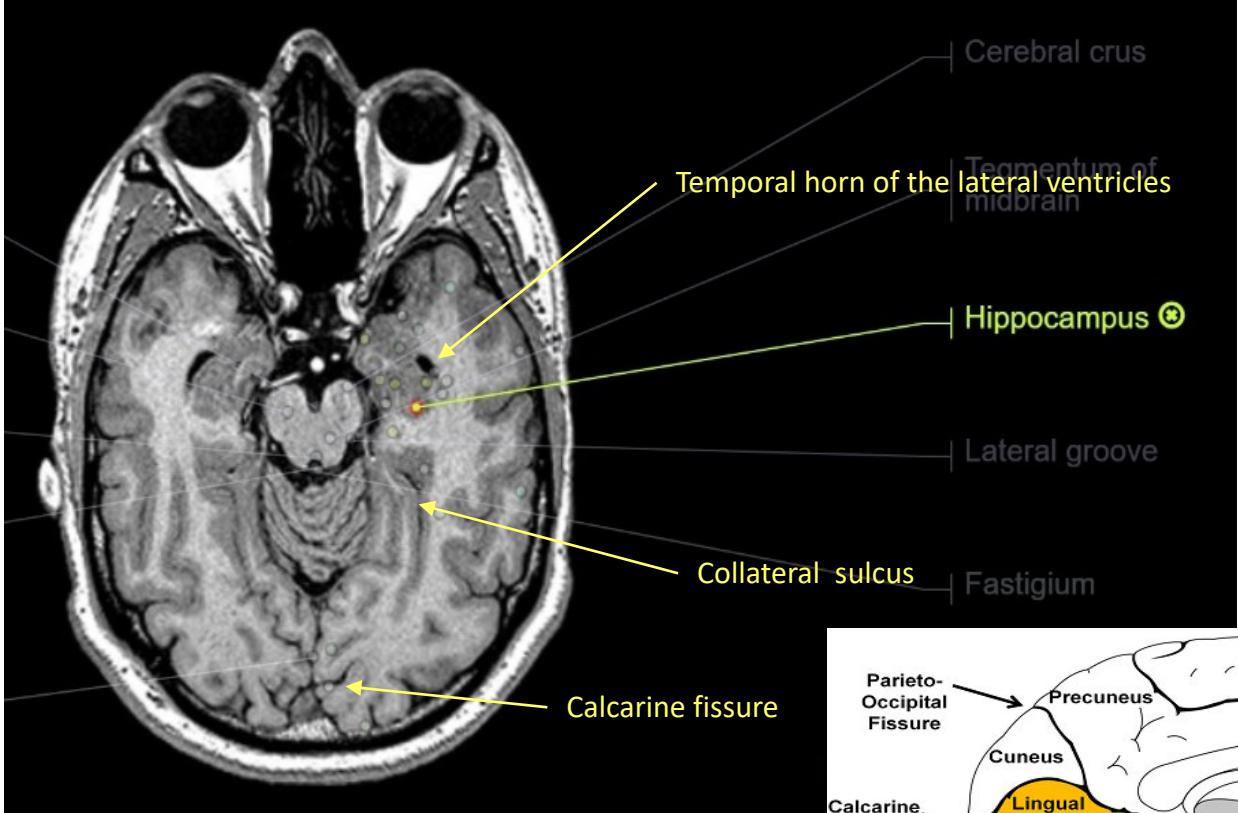
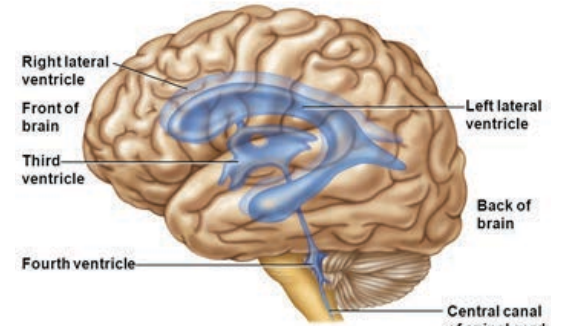


Image REF: <https://www.imaio.com/en/e-Anatomy/Head-and-Neck/Brain-MRI-3D>

# Lateral Ventricles, Sulci, and Lobes



## Lateral Ventricles

- frontal horn
- central body
- note: choroid plexus within

## Frontal Pole

- Most anterior portion of frontal lobe

## Insular sulci

- separates insular lobe from temporal lobe

## Central Sulcus

- separates frontal lobe from parietal lobe

## Lateral Sulcus (ie: Sylvian Fissure)

- separates frontal and parietal lobes from temporal lobe

## Cingulate gyrus:

- The posterior portion is labeled, which is typically preserved in DLB (ie: "Cingulate Island Sign").

## Intraparietal sulcus

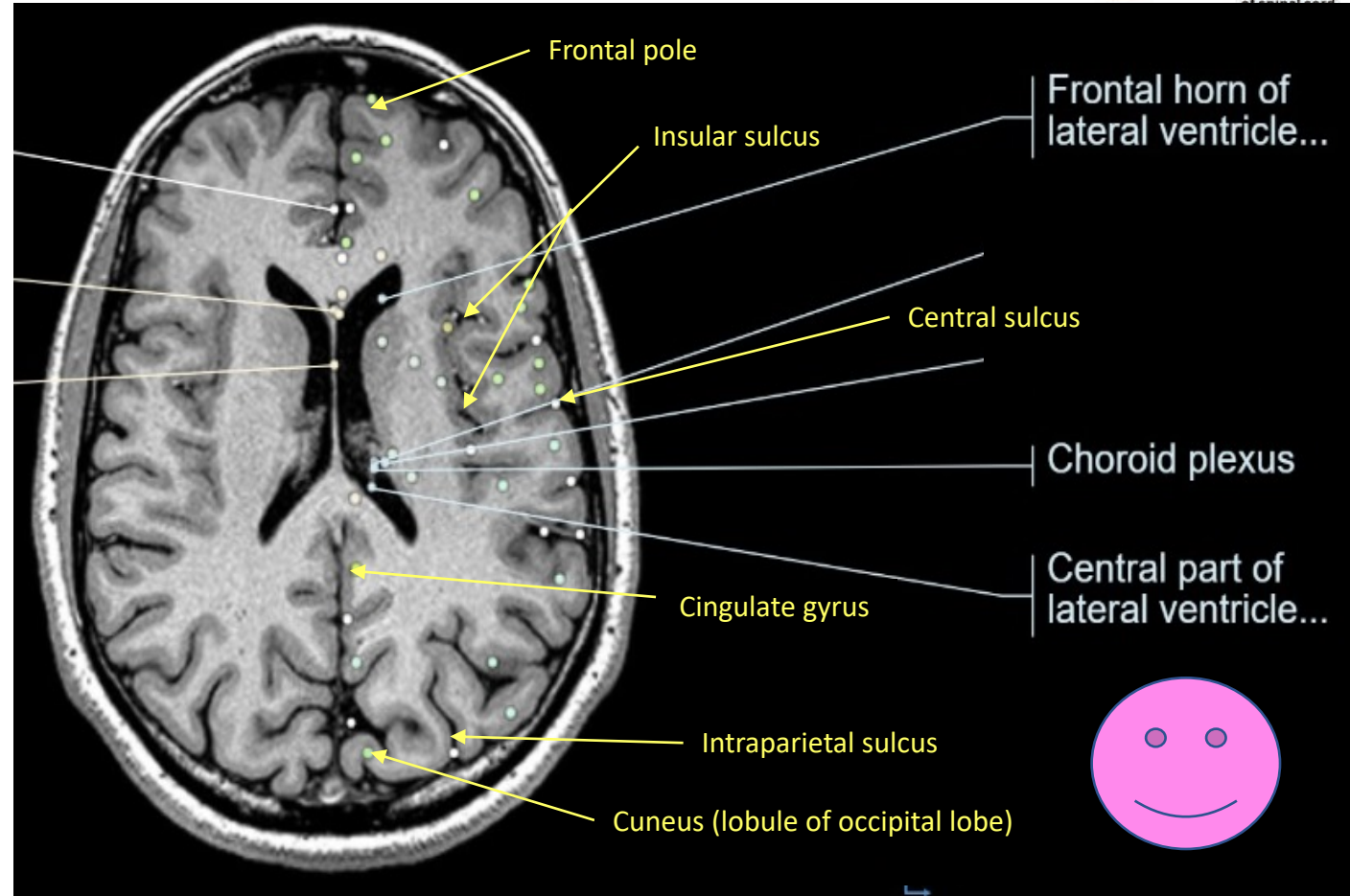
- \*Separates inferior and superior parietal lobe

