Neuroimaging in Dementia

Chukwuma Oraegbunam

Acting Consultant Psychiatrist for Older Adults

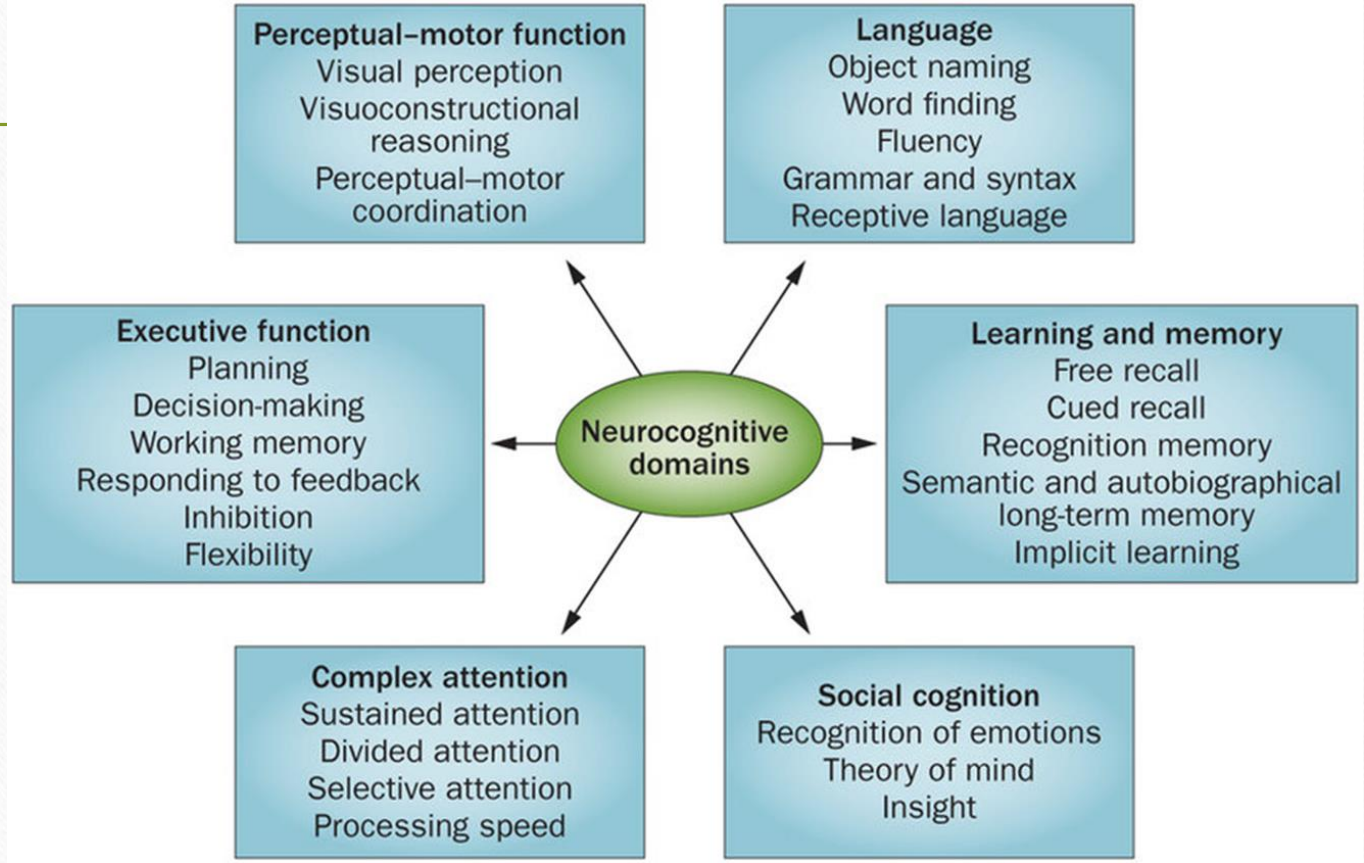
Lancashire and South Cumbria NHS Foundation Trust.

Outline

- Introduction
- Imaging techniques
- Dementia subtypes and common neuroimaging findings
- Summary

Introduction

- Dementia is a disorder that is characterised by impairment of memory and at least one other cognitive domain.



Introduction

- There must be a decline from previous level of function that is severe enough to interfere with daily function and independence
- There are many causes/types of dementia
- Initial assessment of a patient thought to be having cognitive impairment should include a systematic search for reversible causes

Introduction

Structural neuroimaging is one of the fundamental aspects of a routine dementia assessment in secondary care.

- Diagnosing reversible causes of dementia
  - ✓ AD, VD, FTD, DLB
- Diagnosing dementia and subtypes
  - ✓ CVAs, SoLs

Imaging Techniques in Dementia

Grossly grouped into three;

- Structural
- Functional
- Molecular

Imaging Techniques in Dementia

Structural Imaging techniques

- Includes CT and MRI
- Most commonly used
- Relatively cheap and widely available
- Focuses on the anatomical ‘structure’ of cerebral tissue.
- Commonly detect brain atrophy or ischaemia

The Fazekas scale

- **The Fazekas scale** is used to simply quantify the amount of white matter T2 hyperintense lesions usually attributed to chronic small vessel ischaemia, although clearly not all such lesions are due to this.

- Proposed by Fazekas et al. in 1987 one of the most widely used system for describing white matter disease severity for research purposes.
- In clinical practice, terms such as 'mild', 'moderate' and 'severe' are wildly used.

- Classification – depends on size and confluence

The Fazekas scale

periventricular white matter (PVWM) - demyelination, ependymitis granularis, and subependymal gliosis, as well as small vessel ischaemia

- 0 = absent
- 1 = “caps” or pencil-thin lining
- 2 = smooth “halo”
- 3 = irregular periventricular signal extending into the deep white matter

deep white matter (DWM) - chronic small vessel ischaemic in nature

- 0 = absent
- 1 = punctate foci
- 2 = beginning confluence
- 3 = large confluent areas

MR findings in Dementia

	AD	VaD	FTLD	Lewi*
Hippocampal atrophy	+++	++	++	-
Temporal atrophy	++	+	+++	-
Frontal atrophy	-	+	+++	-
Parietal atrophy	++	+	-	-
Lacunes	-	+++	-	-
WML's	-	+++	-	-
Strategic infarcts	-	+++	-	-

MRI Assessment in Dementia

Global Atrophy	Vascular Dementia Normal aging
Med Temp Atrophy	AD, FTLD (asymmetric)
Frontal atrophy	FTLD
WML's	Vascular Dementia Normal aging
Strategic infarcts	Vascular Dementia

Imaging Techniques in Dementia

Functional imaging techniques

- includes HMPAO-SPECT, FDG-PET, DaTscan
- Commonly used to confirm diagnosis of subtypes of dementia
- Less commonly used when diagnosis is clear enough
- More expensive and not easily accessible

Imaging Techniques in Dementia

Functional imaging techniques

- HMPAO SPECT – demonstrates the degree of cerebral blood perfusion, using a lipophilic tracer.
- FDG-PET – demonstrates degree of cerebral glucose metabolism using a glucose analogue
- DaTscan - enables the visualisation of dopaminergic activity in the basal ganglia. Used for assessing suspected Parkinson's disease or dementia with Lewy bodies (DLB)

