

# Nuclear medicine in neurology and psychiatry

## Nuclear medicine - memo

- Functional imaging
  - limited anatomical info
  - but important details in processes of
    - blood flow
    - liquor circulation
    - receptor distribution (molecular level)
    - metabolic activity of tumors, other cerebral areas (molecular level)
- New hybrid devices: SPECT-CT, PET-CT
  - anatomy + function at the same time

2011

Brain

2

## Study types

main fields	gamma emitters SPECT radionuclide - radiopharmaceutical	positron emitters PET radionuclide - radiopharmaceutical
blood perfusion	$^{99m}\text{Tc}$ -HMPAO	$^{15}\text{O}$ -H <sub>2</sub> O
finding tumors	$^{99m}\text{Tc}$ -MIBI	$^{11}\text{C}$ -methionine
metabolism		$^{18}\text{F}$ -FDG
receptor studies	$^{123}\text{I}$ - iodobenzamide	$^{18}\text{F}$ -fluoro-DOPA
infection/inflammation	$^{99m}\text{Tc}$ -WBC	
liquor flow	$^{99m}\text{Tc}$ -DTPA	

2011

Brain

3

## Indications

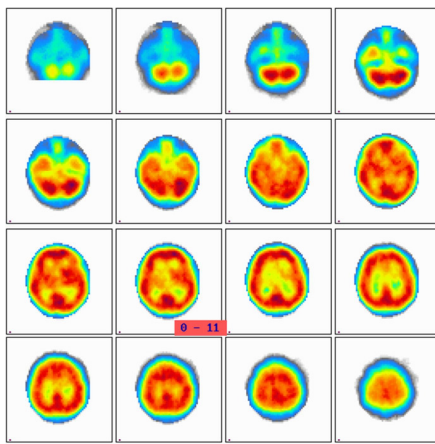
- Perfusion studies:
  - Dementias
  - Vascular disorders (stroke, TIA)
  - Epilepsy
- Metabolic studies:
  - Tumors
  - Epilepsy
- Receptor studies:
  - Parkinson's disease, schizophrenia
- Liquor studies:
  - hydrocephalus
  - liquorrhoea

