Nuclear medicine in oncology

1. Diagnosis
2. Therapy

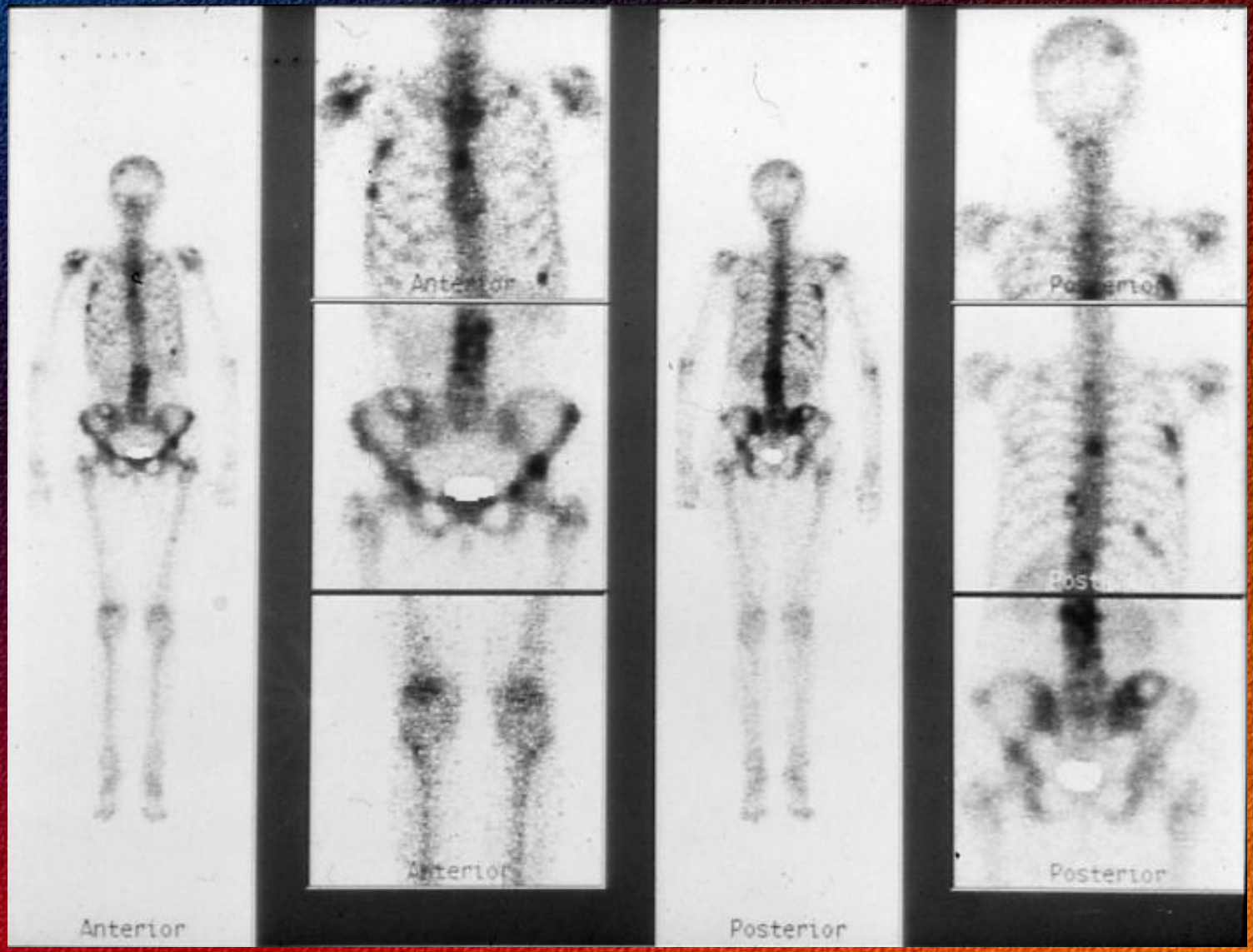
Diagnosis

- Conventional methods

- Nonspecific radiopharmaceuticals cumulating in tumours

- Specific radiopharmaceuticals (receptor- and immunoscintigraphy)

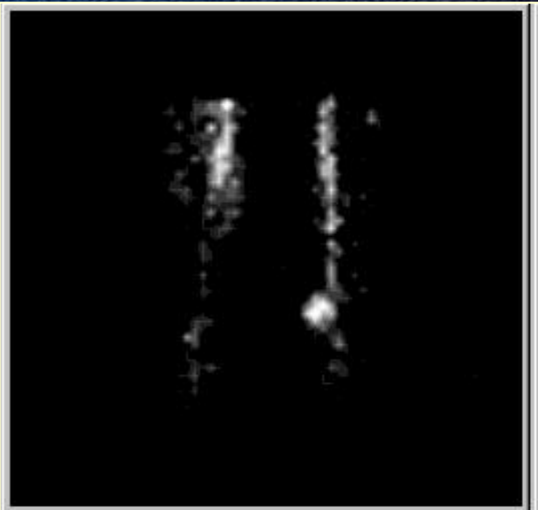
Bone scan – multifocal metastases



Bone scan – primary bone tumour
Osteosarcoma tibiae l.s.

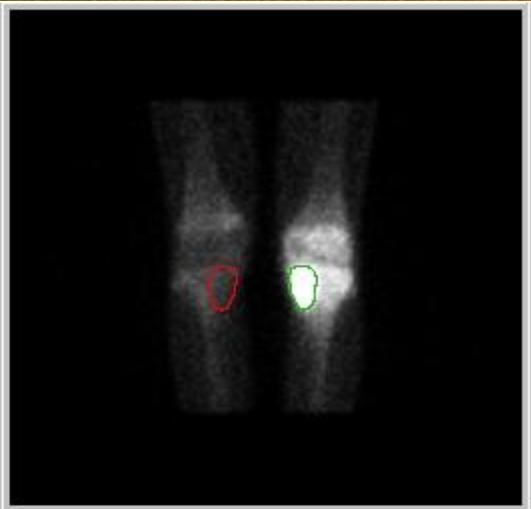
Osteosarcoma tibiae l.s.

three-phase bone scan

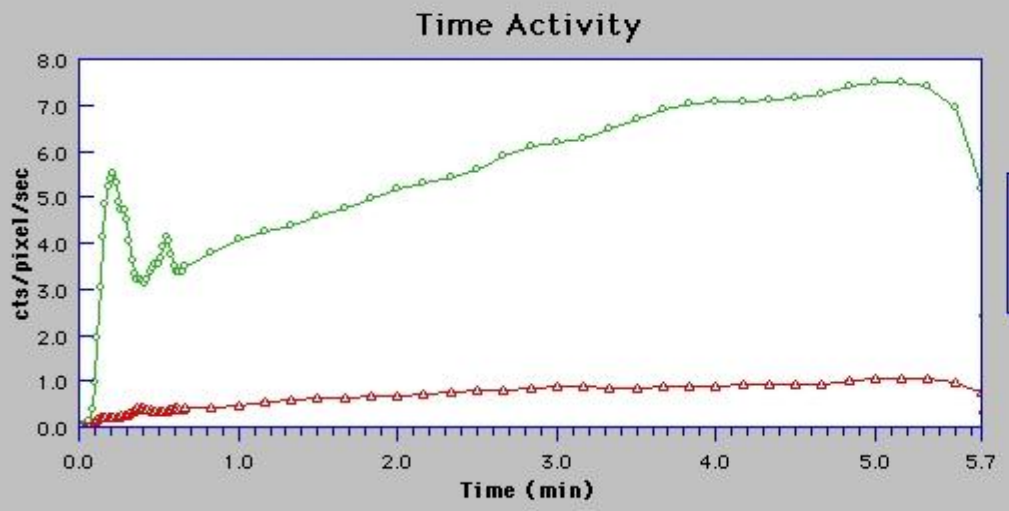


Phase 1 : Perfusion

Phase 2 : Bloodpool



Phase 3 : Skeletal



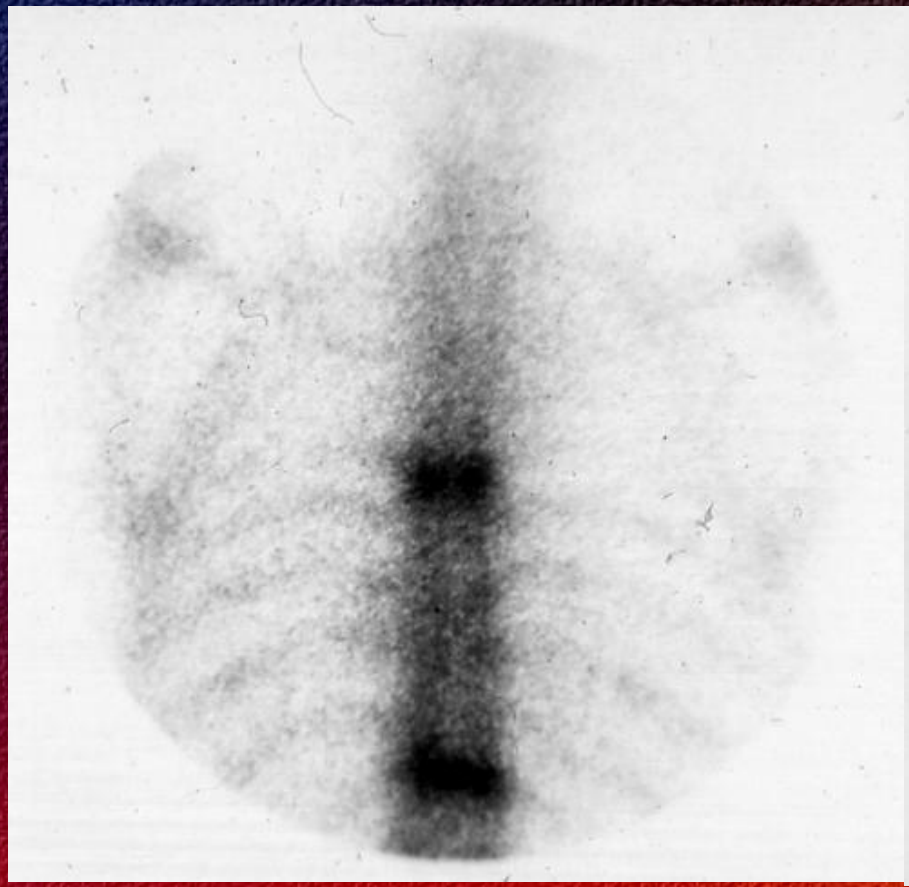
RATIO = LEFT/RIGHT

BLOODPOOL RATIO = 7.40

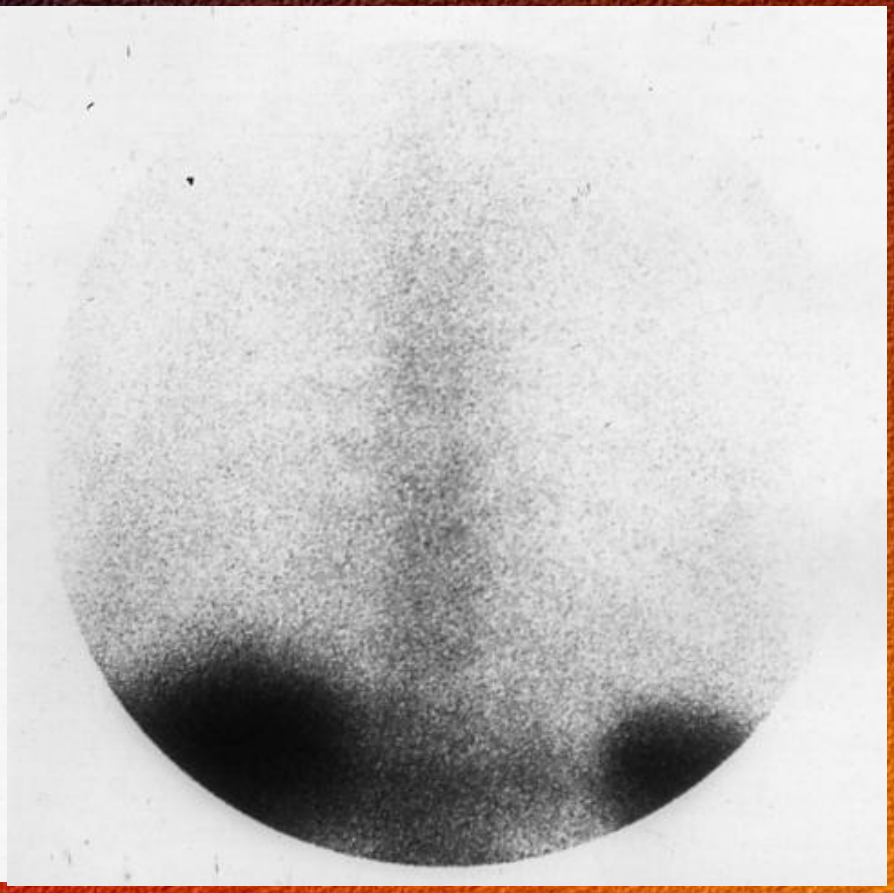
SKELETAL RATIO = 10.31

Vertebra metastases

Bone scintigraphy



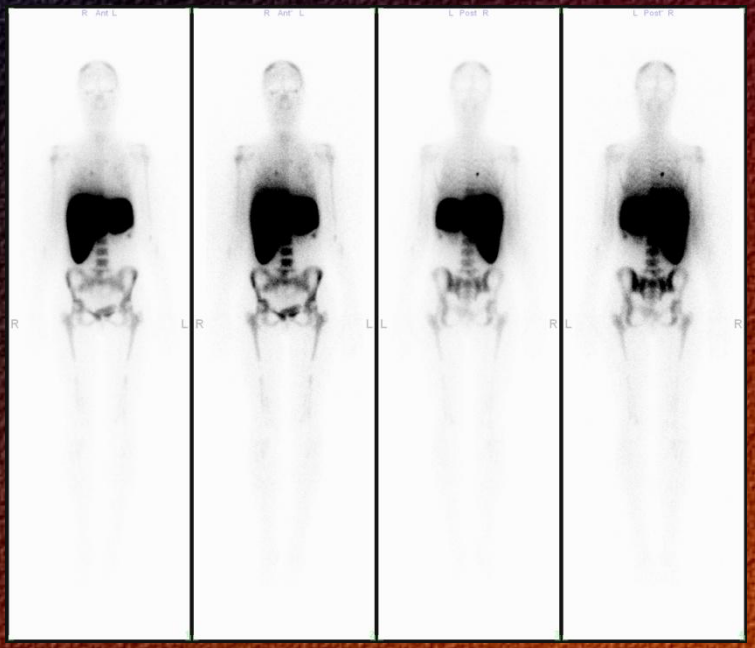
Bone marrow scintigraphy



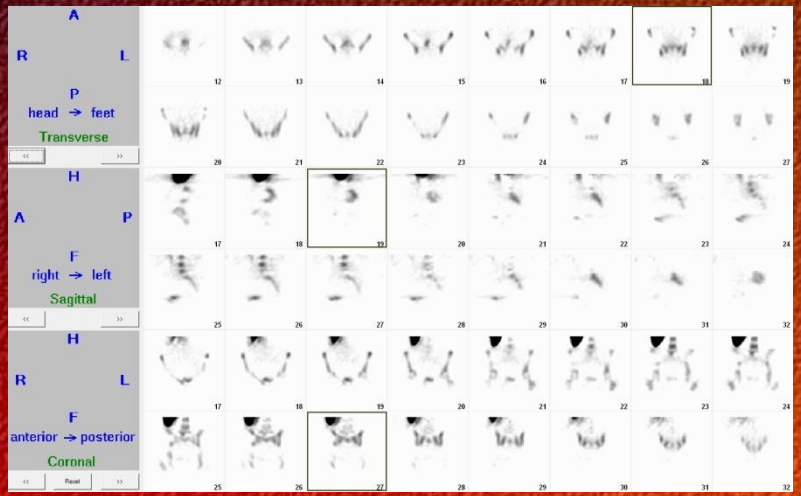
Hodgkin disease

Bone scintigraphy

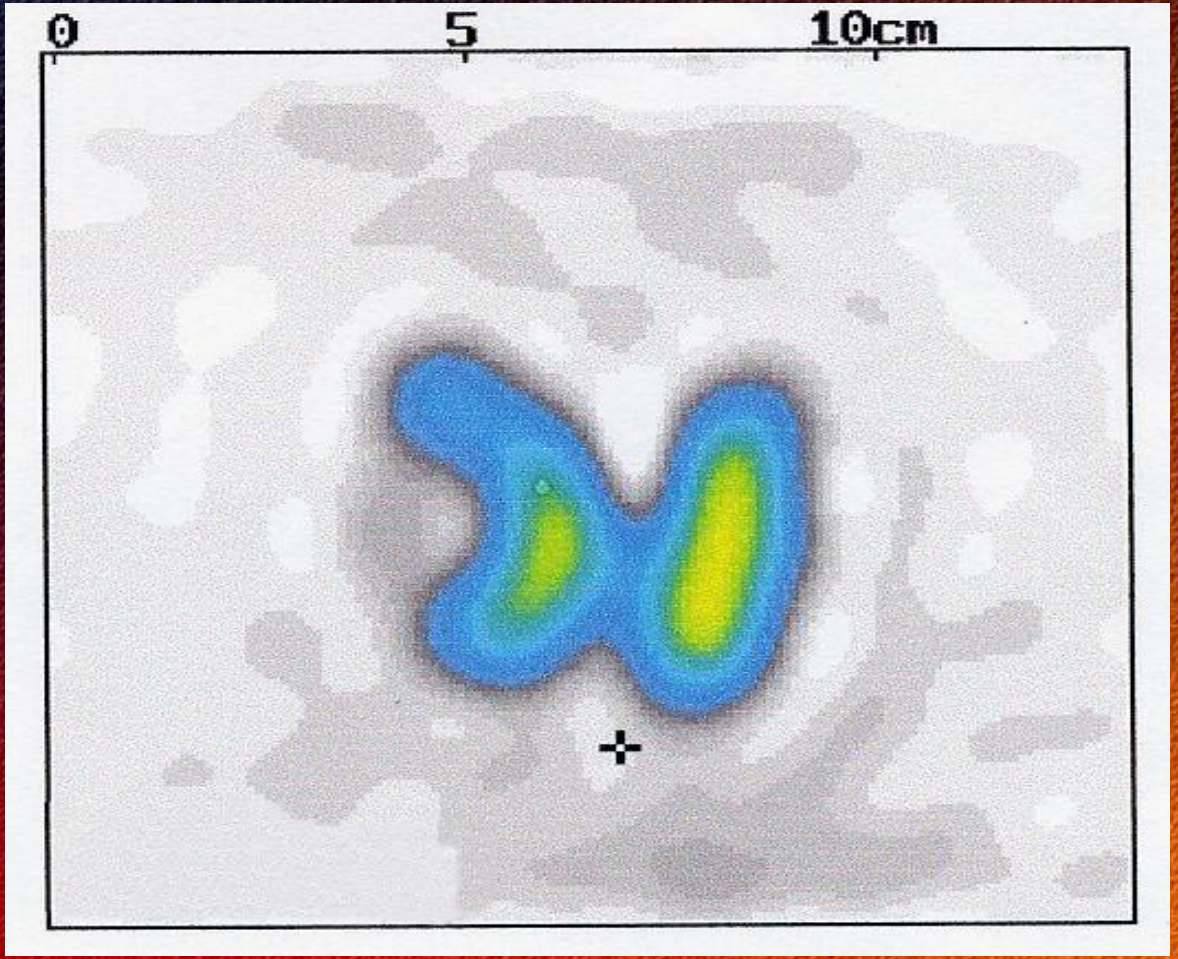
Bone marrow scintigraphy



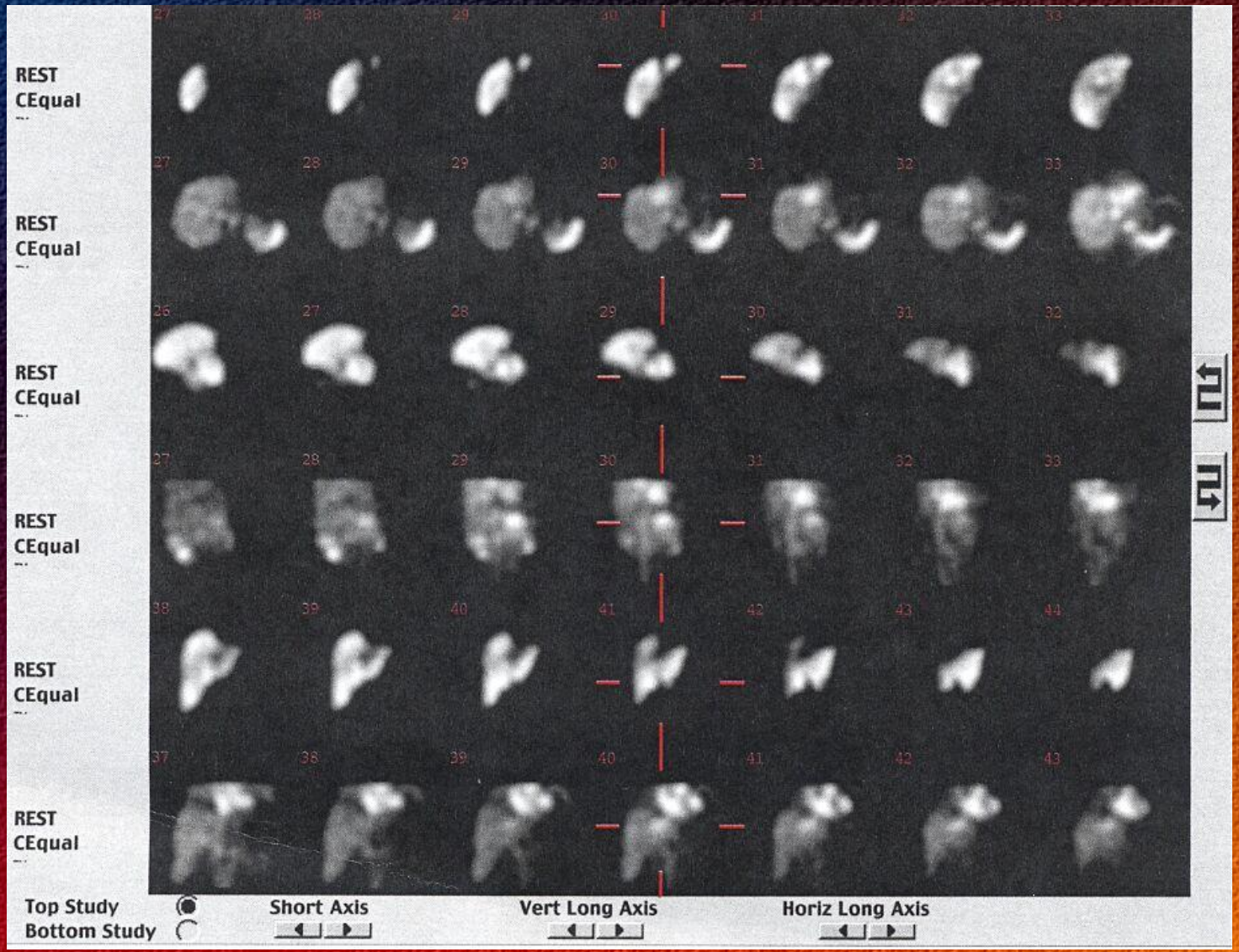
Bone marrow scintigraphy (SPECT)



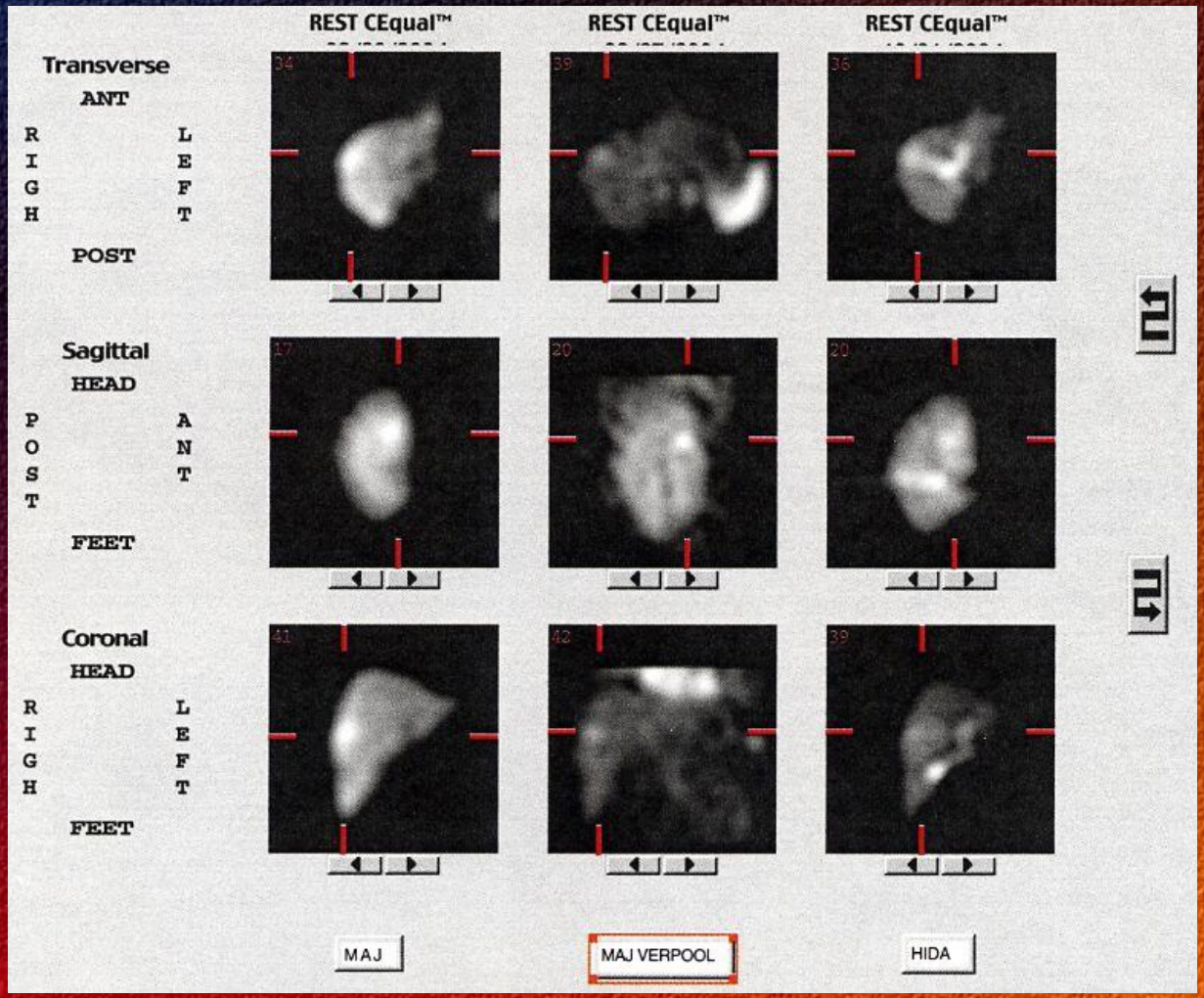
Thyroid scintigraphy
cold nodule



Colloidal and blood pool liver scan



Colloidal, blood pool and hepatobiliary (HIDA) liver scan (FNH)