## Parietooccipital sulcus

- separates parietal lobe and occipital lobe

## Cuneus

- A small very posterior lobule in the occipital lobe





# MRI Hippocampus - Axial View

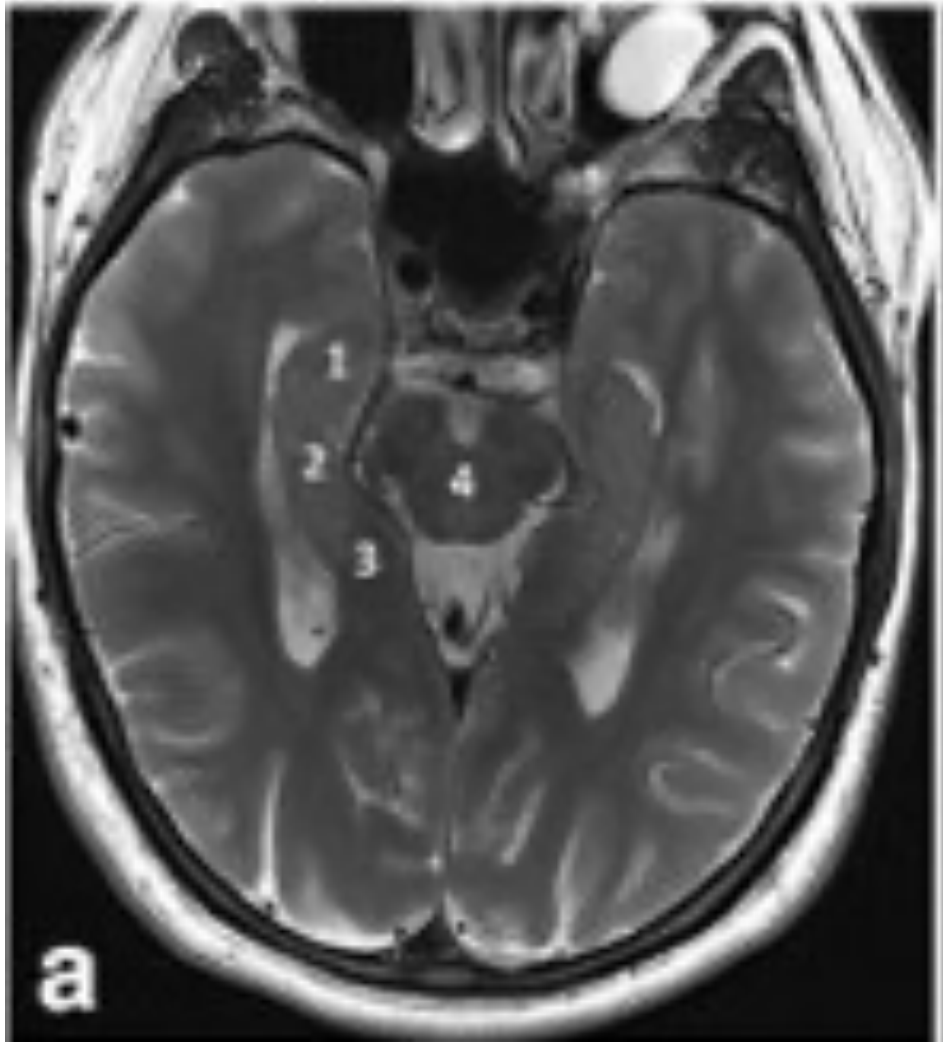


Image Ref: Dekeyzer, et al. 2017

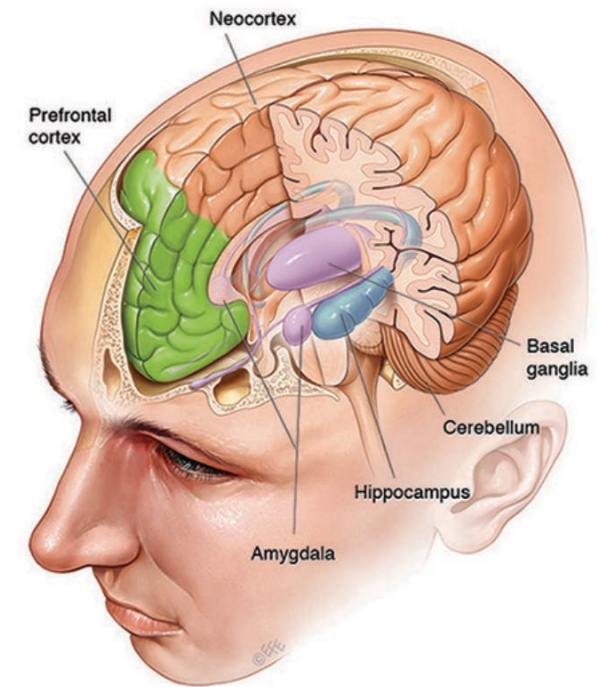


Image: <https://qbi.uq.edu.au/brain-basics/memory/where-are-memories-stored>

## Hippocampus:

**1 = head** is located anterior to the mesencephalon (mid-brain)

**2 = body** is at the level of the mesencephalon

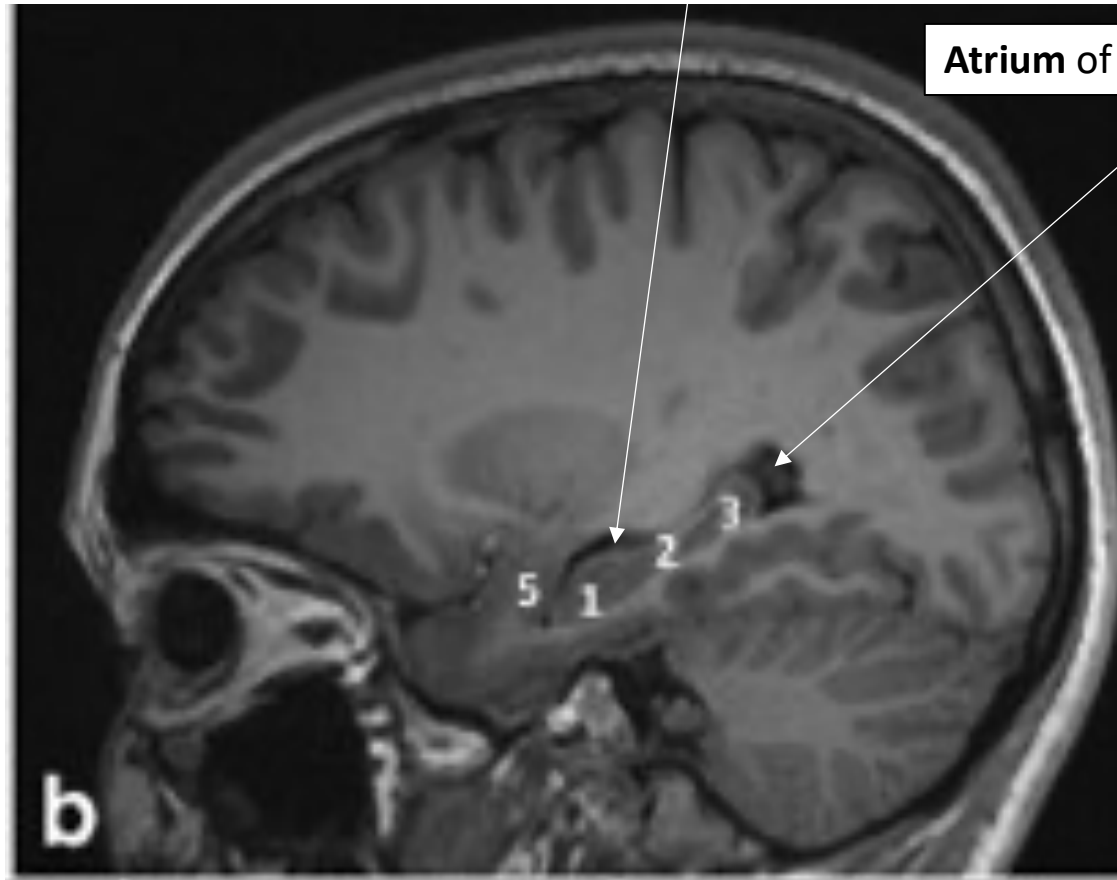
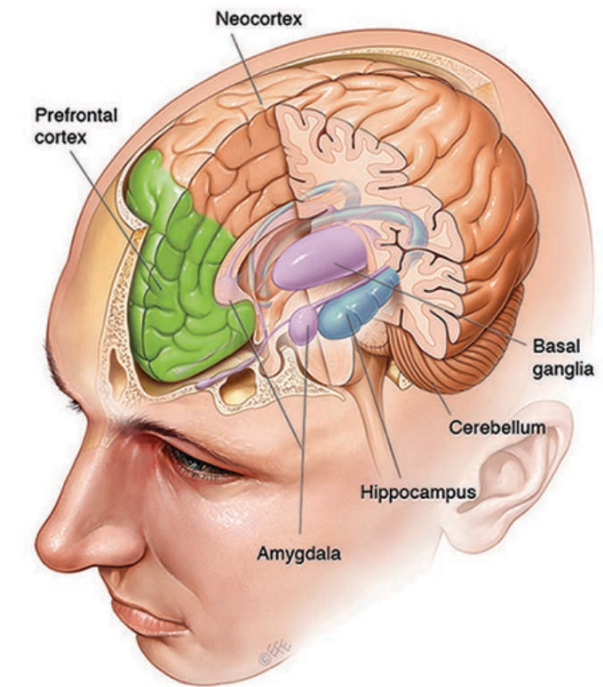
**3 = tail** is posterior to the mesencephalon

**4 = midbrain** (note the cerebral crus)

# MRI Hippocampus Sagittal View

Temporal horn of the lateral ventricle

Atrium of the lateral ventricle



**1 = hippo head** is inferior to **temporal horn** of lateral ventricle.

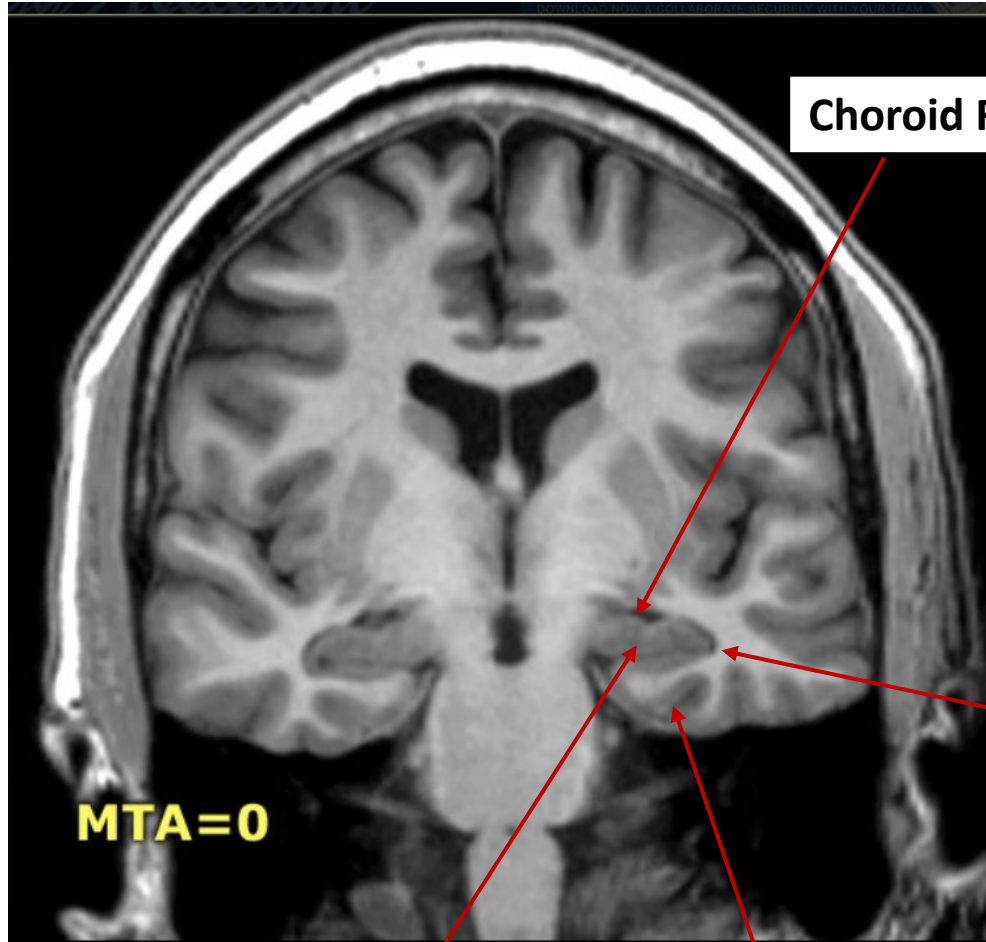
**2 = hippo body** is inferior to the **choroidal fissure** (site of attachment of the choroid plexus in the lateral ventricle)

**3 = hippo tail** Is anterior to the **atrium** of the lateral ventricle.

**5= amygdala** is anterior to the body of the hippocampus.

Image Ref: Dekeyzer, et al. 2017

# MRI Hippocampus - Coronal View



Choroid Fissure

Temporal Horn

(not able to be appreciated)

## Hippocampal Atrophy:

1. Widening of the choroid fissure
2. Widening of the temporal horn
3. Widening of the collateral sulcus
4. Decreased height of hippocampal formation

**Choroid fissure:** a cleft that forms as the height of the hippocampal formation decreases. Widening of this cleft is a very early sign of hippocampal atrophy.