2011

Brain

4

## Normal blood flow – transaxial slices

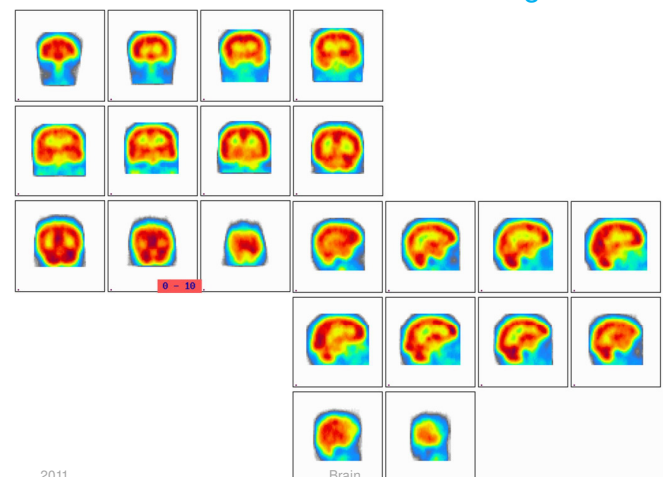


2011

Brain

5

## Normal blood flow – coronal and sagittal slices

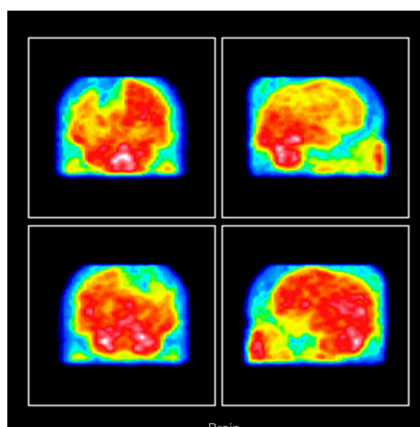


2011

Brain

6

## 3D: Cerebral blood flow SPECT



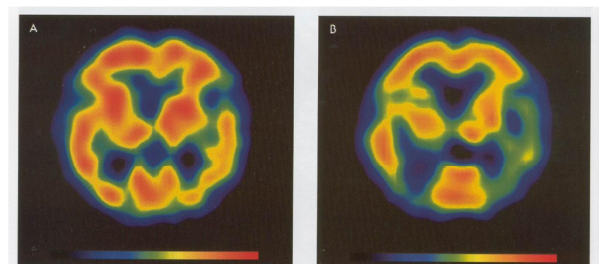
2011

Brain

7

## Brain stress test

Response to acetazolamide: cerebrovascular reserv capacity



12A, 12B ábrák  
Nyugalmi (A) és terhelési (B) véráramlás SPECT transzverzális metszetei. Az anamnézisen TIA. Bal oldalon temporálisan diszkrét csökkent perfúzió (A), ami terhelésre szignifikánsan fokozódik. Csökkent, illetve kesem CVR az ellenoldalon is (B).

before

after

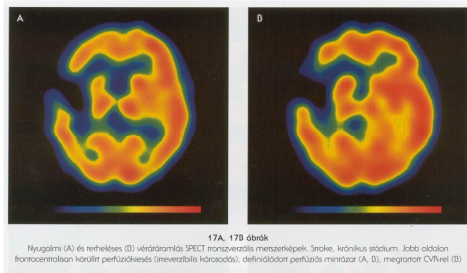
2011

Brain

8

## Brain stress - Diamox test

chronic stroke



before

after

2011

Brain

9

## Dementias

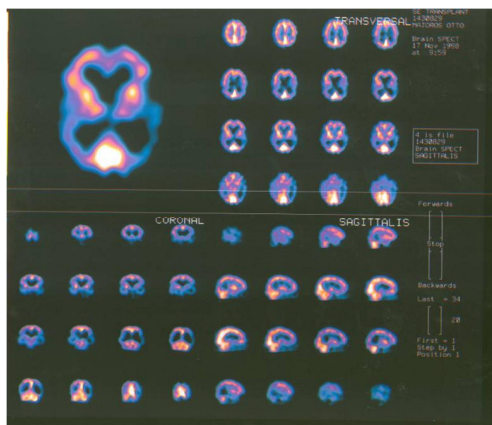
- Alzheimer's:
  - decreased blood-flow: temporal, parietal, later frontal, on both sides (fronto-temporo-parietal)
- multi-infarct:
  - focal reductions, sometimes related to arterial territories
- non-Alzheimer:
  - frontal lobe dementias (incl. Pick's disease): personality changes