Imaging Techniques in Dementia

Molecular imaging techniques

- Includes Amyloid-labelled PET scans, Two ligands, 18F-florbetapir and 18F-florbetaben
- Uses radioactive traces that bind to specific diagnostic molecules
- An emerging area and used mostly for clinical trials at this stage
- Some have been licensed for clinical use

Imaging Techniques in Dementia

- **Molecular imaging techniques**

➢ Detection of amyloid is not on its own diagnostic of AD

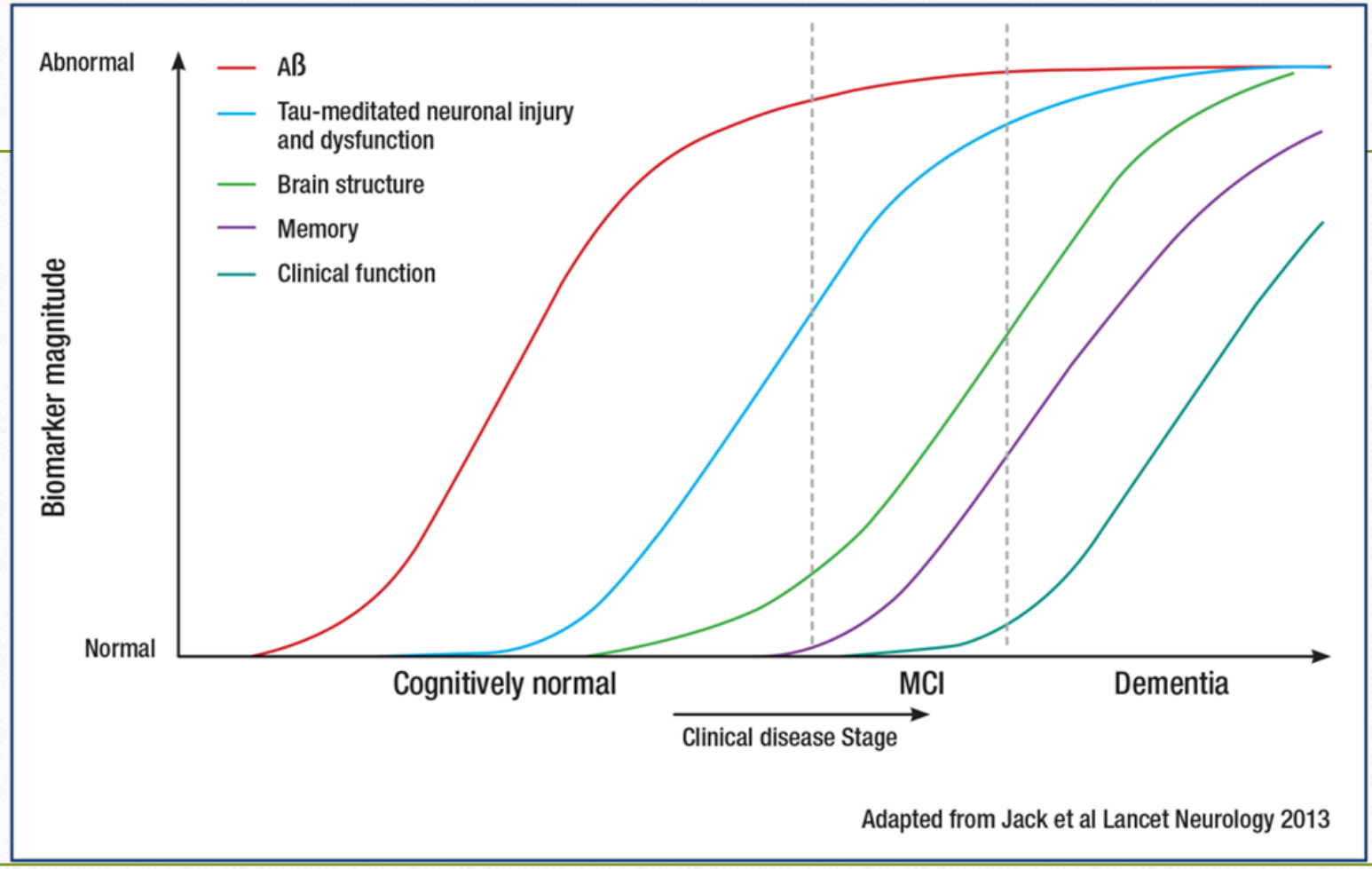
➢ Negative scan effectively excludes amyloid pathology

➢ Most useful in differentiating AD from FTD, YOD and in cases where there are multiple pathologies, e.g. depression, vascular

Molecular Imaging

❑**Tau -/Aß -**	➢**Normal aging, depression, meds**
❑Tau +/Aß +	➢ Alzheimer's disease, AD/LBD
❑Tau -/Aß +	➢ Premorbid AD, normal aging
❑Tau +/Aß -	➢ CTE, FTD, MSA > AD

Dementia in Alzheimer's disease



Dementia subtypes and common neuroimaging findings

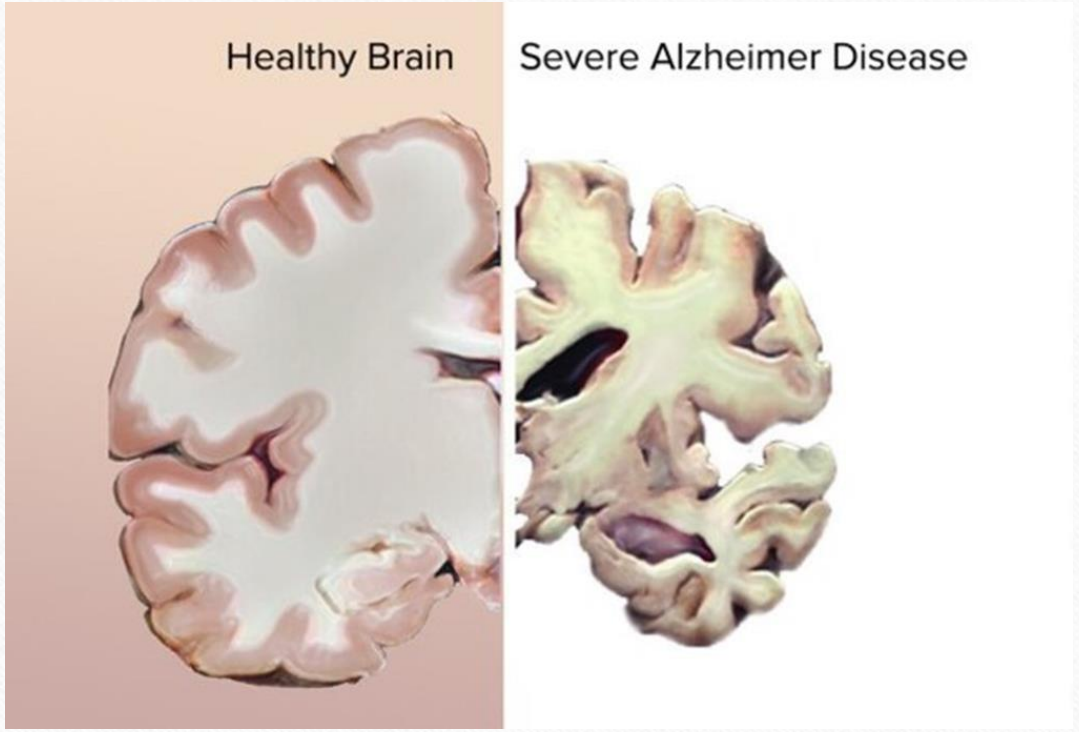
Dementia Subtypes

- Dementia in Alzheimer's disease
- Vascular dementia
- Frontotemporal dementia
- Lewy Bodies dementia
- Dementia in Parkinson's disease
- Others