Hippocampus

Collateral Sulcus

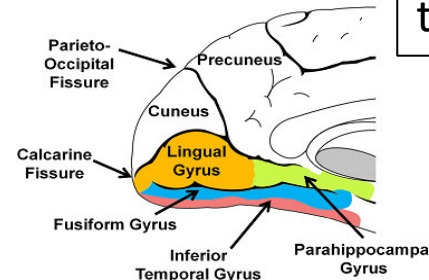
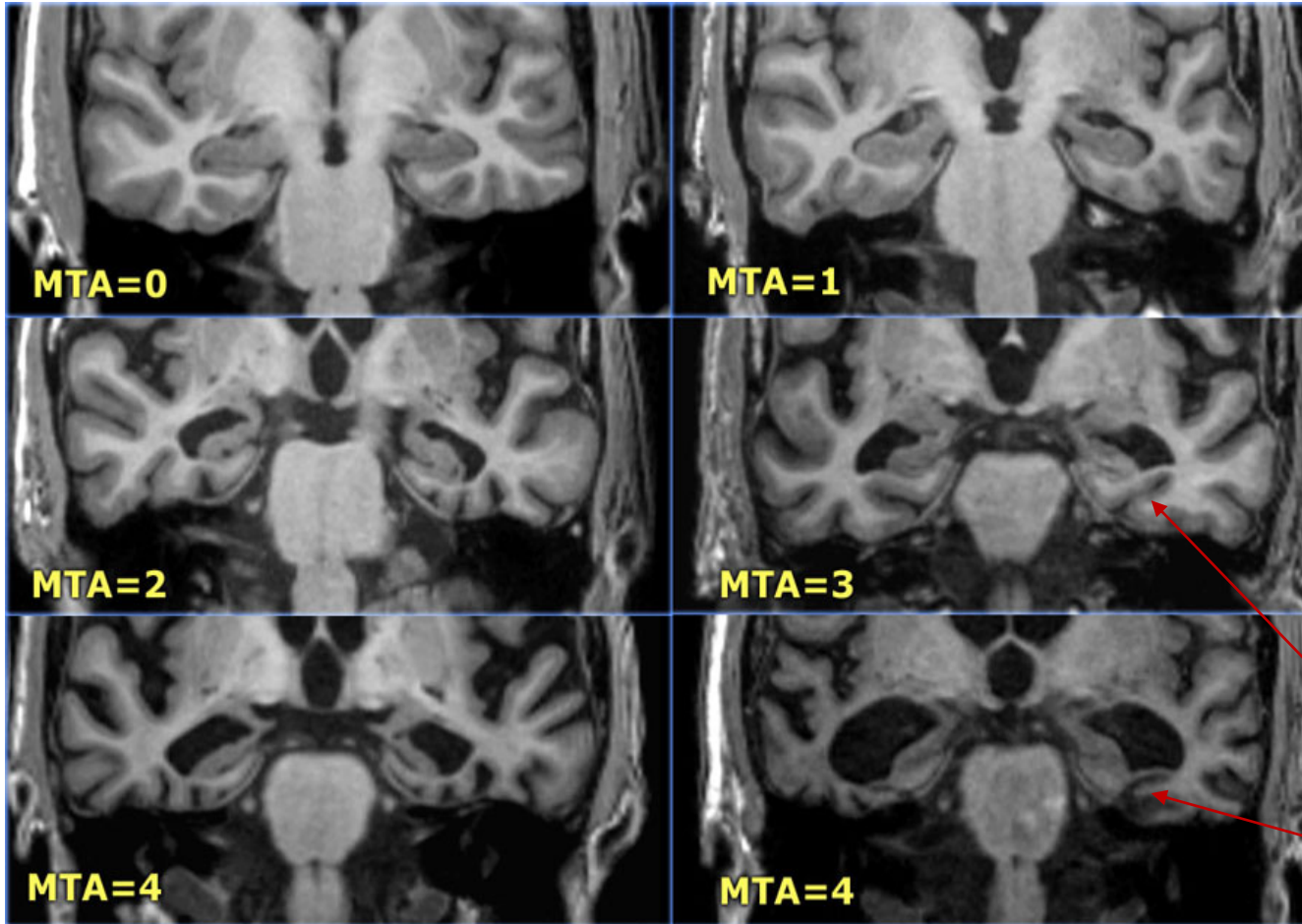


Image REF: <https://www.imaios.com/en/e-Anatomy/Head-and-Neck/Brain-MRI-3D>

# MRI: Hippocampal Atrophy and MTA Score (Scheltens)



MTA Score	Width of choroid fissure	Width of temporal horn	Height of hippocampal formation
0	N	N	N
1	↑	N	N
2	↑↑	↑	↓
3	↑↑↑	↑↑	↓↓
4	↑↑↑	↑↑↑	↓↓↓

**<75 years:  $\geq 2$  is abnormal**  
 **$\geq 75$  years:  $\geq 3$  is abnormal**

**Collateral sulcus**

# Microhemorrhages

## Two types of MR Imaging:

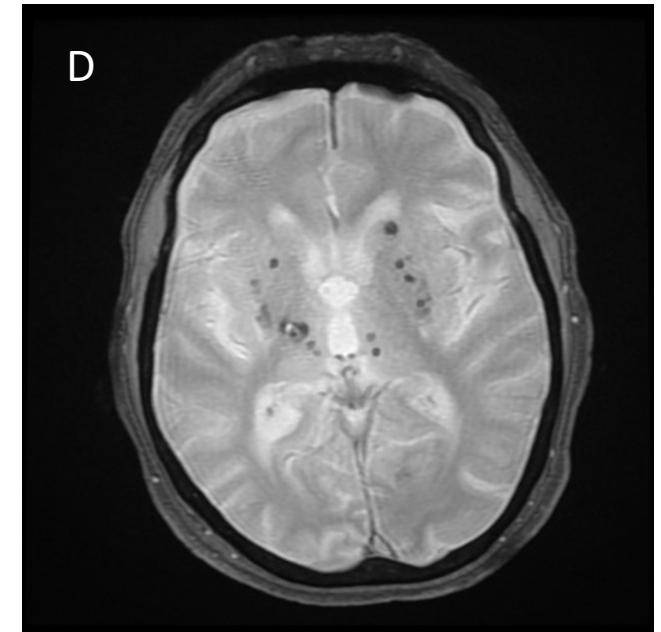
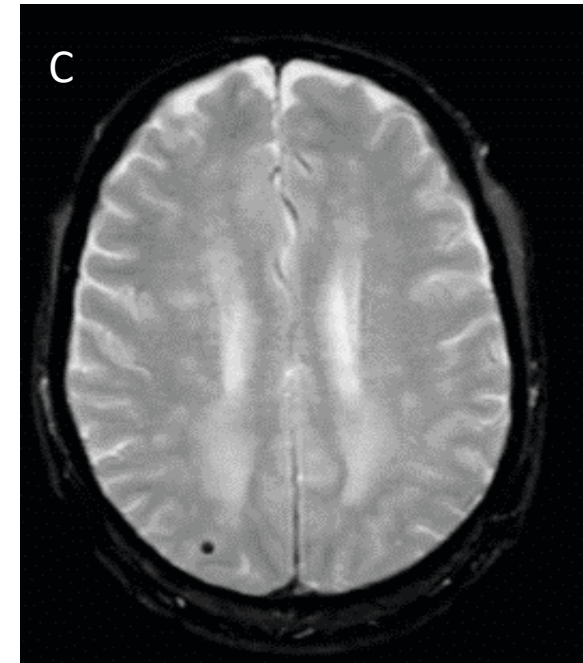
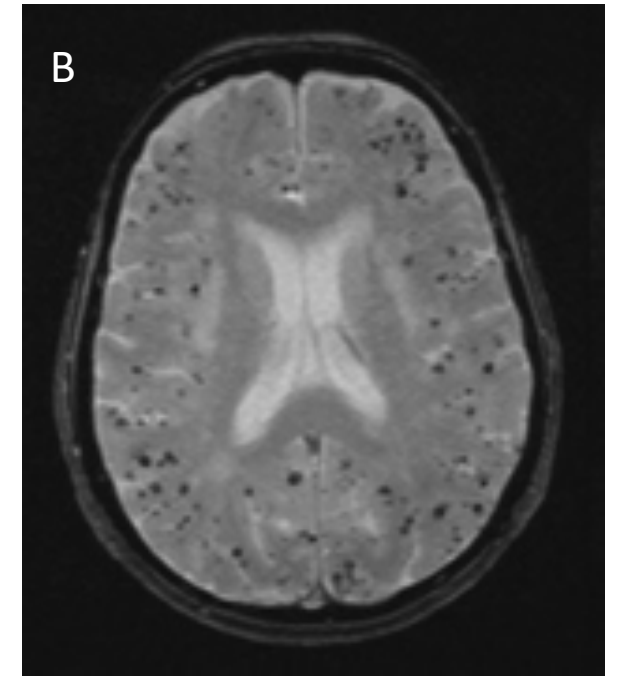
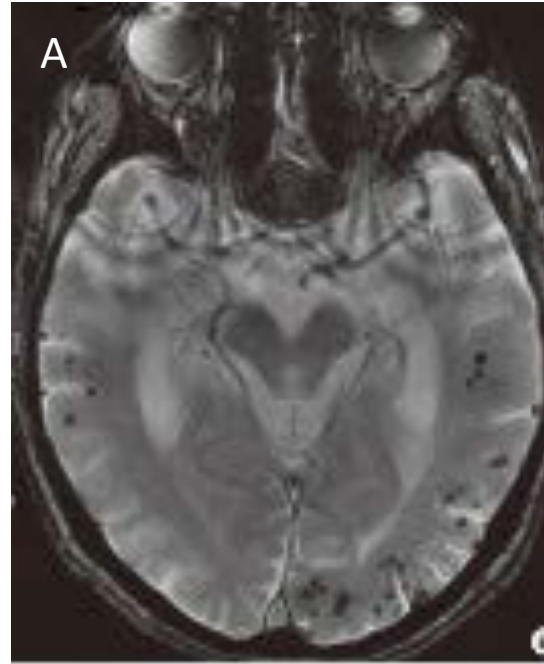
1. **SWI:** Susceptibility Weighted Imaging
2. **GRE:** Gradient (Recalled) Echo Imaging

## Images A, B, C:

- **Cerebral amyloid angiopathy (CAA):** microhemorrhages in the **peripheral cortical distribution**, associated with **Alzheimer's disease**.

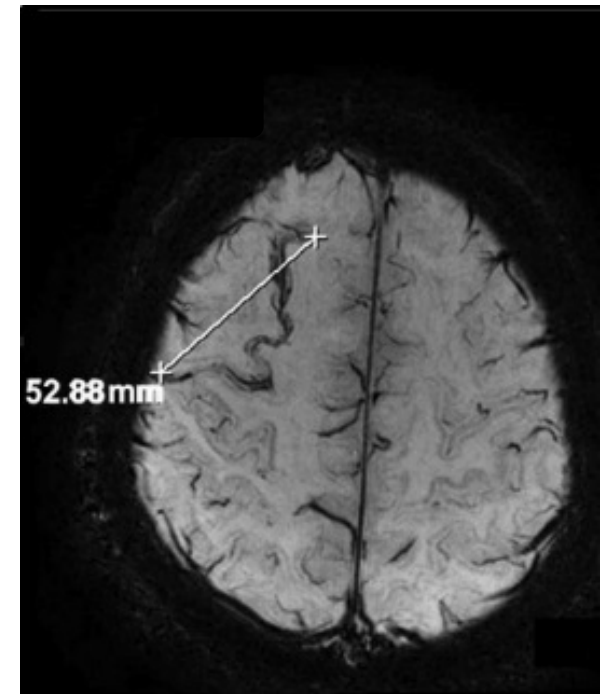
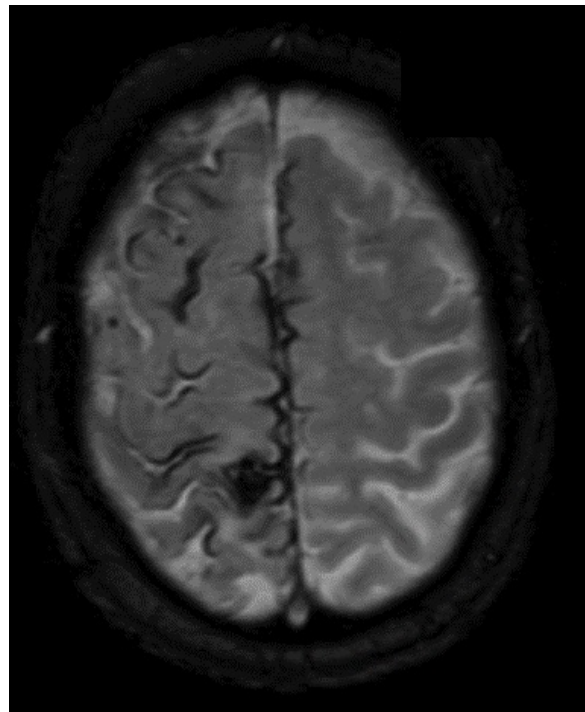
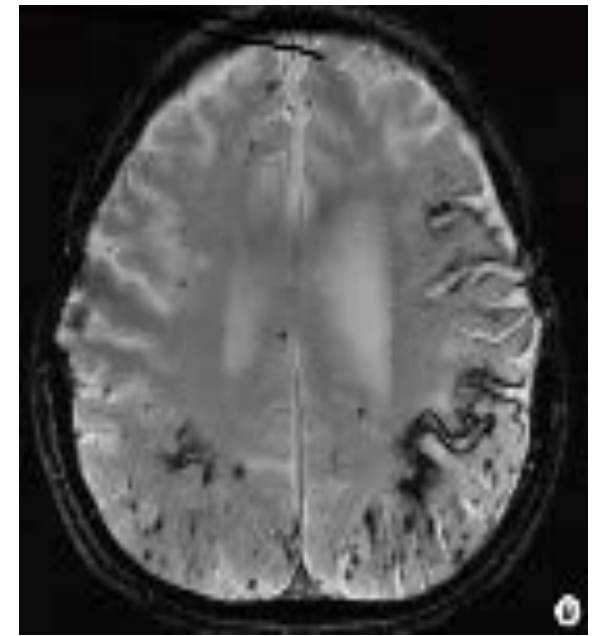
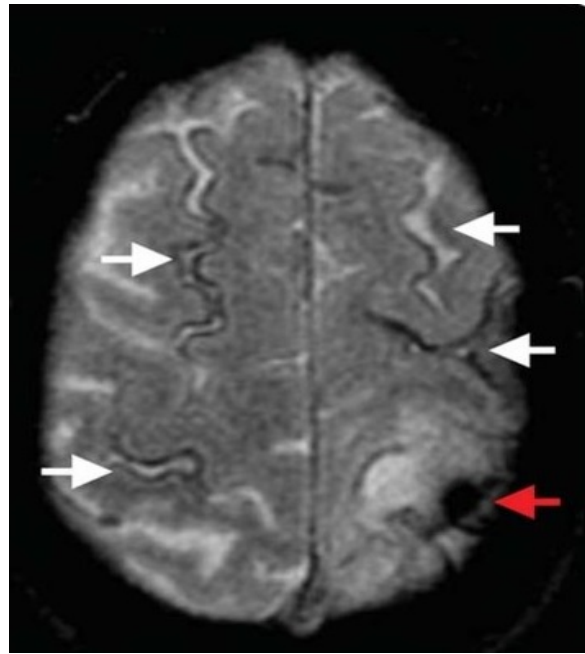
## Image D:

- **Hypertensive microangiopathy:** microhemorrhages in the **basal ganglia, pons and cerebellar hemispheres**, associated with **chronic HTN**.



# Superficial Siderosis

- **GRE** or **SWI** sequences will show a **serpentine pattern** of **blood deposits** within **sulci**.
- **Superficial hemorrhage** within the **subarachnoid** and/or **subpial space**.
- May often be associated with **cerebral amyloid angiopathy**.



# PMC-Consensus Diagnoses

1. Alzheimer's Disease
2. Logopenic Primary Progressive Aphasia (lvPPA)
3. Posterior Cortical Atrophy (PCA)
4. Dementia of Lewy Bodies
5. Semantic Primary Progressive Aphasia (svPPA)
6. Agrammatic/non-fluent Primary Progressive Aphasia (nfPPA)
7. Behavioral Variant of FTD (bvFTD)

# Focus: Four Major *Functional* Cognitive Systems

- 1. Medial Temporo-Limbic Network: memory and learning**
  - ✓ Alzheimer's Disease and MCI with AD etiology
- 2. Occipito-Temporal /Occipito-Parietal Network: vision and object recognition**
  - ✓ Posterior Cortical Atrophy (PCA)
  - ✓ Dementia of Lewy Bodies (DLB)
- 3. Perisylvian Language Network: language**
  - ✓ Primary Progressive Aphasia- **Logopenic (lvPPA)**
  - ✓ Primary Progressive Aphasias- **Semantic (svPPA)**
  - ✓ Primary Progressive Aphasia- **Agrammatic/Non-fluent (nfvPPA)**
- 4. Fronto-Temporal Network: executive, attention, behavior**
  - ✓ Behavioral Variant of Frontotemporal Dementia (bvFTD).



# Clinical Vignette 1

58 y/o R-handed F presents w/ “**memory problems**” x 1.5 yrs. Ed = 20 yrs. PhD in immunology. Worked 25 yrs as a infectious disease researcher. She retired last year due to inability to perform her duties.

1. **Medial Temporo-Limbic Network:** *memory and learning*
2. **Occipito-Temporal /Occipito-Parietal Network:** *vision and object recognition*
3. **Perisylvian Language Network:** *language*
4. **Fronto-Temporal Network:** *executive, attention, behavior*

## *Per her husband,*

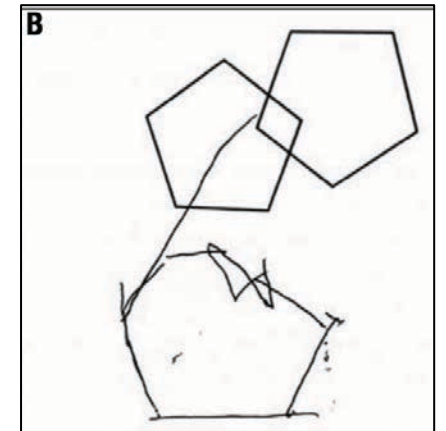
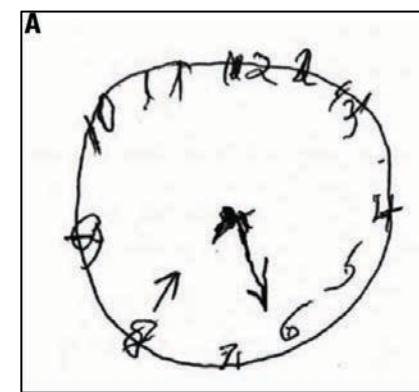
- She is fairly accurate recalling details of recent events. Endorses some **word-finding** problems, mostly recalling proper names of celebrities she used to know.
- **Comprehension** has declined. Used to be an avid reader, but barely reads at all.
- C/o **difficulty reading**. Optometry and ophthalmology evals have been unsuccessful in procuring effective reading glasses, in spite of multiple attempts.
- Her **handwriting** has **significantly deteriorated**, and she has difficulty with **buttons** and **zippers** when **dressing**.
- She had a **four fender-benders** in the last year, and she reported some **confusion navigating** in familiar areas.
- **two falls** in the last 6 mos. One going down curb, the second going down steps.
- Still cooks (recipes she spontaneously recalls), does laundry, cleans (not as well), and her **husband had to take over managing finances** last year.

# Clinical Vignette 1

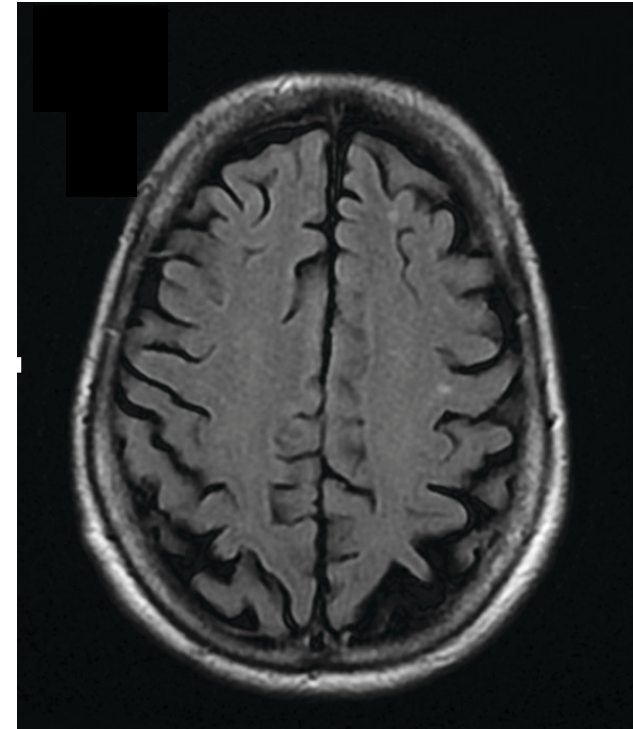
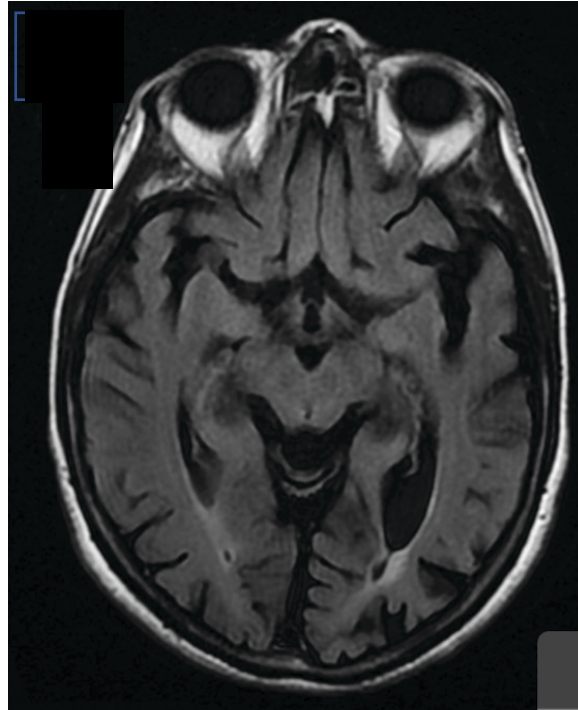
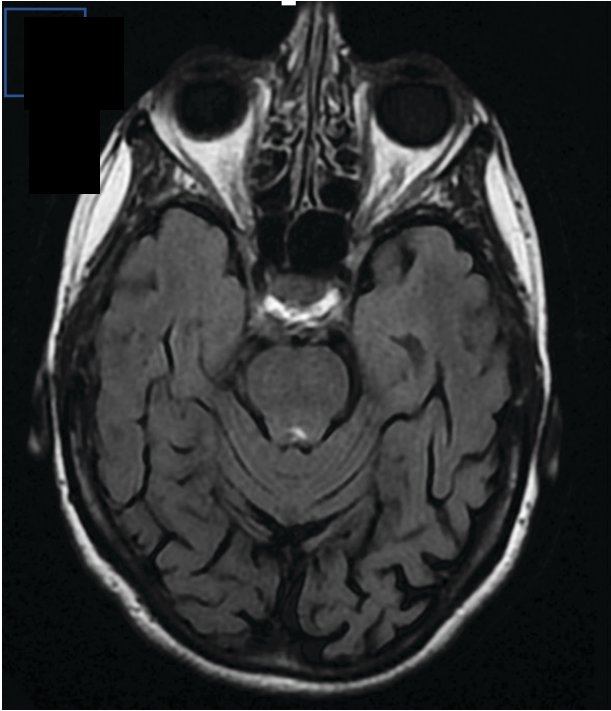
## Exam and NP Testing:

- Bedside **visual field testing** was inconsistent.
- + **Oculomotor apraxia** on EOM testing.
- + **Optic ataxia** noted on FTN testing.
- + **Simultanagnosia**: able to identify smaller numbers in Navon letters, but failed to appreciate global figures. Had trouble describing the **Cookie-Thief picture** (eg: boy was “leaning backwards” and mother was a “making breakfast”).
- + **Acalculia**: UNABLE to calculate nickels in \$1.00 (=30) or quarters in \$6.75 (=9).
- Had difficulty w/ **clock-draw** and **Benson-copy**.
- All other NP testing was WNL