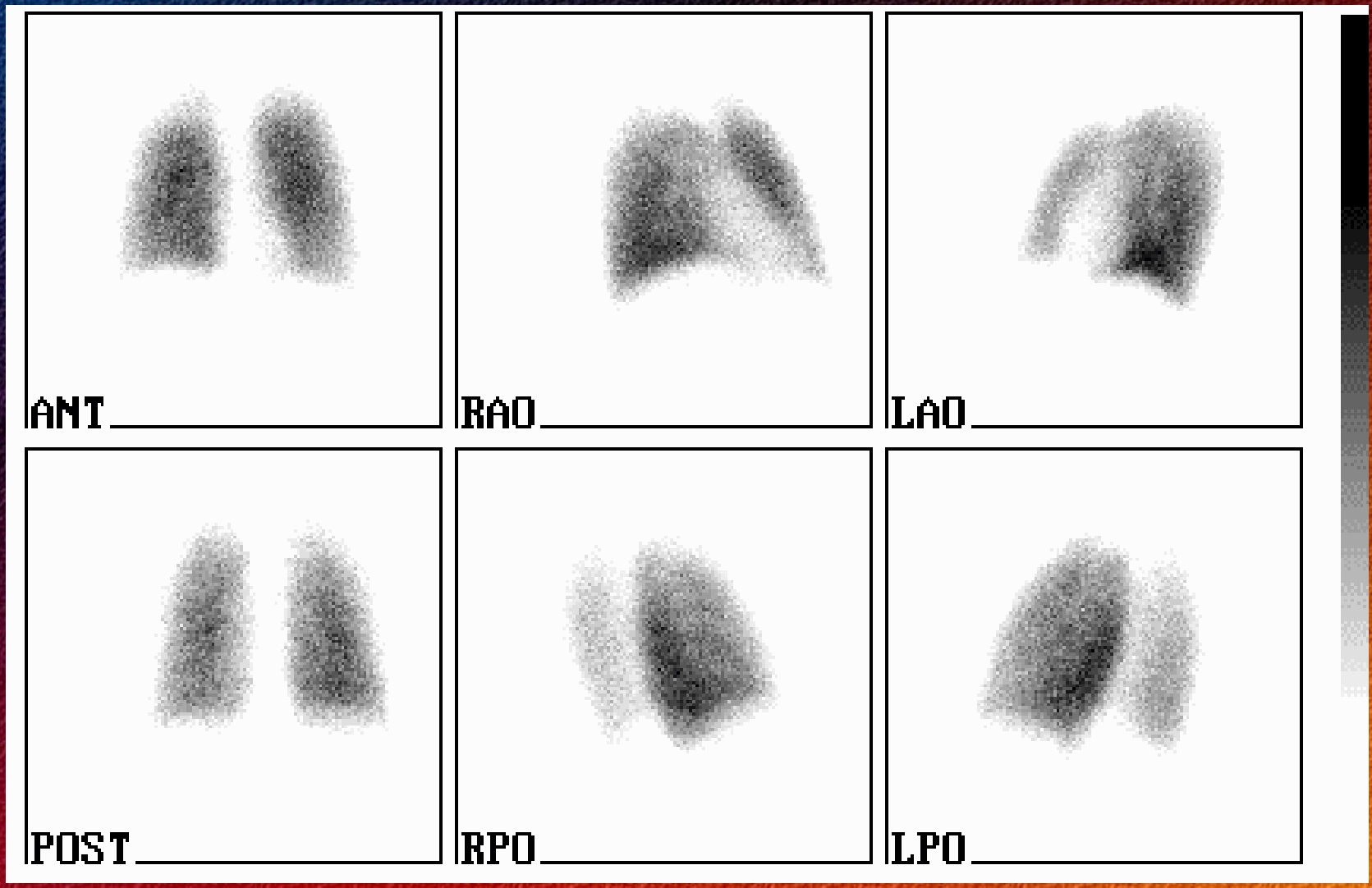


Perfusion lung scan

- Perfusion lung scan shows the accurate regional perfusion of the lung

- Injected subject: 99mTc-macroaggregate albumin with mean particles size of about 30 micrometer
- It blocks only less than 0,1 % of precapillary arterioles

Normal perfusion lung scan



Indication of the perfusion scintigraphy

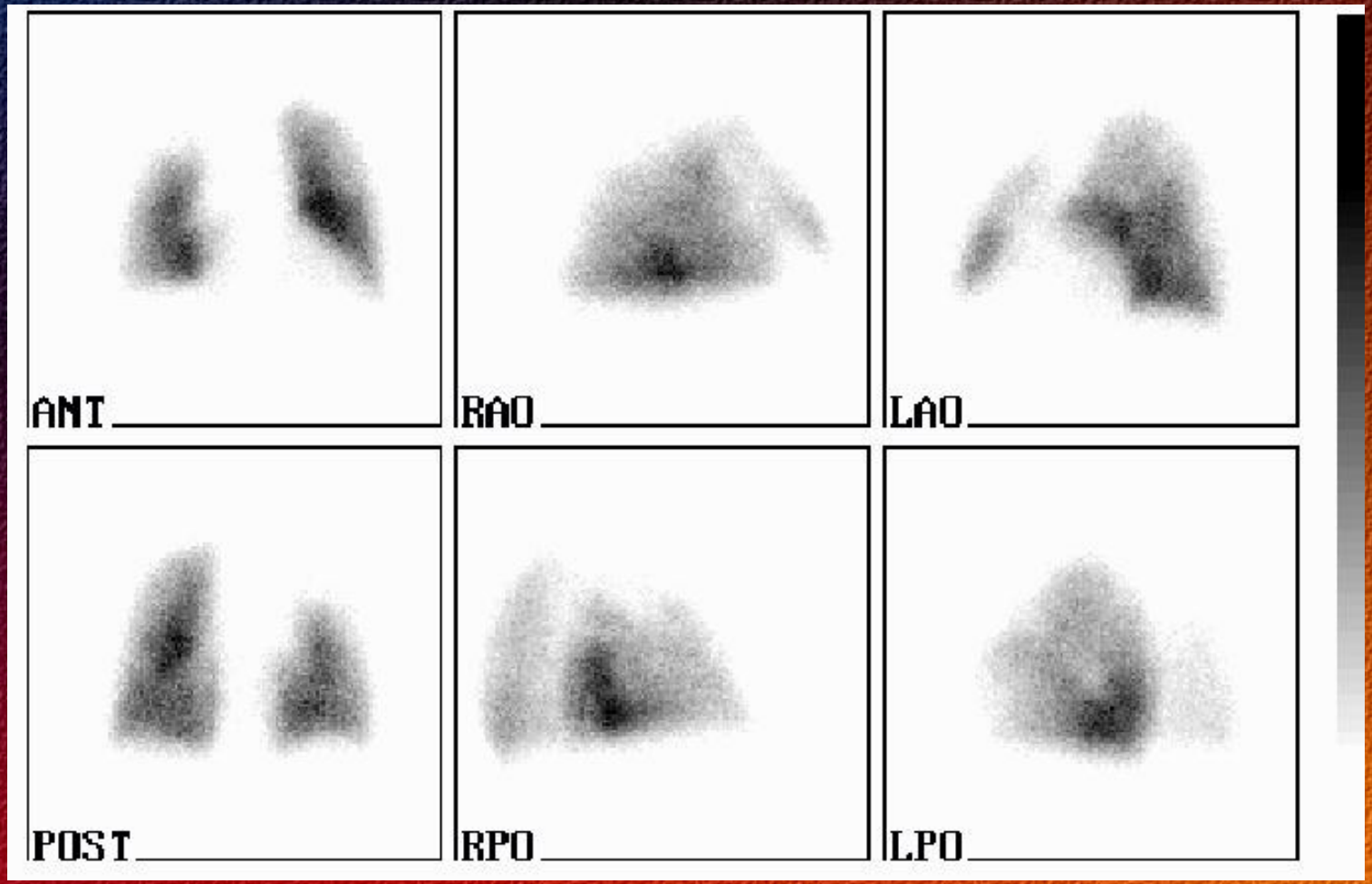
- The search for pulmonary embolism
  (couple of the chest X-ray!)

- The evaluation of regional lung function in
  patients with lung tumour before the operation

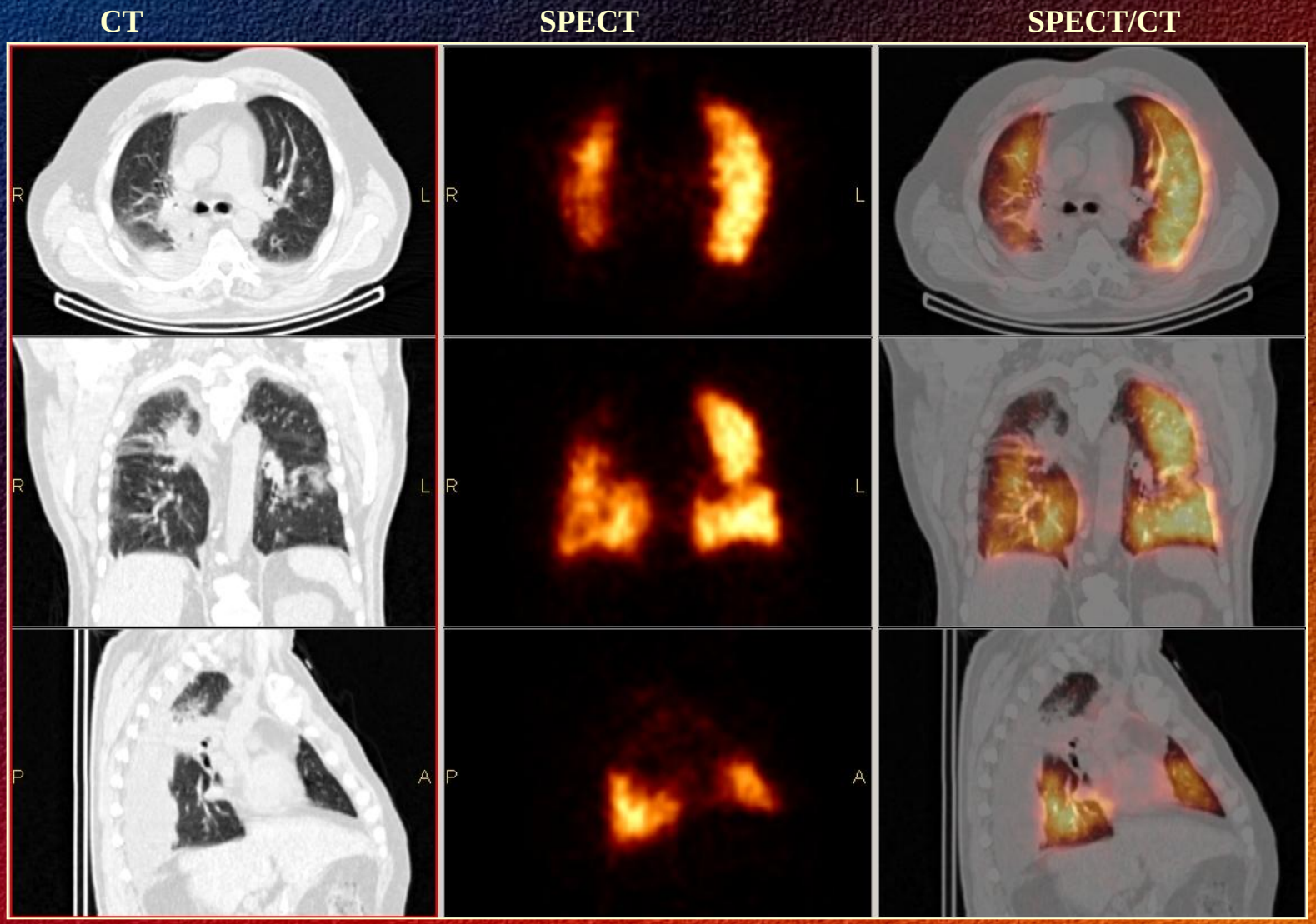
- The evaluation of regional lung function in
  asthmatic and obstructive lung diseases

- The assessment of regional lung function
  after the therapy

Lung cancer in the right upper lobe and in the left lung

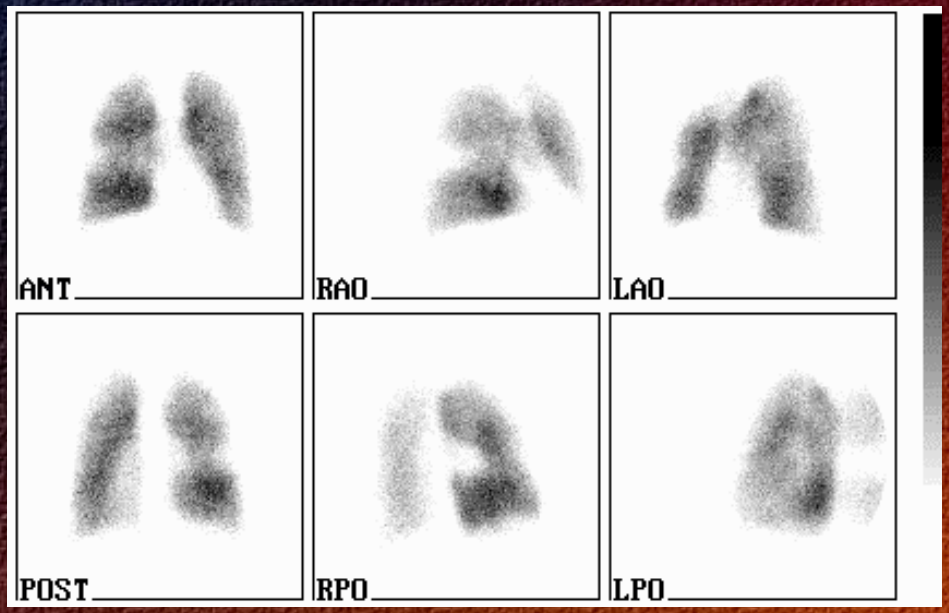


Lung cancer in the right upper lobe and in the left lung

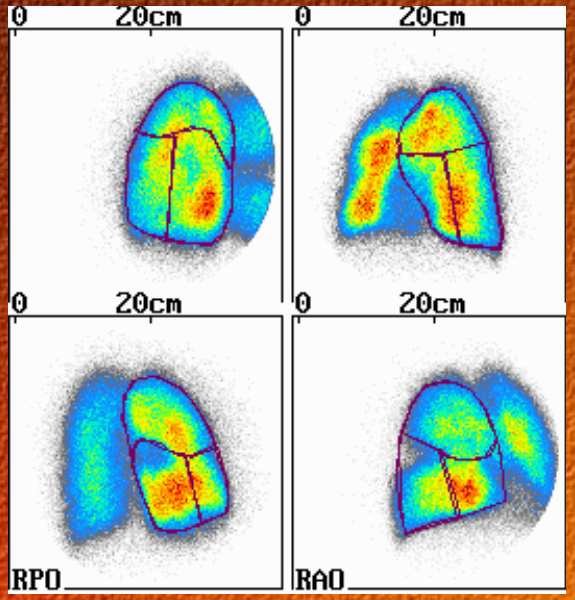


Evaluation of regional lung function

Periferial tumour in the right lung



The activity of the lung:
Both lung: 17216 cps
Left lung: 48.3 %
Right lung: 51.7 %
Left upper lobe: 2597 cps
Lingula: 2307 cps
Left lower lobe: 3766 cps
Right upper lobe: 3594 cps
Right middle lobe: 2423 cps
Right lower lobe: 3211 cps



Diagnosis

- Conventional methods

- Nonspecific radiopharmaceuticals cumulating in tumours

- Specific radiopharmaceuticals (receptor- and immunoscintigraphy)

Radiopharmaceuticals cumulating nonspecifically in tumours

- 99mTc-MIBI, (retentioned by mitochondrial membrane, primary role in the assestment of myocardial perfusion)

- 99mTc-MDP (primary role in bone scintigraphy, tumor calcifications)

- 201-TlCl (biologic properties similar to potassium, primary role in the assestment of myocardial perfusion)

(e.g. brain, bone, lung, thyroid, parathyroid and breast tumours)

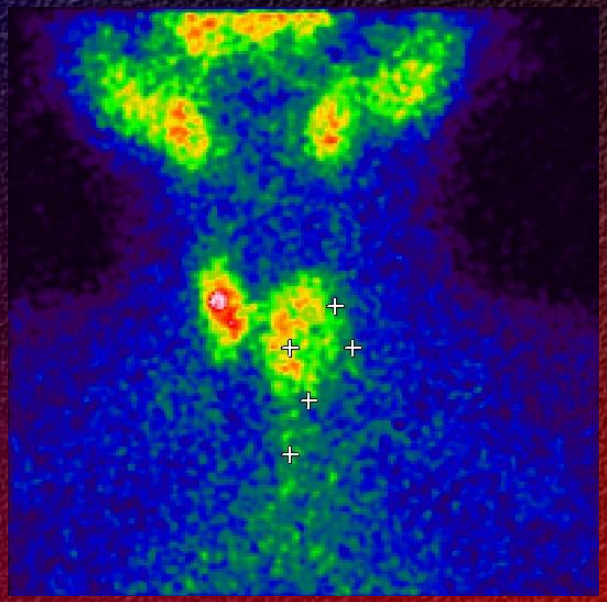
- 67-Ga-citrate (similar to iron, binds to transferrin,
e.g. lymphomas, lung and bone tumours)

-FDG, C-11 -methionine (PET) (the greatest importance in clinical practice)

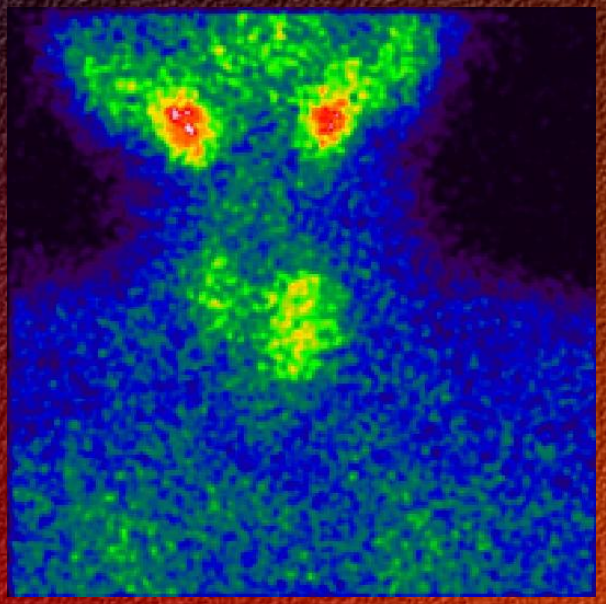
PROBLEM: Not only tumour accumulation, positiv in inflammatory diseases too!)

Thyroid cc. - MIBI cumulation

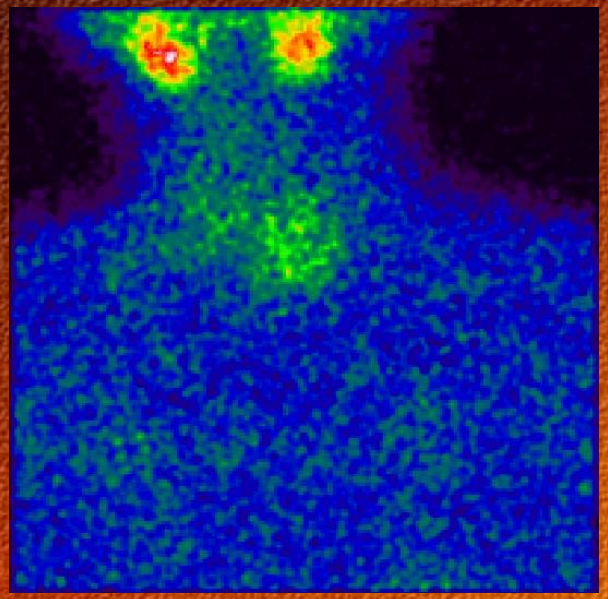
99mTc



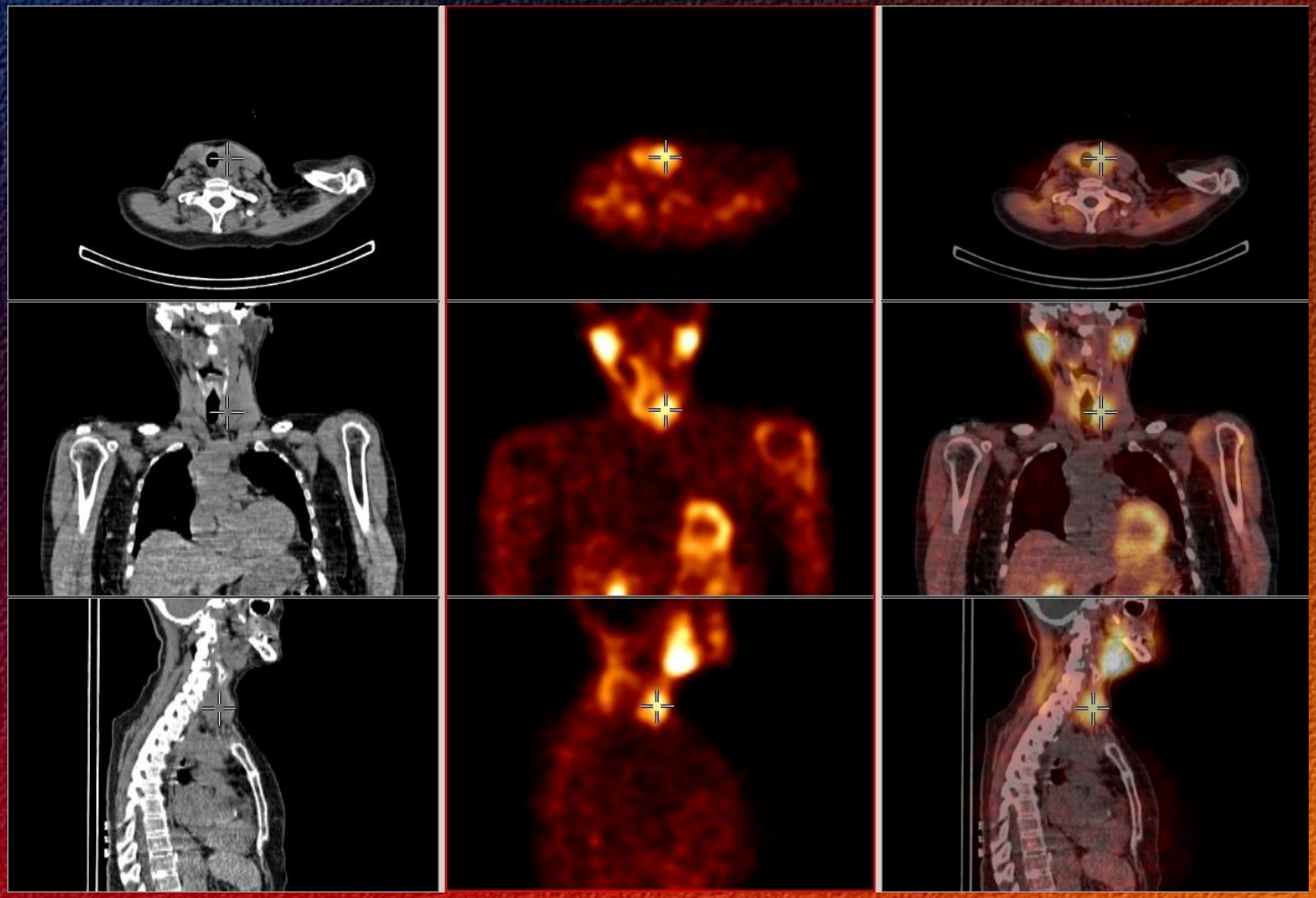
99mTc-MIBI (early)



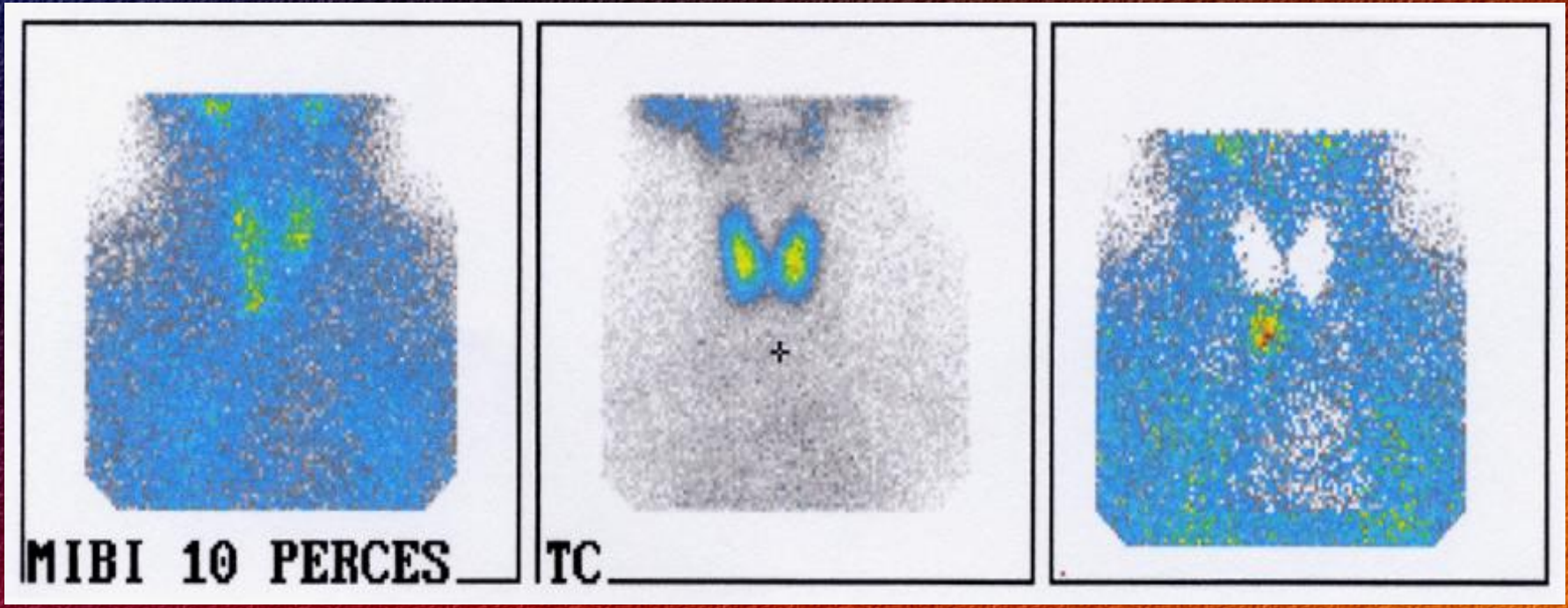
99mTc-MIBI (delayed)