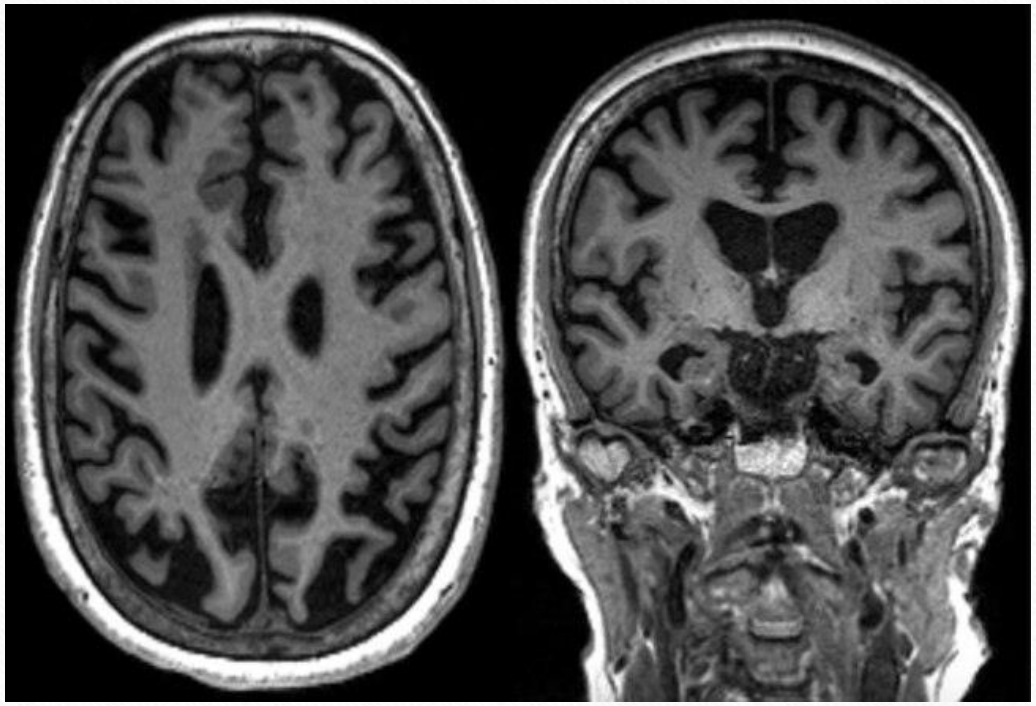
Dementia in Alzheimer's disease

Structural

- Early: Normal or medial temporal atrophy
- Late: Generalized atrophy, widening of sulci and ventricles
- *Hippocampal atrophy*
- Focal atrophy
- White matter hyper intensities



Dementia in Alzheimer's disease



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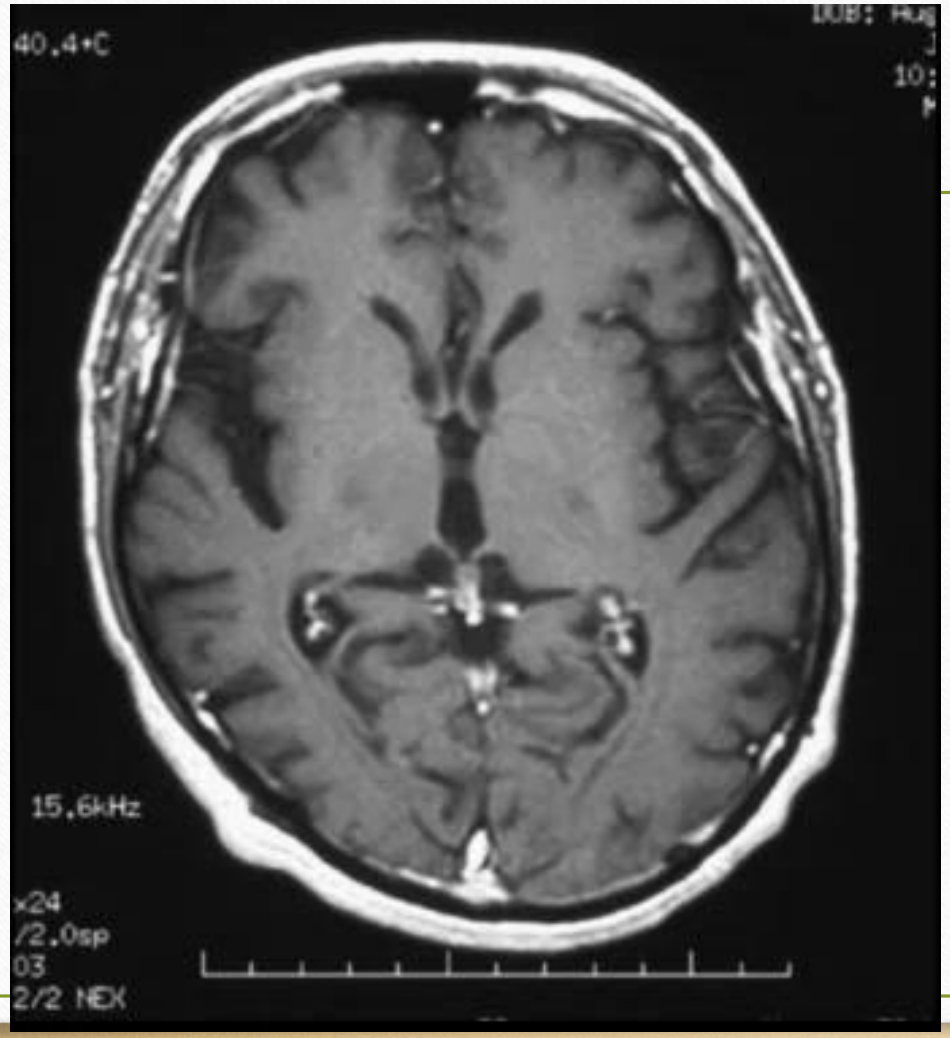
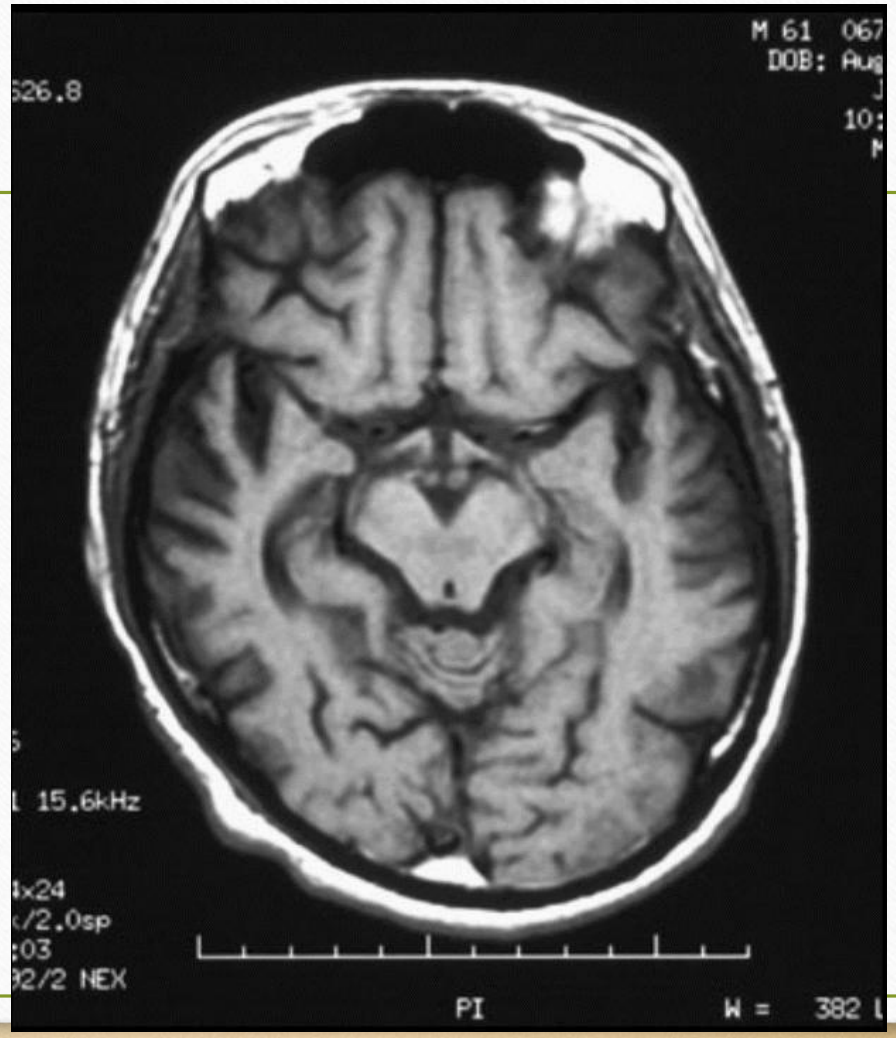