**Remaining neurological exam was normal.**

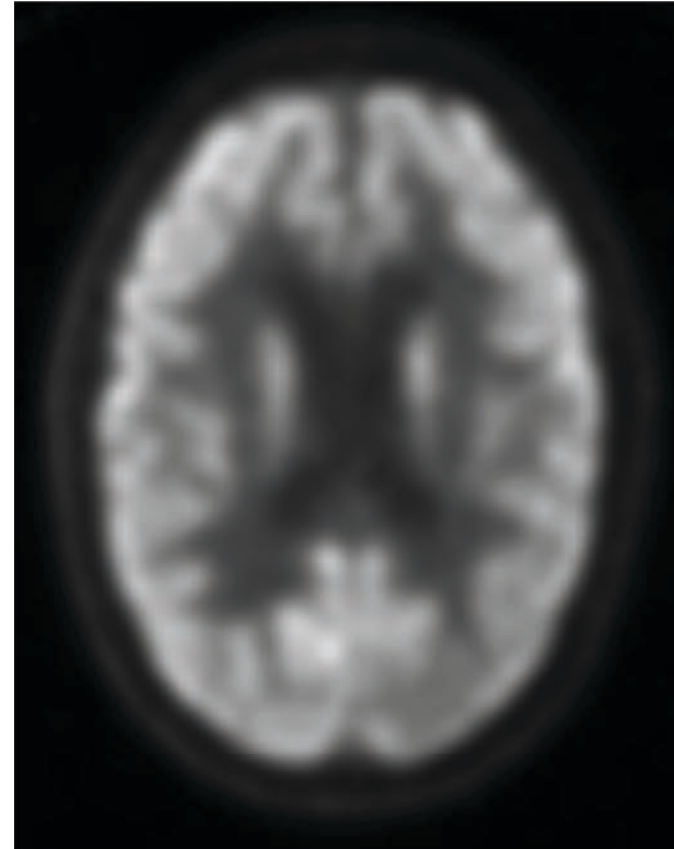
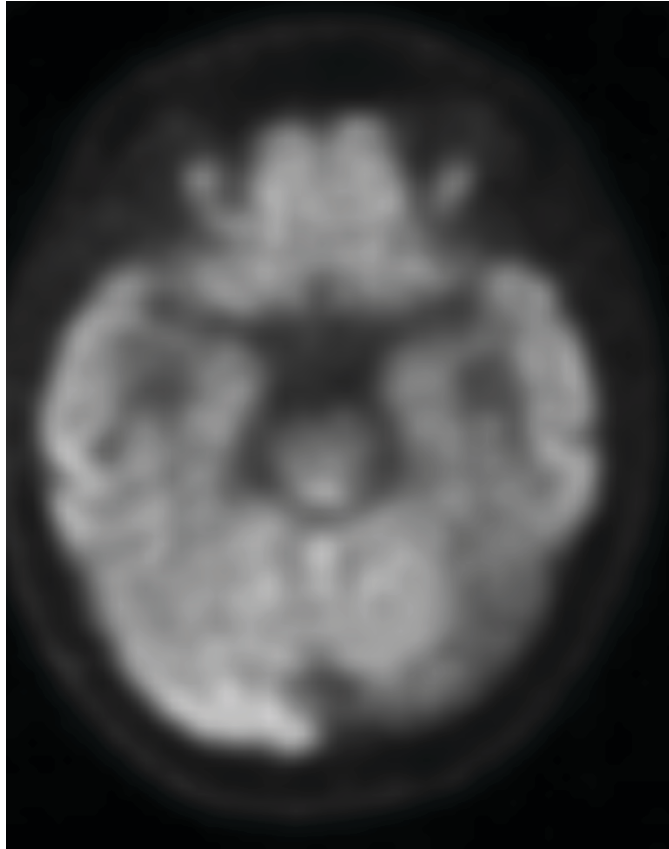


# Clinical Vignette 1 - MRI



Predominantly occipito-parietal or occipito-temporal atrophy L>R

# Clinical Vignette 1 - FDG PET



Hypometabolism L occipital lobe, L temp lobe, and biparietal L>R

***FDG*** = fluorodeoxyglucose F 18- a glucose analog tagged w/ a radiotracer.- uptake in this image is white.

# Focus: Four Major *Functional* Cognitive Systems

1. **Medial Temporo-Limbic Network:** memory and learning
2. **Occipito-Temporal /Occipito-Parietal Network: vision and object recognition**
  - ✓ Posterior Cortical Atrophy (**PCA**)- most often a variant of AD (*amyloid plaques and ptau tangles*)
    - **MRI:** predominant occipito-parietal/occipito-temporal atrophy (posterior cingulate *involved*)
    - **FDG PET:** hypometabolism in same areas.
  - ✓ Dementia of Lewy Bodies (**DLB**)- (*abnormal alpha-synuclein w/ Lewy bodies and Lewy neurites*)
    - ✓ **MRI:** predominant occipito-parietal atrophy (posterior cingulate gyrus will be *spared*)
    - ✓ **FDG PET:** hypometabolism in same areas.

**\*\*FDG PET:** hypometabolism in corresponding areas (DLB w/ “*cingulate Island*” sign)
3. **Perisylvian Language Network:** PPAs- language
4. **Fronto-Temporal Network:** executive, attention, behavior

# Clinical Vignette 2

75 y/o R-handed M presents with “**memory problems**” x 2 yrs. ED = 16 yrs. MS in Civil Engineering. Worked as a certified safety engineer for Cigna x 30 yrs. Retired 2 yrs ago, memory was contributory.

1. **Medial Temporo-Limbic Network:** memory and learning
2. **Occipito-Temporal /Occipito-Parietal Network:** vision and object recognition
3. **Perisylvian Language Network:** language
4. **Fronto-Temporal Network:** executive, attention, behavior

## *Per his wife,*

- He will **forget** something she said 10 min later. **Misplaces** items more. **Repeats** often.
- He **searches for words** frequently, but never uses wrong words.
- **Missed** a few doctors **apts**, and was **late paying a few bills**, so his wife now assists with apts and she took over bill pay.
- Pt continues to complete minor electrical, plumbing, and carpentry repairs in the home, well. However, tasks **take him much longer**.
- He manages his own meds, cooks simple meals, and helps with laundry.
- No problem noted with driving. Sleeps well.
- Seems a bit **more anxious**, and **angers more easily**, especially when he forgets things. Does not seem depressed.

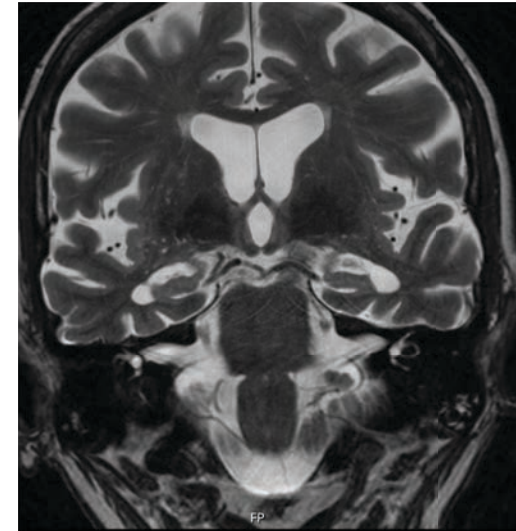
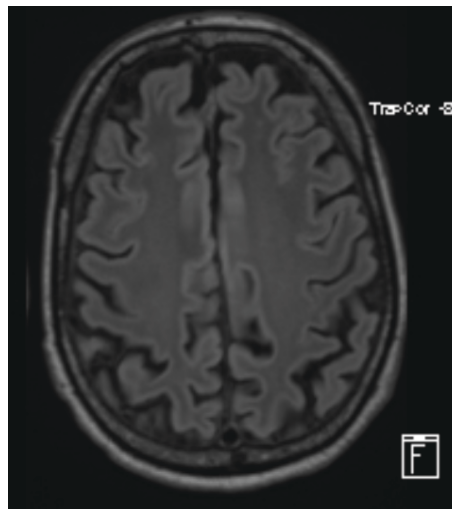
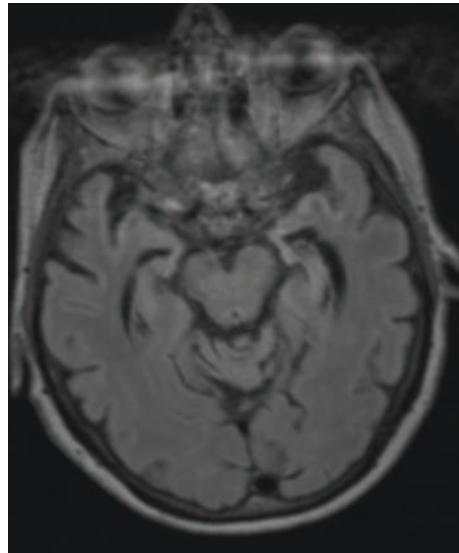
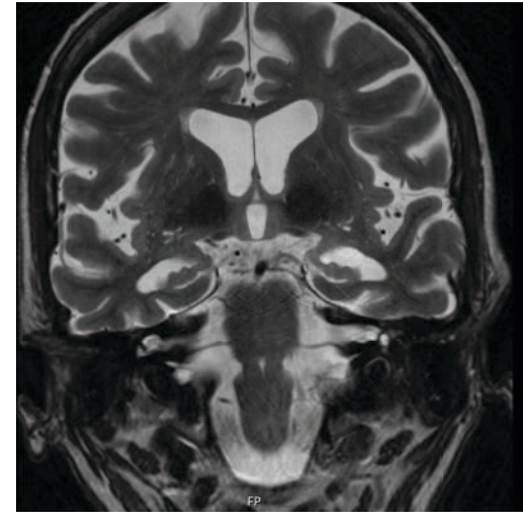
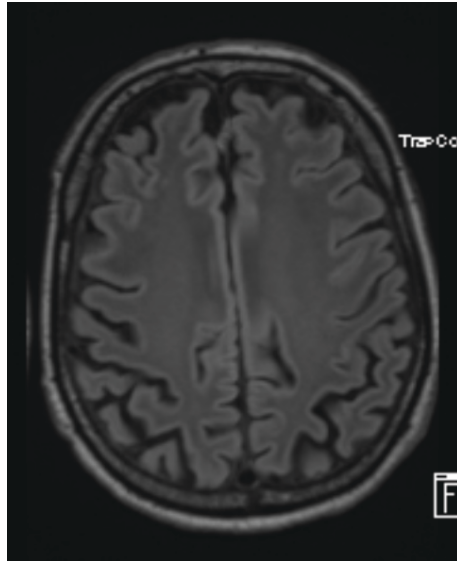
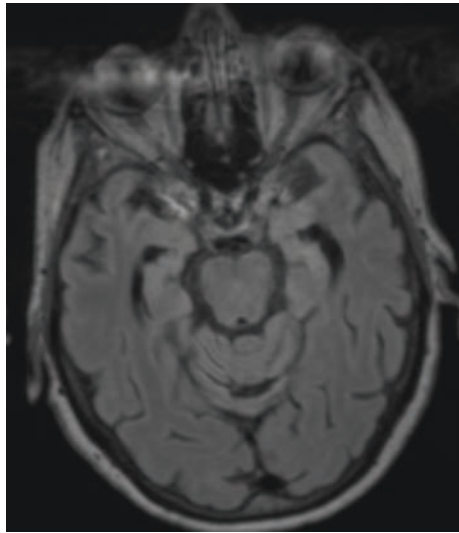
# Clinical Vignette 2

## **Exam and NP testing:**

- MoCA score = 26/30, lost 4 on word recall.
- Able to encode 5/5 elements of a name and address.
- After a 5 min delay, able to recall 1/5; with cuing 2/5.
- Correctly recognized 15 of 20 words.
- Able to name 13 F words and 12 animals.
- Boston Naming = 27/30.
- Trails B was in low normal range.
- All other scores were WNL.