2011

Brain

10

## Alzheimer's disease - SPECT

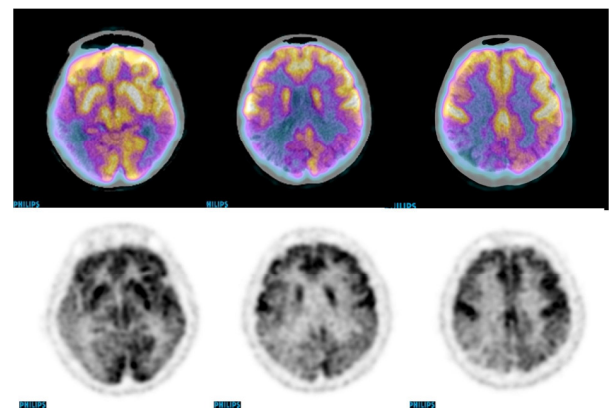


2011

Brain

11

## Alzheimer's disease - FDG-PET/CT

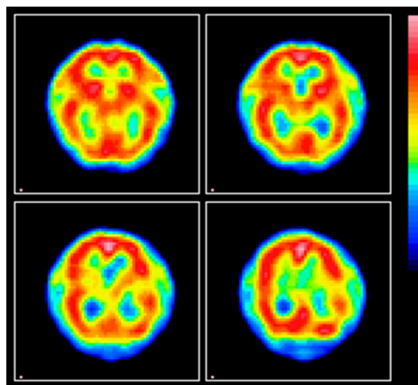


2011

Brain

12

## Multi-infarct dementia

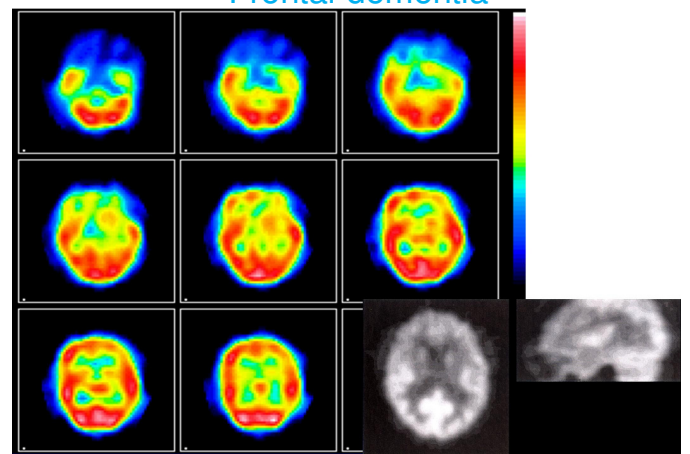


2011

Brain

13

## Frontal dementia

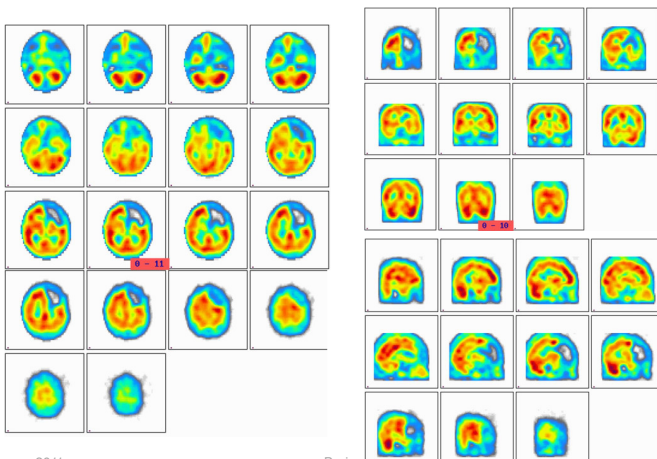


2011

Brain

14

## Vascular diseases - a. cerebri ant. occlusion

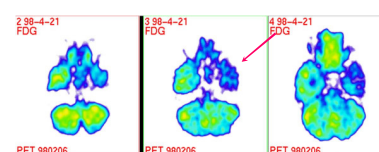


2011

Brain

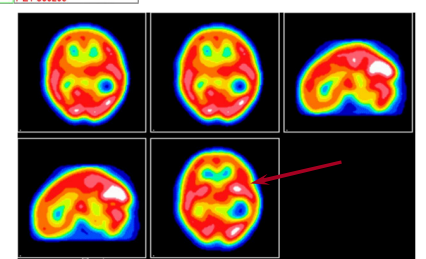
15

## Epilepsy



interictal PET: seizure focus have reduced glucose metabolism