Dementia in Alzheimer's disease

Functional (FDG PET)

- Early: Hypo metabolism in the temporal/parietal regions
- Late: Generalized hypo metabolism (with sparing of primary sensorimotor cortex)

Dementia in Alzheimer's disease

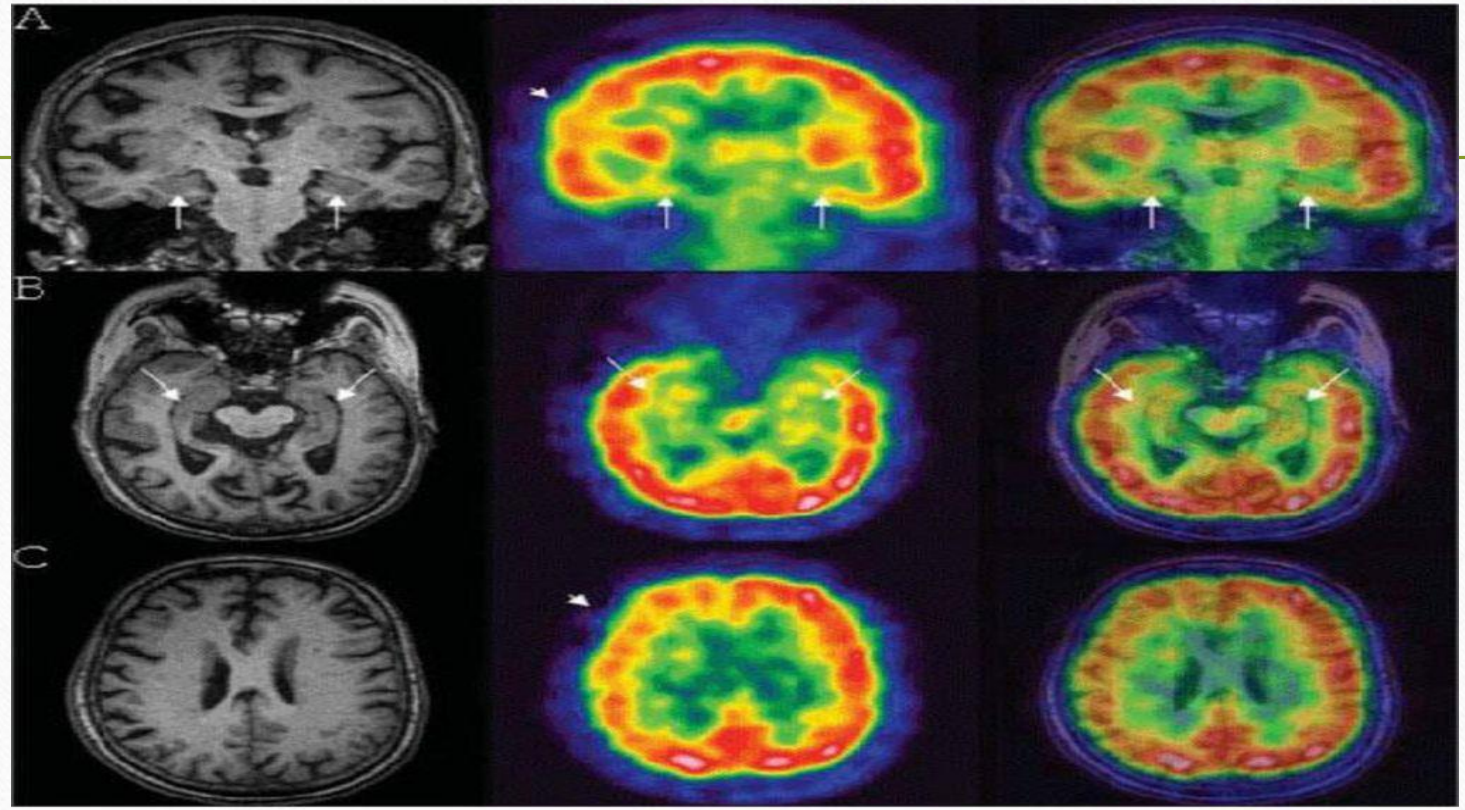
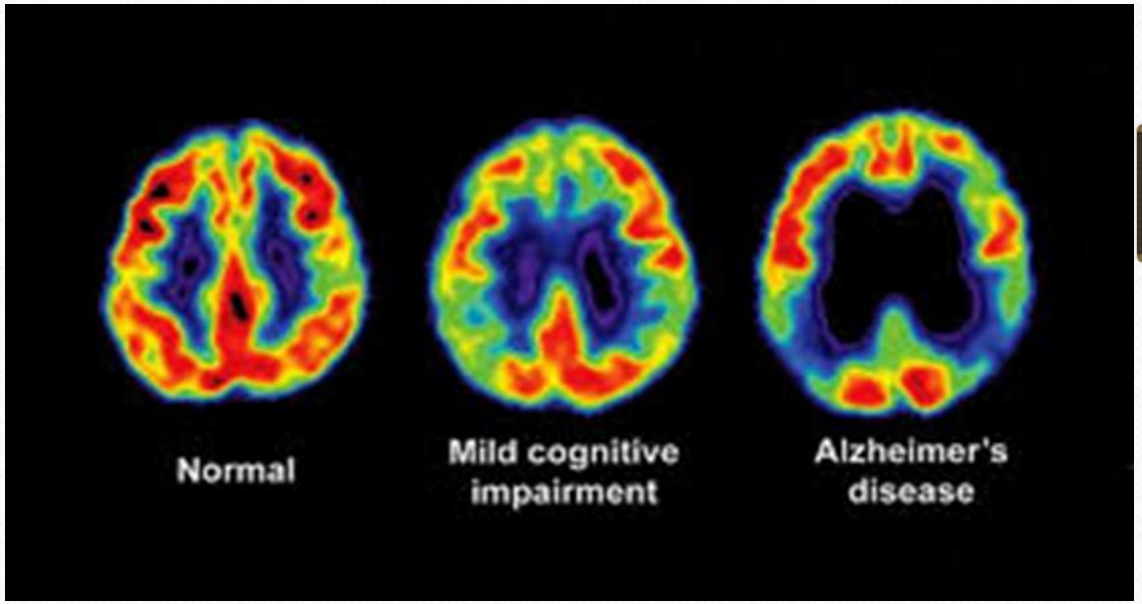