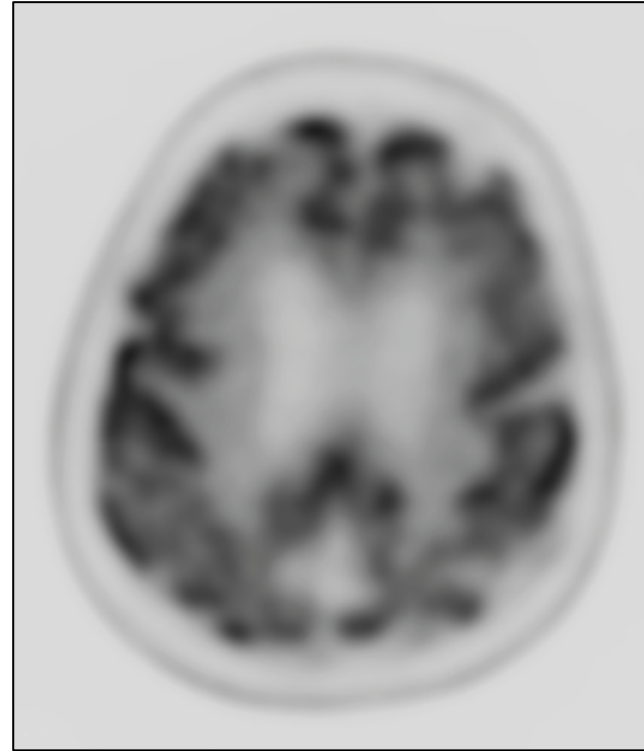
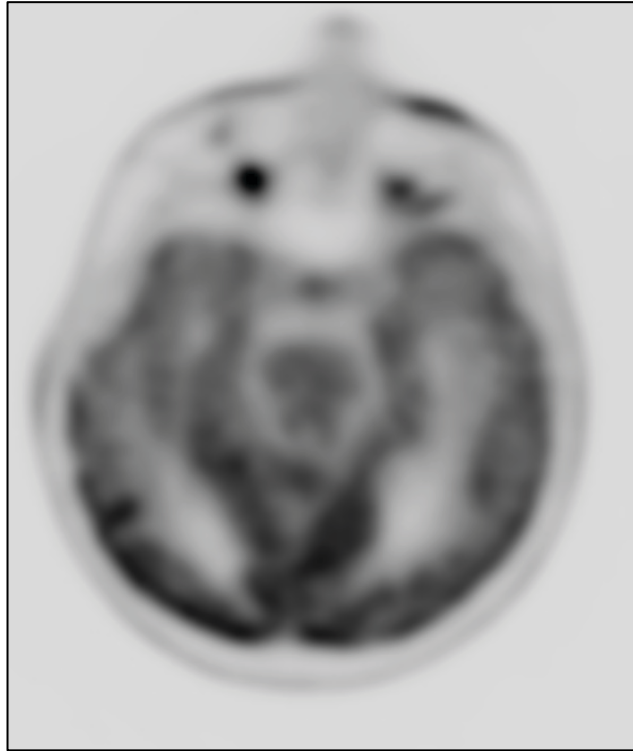
**Neurological Exam:** unremarkable.

# MRI - Clinical Vignette 2





## Clinical Vignette 2 - FDG PET



Hypometabolism b/l temporal lobes L>R, biparietal hypometabolism L>R

***FDG*** = fluorodeoxyglucose F 18- a glucose analog tagged w/ a radiotracer.- uptake in this image is black.

# Focus: Four Major *Functional* Cognitive Systems

- 1. Medial Temporo-Limbic Network: memory and learning**
  - ✓ Alzheimer's Disease and MCI with AD etiology (*amyloid plaques and ptau tangles*)
    - **MRI:** predominant MTL, posterior parietal atrophy. SWI w/ cortical microbleeds/superficial siderosis.
  - \*\*FDG PET:** hypometabolism in corresponding areas.
- 2. Occipito-Temporal /Occipito-Parietal Network:** visual or object recognition
- 3. Perisylvian Language Network:** PPAs- language
- 4. Fronto-Temporal Network:** executive, attention, behavior

# Clinical Vignette 3

A 69 y/o M presents with “**memory problems**” x 3 yrs. PMH is notable for HTN, HLD, cholecystectomy one yr ago. Ed = 19 yrs. JD, part owner of cooperate law firm. Retired age 63, no memory problems.

1. **Medial Temporo-Limbic Network:** *memory and learning*
2. **Occipito-Temporal /Occipito-Parietal Network:** *vision and object recognition*
3. **Perisylvian Language Network:** *language*
4. **Fronto-Temporal Network:** *executive, attention, behavior*

## *Per his wife,*

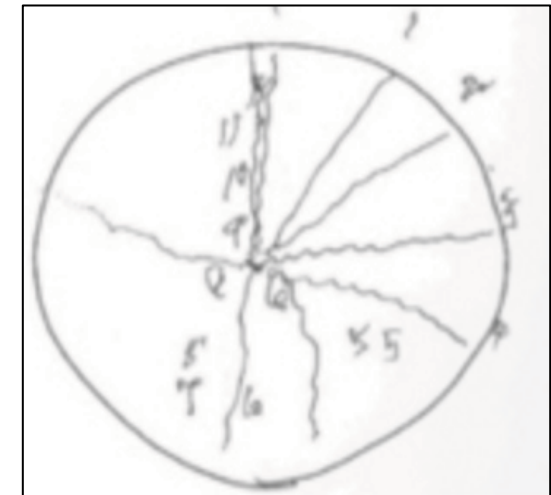
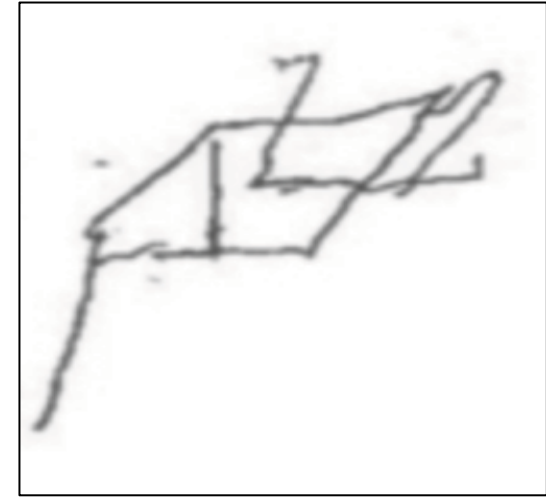
- Prob are due to **anesthesia** received during surgical removal of gallbladder. Pt + **post-op delirium**.
- Since his surgery, he can no longer manage his own **meds** or **apts**.
- Wife took over **finances**. He double-paid a bill, and then sent the HOA bill to the car insurance co.
- Has gotten **lost driving** on **several occasions** in familiar areas, eg: country club, and dgts home.
- Sees **children playing in the house at night**, and on two occasions **thought is wife was a “friend”**.
- Some days he seems to be his “**old self**”. Whereas, other days, he is **very confused**, and becomes **agitated** and **easily angry**. Prior, his personality was very easy-going.
- Wife makes all his meals. He dresses and showers autonomously without prompting.
- He **talks in his sleep** and **flails his arms** around. Has **hit his wife** on a three occasions.
- **Gait is slower**. He has had **two falls** in the last 3 months. Does not seem to shuffle. **No tremors**.

# Clinical Vignette 3

## Exam and NP testing

- MoCA = 14/30. He lost points for **cube, clock, and trails**. Also, lost points for **digits, naming, and abstraction**. Delayed recall 3/5
- Craft Story recall = 4
- F words = 7, animals = 13
- Digits forward =4, backwards =2
- Trails A time was below > 1.5 SD below nl for age and ed.
- He timed out on Trails B
- Clock and Benson Figure shown to R

**Neurological exam** was notable for UE cogwheeling R>L. Gait was bradykinetic, slightly hunched, reduced R arm swing. Stride length and base width were nl, w/ no shuffling.