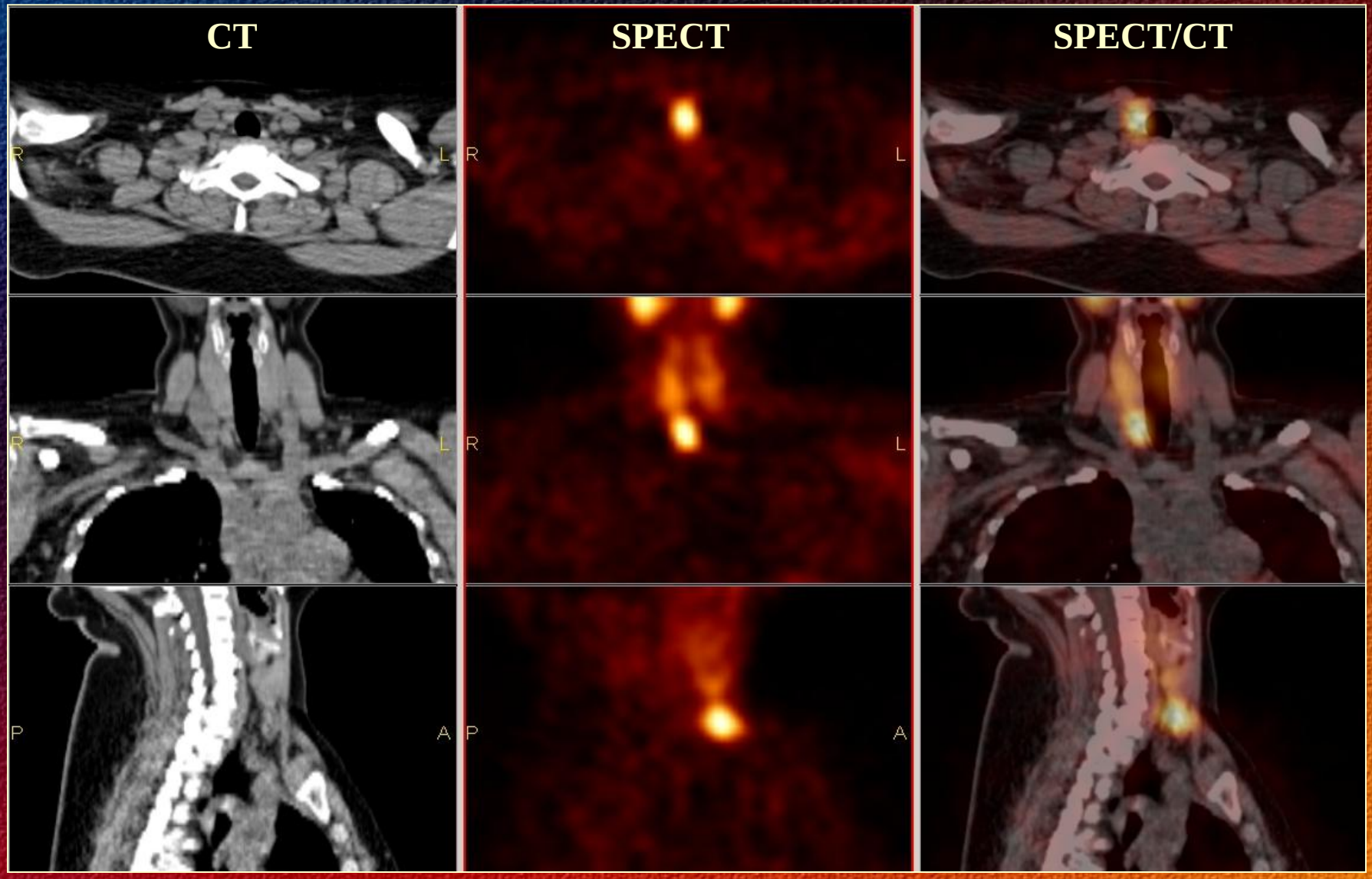
Thyroid cc. 99mTc-MIBI cumulation (SPECT/CT)



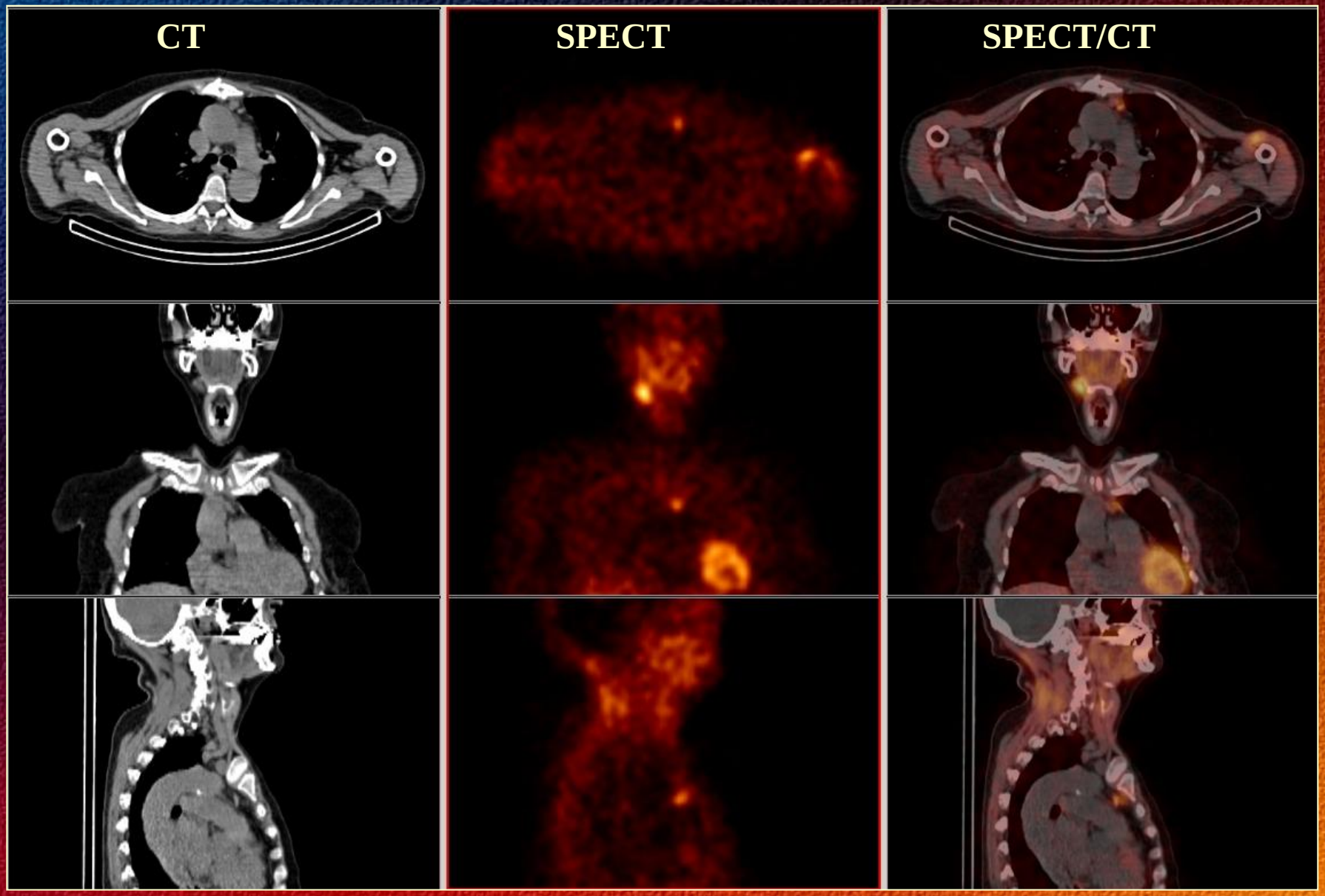
Parathyreoid adenoma subtraction protocoll



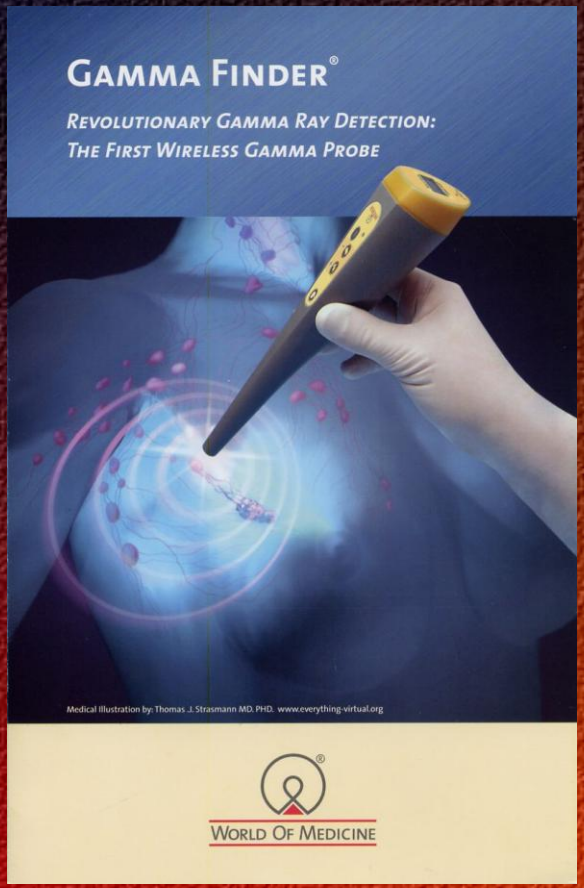
Parathyreoid adenoma (SPECT/CT)



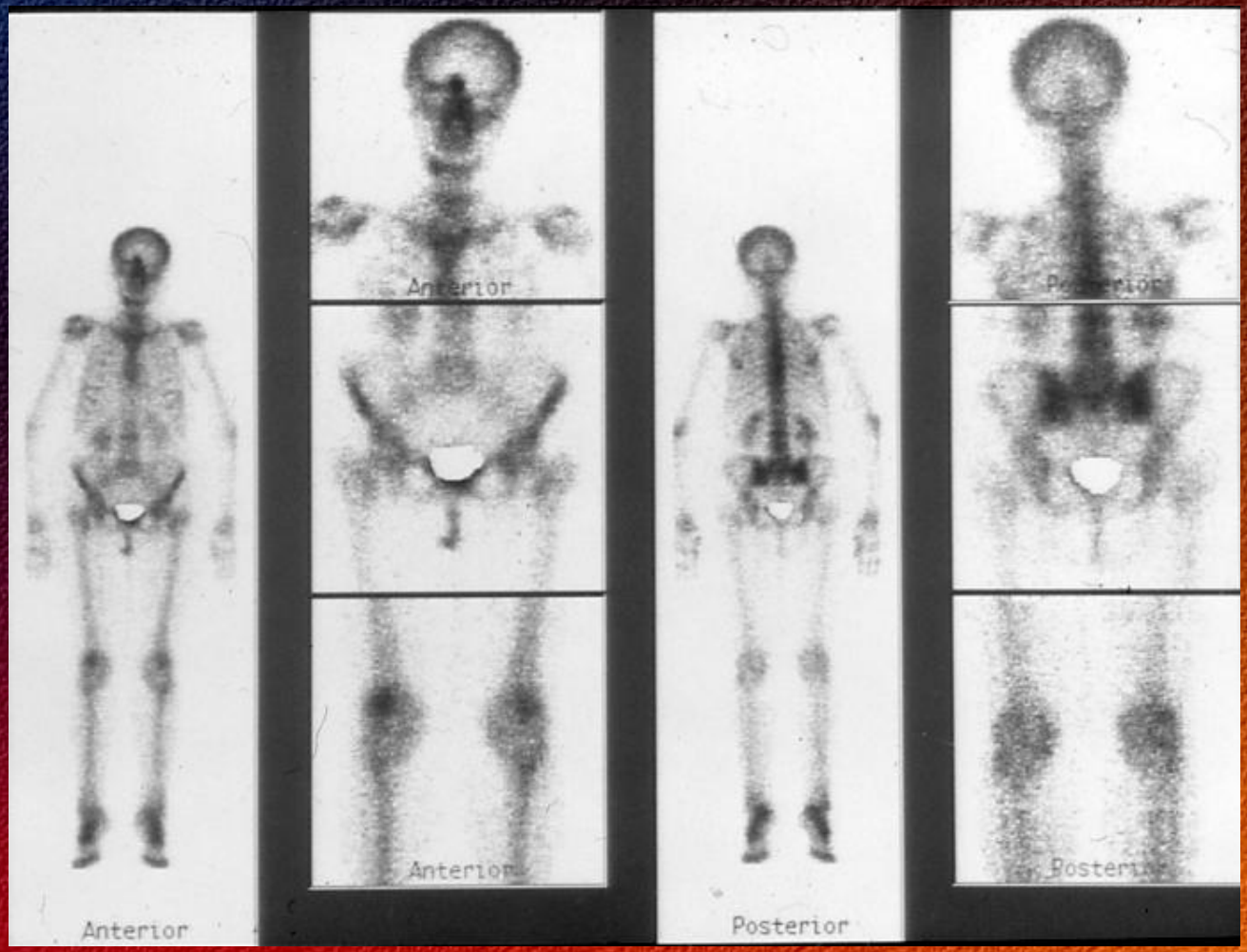
Parathyreoid adenoma (SPECT/CT) (retrosternal)



Intraoperatíve Gamma Probe

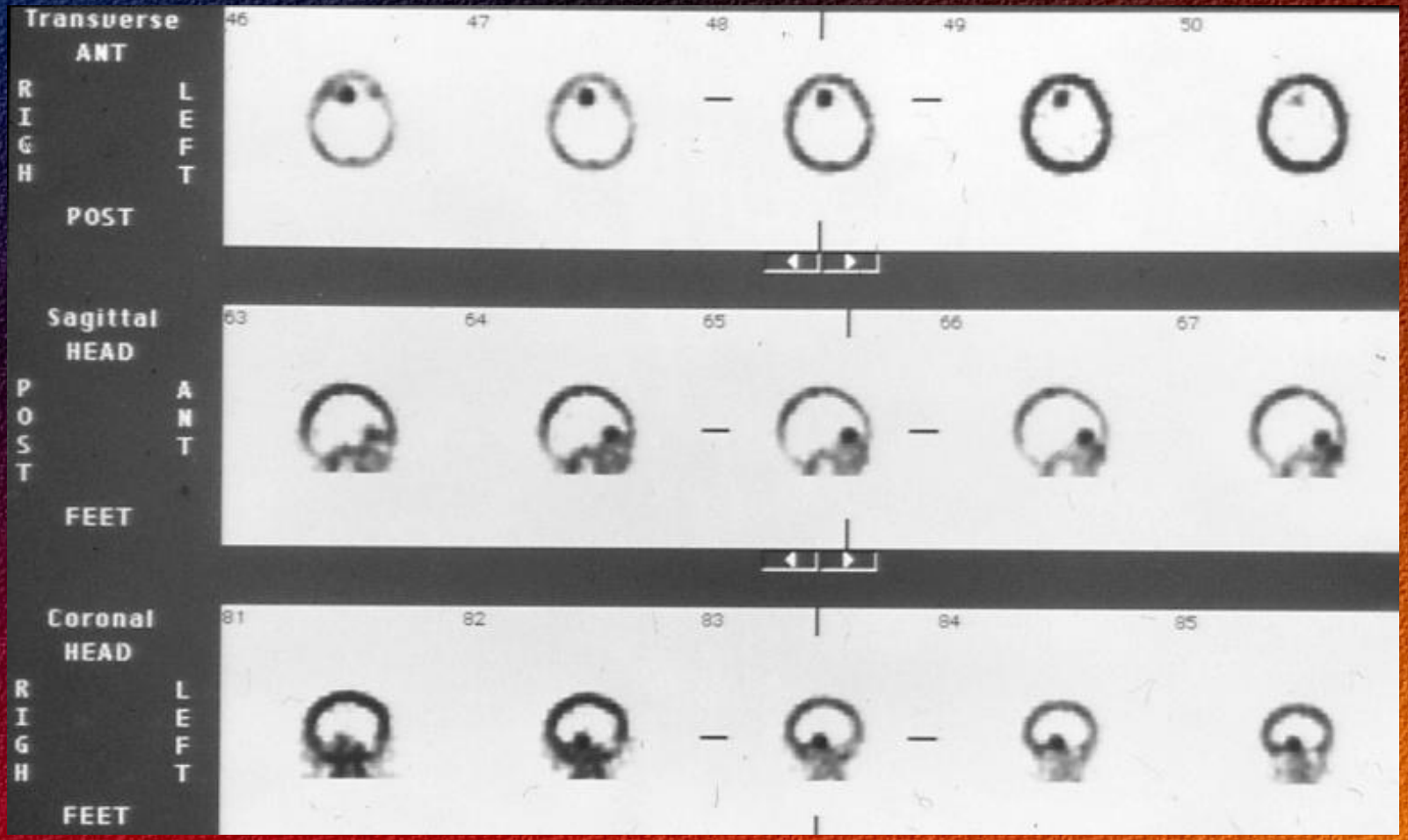


Extraosseal phosphate cumulation

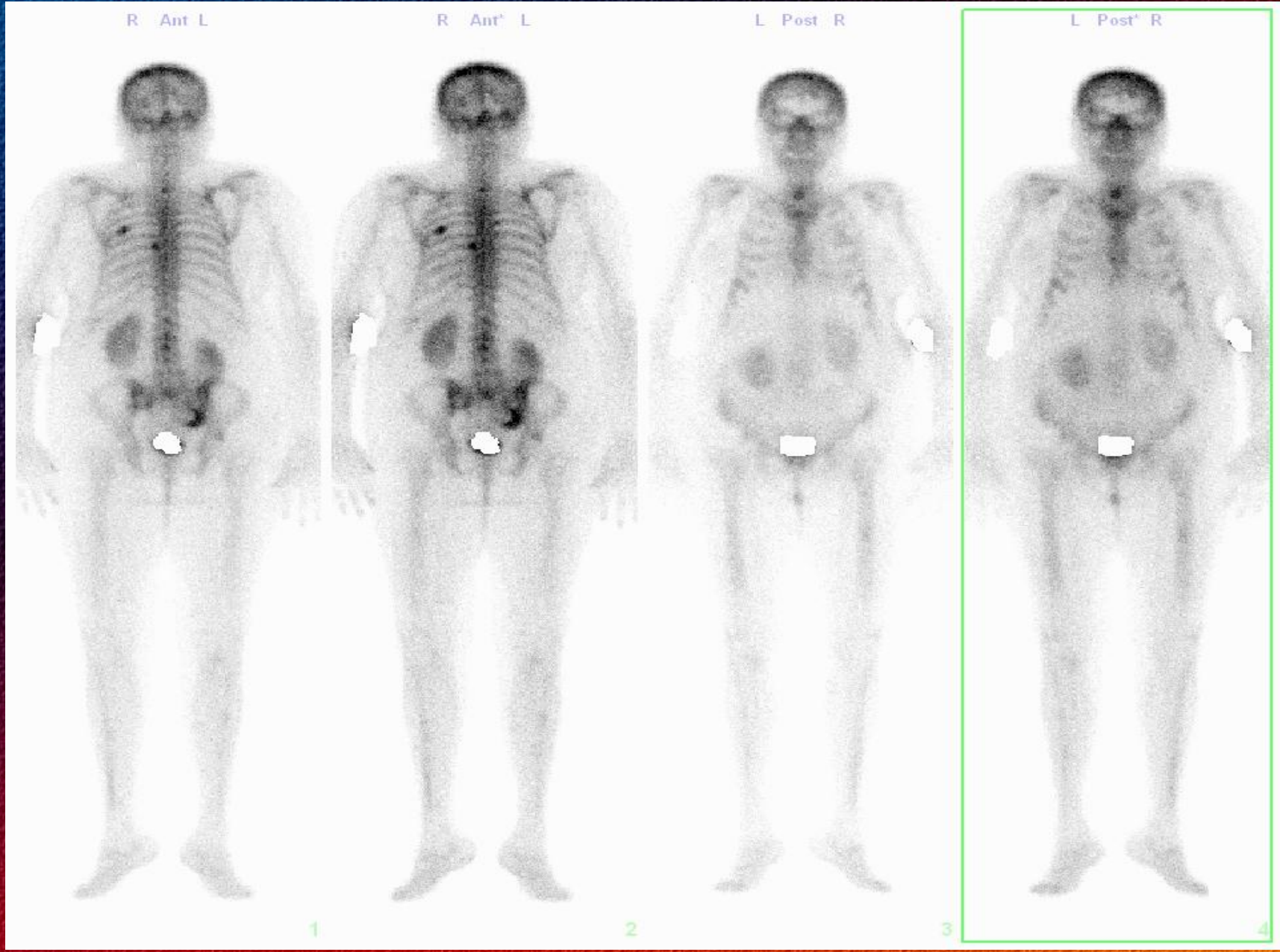


Extraosseal phosphate cumulation (meningeom)