Figure 3. G.M.R., a 62-year-old patient presenting progressive memory loss for one year. Mini mental statement examination score of 22 (N > 24). Lines **A**, **B** and **C** represent MRI and PET images and PET/MRI coregistration. Both hippocampi present a subtle metabolism decrease (arrows on **A** and **B**). Additionally, a mild hypometabolism can be observed in the frontotemporoparietal cortex at right (arrowheads on **A** and **C**).

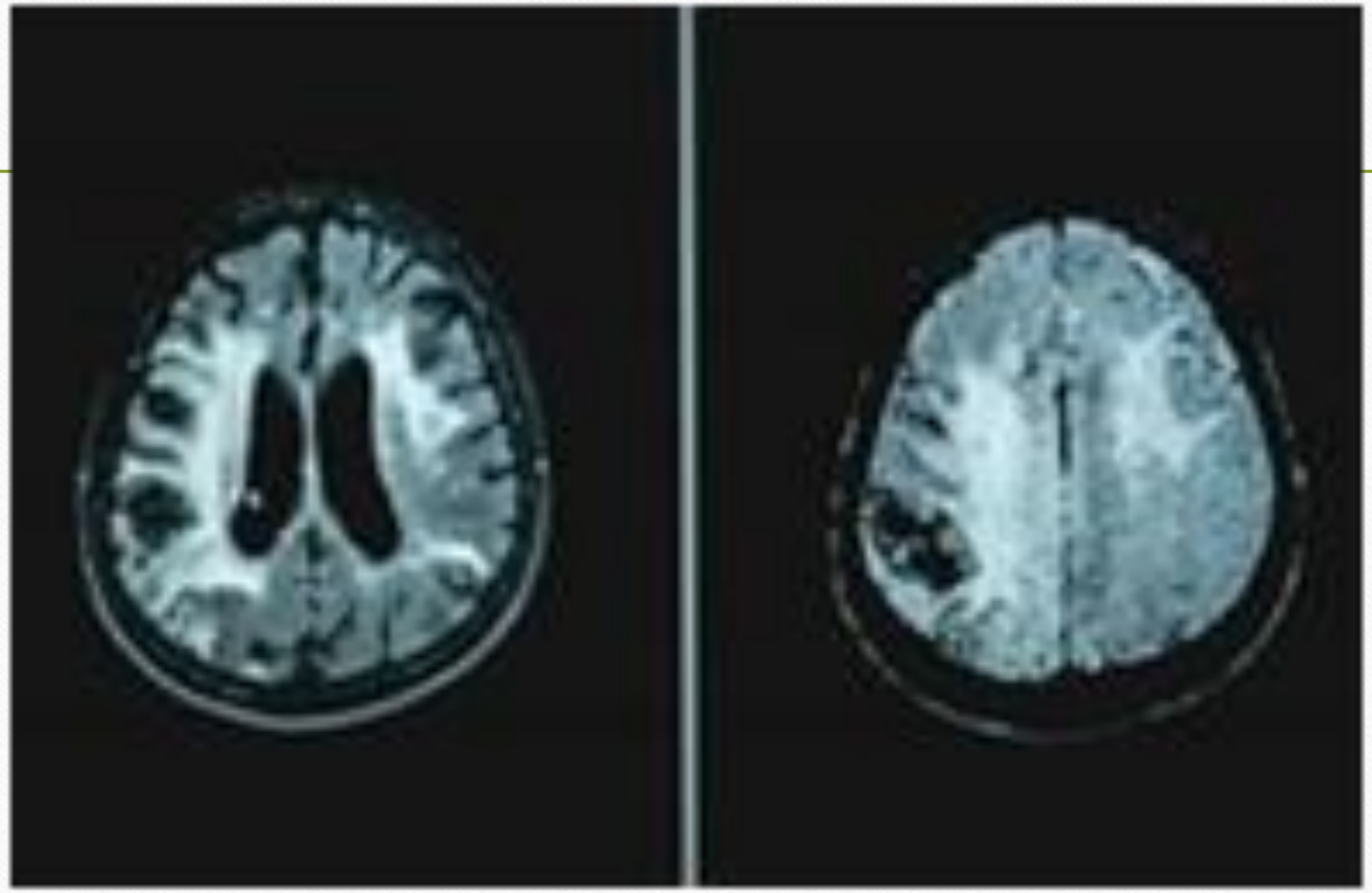
Dementia in Alzheimer's disease

Molecular (Amyloid PET)

- All stages: Generalized cortical amyloid deposition
- Note that amyloid binding may also occur with normal aging