# MRI- Clinical Vignette 3

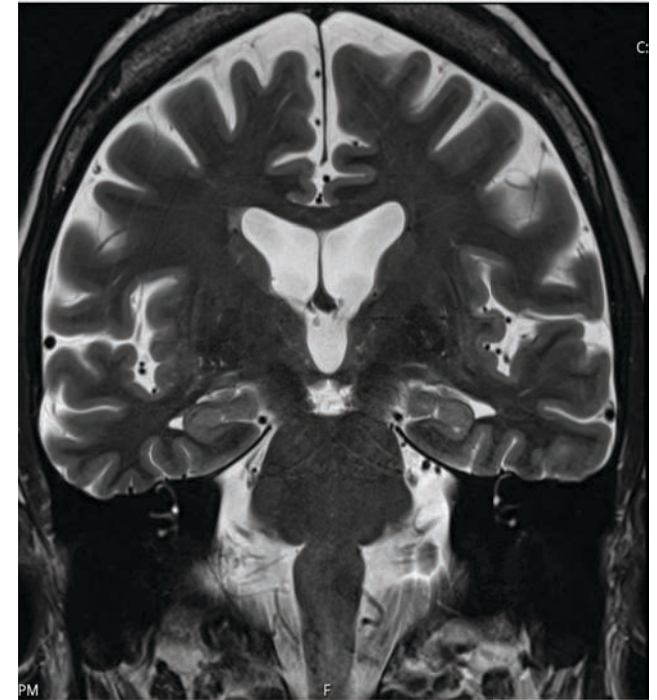
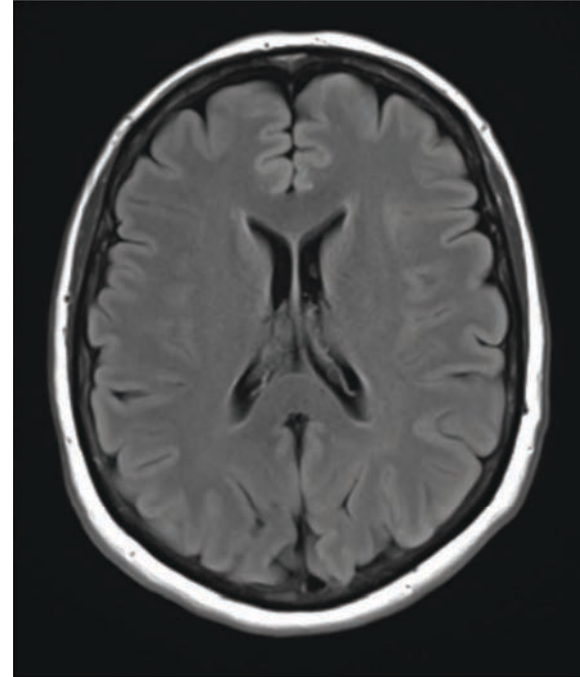
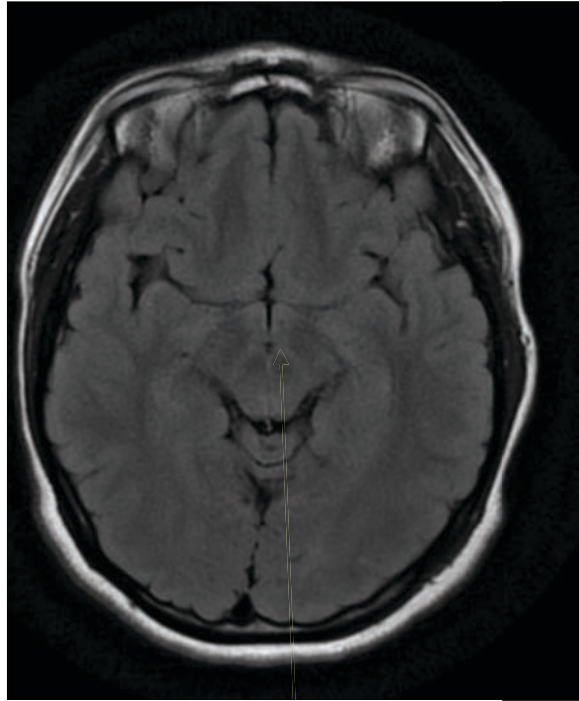
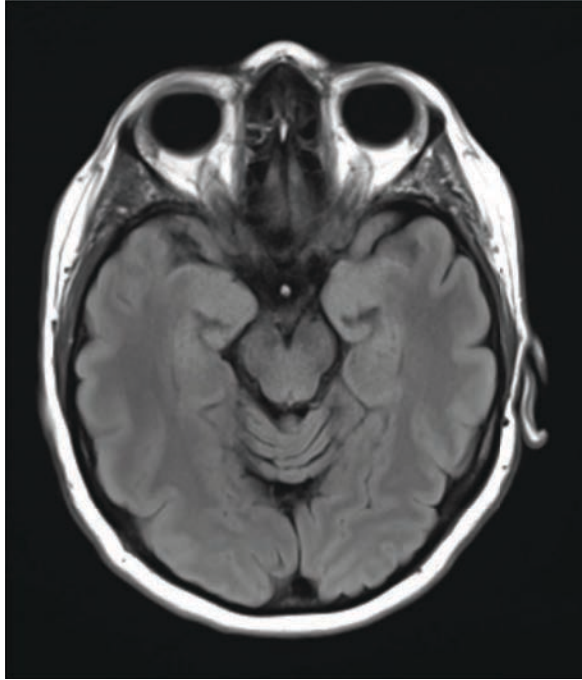
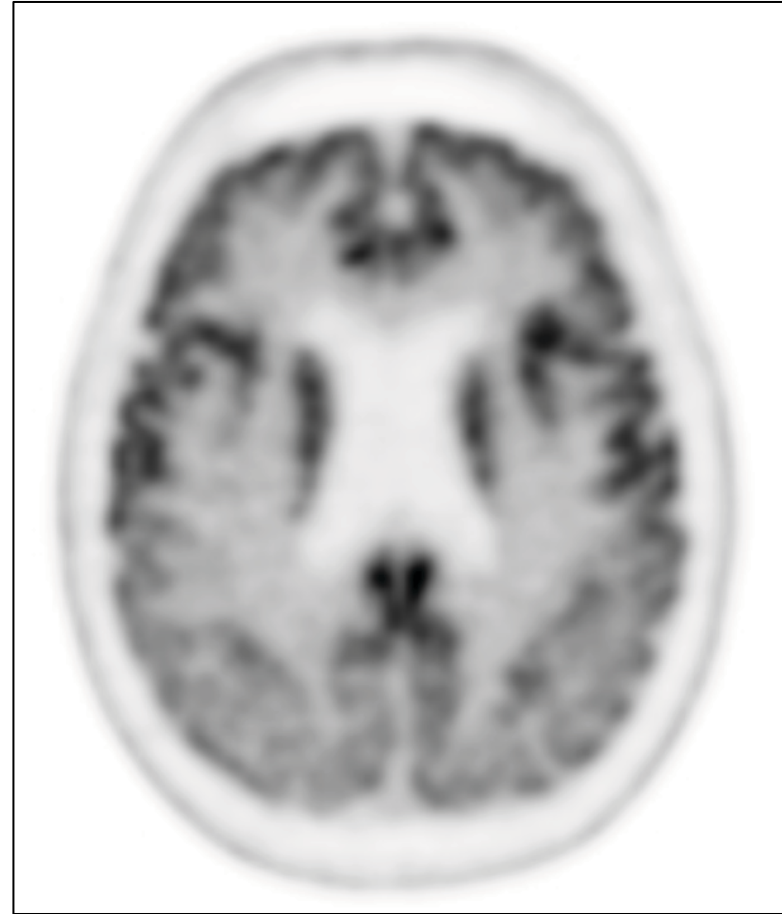
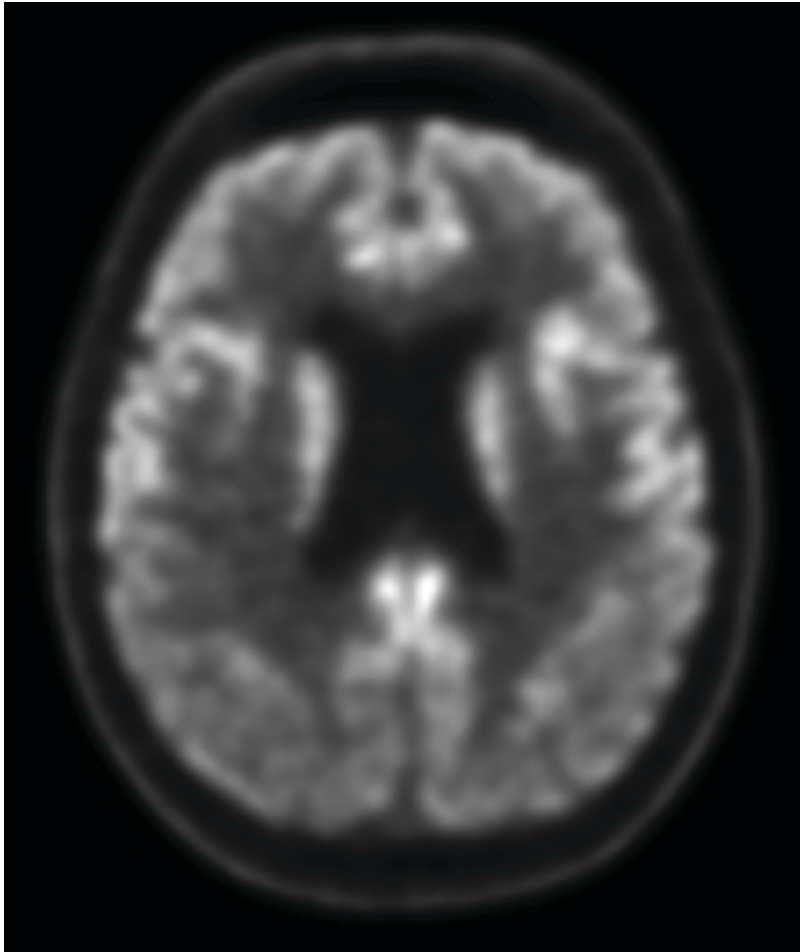


Image ref: <https://radiopaedia.org/cases/normal-mri-brain-neurodegenerative-protocol?lang=us>

## FDG PET- Clinical Vignette 3



**FDG PET:** hypometabolism posterior parietal (and occipital lobe- not shown well on this slice)  
Note the ***Cingulate Island Sign*** (preserved cingulate gyrus)

# Focus: Four Major *Functional* Cognitive Systems

1. **Medial Temporo-Limbic Network:** memory and learning
2. **Occipito-Temporal /Occipito-Parietal Network: vision and object recognition**
  - ✓ Posterior Cortical Atrophy (**PCA**)- most often a variant of AD (*amyloid plaques and ptau tangles*)
    - **MRI:** predominant occipito-parietal/occipito-temporal atrophy (posterior cingulate *involved*)
  - ✓ Dementia of Lewy Bodies (**DLB**)- (*abnormal alpha-synuclein w/ Lewy bodies and Lewy neurites*)
    - ✓ **MRI:** predominant occipito-parietal atrophy (posterior cingulate gyrus will be *spared*)

**\*\*FDG PET:** hypometabolism in corresponding areas (DLB w/ “*cingulate Island*” sign)
3. **Perisylvian Language Network:** PPAs- language
4. **Fronto-Temporal Network:** executive, attention, behavior

# 4<sup>th</sup> Consensus Criteria for Clinical Dx of Dementia of Lewy Bodies

## Required Criterion

- ◆ Dementia, often with early and prominent deficits in attention, executive function, and visuo-perceptual ability; prominent or persistent memory impairment tends to occur with progression.

## Probable Dementia With Lewy Bodies

- ◆ Presence of two or more core clinical features (with or without indicative biomarker)
- ◆ One core clinical feature plus at least one indicative biomarker

## Possible Dementia With Lewy Bodies

- ◆ Presence of one core clinical feature (no indicative biomarker)
- ◆ Presence of one or more indicative biomarkers but no core clinical features

## Core Clinical Features

- ◆ Fluctuating cognition with pronounced variations in attention and alertness
- ◆ Recurrent visual hallucinations
- ◆ Rapid eye movement (REM) sleep behavior disorder (may precede other symptoms)
- ◆ Parkinsonism (defined as one or more spontaneous cardinal features: bradykinesia, rest tremor, rigidity)<sup>b</sup>

## Supportive Clinical Features

- ◆ Severe sensitivity to antipsychotic agents
- ◆ Postural instability
- ◆ Repeated falls
- ◆ Syncope or other transient episodes of unresponsiveness
- ◆ Severe autonomic dysfunction (eg, constipation, orthostatic hypotension, urinary incontinence)
- ◆ Hypersomnia/excessive daytime sleepiness
- ◆ Hyposmia
- ◆ Hallucinations in nonvisual modalities
- ◆ Systematized delusions
- ◆ Apathy, anxiety, and depression



# Clinical Vignette 4

A 65 y/o F presented with a 4-yr hx of “**talking in fragments**” and **worsening word-finding problems**.  
Ed 20 yrs. History professor x 34 yrs. Retired early age 63, due to problems presenting lectures to her students.

1. **Medial Temporo-Limbic Network:** *memory and learning*
2. **Occipito-Temporal /Occipito-Parietal Network:** *vision and object recognition*
3. **Perisylvian Language Network:** *language*
4. **Fronto-Temporal Network:** *executive, attention, behavior*

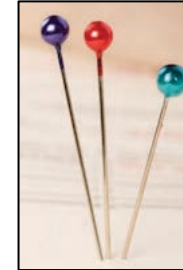
## *Per her husband,*

- He does not notice sig problems recalling recent events. Does not misplace things more often. Does not repeat questions or conversations.
- Most salient sx is she has “**difficulty getting the words out**”. She frequently refers to common objects as the “**it**” or “**thing**”.
- **Comprehension** declined. Has to re-read sentences often, and she often asks her husband to repeat what he said.
- Overall, she seems to have **lost much of her vocabulary**, which was quite advanced.
- Although she had been an avid reader, she **no longer reads**.
- Still able to make meals, clean house, pay bills, gardens and enjoys oil painting.
- Still driving, no navigational confusion.
- **Easily frustrated and angry**, esp when she has trouble communicating.

# Clinical Vignette 4

## NP Testing:

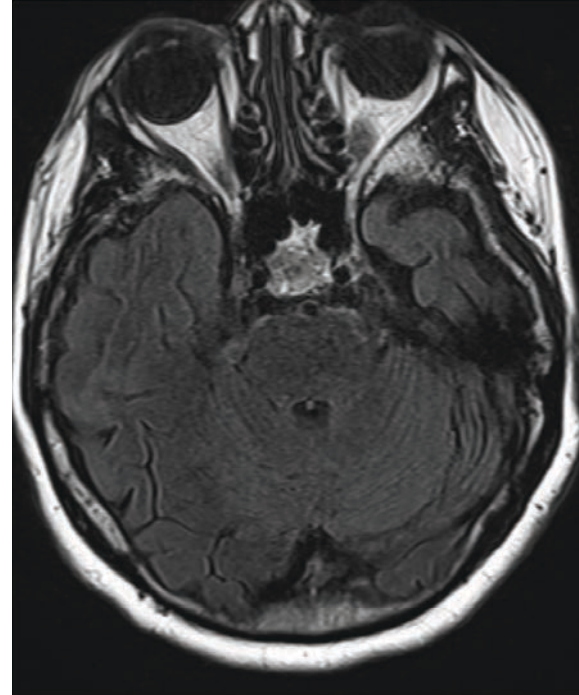
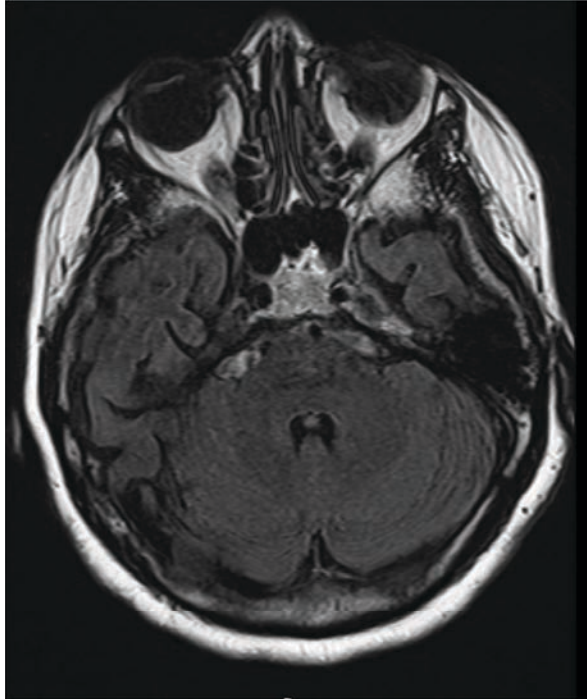
- Shown 5 shapes of different colors, able to pick out 5 correct shapes when shown 10 shapes 5 minutes later.
- Able to name 2 F-words, and 4 animals.
- Scored 15/31 on the Boston Naming test.
- \* Had **difficulty reading irregular words**, eg: pronounced “**y**acht” = “yah ked”, **a**che” = “a-CHee”, “**p**int” = “pint” →
- Had **difficulty naming common objects**, with only mild improvement after cueing, eg: a screwdriver was a “tool”, a pen was a “something used in an office”.