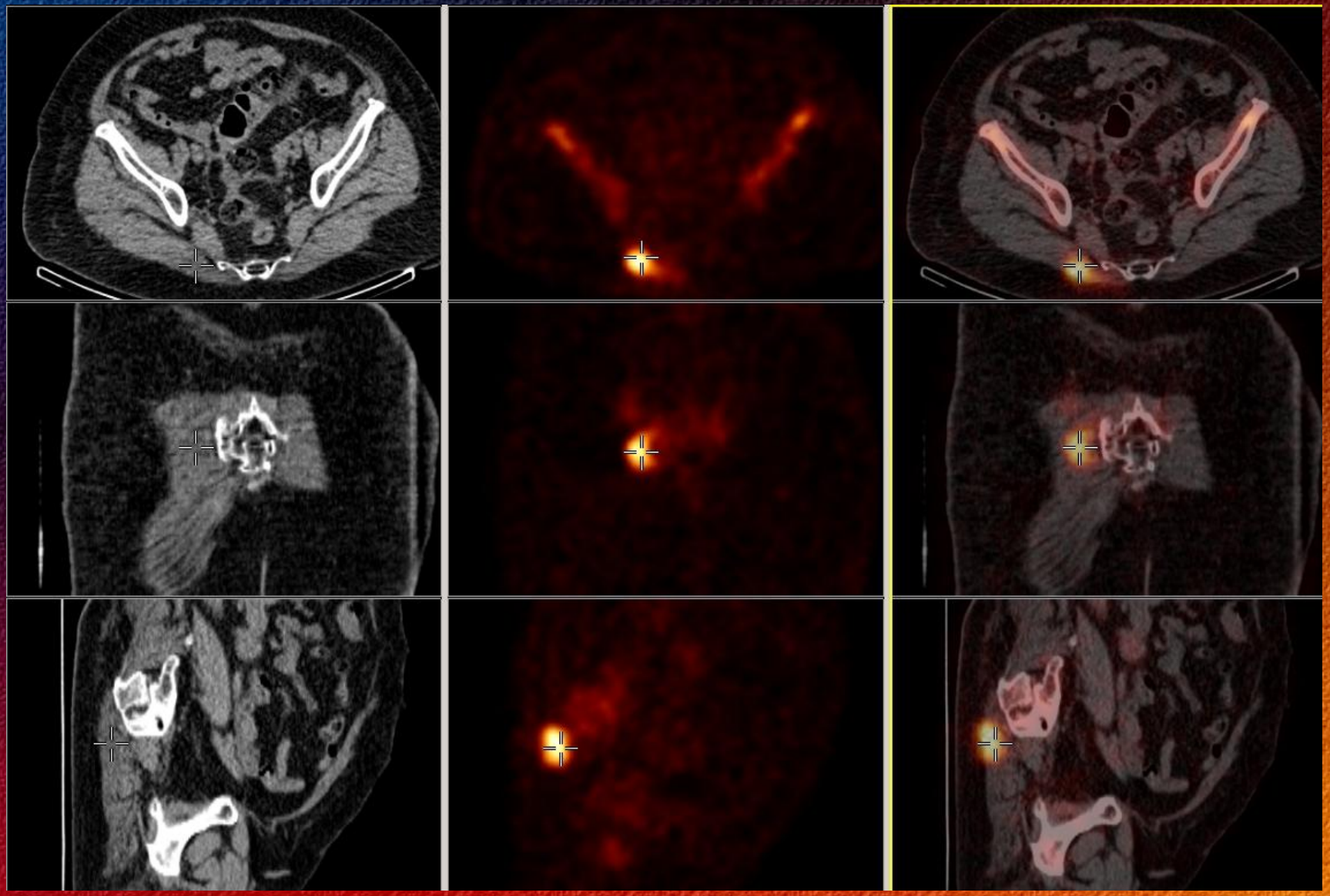
SPECT-image of the skull



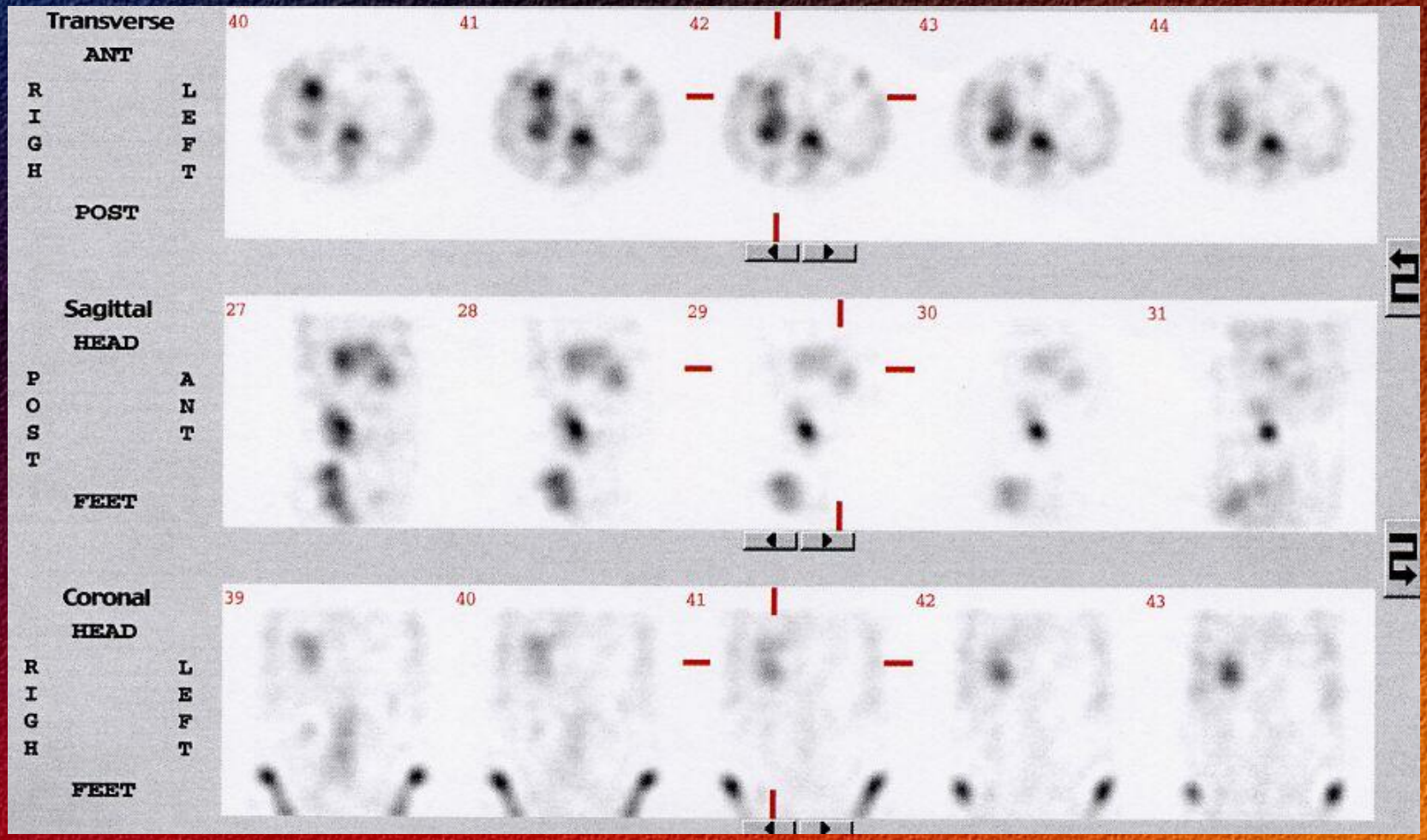
Extraosseal phosphate cumulation



Extraosseal phosphate cumulation
in m. gluteus maximus



Extraosseal 99mTc-MDP cumulation in liver metastases

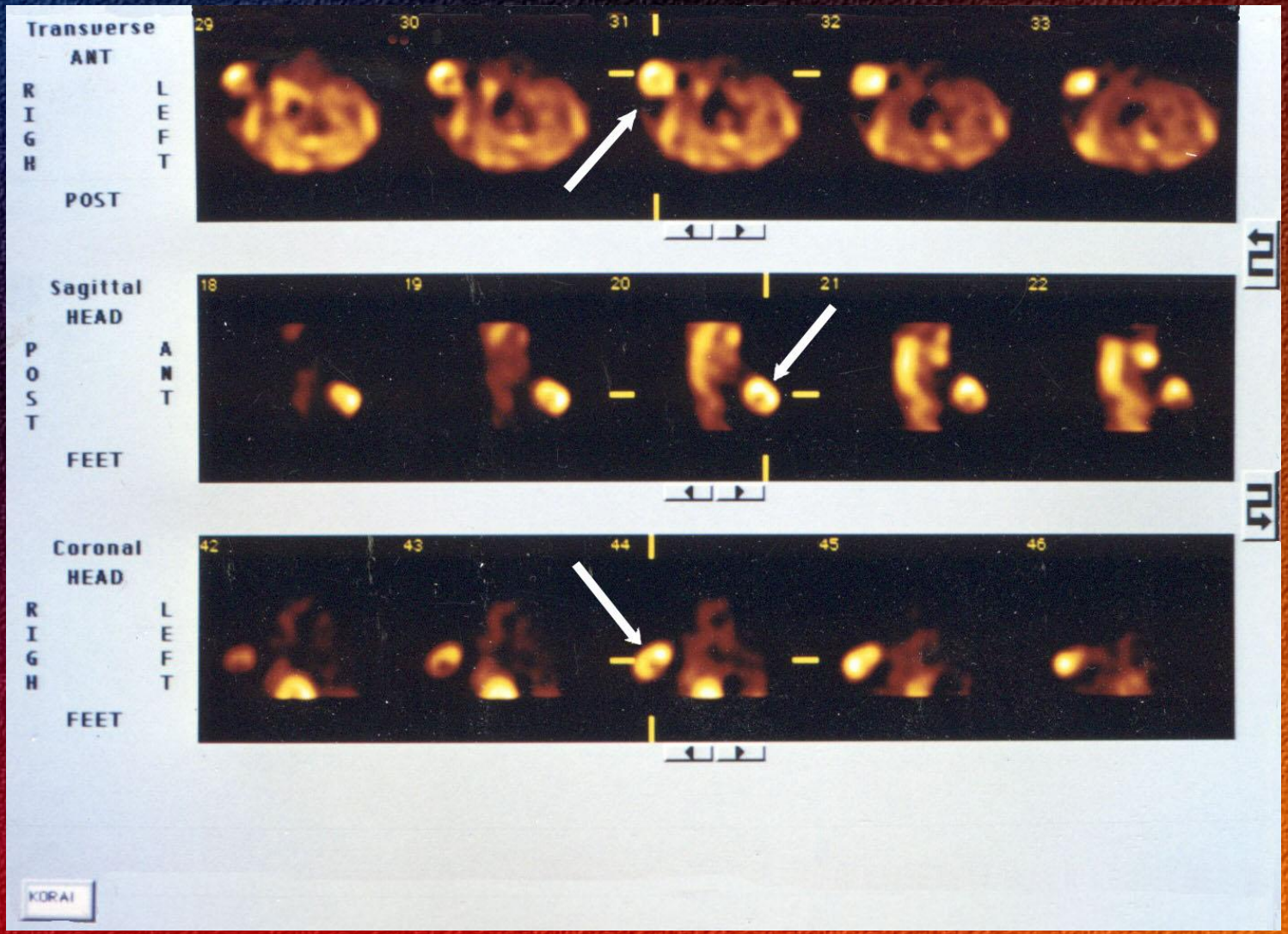


Scintimammography

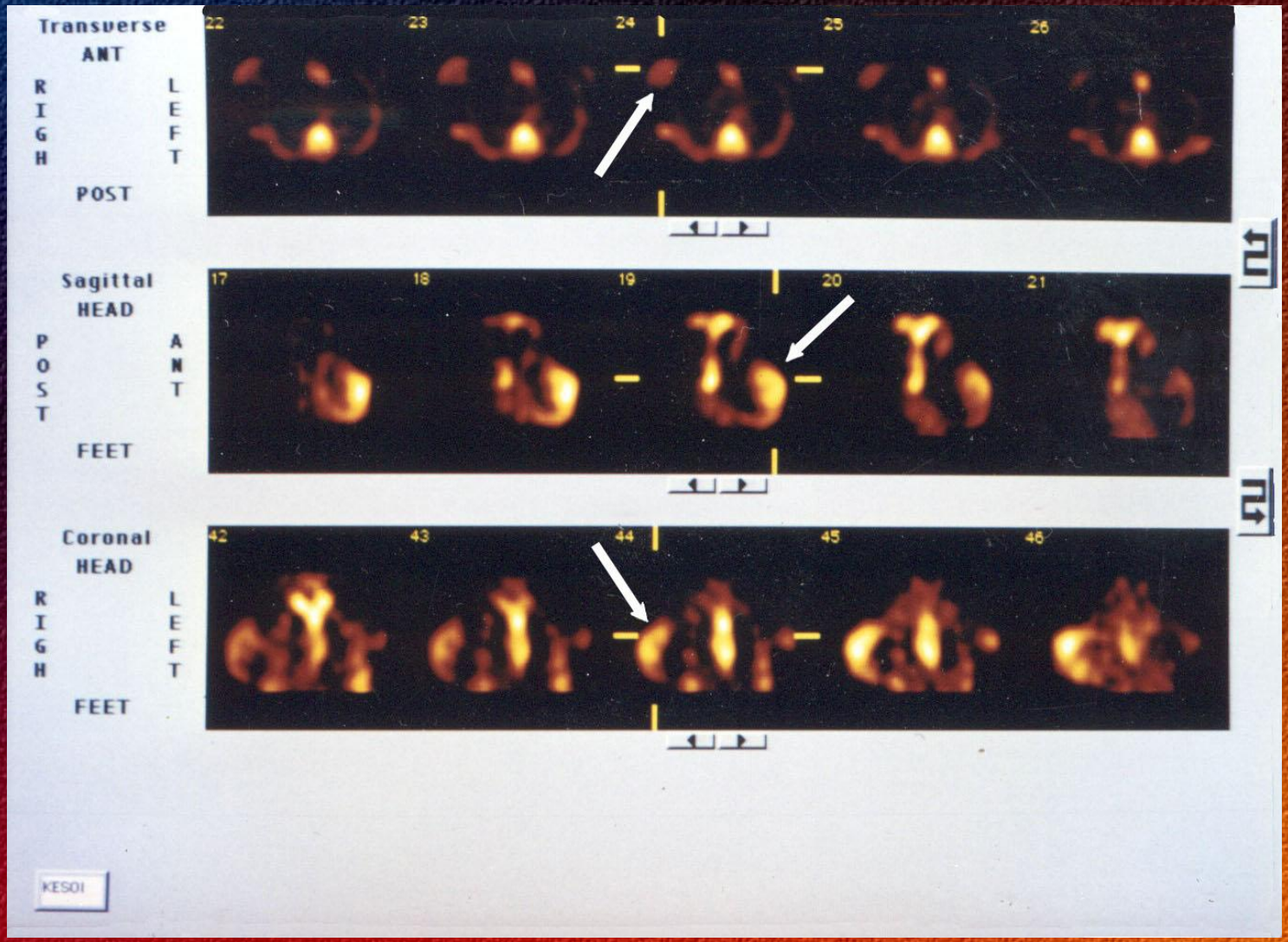
Radiopharmacon: - 99mTc-MIBI
- 99mTc-MDP(together with bone scan!)

- Taking early and delayed scans and SPECT image.

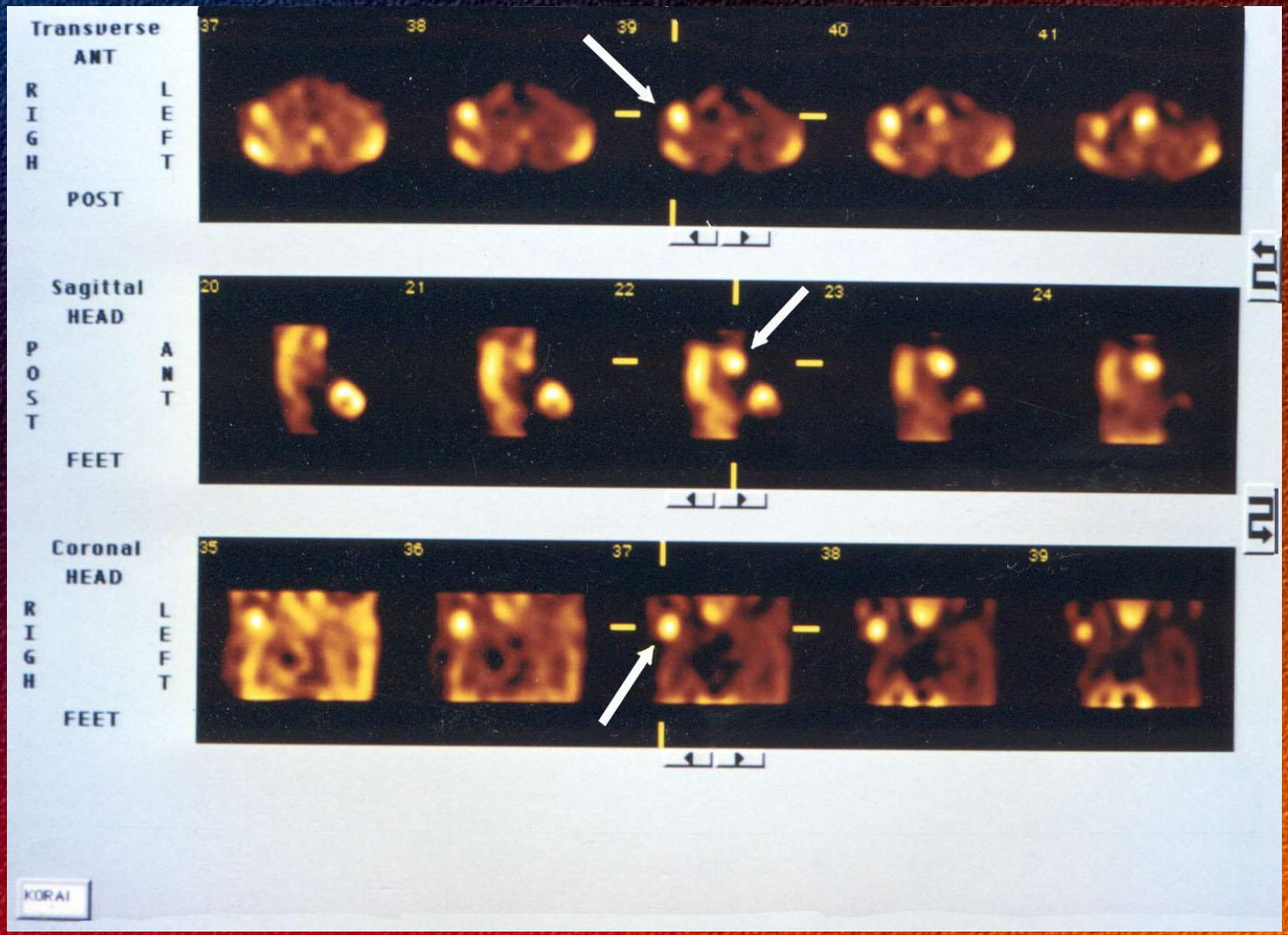
Pathological 99-mTc-MIBI cumulation in the right breast (cc ductale l.d.)



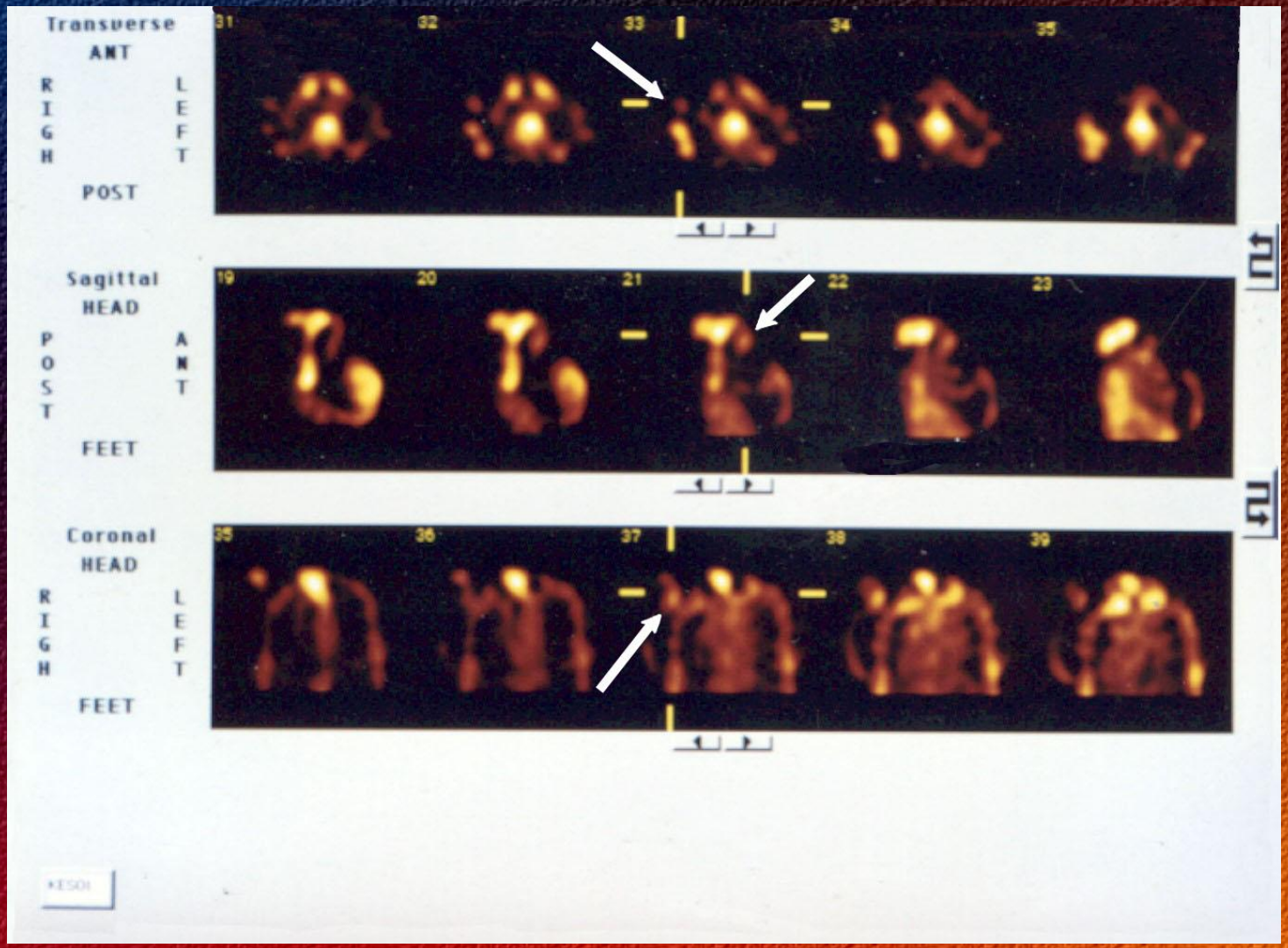
Pathological 99-mTc-MDP cumulation in the right breast (cc ductale l.d.)



Pathological 99-mTc-MIBI cumulation in the right axilla (cc ductale l.d.)



Pathological 99-mTc-MDP cumulation in the right axilla (cc ductale l.d.)



The diagnostic value of scintimammogrphy according to histology

	99mTc-MIBI	99mTc-MDP
Sensitivity:	87%	81%
Specificity:	88%	77%
Validity:	88%	79%

Today importance in „dens breast”

Sentinel lymph node (SLN) scintigraphy

- The technical conception of sentinel lymph node biopsy is based on the process of lymphatic dissemination of tumour cells.

- The peritumoral injected radiopharmaceutical passes the same way as the tumour cells.

- The peritumoral injected tracer cumulates in the SLN, which is hereby detectable (gamma probe).

Why is SLN scintigraphy useful?

- Unnecessary total axillary dissection may be avoided.
(According to literature, if the SLN is negative, the other LN-s are in 97% negative too.)

- The first LN, belonging to the tumour will be removed by all means.
(According to literature the total axillary dissection gives in 10-30% false negative results!)

- **The indication of SLN scintigraphy:**
  early tumour stage (breast cancer, malignant melanoma, vulva cc.)

- **Method - peritumoral injection in 4-8 portions, using 99mTc-HSA colloid (99mTc-Senti-scint)**

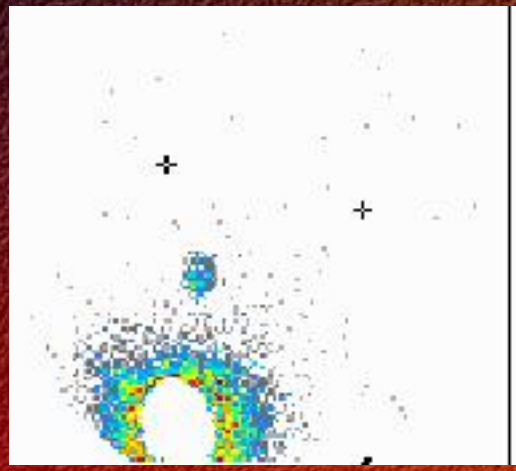
  - scans will be performed right after the injections, and after 1 and 3 hours again