Vascular Dementia



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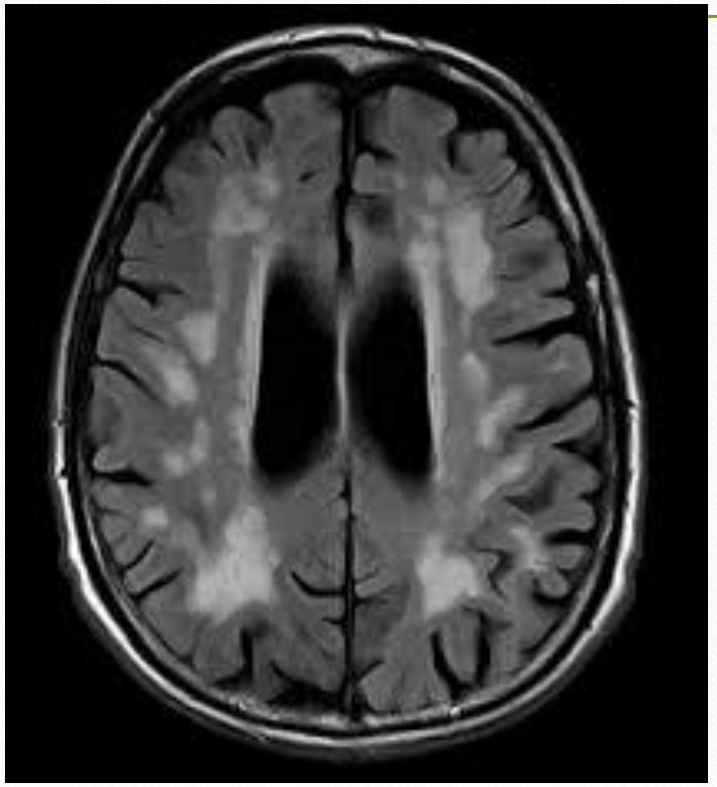