ictal SPECT:  
up to 300% increase  
in rCBF

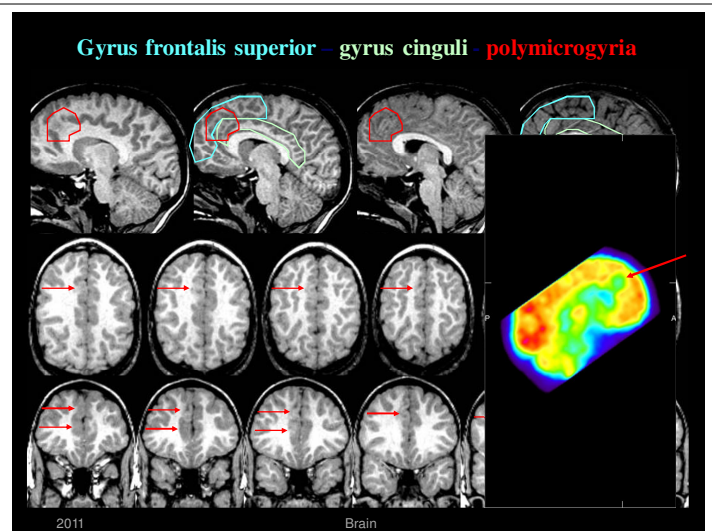
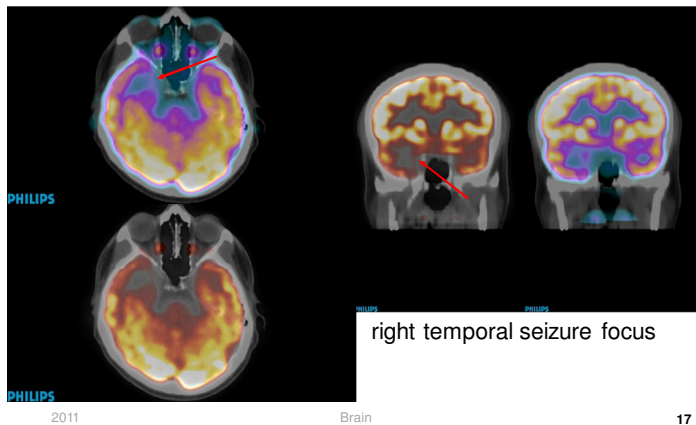


2011

Brain

16

## Epilepsy – interictal FDG-PET/CT

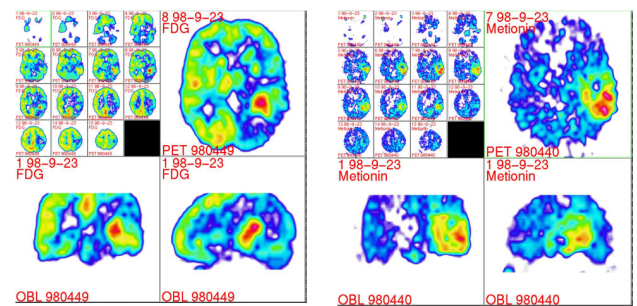


## Tumors

- grade (glucose metabolism):
  - high grade: increased
  - low grade: decreased
- how far does it extend into surrounding normal tissue
- heterogeneity

2011 Brain 19

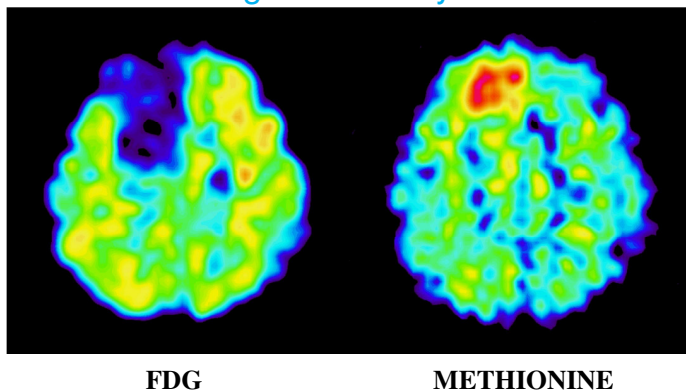
## Tumors – high grade glioma



$^{11}\text{C}$ -methionine: defines the extent of tumors, but cannot reliably separate low from high grade gliomas