  - the projection of SLN-s will be marked on the skin

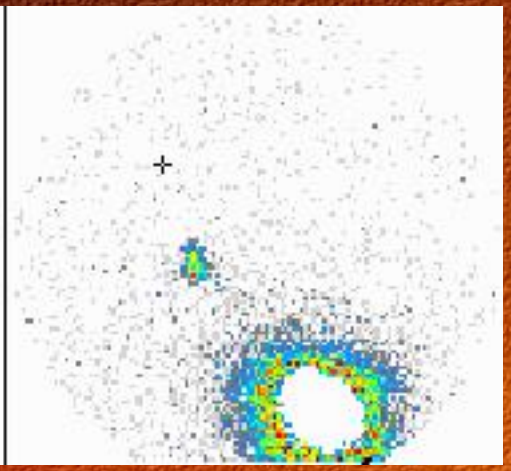
  - operation on next day

SLN scintigraphy in breast cancer

Antero-posterior

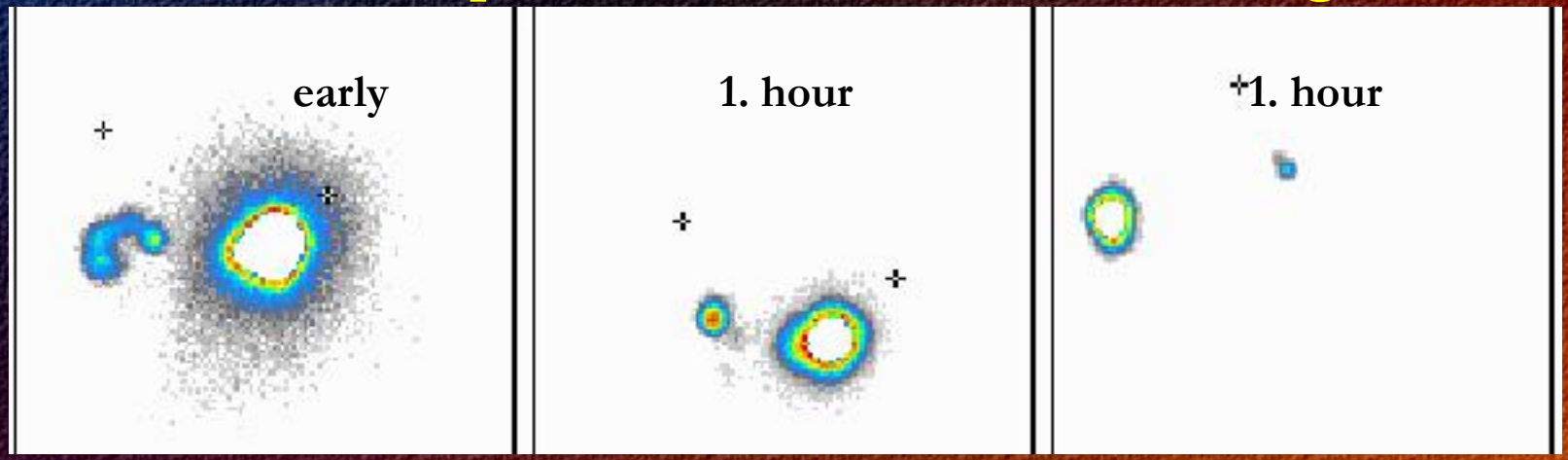


Lateral-right

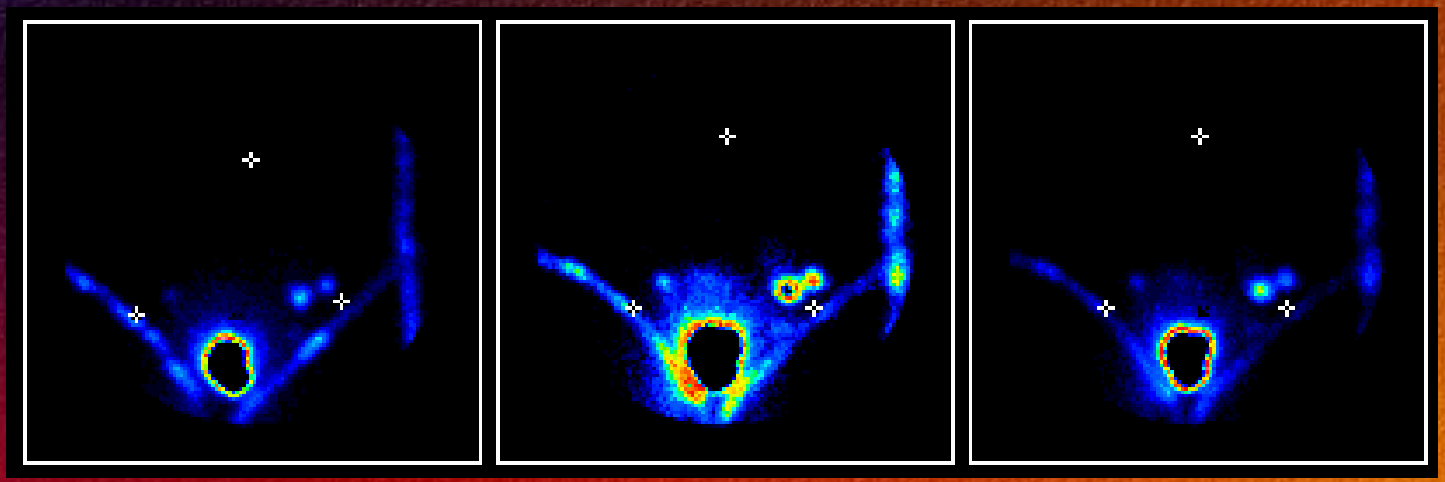


SLN scintigraphy in malignant melanoma

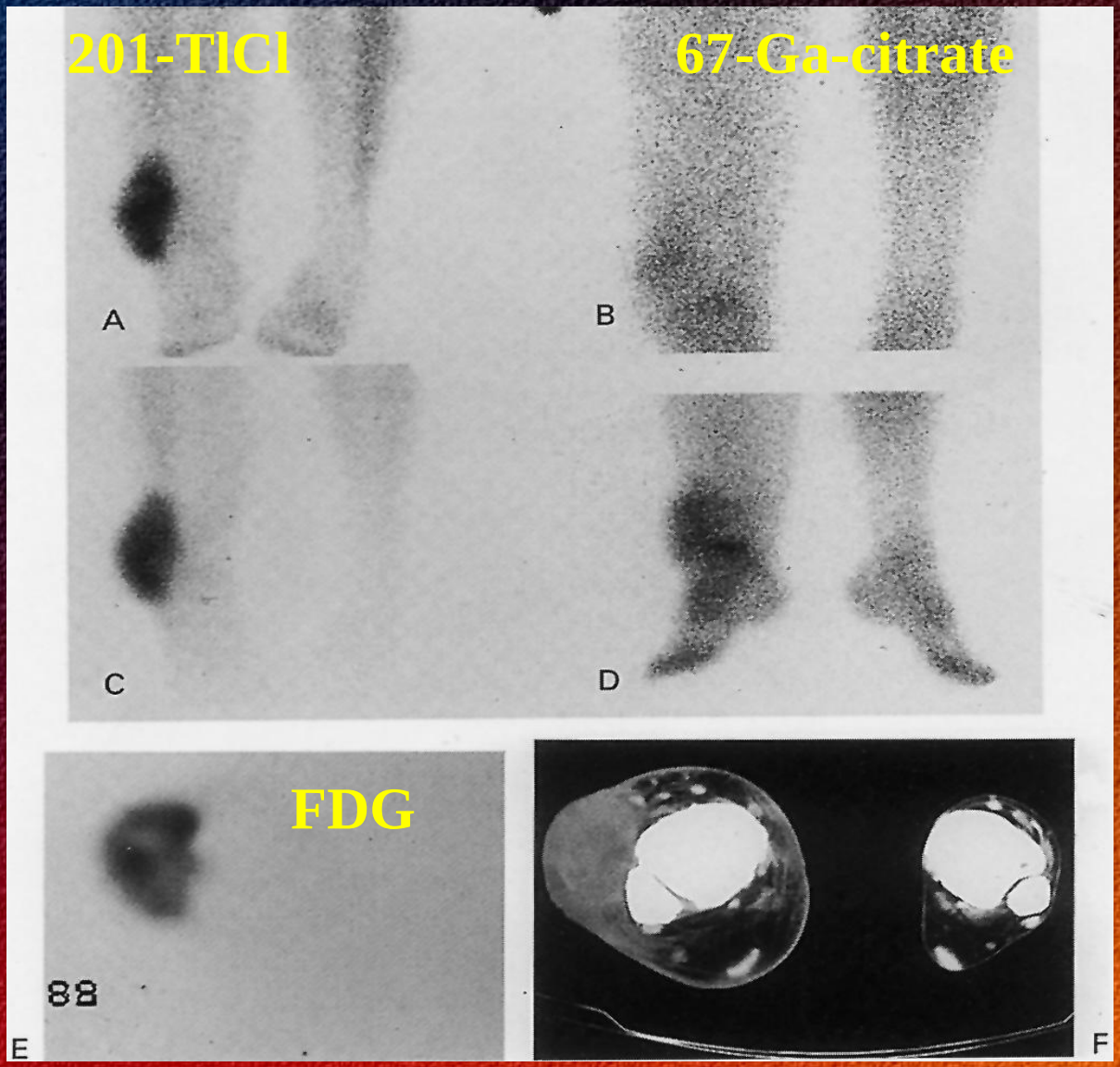
Antero-posterior **Lateral-right**



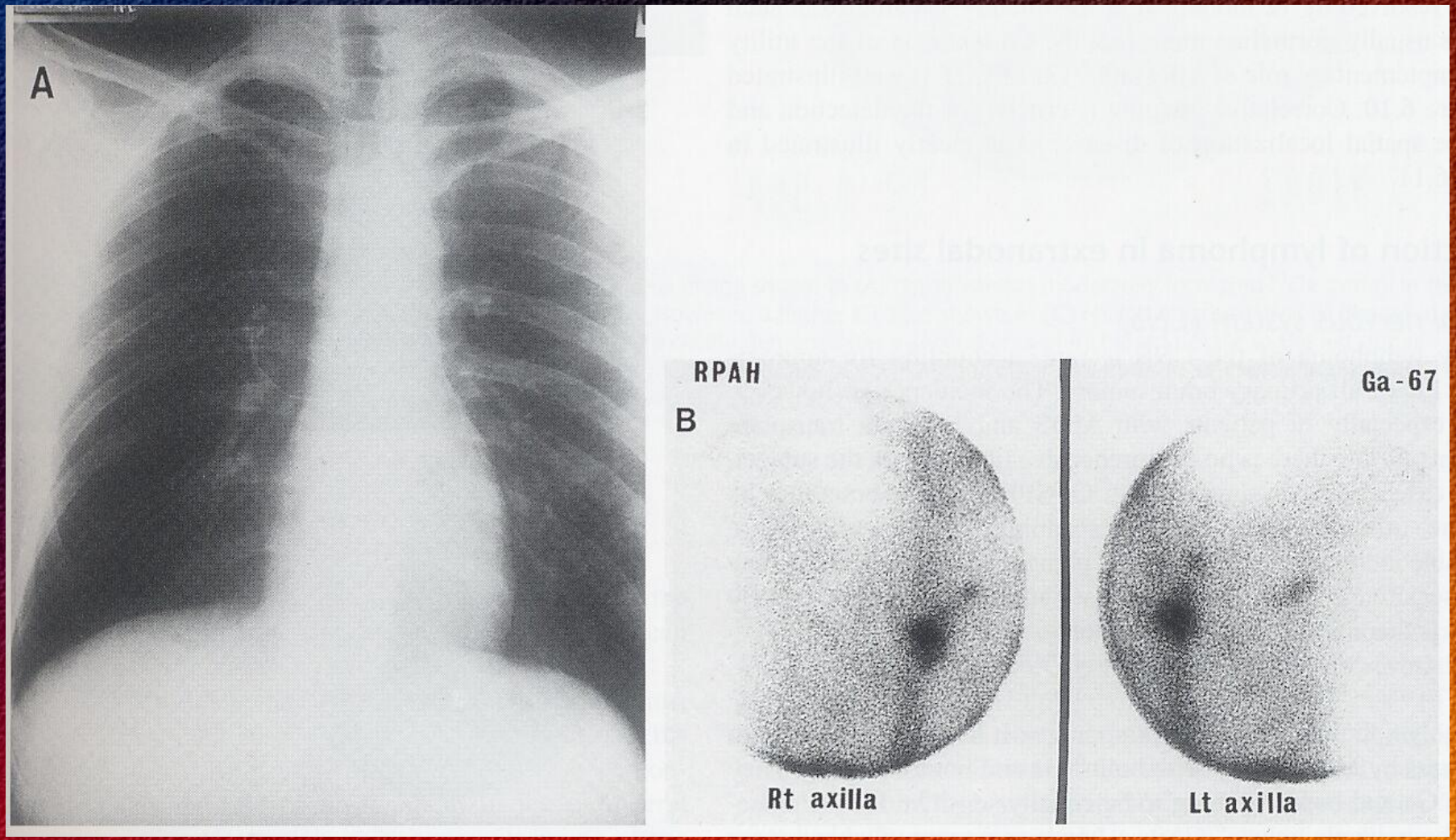
SLN scintigraphy in vulva cc.



Rhabdomyosarcoma of the soft tissues of the right ankle



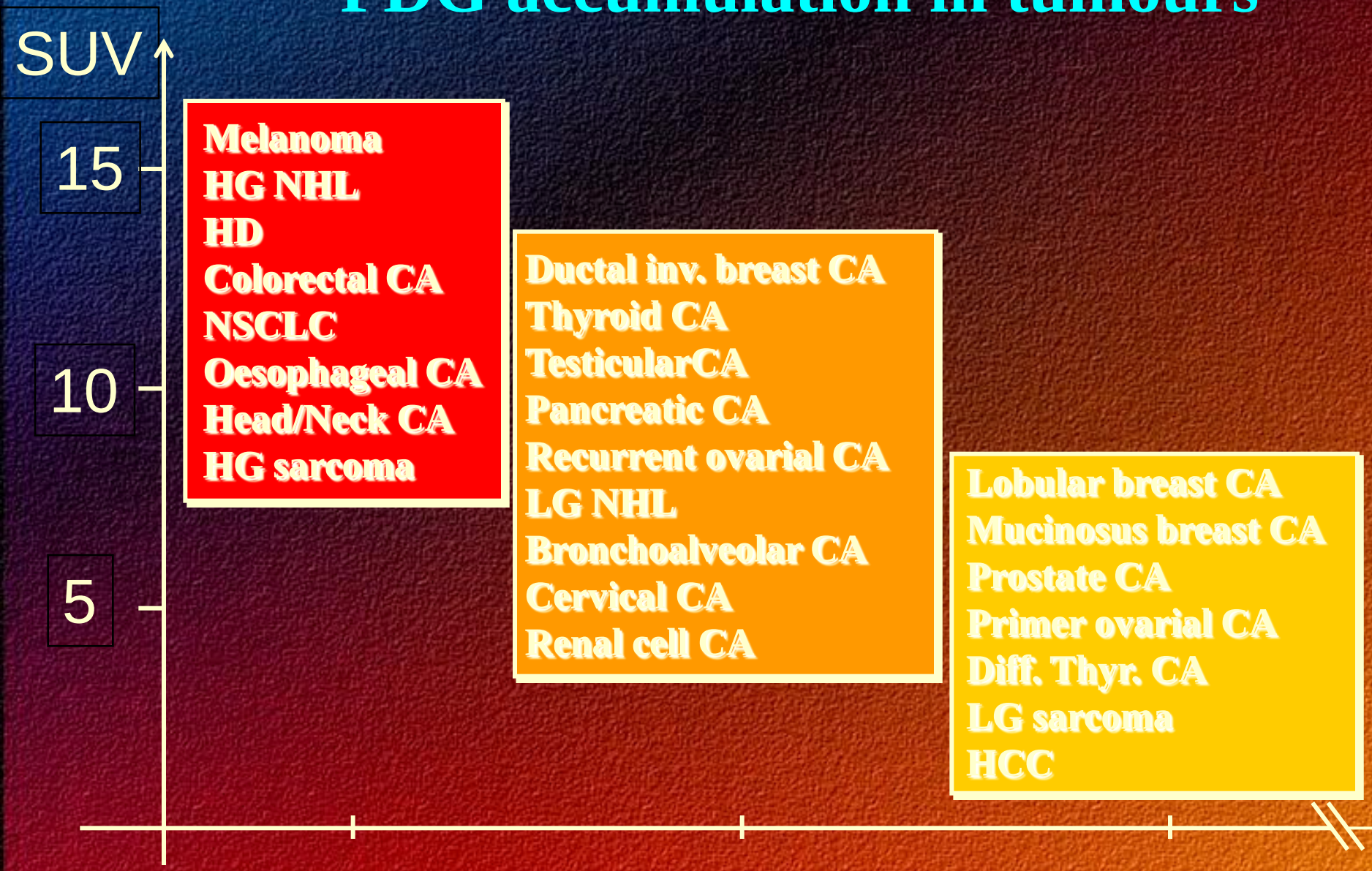
Ga-67 accumulation in NHL



PET radiopharmaceuticals in oncology

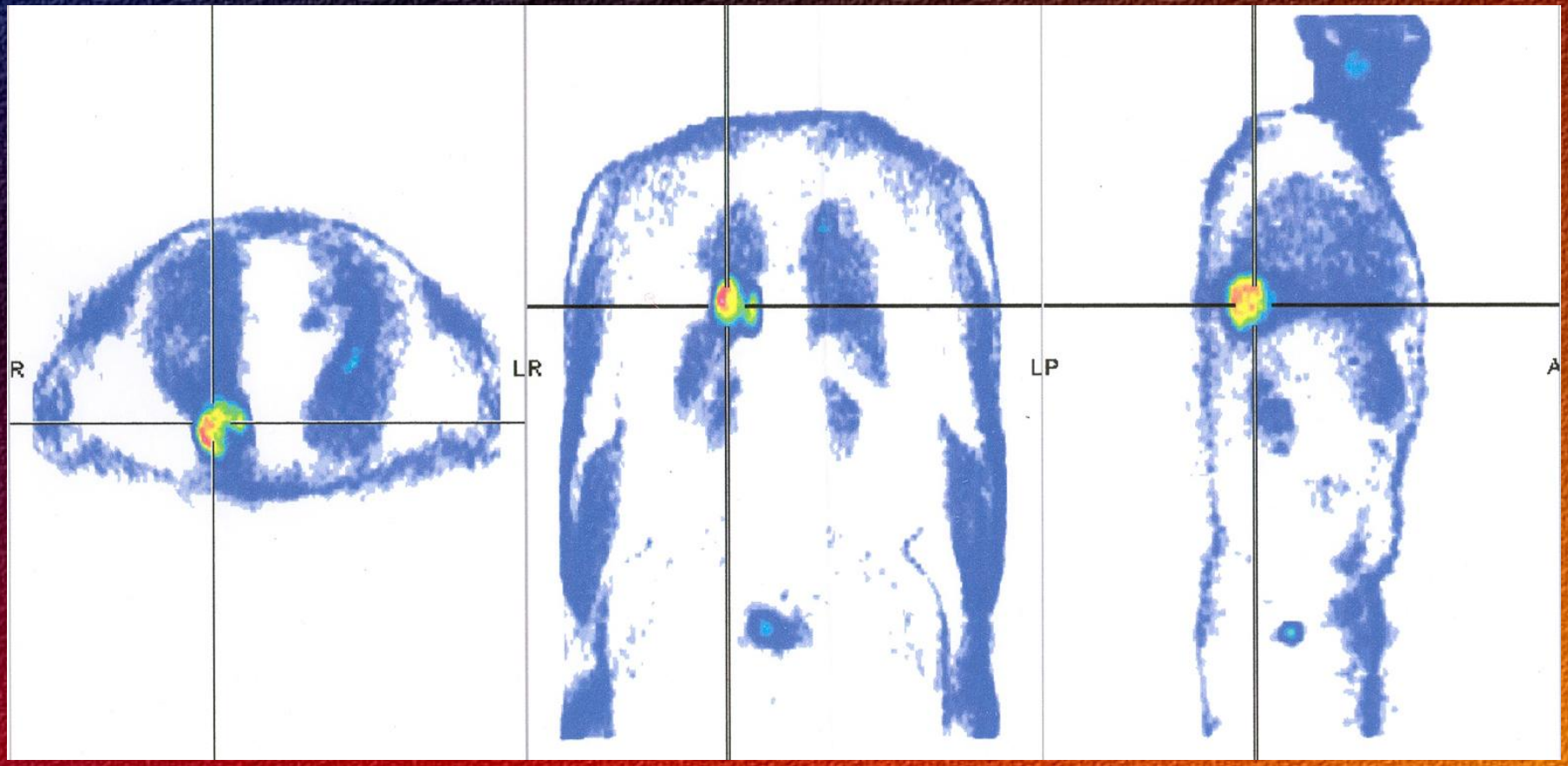
• Bloodflow	15O-water
• **Glucose-transzport**	**18F-FDG**
• Tumour-hypoxia	18F-misonidazole
• Amino acid synthesis	11C-methionine
• DNA-synthesis	11C-thymidine
• DNA-synthesis analog	18F-FLT
• Tumour-receptor	68Ga-SMS
• Chemotherapeutical agent	18F-fluorouracil
• Thyroid function	124I

FDG accumulation in tumours



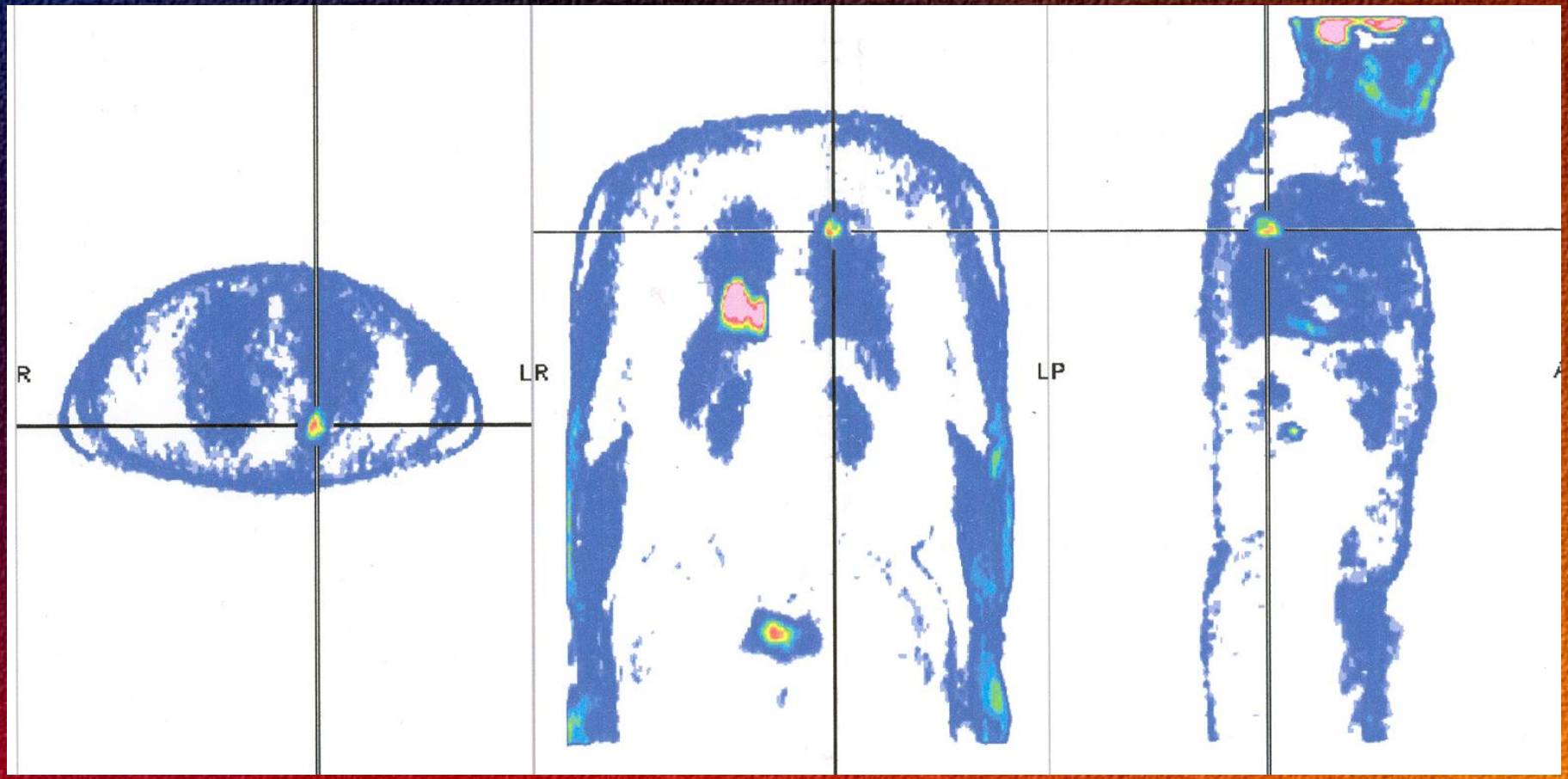
Adenocarcinoma in the right lung

PET (FDG)



Adenocarcinoma in the left upper lobe

PET (FDG)



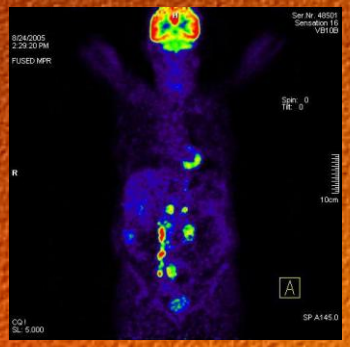
PET/CT

CT


H
8/24/2005
2:29:20 PM
FUSED MPR
R
10cm
A
SP A145.0


H
Ser.Nr. 48501
Sensation 16
VB10B
8/24/2005
2:29:20 PM
FUSED MPR
R
10cm
A
CQ !
SL: 5.000
SP A145.0

PET


H
8/24/2005
2:29:20 PM
FUSED MPR
R
10cm
A
SP A145.0

The indications of PET/CT

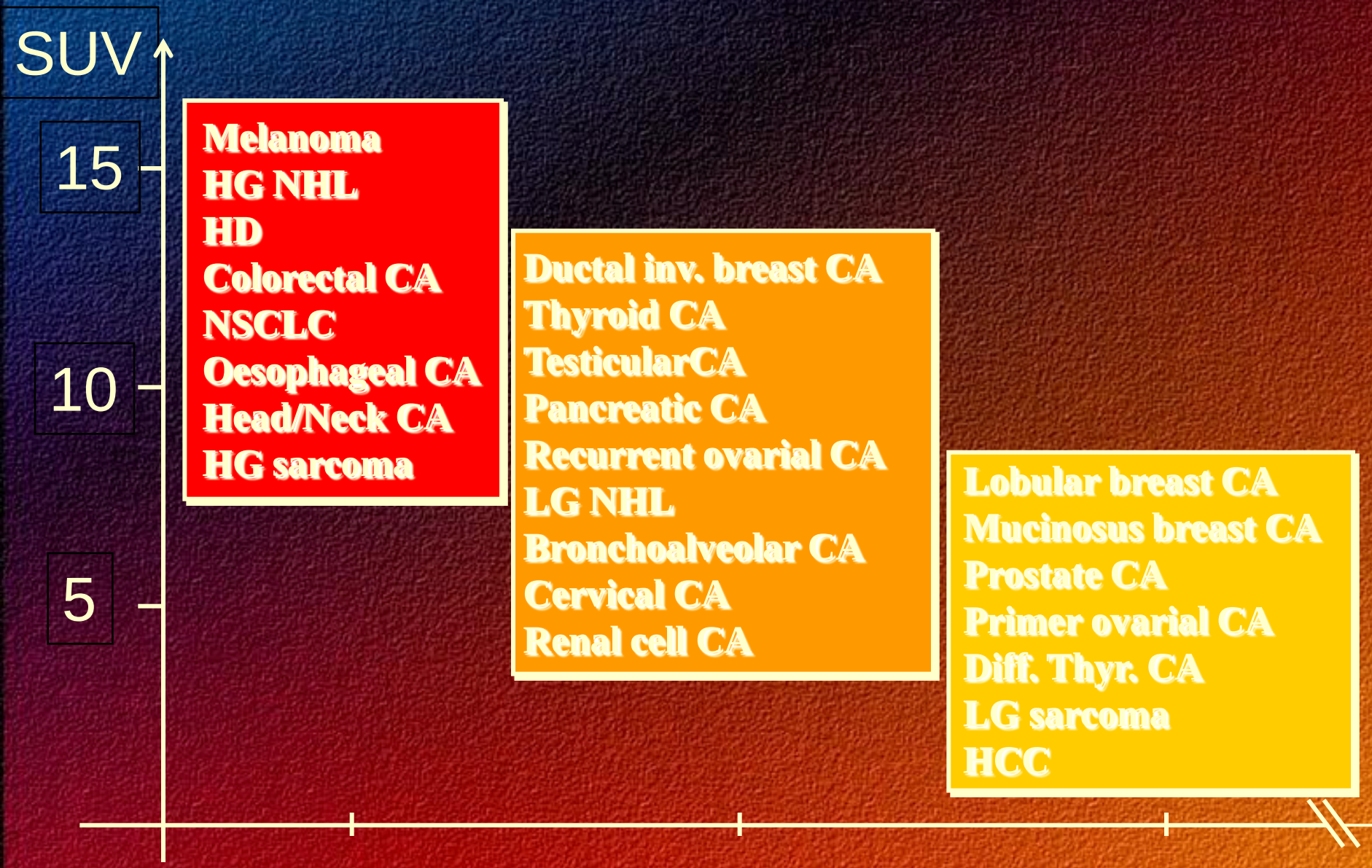
- Differentiation between malignant and benign lesions
- Residual tumor after radio- or chemotherapy
- Verification of tumour recurrence
- Staging (TNM)
- Optimization of biopsia
- Search of an unknown primary tumour
- Measuring of malignity
- Monitorization of the effectiveness of treatment
- Radiotherapy planning

Problems relating to differentiation between malignant and benign lesions

- FDG negative tumours
- The FDG uptake relates to the tumour grade and proliferation status
- FDG – nonspecific radiopharmaceuticals, not only tumour accumulation, positiv in inflammatory diseases too!)
- Chemotherapy: 3 weeks

  Radiotherapy: 3 mounths

FDG accumulation in tumours

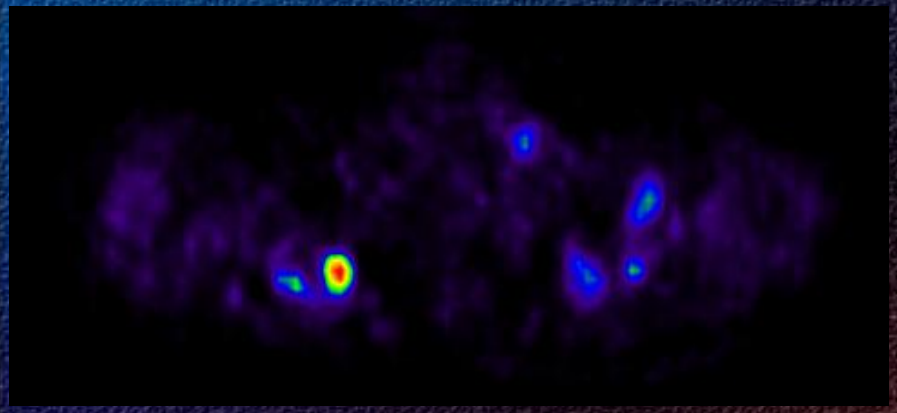


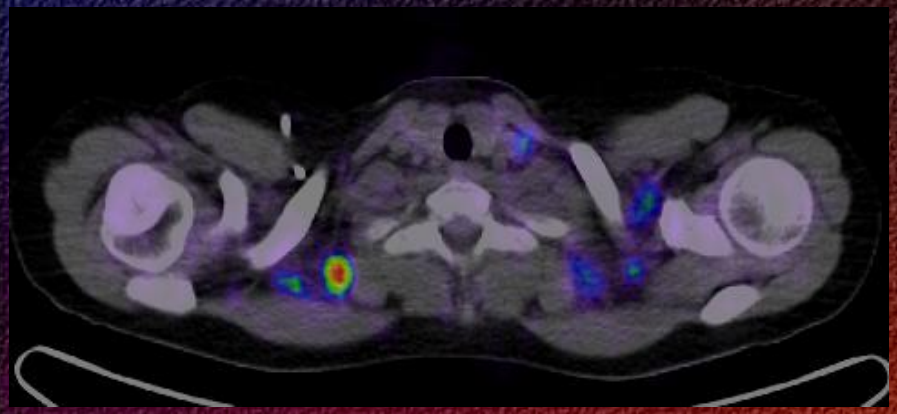
Problems relating to differentiation between malignant and benign lesions

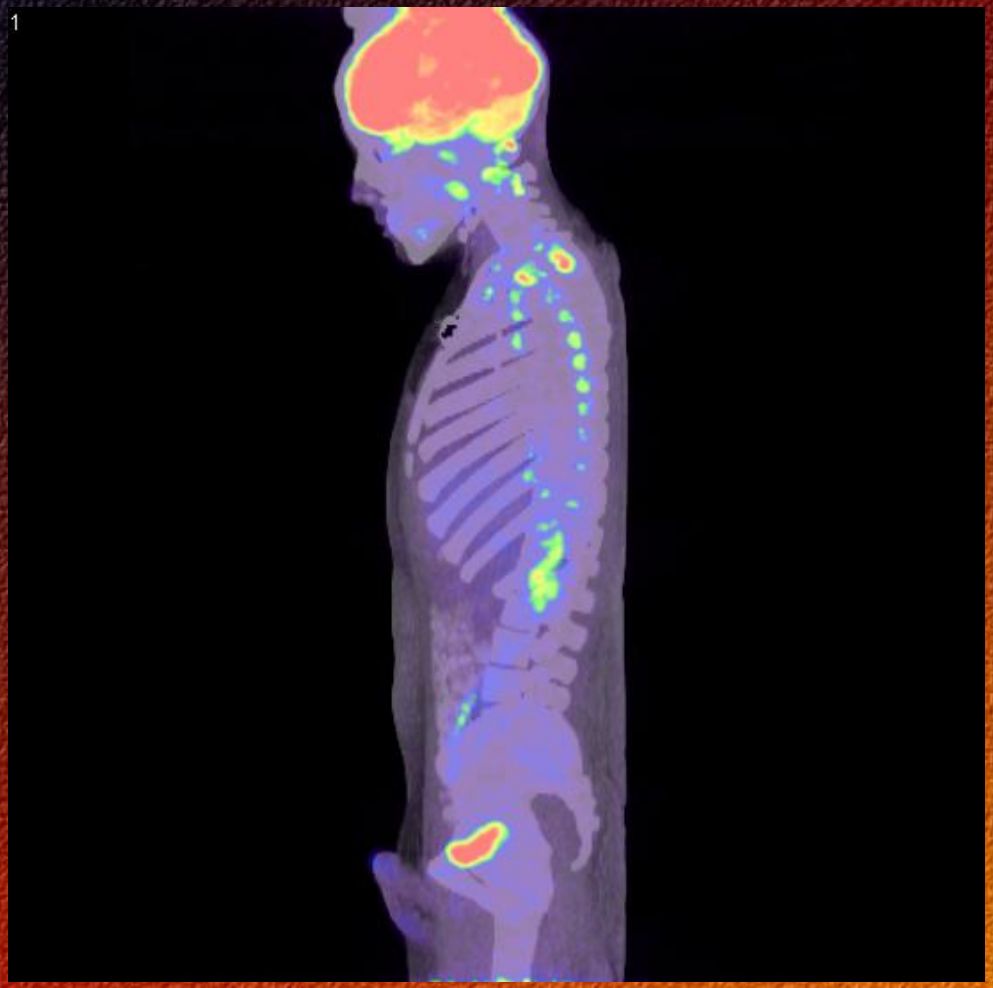
- FDG negative tumours
- FDG – nonspecific radiopharmaceuticals, not only tumour accumulation, positiv in inflammatory diseases too!)
- The FDG uptake relates to the tumour grade and proliferation status
- Chemotherapy: 3 weeks