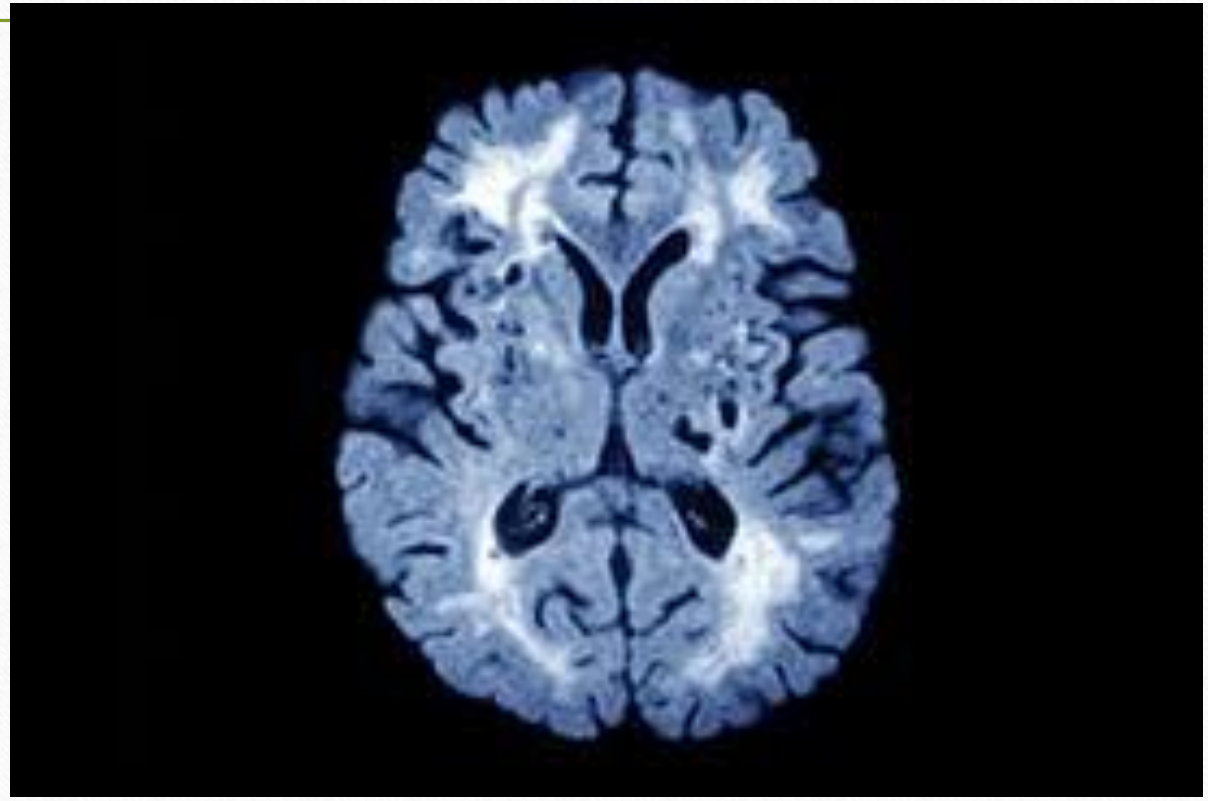
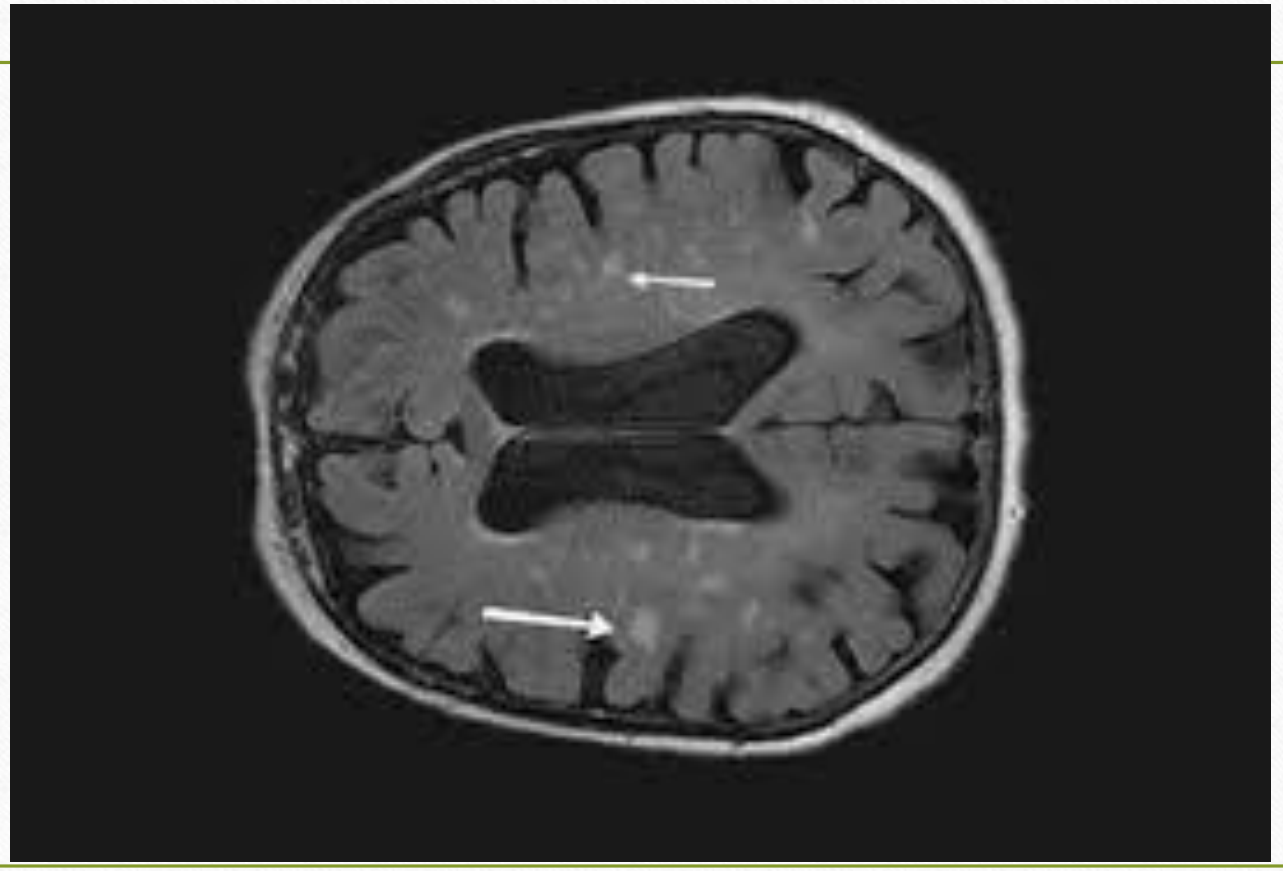
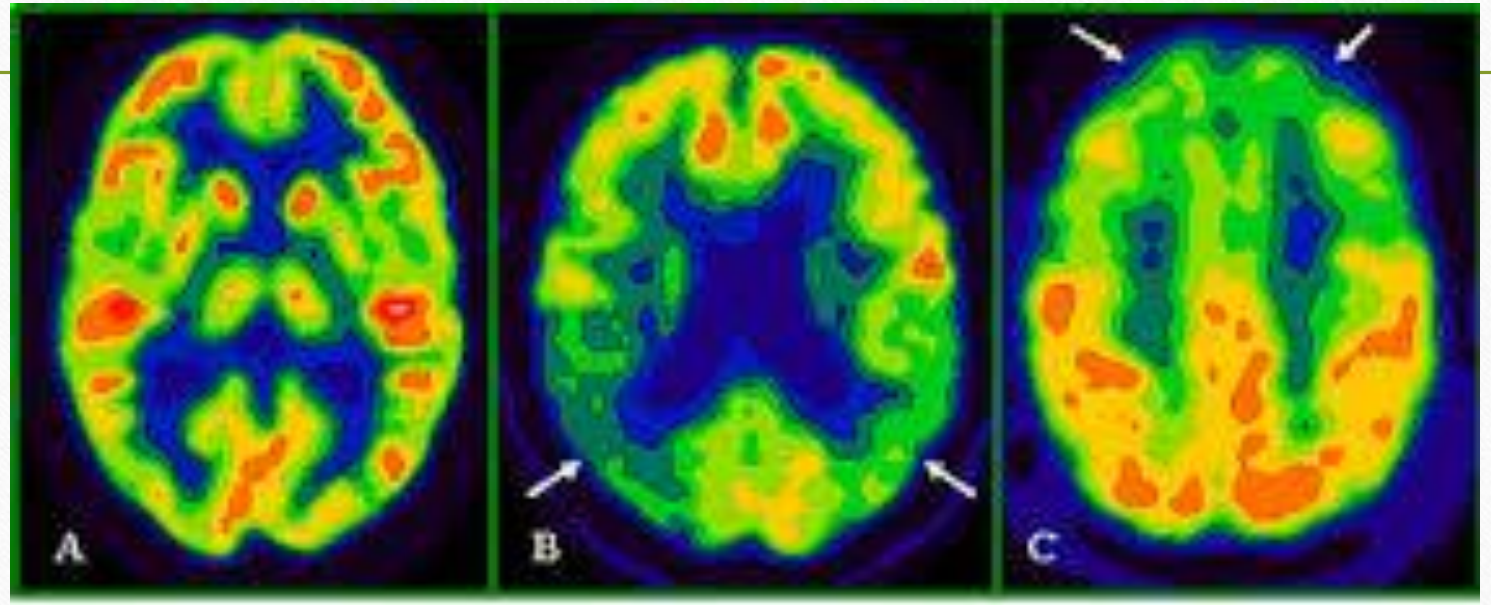