## Neurological exam:

- **Frequent pauses and circumlocutions.** Spoke in sentences with normal prosody and syntax.
- Exam otherwise normal.

## Clinical Vignette 4 – MRI



**Predominantly, anterior temporal pole atrophy L>R.**

Middle and inferior temporal gyri, fusiform gyri, and **amygdala** often involved (mood sx common).

# Focus: Four Major *Functional* Cognitive Systems

1. **Medial Temporo-Limbic Network:** memory and learning
2. **Occipito-Temporal /Occipito-Parietal Network:**
3. **Perisylvian Language Network: PPAs- language (*is the primary and principle deficit*)**
  - ✓ Primary Progressive Aphasia- **Logopenic (lvPPA)**
    - **MRI:** peak atrophy in temporo-parietal junction L>R and post parietal cortex (incl *Wernicke's area*).
  - ✓ Primary Progressive Aphasia- **Semantic (svPPA)**
    - **MRI:** peak atrophy in the anterior temporal pole, L>R
  - ✓ Primary Progressive Aphasia- **Agrammatic/Non-fluent (nfvPPA)**
    - **MRI:** peak atrophy in ventro-lateral portion of the inferior frontal gyrus (*Broca's area*) and premotor cortex.

**\*\*FDG PET:** hypometabolism in corresponding areas
4. **Fronto-Temporal Network:** executive, attention, behavior

# PPA: Perisylvian Language Network - Clinical Features

	Nonfluent/Agrammatic Variant Primary Progressive Aphasia	Logopenic Variant Primary Progressive Aphasia	Semantic Variant Primary Progressive Aphasia
<b>Core features</b>	<p>At <u>least one</u> of the following:</p> <ul style="list-style-type: none"> <li>Agrammatism in language production</li> <li>Effortful, halting speech with inconsistent speech sound errors (apraxia of speech)</li> </ul>	<p><u>Both</u> of the following core features must be present:</p> <ul style="list-style-type: none"> <li>Impaired single-word retrieval in spontaneous speech and naming</li> <li>Impaired repetition of sentences and phrases</li> </ul>	<p><u>Both</u> of the following core features must be present:</p> <ul style="list-style-type: none"> <li>Impaired confrontation naming</li> <li>Impaired single-word comprehension</li> </ul>
<b>Supportive features</b>	<p>At least two of the following:</p> <ul style="list-style-type: none"> <li>Impaired comprehension of syntactically complex sentences</li> <li>Spared single-word comprehension</li> <li>Spared object knowledge</li> </ul>	<p>At least three of the following:</p> <ul style="list-style-type: none"> <li>Speech (phonologic) errors in spontaneous speech and naming</li> <li>Spared single-word comprehension and object knowledge</li> <li>Spared motor speech</li> <li>Absence of frank agrammatism</li> </ul>	<p>At least three of the following:</p> <ul style="list-style-type: none"> <li>Impaired object knowledge, particularly for low-frequency or low-familiarity items</li> <li>Surface dyslexia or dysgraphia</li> <li>Spared repetition</li> <li>Spared speech production (grammar and motor speech)</li> </ul>

<https://journals.lww.com/continuum/pages/videogallery.aspx?autoPlay=false&videoid=156>

<sup>a</sup> Modified with permission from Gorno-Tempini ML, et al, Neurology.<sup>1</sup> © 2011 American Academy of Neurology.

# PPA: Pathology / Proteinopathy

Feature	<b>Logopenic Variant Primary Progressive Aphasia</b>	<b>Semantic Variant Primary Progressive Aphasia</b>	<b>Non-fluent/Agrammatic Variant Primary Progressive Aphasia</b>
<b>Underlying etiology and pathology</b>	Alzheimer's disease (50%) Frontotemporal lobar degeneration (TDP-43 38%, tau 12%)	Frontotemporal lobar degeneration (TDP-43 69%, tau 6%) Alzheimer's disease (25%)	Frontotemporal lobar degeneration (tau 52%, TDP-43 19%, other 4%) Alzheimer's disease (25%)
<b>Cortical atrophy or hypometabolism</b>	Left temporoparietal	Anterior temporal, often left greater than right	Left posterior fronto-insular

Ref: Gorno-Tempini et al., 2011; Grossman, 2012; Josephs et al., 2014; Jung et al., 2013; Wicklund et al., 2014. Budson, Andrew E.. Memory Loss, Alzheimer's Disease, and Dementia E-Book . Elsevier H.S. Kindle Edition.

# Clinical Vignette 5

A 56 y/o F presented with **4 yrs of behavioral sx**. She was a emergency RN x 30 yrs. She recently had an **extramarital affair w/ a male patient** whom she treated for a dislocated finger, whom she found “irresistible”, which resulted in her termination.

1. **Medial Temporo-Limbic Network:** memory and learning
2. **Occipito-Temporal /Occipito-Parietal Network:** vision and object recognition
3. **Perisylvian Language Network:** language
4. **Fronto-Temporal Network:** executive, attention, behavior

## *Per her husband,*

- She openly **criticized her dgt-in-law for being overweight**, and told her **husband to “shut-up”** when they were out to dinner with friends.
- She has become **preoccupied with Starbucks Cold Brews**, consuming three to four large beverages per day.
- Her husband recently discovered she **spent \$5,000 on Amazon** in last three mos, on toilet paper, paper towels, and cleaning supplies, which she has been stock-piling in their basement.
- She refused to go to her sons’ **basketball games**, explaining that she has always hated sports, and she has never really enjoyed their games anyway.
- She does not seem to have any problem recalling recent events, driving, shopping.

# Focus: Four Major *Functional* Cognitive Systems

1. **Medial Temporo-Limbic Network:** memory and learning
2. **Occipito-Temporal /Occipito-Parietal Network:**
3. **Perisylvian Language Network:** PPAs- language
4. **Fronto-Temporal Network:** executive, attention, behavior
  - ✓ Behavioral Variant of Frontotemporal Dementia (bvFTD)
  - ✓ Often a Clinical Dx.
  - ✓ MRI with b/I frontal, anterior temporal atrophy.
  - \*\*FDG PET: hypometabolism in corresponding areas



# bvFTD Clinical Diagnostic Criteria

## Possible Behavioral Variant Frontotemporal Dementia (bvFTD)

Three of the following as persistent or recurrent features:

- A Early behavioral disinhibition
- B Early apathy or inertia
- C Early loss of sympathy or empathy
- D Early perseverative, stereotyped, or compulsive/ritualistic behavior
- E Hyperorality and dietary changes
- F Neuropsychological profile: executive/generation deficits with relative sparing of memory and visuospatial functions

## Probable bvFTD

All of the following:

- A Meets criteria for possible bvFTD
- B Exhibits significant functional decline (by caregiver report, Clinical Dementia Rating, or Functional Activities Questionnaire)
- C Imaging results consistent with bvFTD:
  - C1 Frontal and/or anterior temporal atrophy on MRI or CT
  - C2 Frontal and/or anterior temporal hypoperfusion or hypometabolism on PET or SPECT

# To Summarize: Functional Cognitive Systems & Imaging

## 1. Medial Temporo-Limbic Network: **memory and learning**

- ✓ Alzheimer's Disease and MCI with AD etiology
  - **MRI:** predominant MTL, posterior parietal atrophy. SWI-cortical microbleeds/superficial siderosis. **PET** same.

## 2. Occipito-Temporal /Occipito-Parietal Network: **vision or object recognition**

- ✓ Posterior Cortical Atrophy (PCA)
  - ✓ **MRI:** Predominant occipito-parietal or occipito-temporal atrophy (**posterior cingulate gyrus involved** on PET).
- ✓ Dementia of Lewy Bodies (DLB)
  - ✓ **MRI:** often normal. May have occipito-parietal atrophy (**posterior cingulate gyrus spared** on PET).

## 3. Perisylvian Language Network: **PPAs- language**

- ✓ Primary Progressive Aphasia- **Logopenic (lvPPA)**
  - **MRI:** atrophy in the temporo-parietal junction L>R and posterior parietal cortex. **PET** same.
- ✓ Primary Progressive Aphasias- **Semantic (svPPA)**
  - **MRI:** atrophy in the anterior temporal pole, L>R . **PET** same.
- ✓ Primary Progressive Aphasia- **Agrammatic/Non-fluent (nfvPPA)**
  - **MRI:** atrophy in ventro-lateral portion of inferior frontal gyrus (*Broca's area*) and premotor cortex. **PET** same

## 4. Fronto-Temporal Network: **executive, attention, behavior**

- ✓ Behavioral Variant of Frontotemporal Dementia (bvFTD). **MRI:** frontal and anterior temporal atrophy. **PET** same.

# References

1. Armstrong, Melissa, J. MD, MSc, FAAN. Lewy Body Dementia. CONTINUUM. DEMENTIA p. 128-146. February 2019, Vol. 25, No 1.
2. Beh SC, Muthusamy B, Calabresi P, *et al.* Hiding in plain sight: a closer look at posterior cortical atrophy. *Practical Neurology* 2015;**15**:5-13. <https://pn.bmj.com/content/15/1/5>
3. Budson, Andrew E., Solomon, Paul, R. Memory Loss, Alzheimer's Disease, and Dementia E-Book . Elsevier Health Sciences. Kindle Edition
4. Botha, Hugo, MBChB; Keith A. Josephs, MD, MST, MSc. Primary Progressive Aphasia and Apraxia of Speech. CONTINUUM. Dementia p. 101-127. February 2019, Vol.25, No.1
5. Dekeyser, DeKock, et al. “Unforgettable” – a pictorial essay on anatomy and pathology of the hippocampus. *Insights Imaging* (2017) 8:122-212.
6. Imaios: Online Radiology Reference <https://www.imaios.com/en/e-Anatomy/Head-and-Neck/Brain-MRI-3D>
7. Martinez de Souza, Ricardo Krause, et al. A patient with posterior cortical atrophy due to Alzheimer’s disease. *Dement Neuropsychol* 2018 September;**12** (3):326-328. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6200153/>
8. McKeith, Ian, et al. Diagnosis and management of dementia with Lewy bodies. Fourth consensus report of DLB Consortium. *Neurology* 89, July 4, 2017. <https://n.neurology.org/content/neurology/89/1/88.full.pdf>
9. Quach, C. Hommet, C., et al. “Early-onset dementias: Specific etiologies and contribution of MRI. *Diagnostic and Interventional Imaging* (2014) 95, 377-398.
10. Rabinovici, Gil D. MD. Late-onset Alzheimer Disease. CONTINUUM. Dementia p. 14-33. February 2019, Vol.25, No.1.
11. Radiology Assistant: free radiology reference: <http://www.radiologyassistant.nl/en/p43dbf6d16f98d/dementia-role-of-mri.html>
12. Radiopaedia: Online Radiology Reference: <https://radiopaedia.org/?lang=us>
13. Schott, Jonathan M. , MD, FRCP, FEAN, SFHEA; Crutch, Sebastian J. PhD, Cpsych. Posterior Cortical Atrophy. CONTINUUM. Dementia p. 52-75. February 2019. Vol. 25, No 1.
14. William W. Seeley, MD, Behavioral Variant Frontotemporal Dementia. CONTINUUM, Dementia p. 76-100 February 2019, Vol.25, No.1.



Questions?

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