  Radiotherapy: 3 mounths

FDG uptake in brown adipose tissue (hibernating fat)



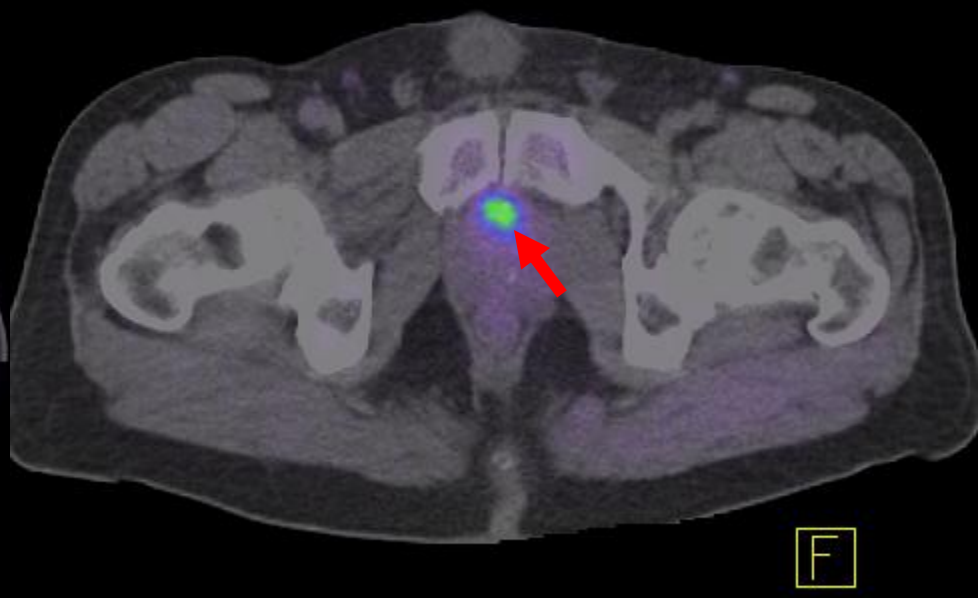




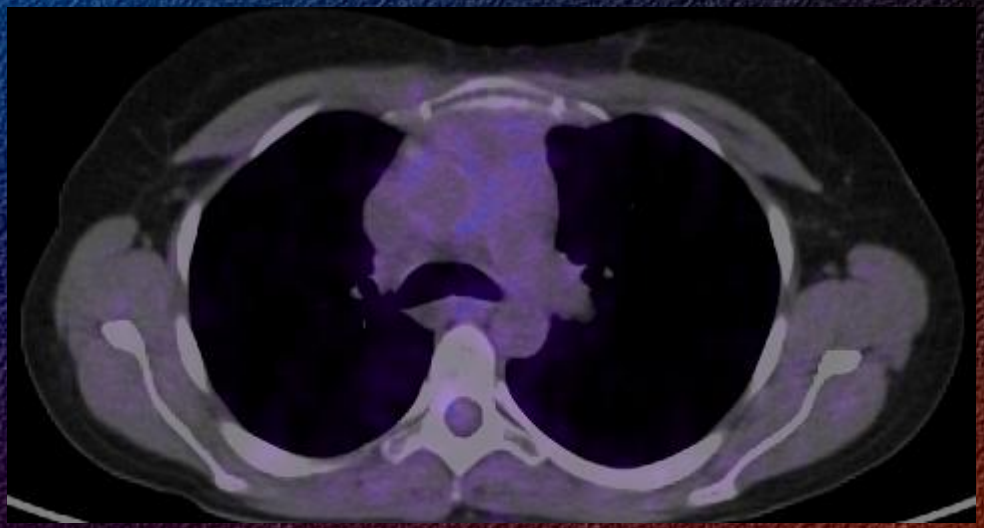
FDG negative tumours - Prostate CA

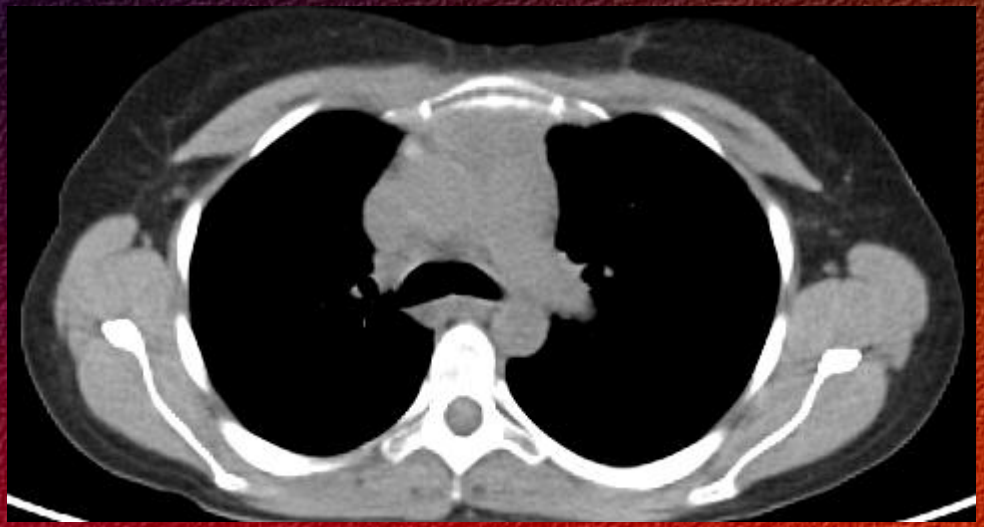
18F-FDG

11C-Acetate



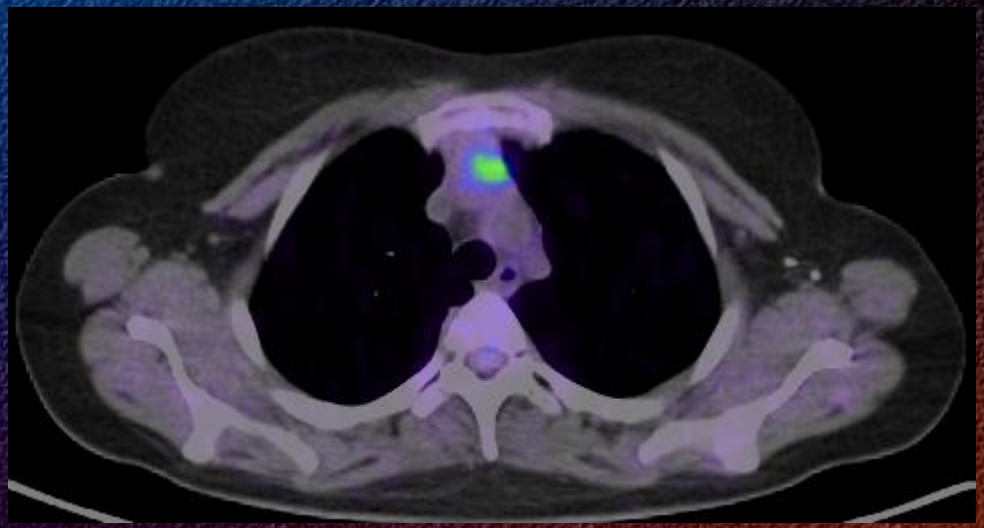
FDG negative, no residue

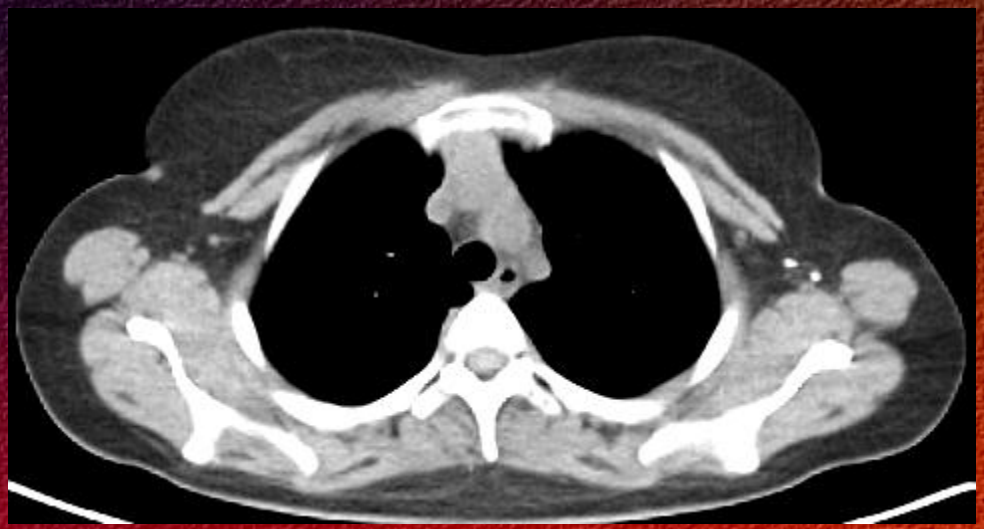




NHL, 2,5 mounths after chemo- and radiotherapy

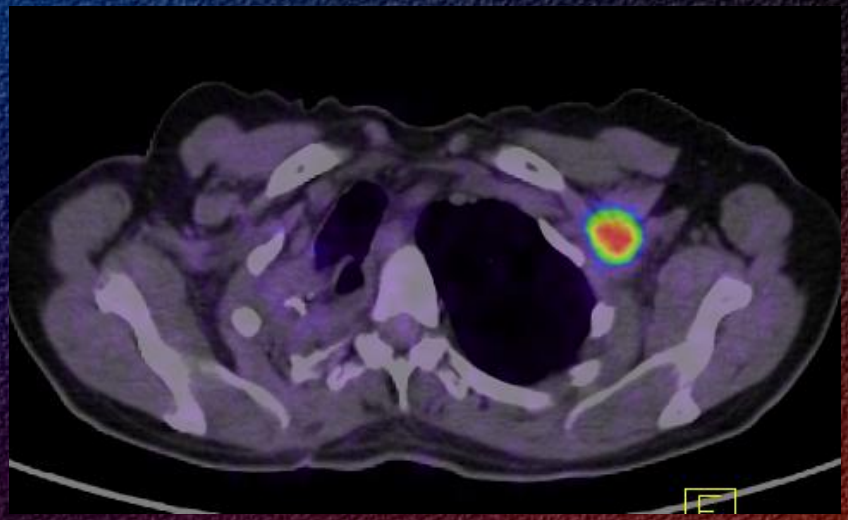
FDG pozitive, residual tumour

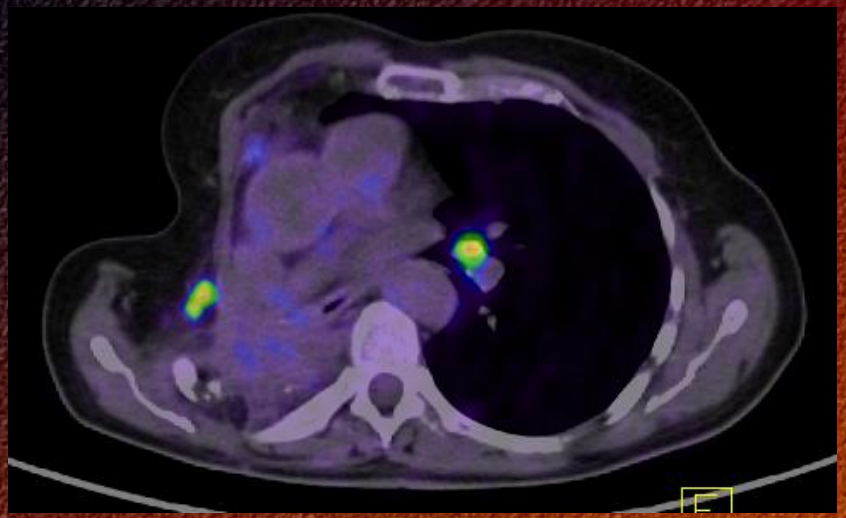


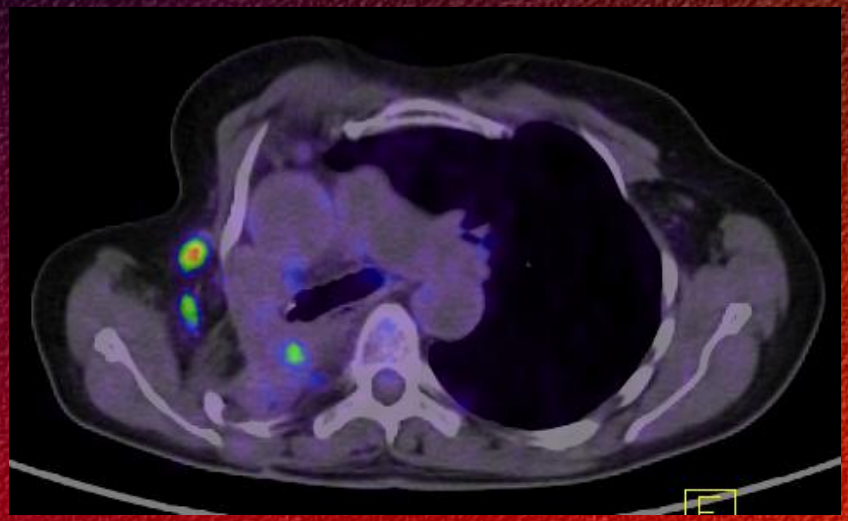


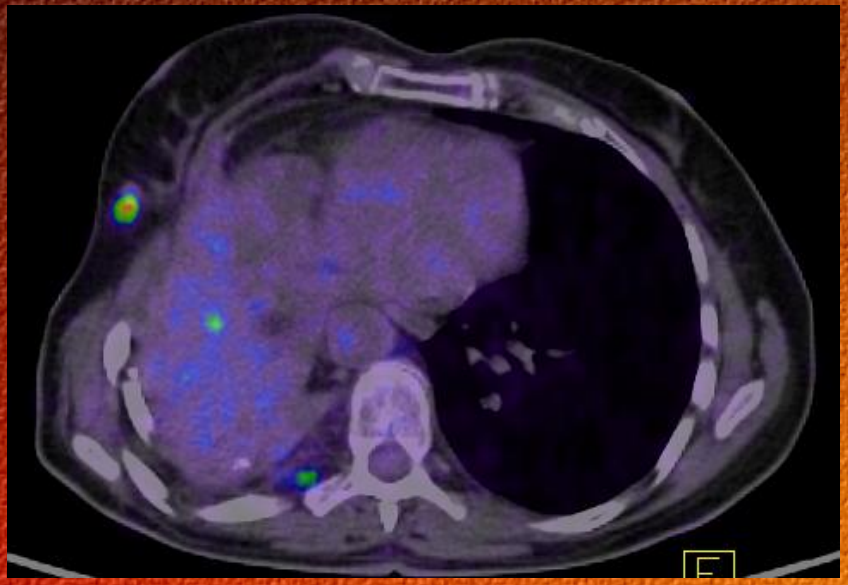
NHL, 6 mounths after chemotherapy and embryonic stem cell transplantation