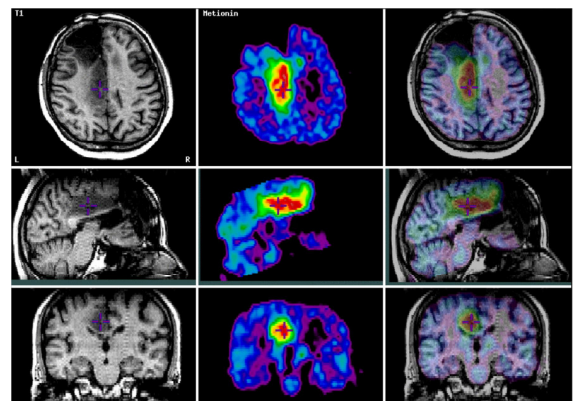
2011 Brain 20

## Low-grade astrocytoma



2011 Brain 21

## Low-grade recidive glioma



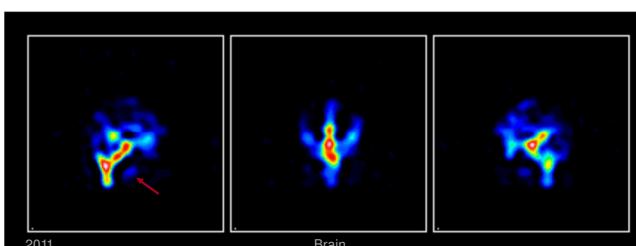
2011 Brain 22

## Liquor flow investigations

- $^{99\text{m}}\text{Tc}$ -DTPA: lumbar or cysternal injection
- planar camera and/or SPECT after 1, 2, 6, 12, 24 h

Liquor leakage: rhinorrhea, otorrhea, shunt assessment

Rhinorrhea:



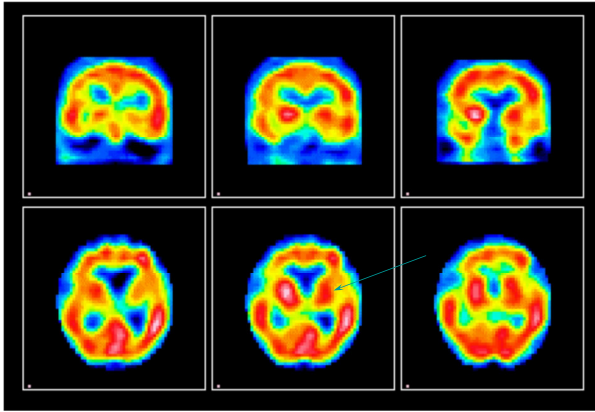
## Brain: examples

- Which function is imaged?
- Where can you find abnormal increase or decrease in the activity?
- What could have caused the abnormality?