Vascular Dementia

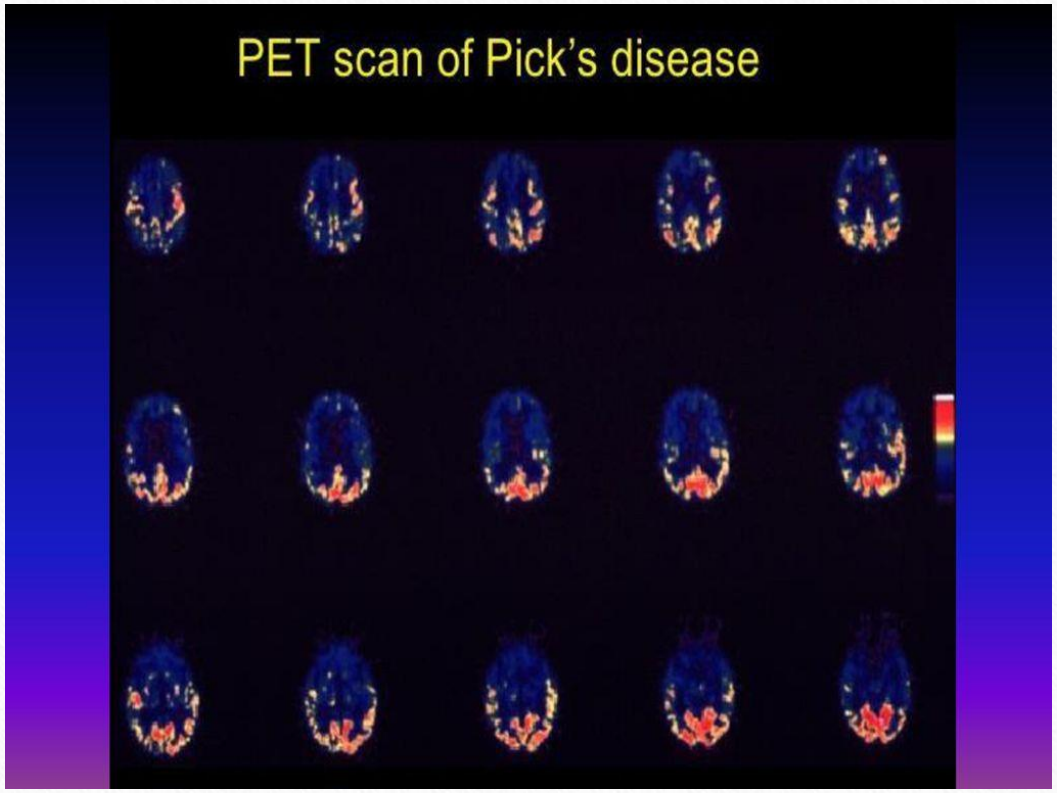


Frontotemporal dementia

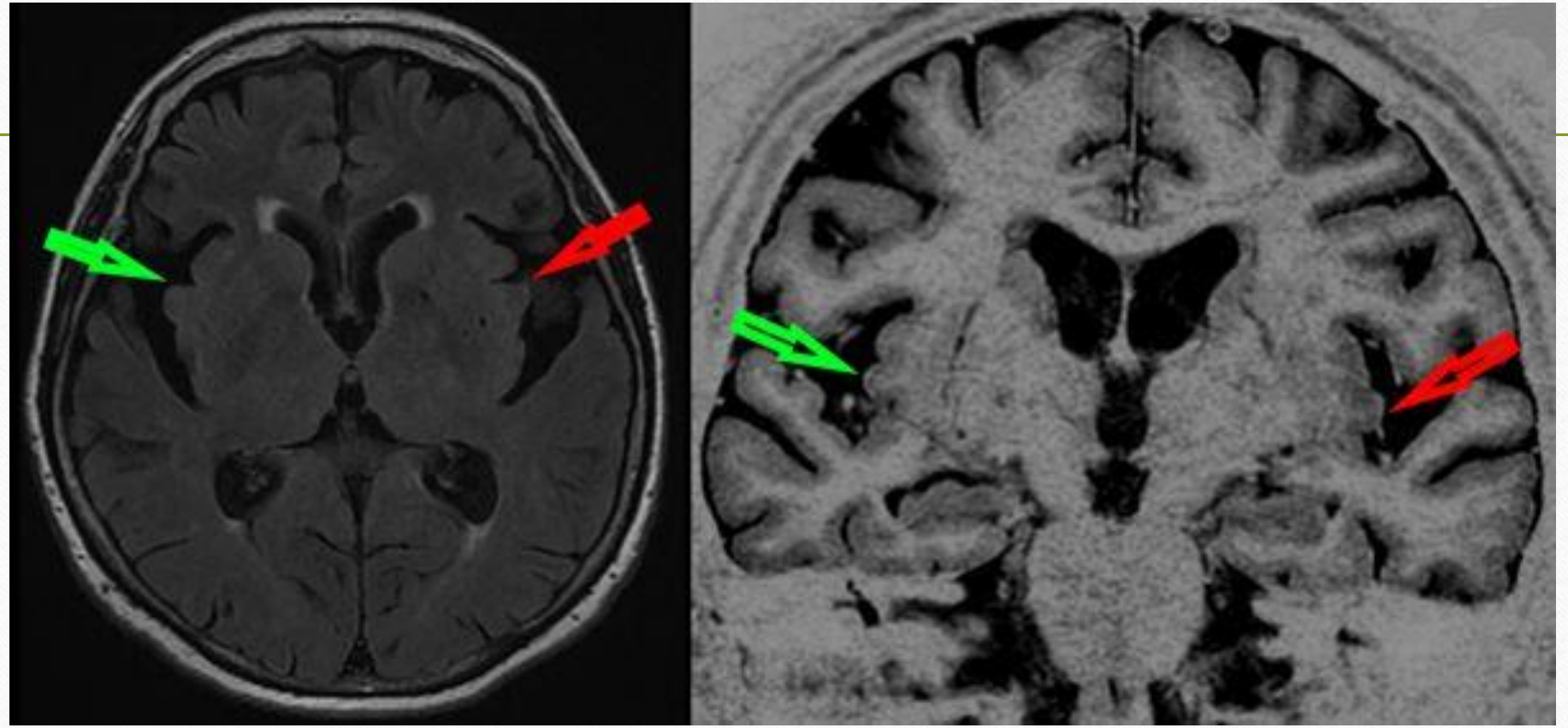


NORMAL AD FTD

Frontotemporal dementia

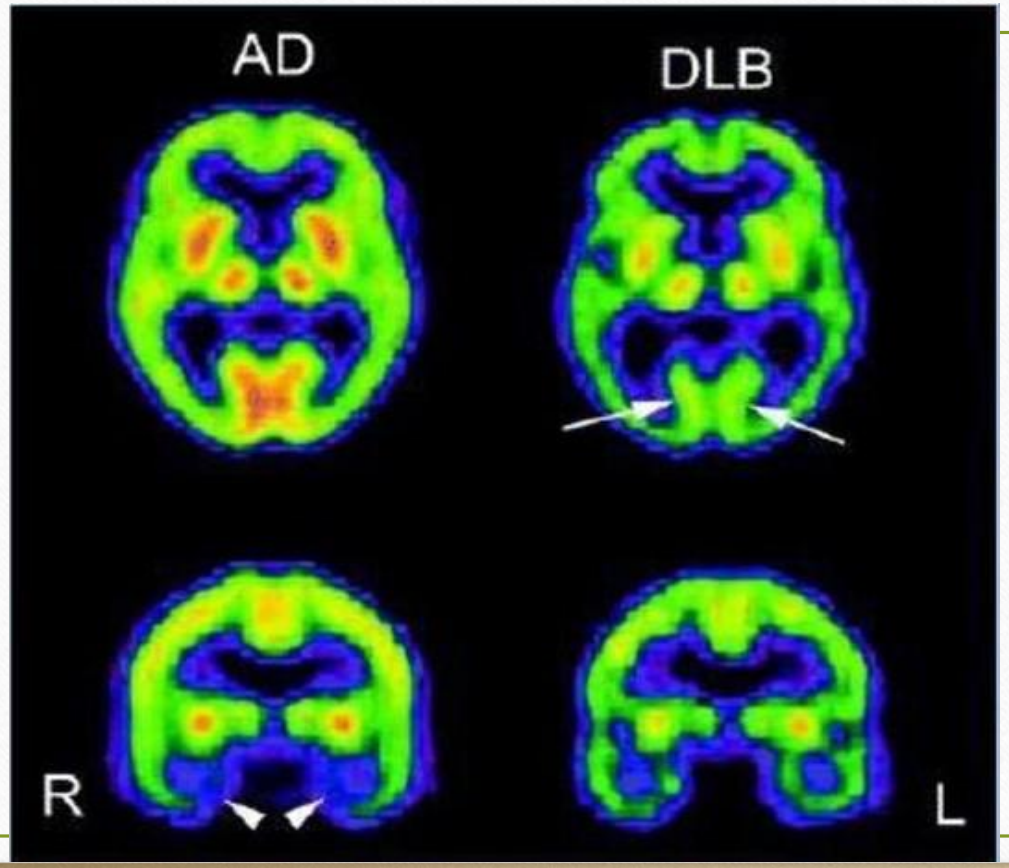


Dementia with Lewy Bodies



Brain MRI of a dementia with Lewy bodies patient at the prodromal stage with clear atrophy of the insula (red and green arrows). Pic-Frédéric Blanc

Dementia with Lewy Bodies



- SPECT scan
- lower perfusion in occipital areas for DLB
- Lower perfusion in medical temporal areas for AD

Summary

Neuroimaging;

- Detects reversible causes of dementia.
- Support clinical diagnosis of dementia and its subtypes.
- May not always be helpful
  - False positives
  - False negatives
- Review images when you can or ask second opinion, if in doubt.
- Structural imaging (MRI>CT) is the preferred first line.
- Molecular imaging techniques are increasingly more available for clinical use.

Questions?

References

Thanks for your attention!