Tumour recurrence – NSCLC St. post pulmonectomiam

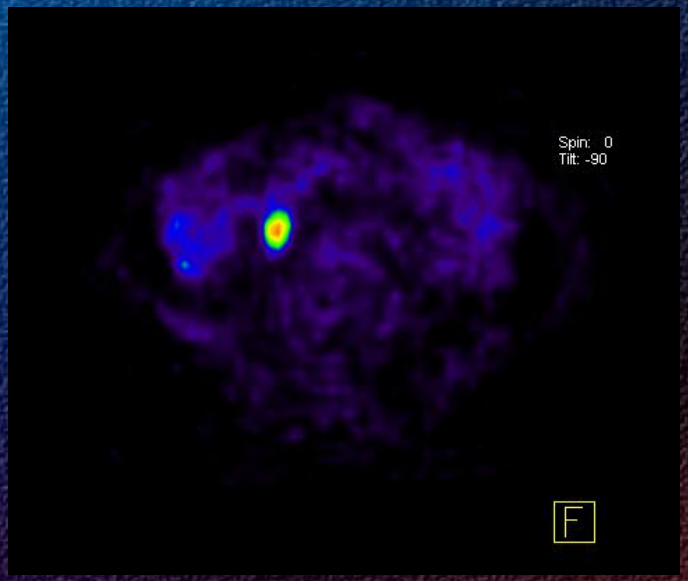


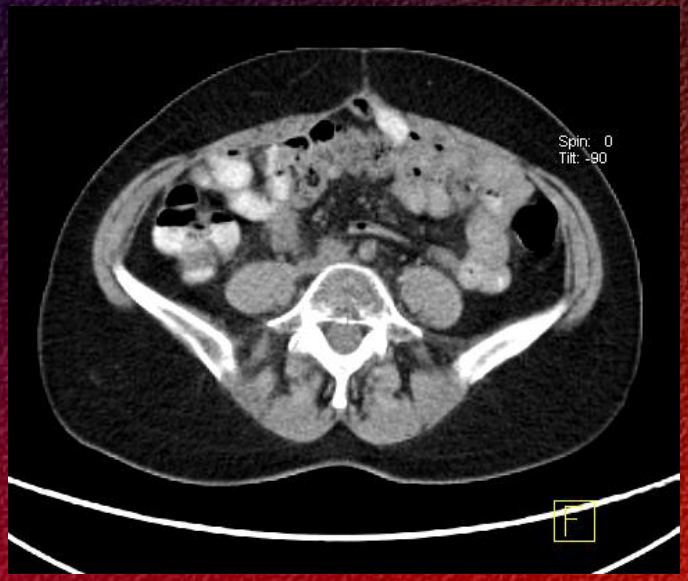


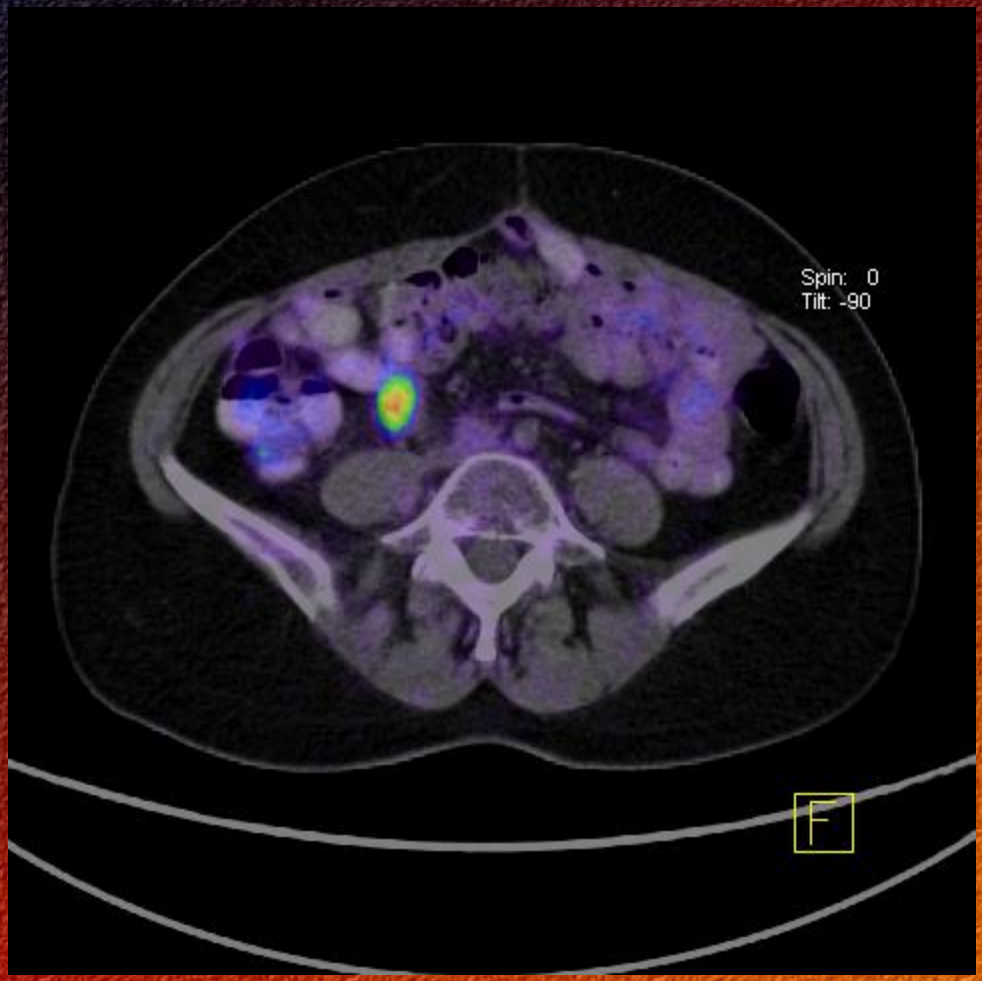




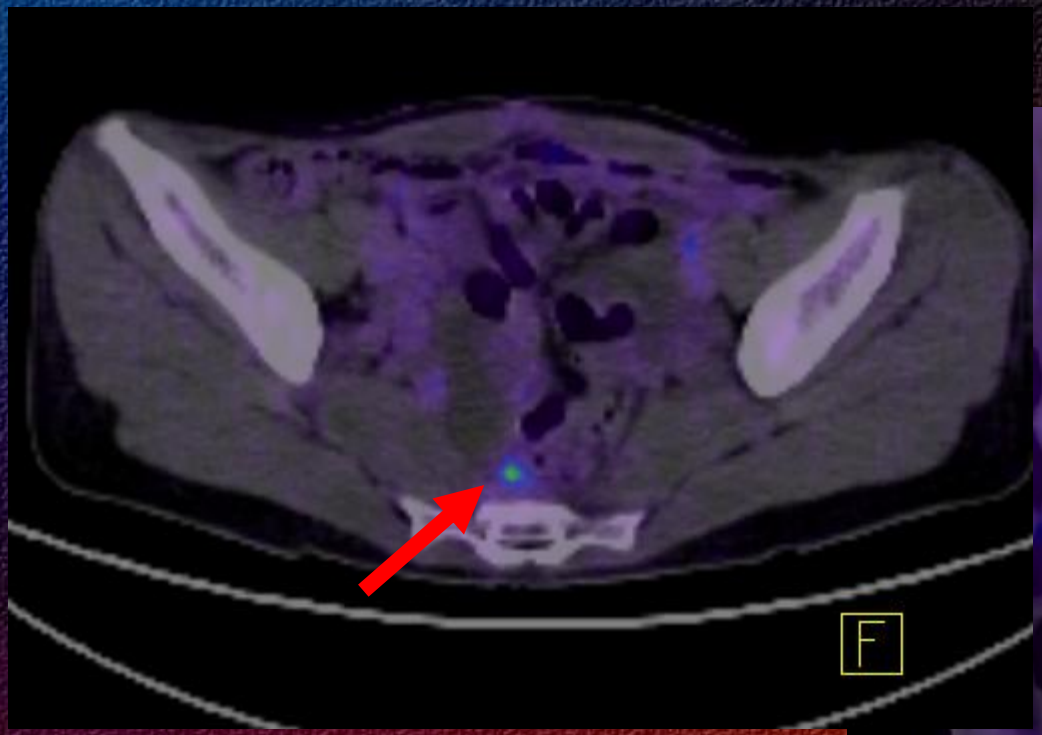
Tumour recurrence – ovarial CA

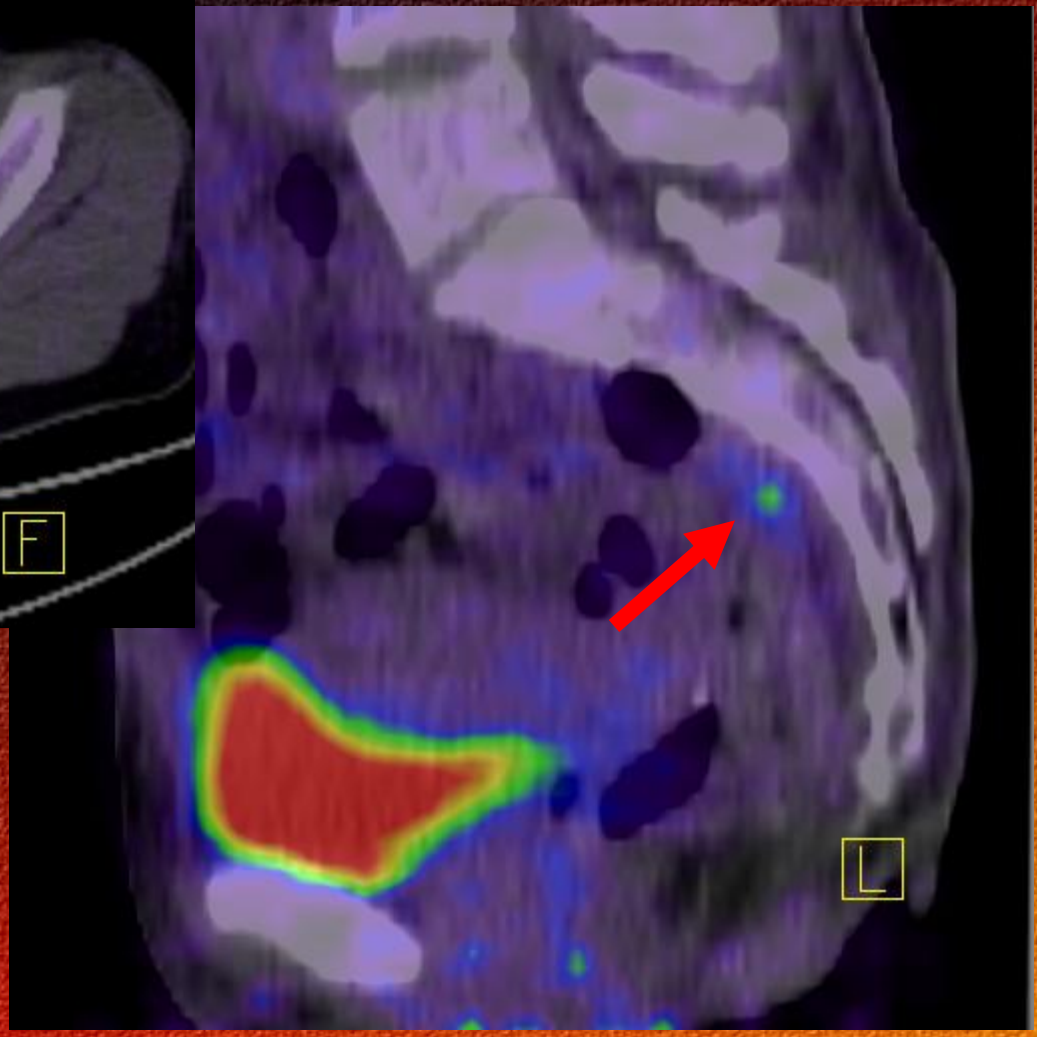






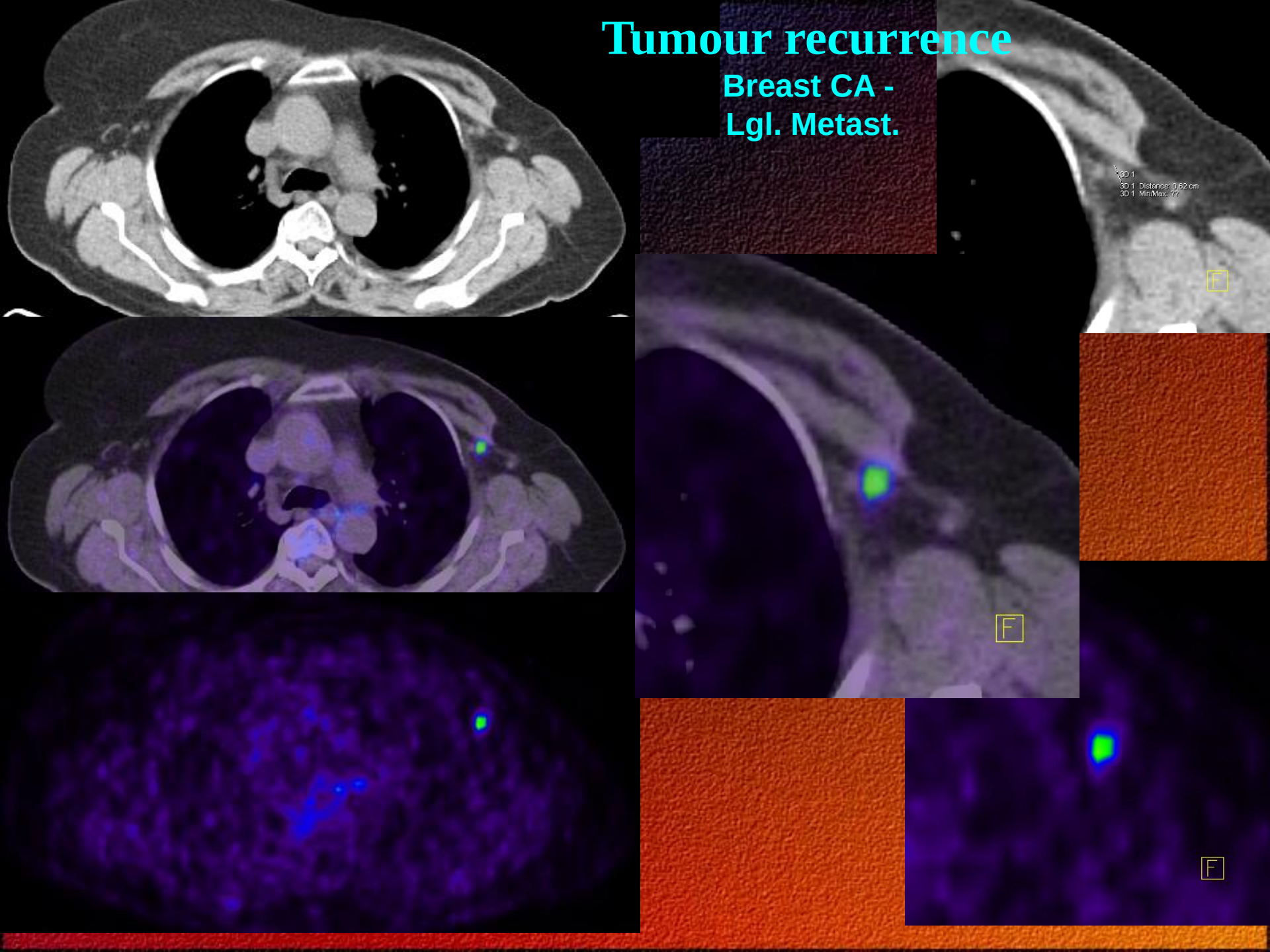
Tumour recurrence - sigma cc. – presacralis rec.



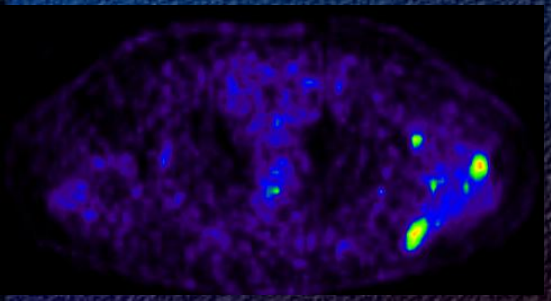
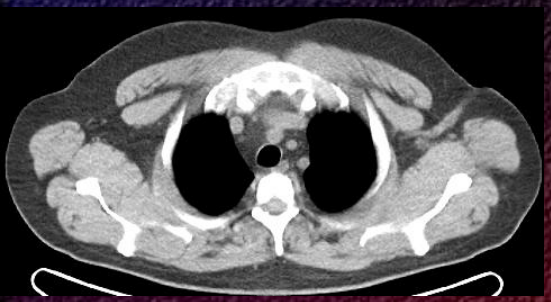
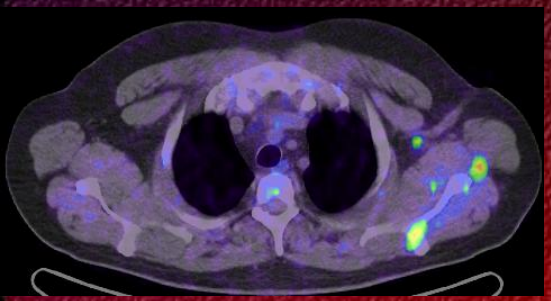
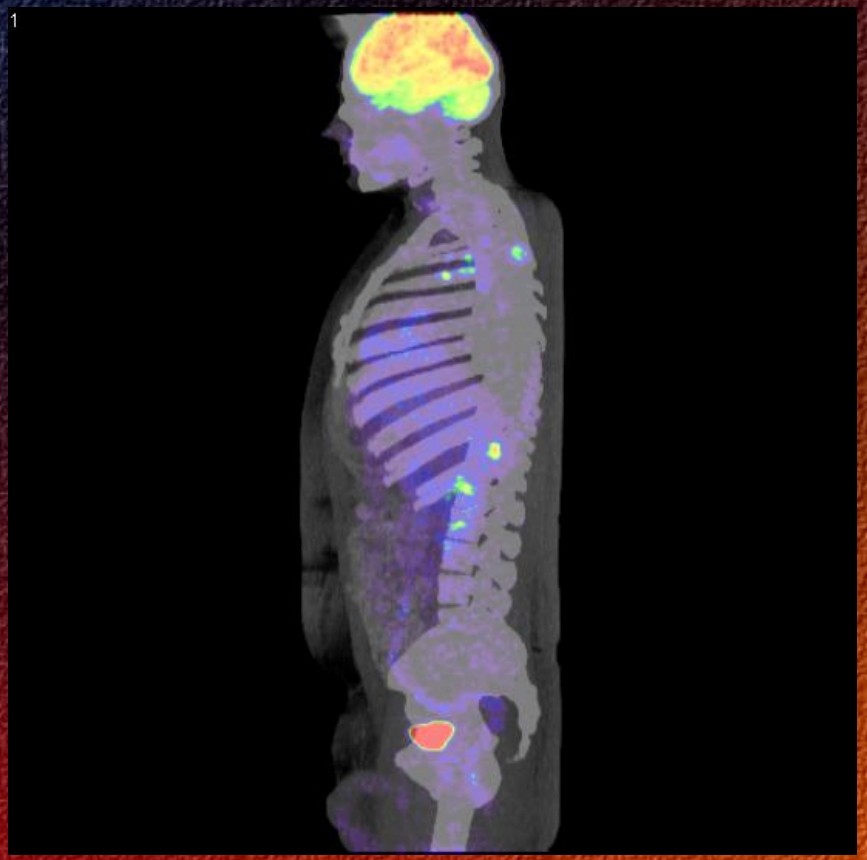


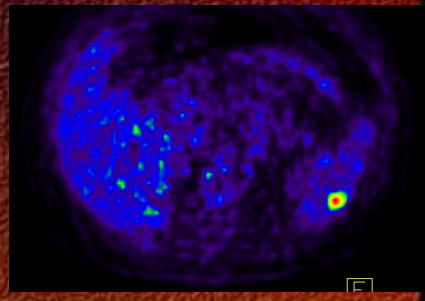
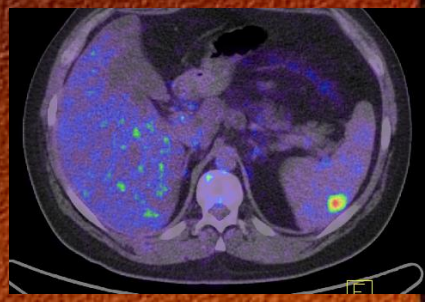
Tumour recurrence

Breast CA -
Lgl. Metast.



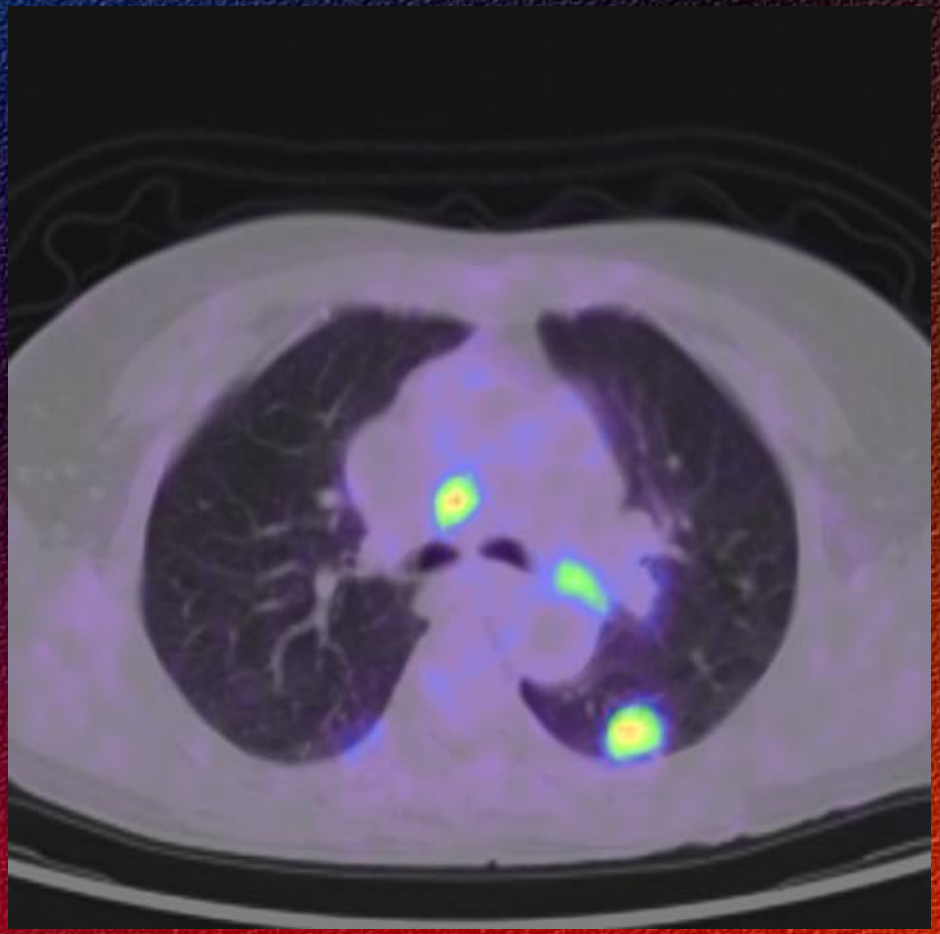
Staging - NHL, extranodál manifestation

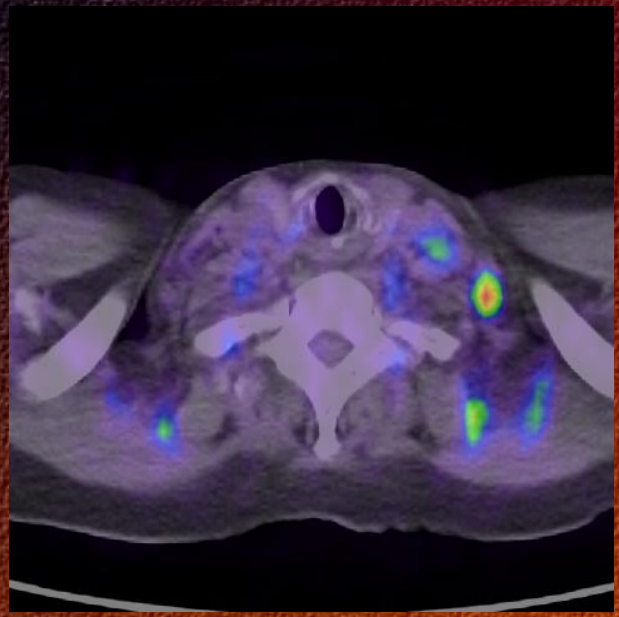





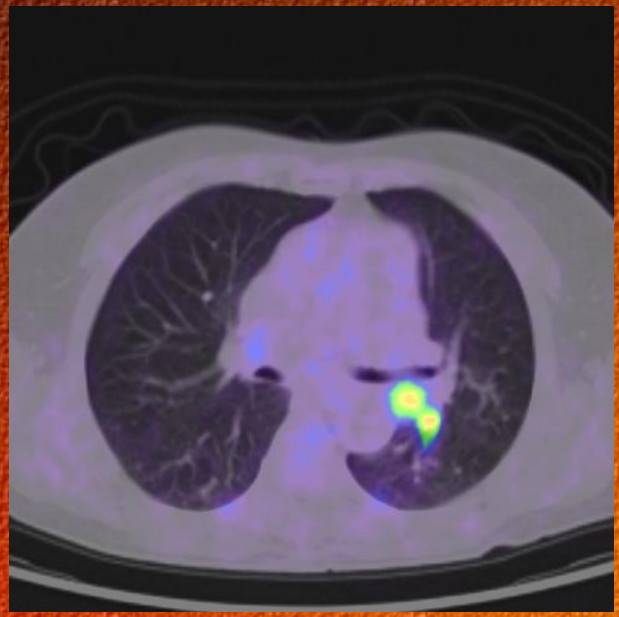



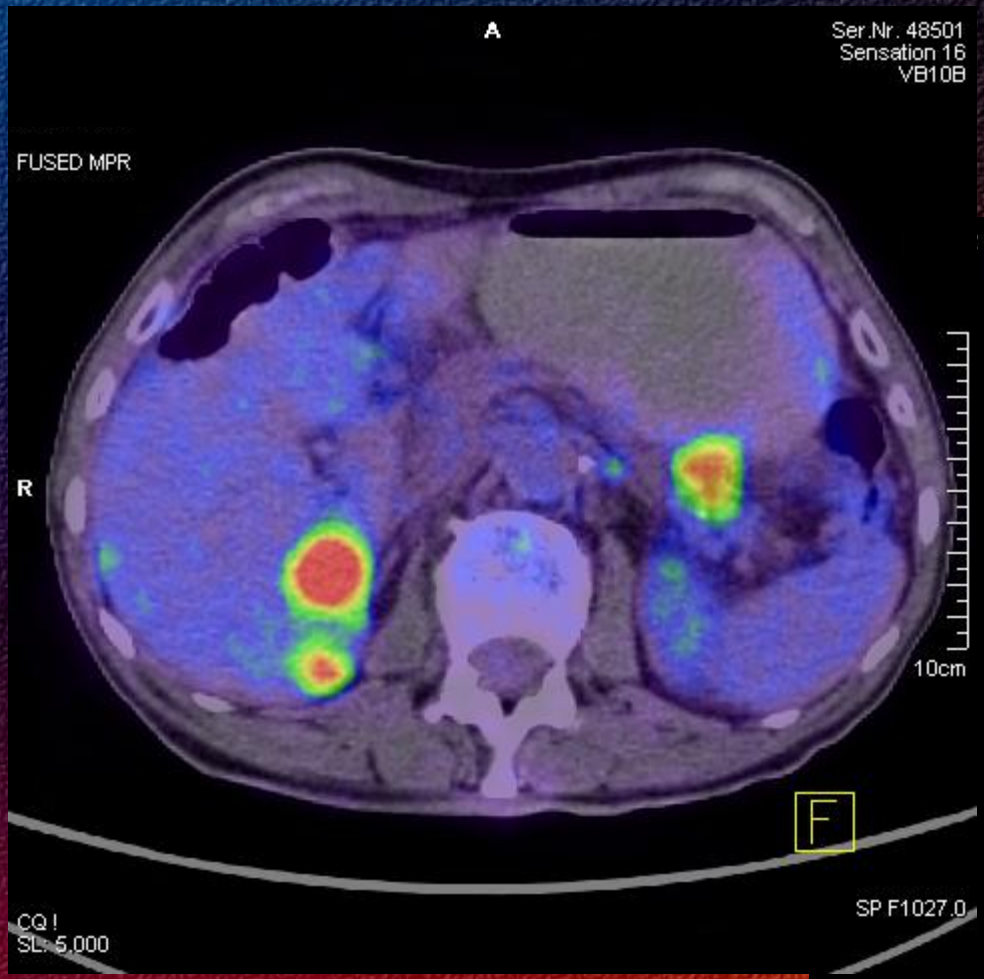

Thill R, *Nuklearmedizin*, 1997:36:234-239, Rini J et al Clin Nucl Med, 2002:27, 572

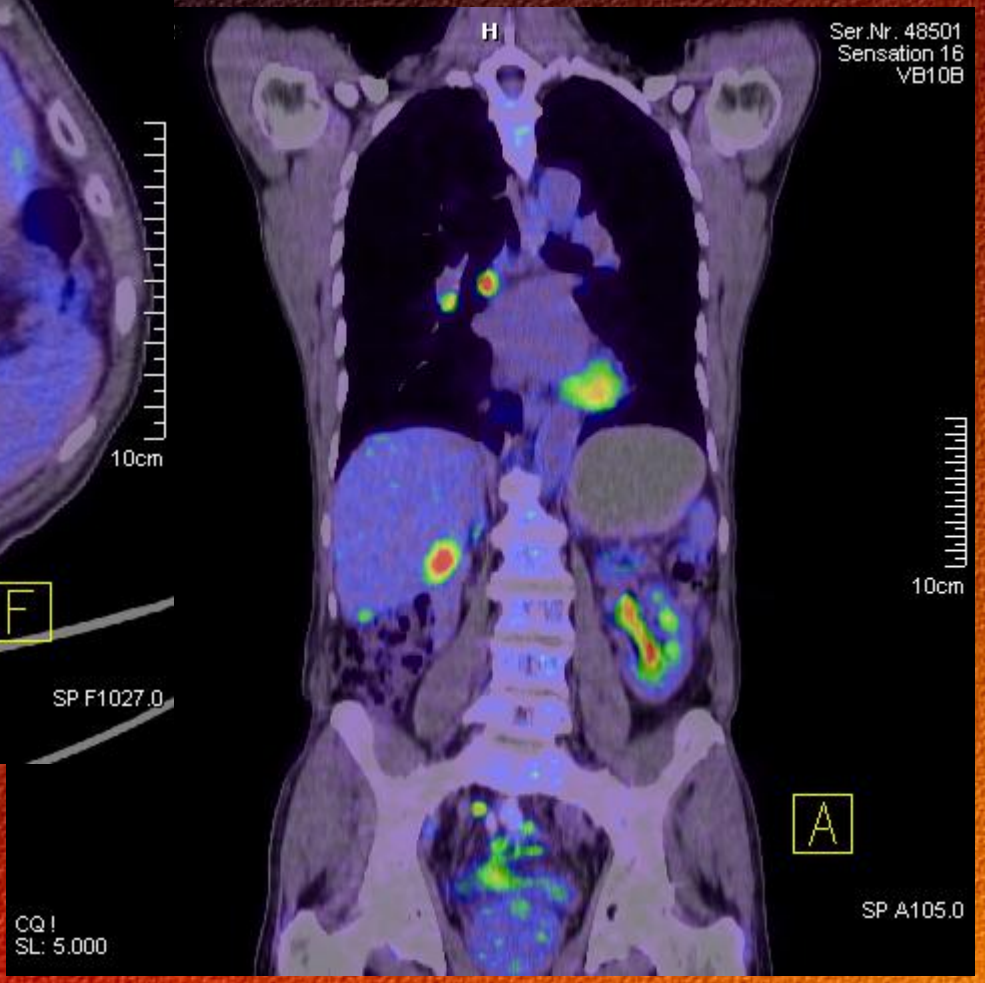
Staging - Adenocarcinoma pulm. l.s





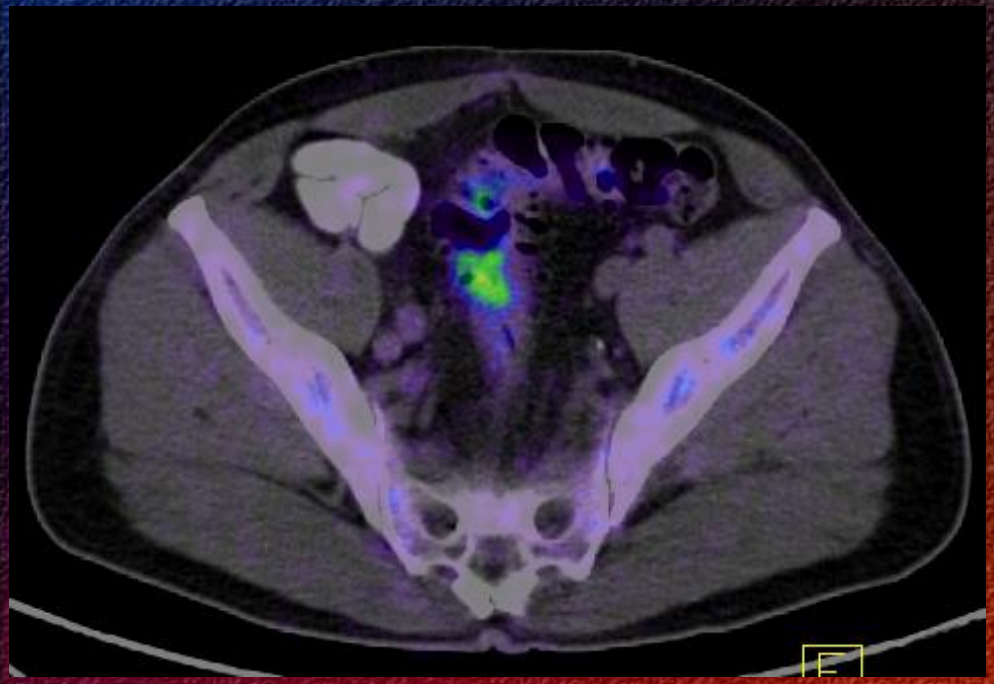


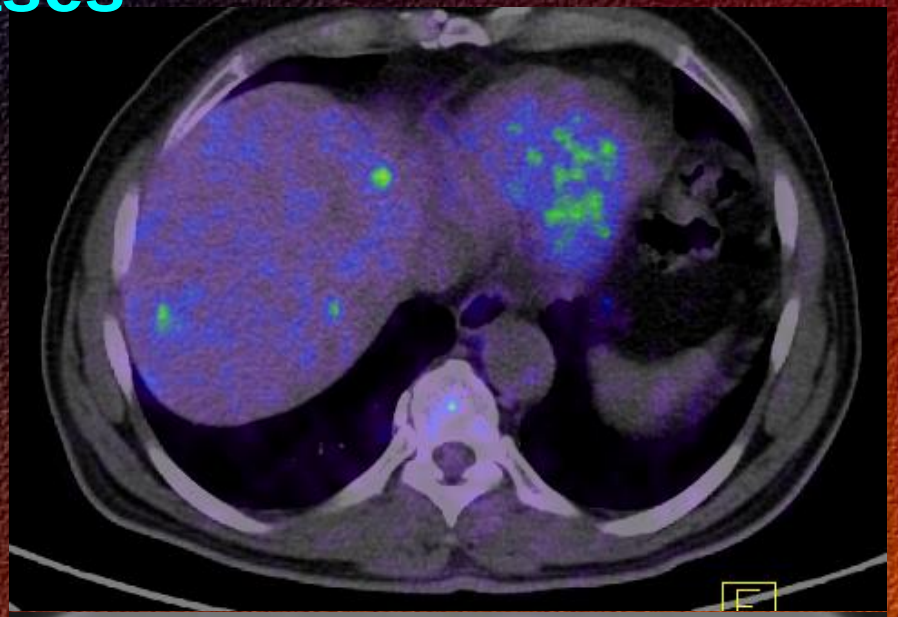




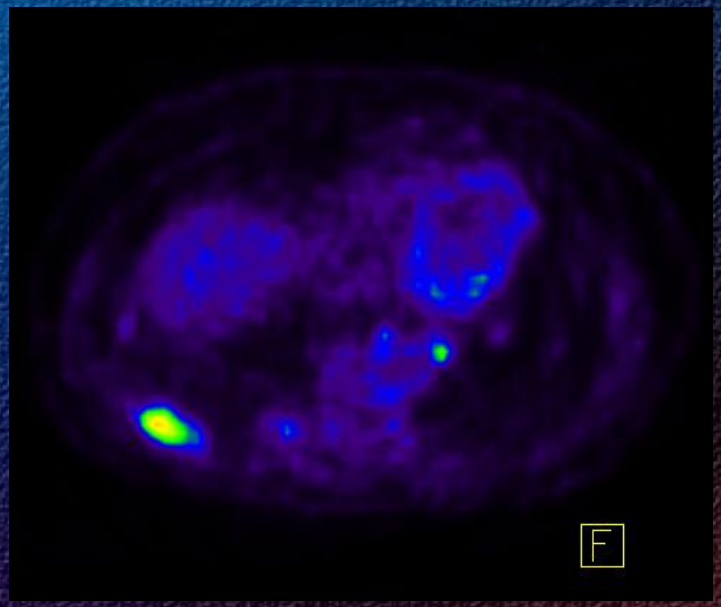
Pancreas cc. - staging

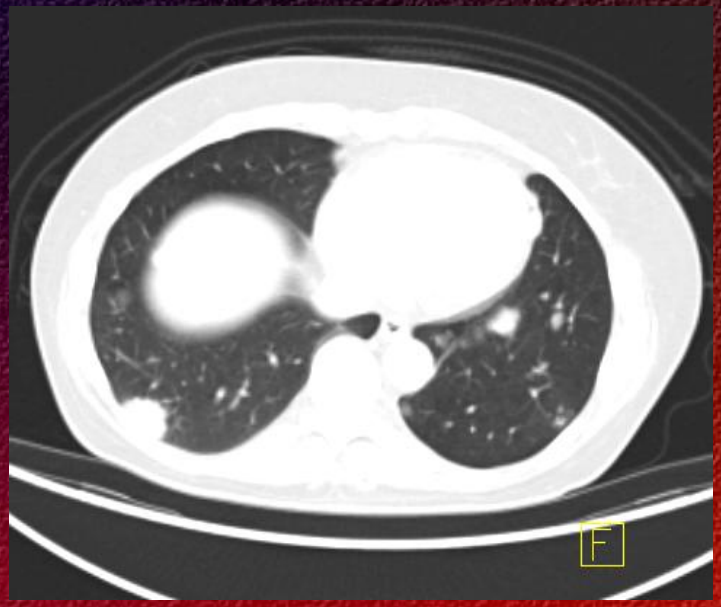
Staging - adenocarcinoma sigmae - liver and lung mtastases