2011 Brain 24



Brain #1: [Tc-99m] HMPAO

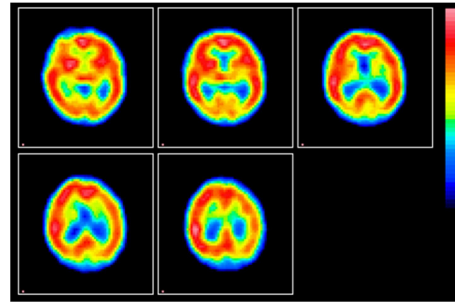


2011

Brain

25

Brain #2: [Tc-99m] HMPAO

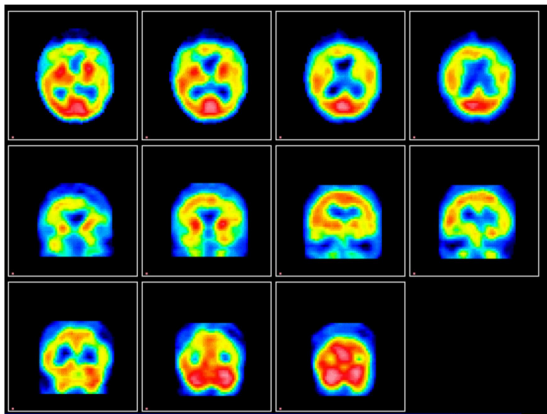


2011

Brain

26

Brain #3: [Tc-99m] HMPAO

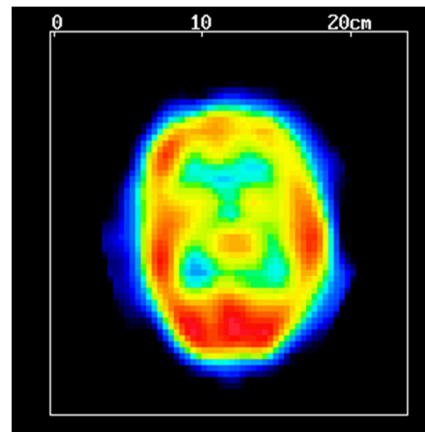


2011

Brain

27

Brain #3: [Tc-99m] HMPAO

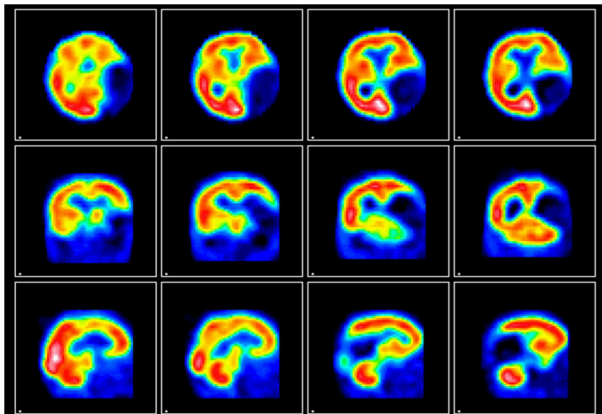


2011

Brain

28

Brain #4: [Tc-99m] HMPAO



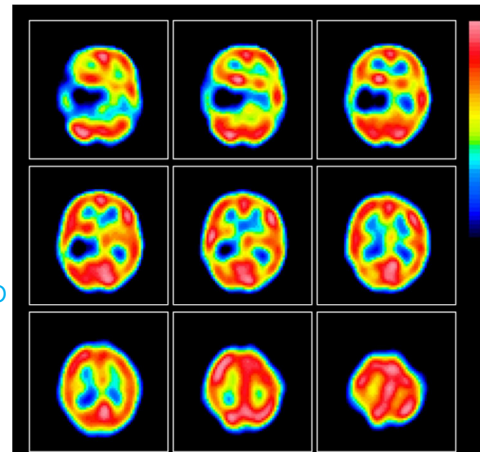
2011

Brain

29

ah70480

Brain #5:  
[Tc-99m] HMPAO

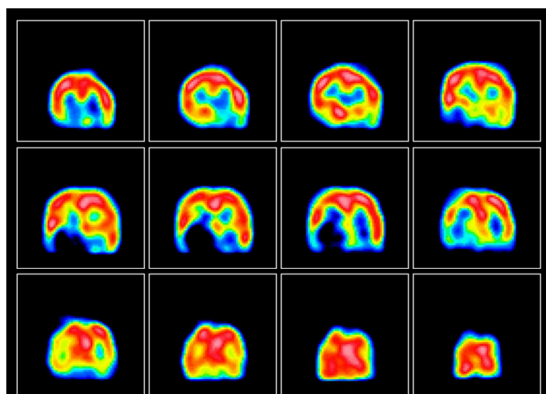


2011

Brain

30

ah70481

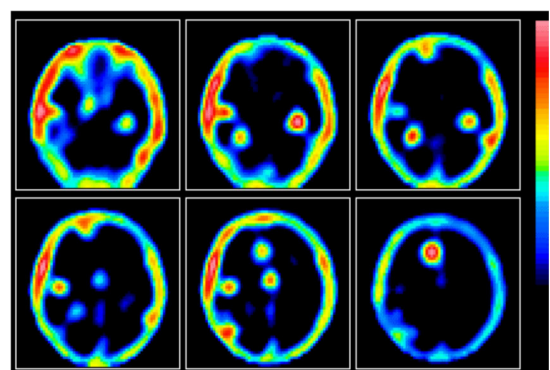


2011

Brain

31

Brain #6: [Tc-99m] DTPA



2011

Brain

32