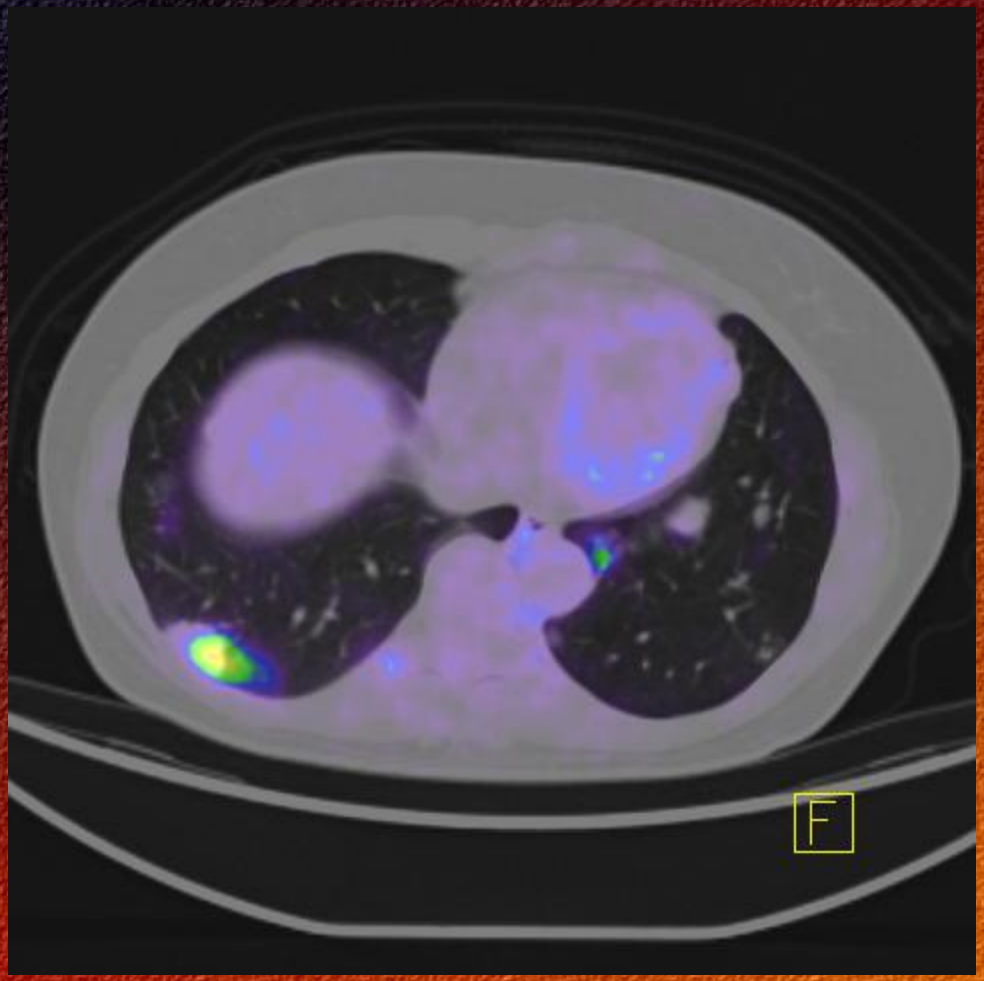




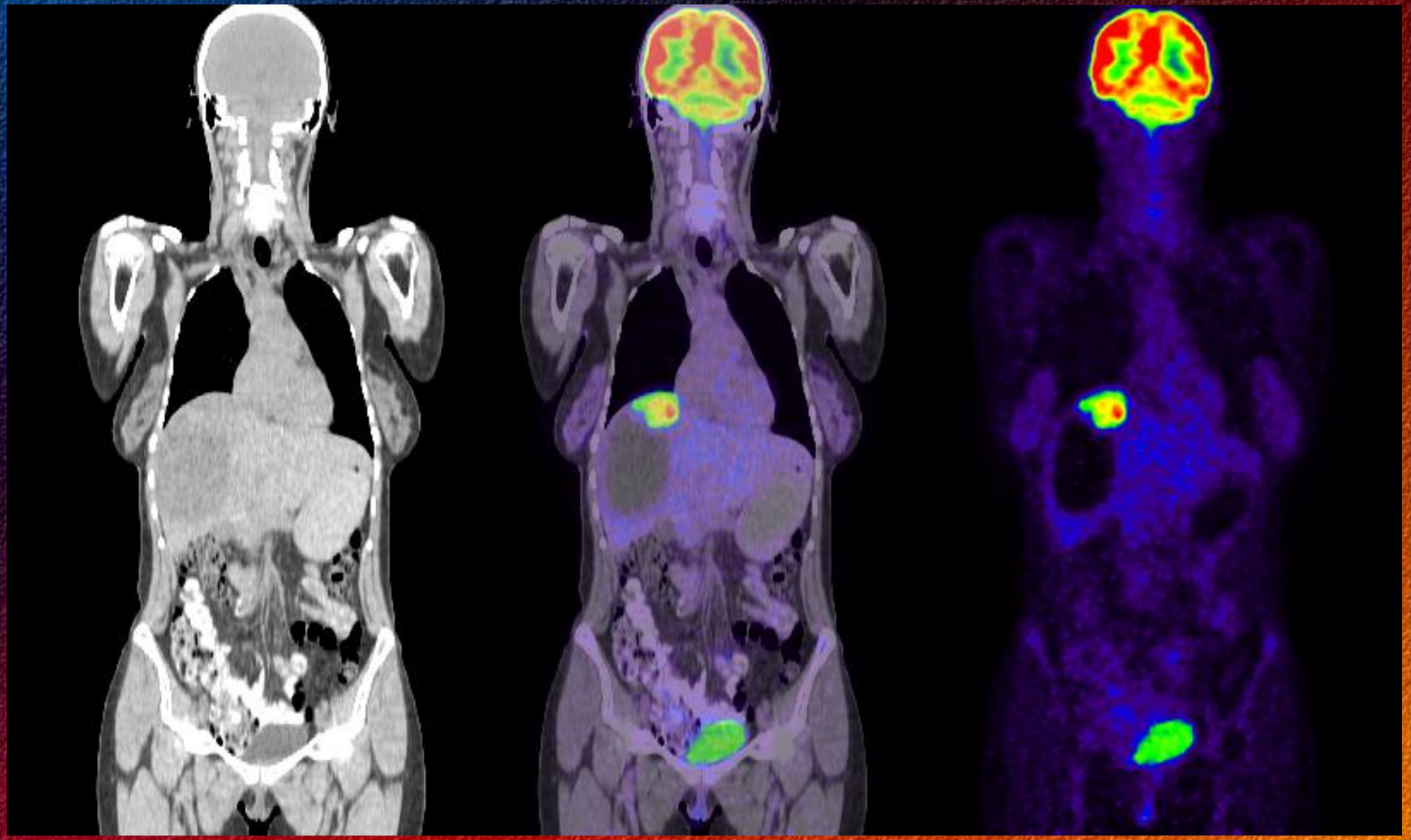
Biopsy



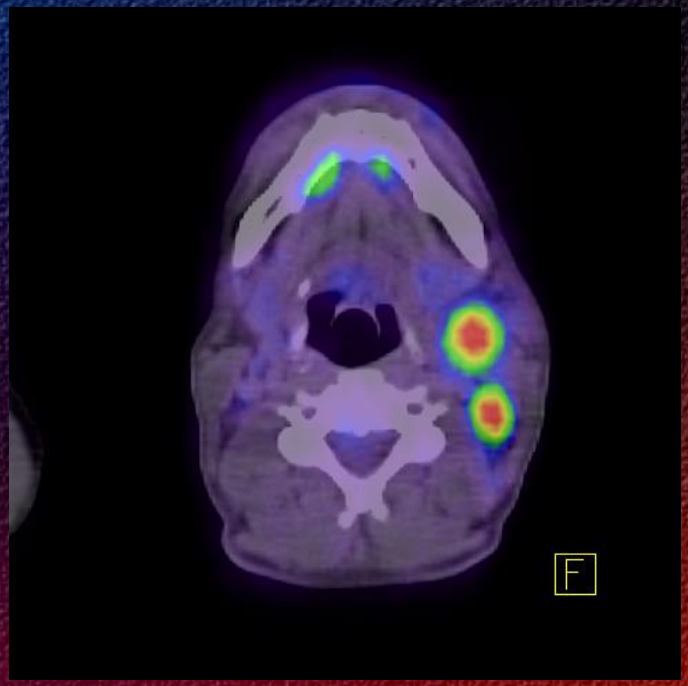


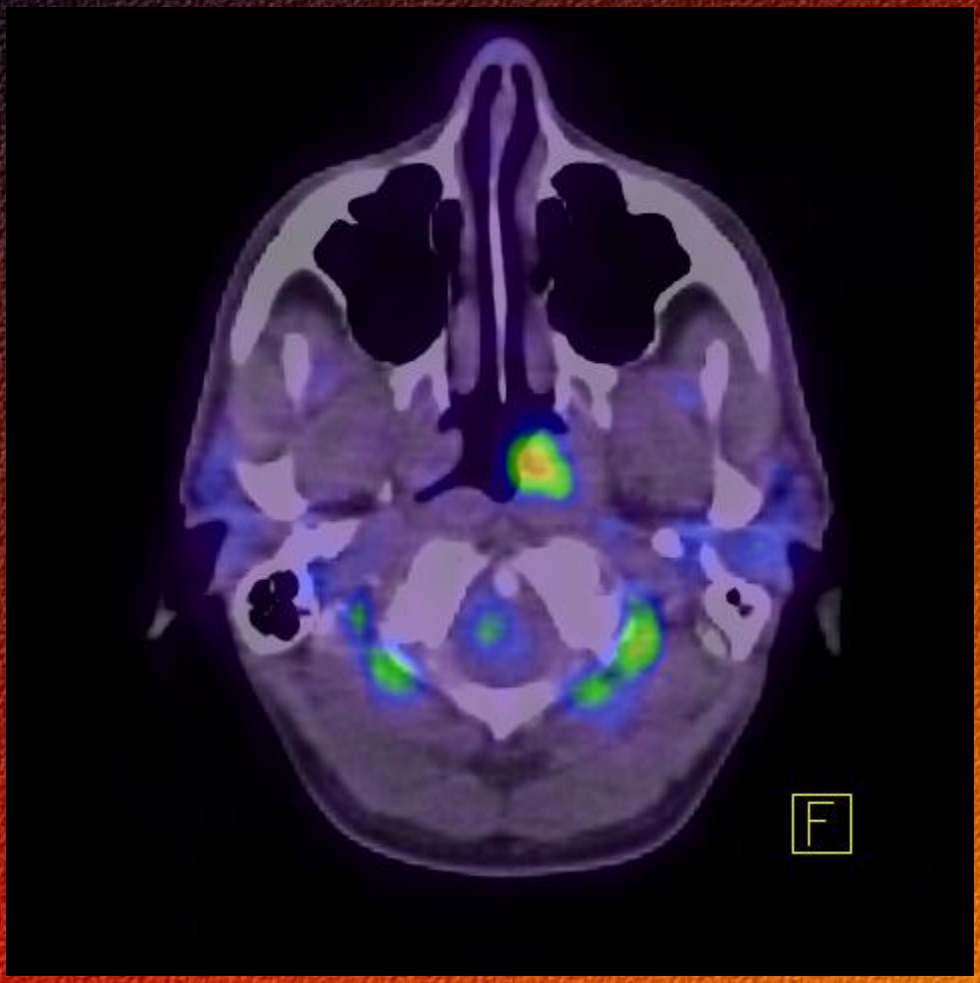


Biopsy

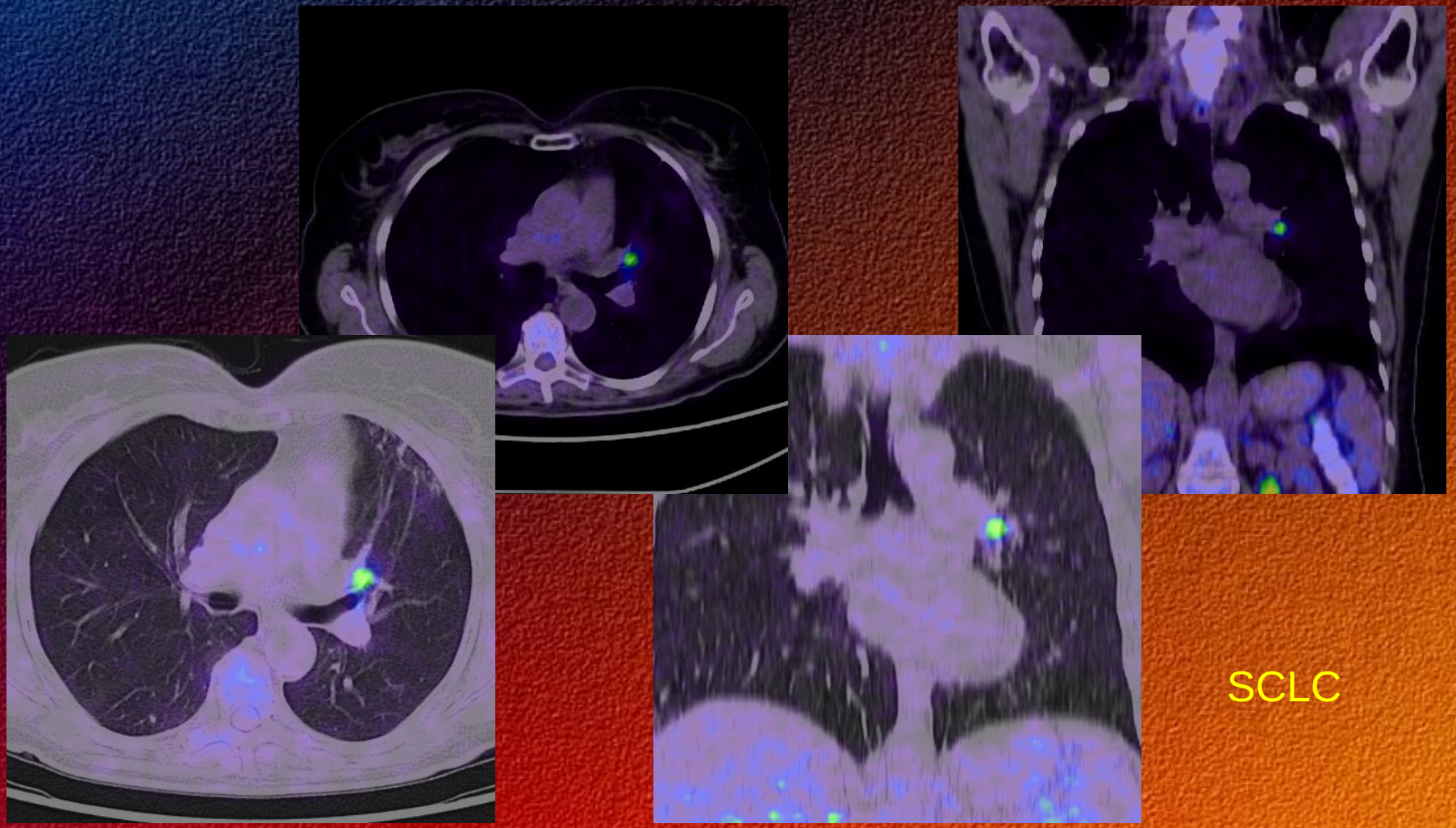


Search of an unknown primary tumour



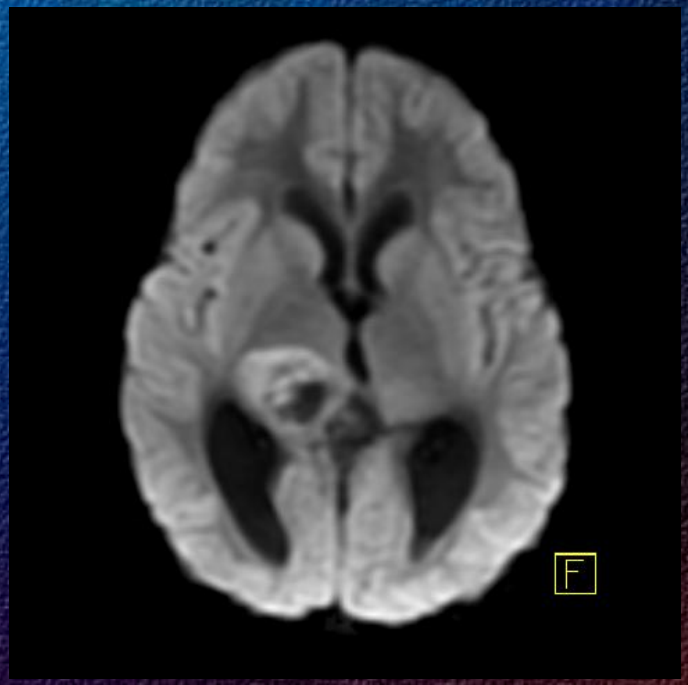


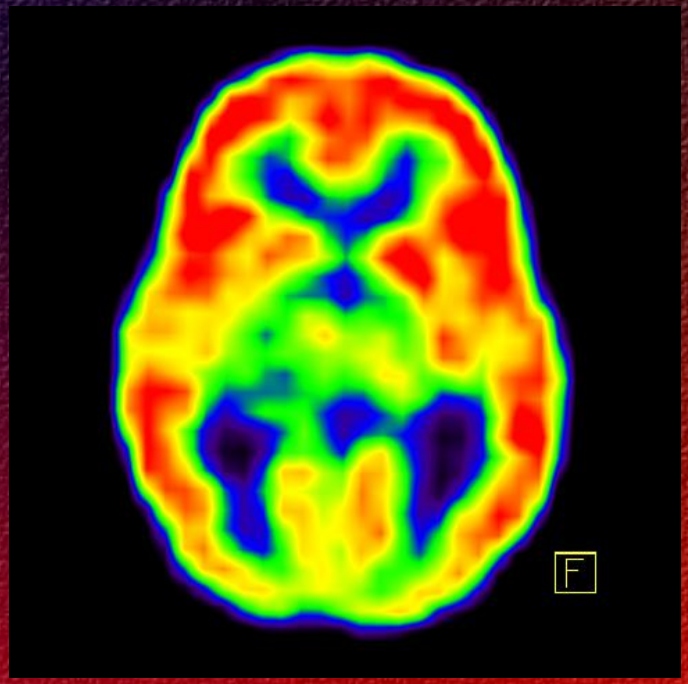
Search of an unknown primary tumour

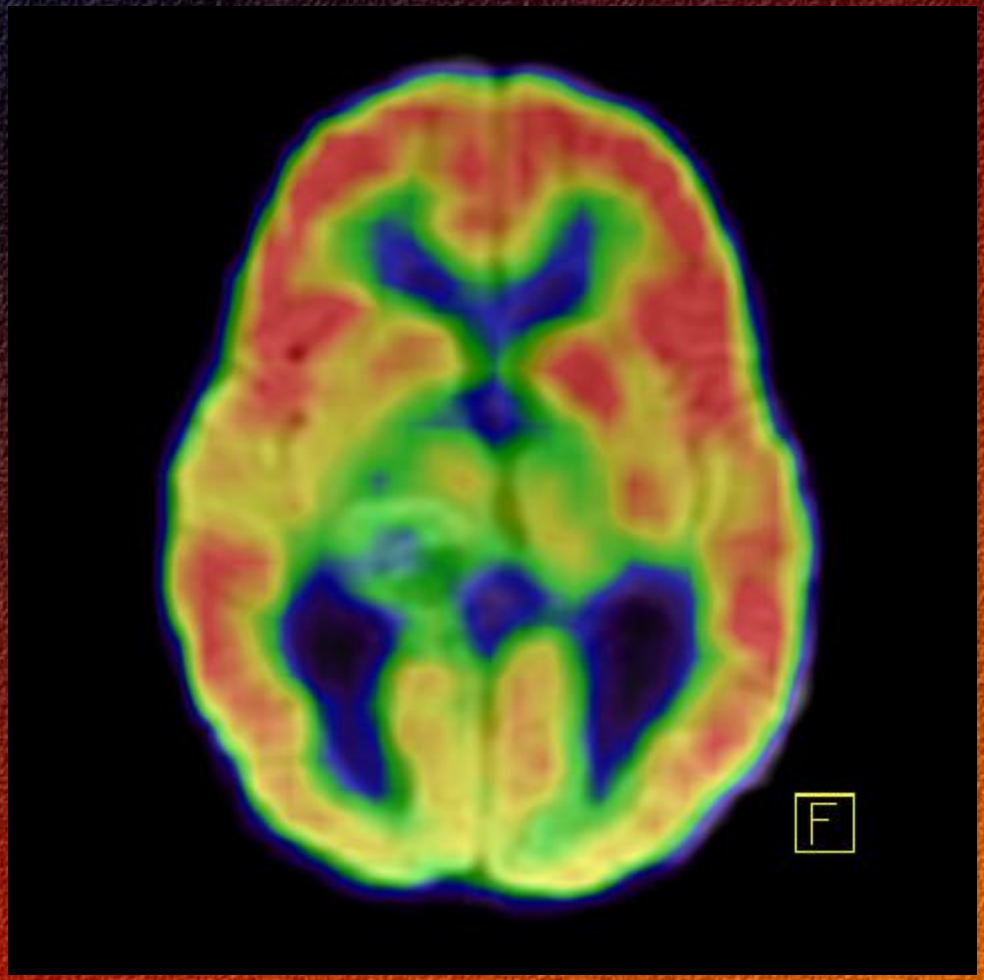


SCLC

Measuring of malignity

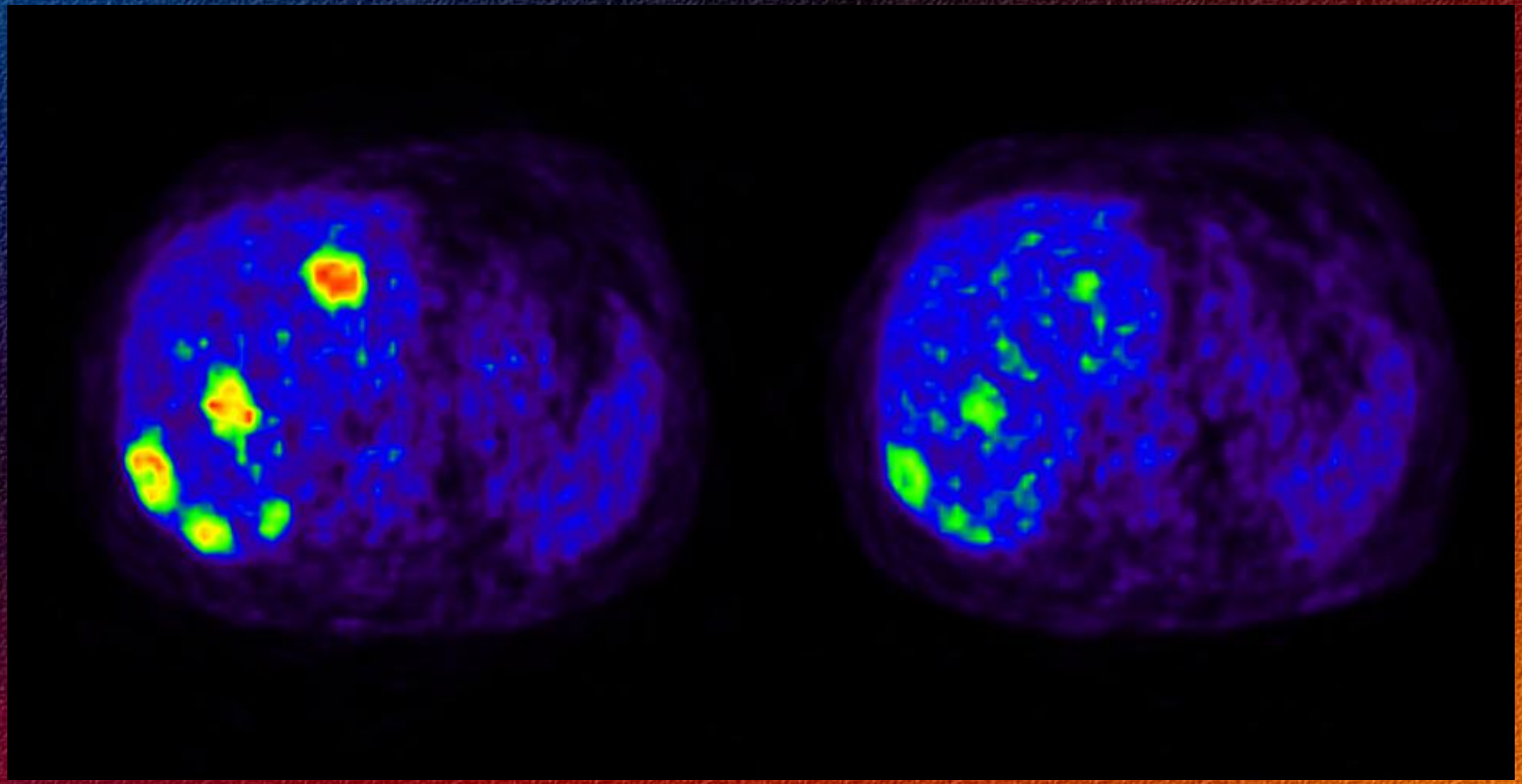






Monitorization of the effectiveness of treatment

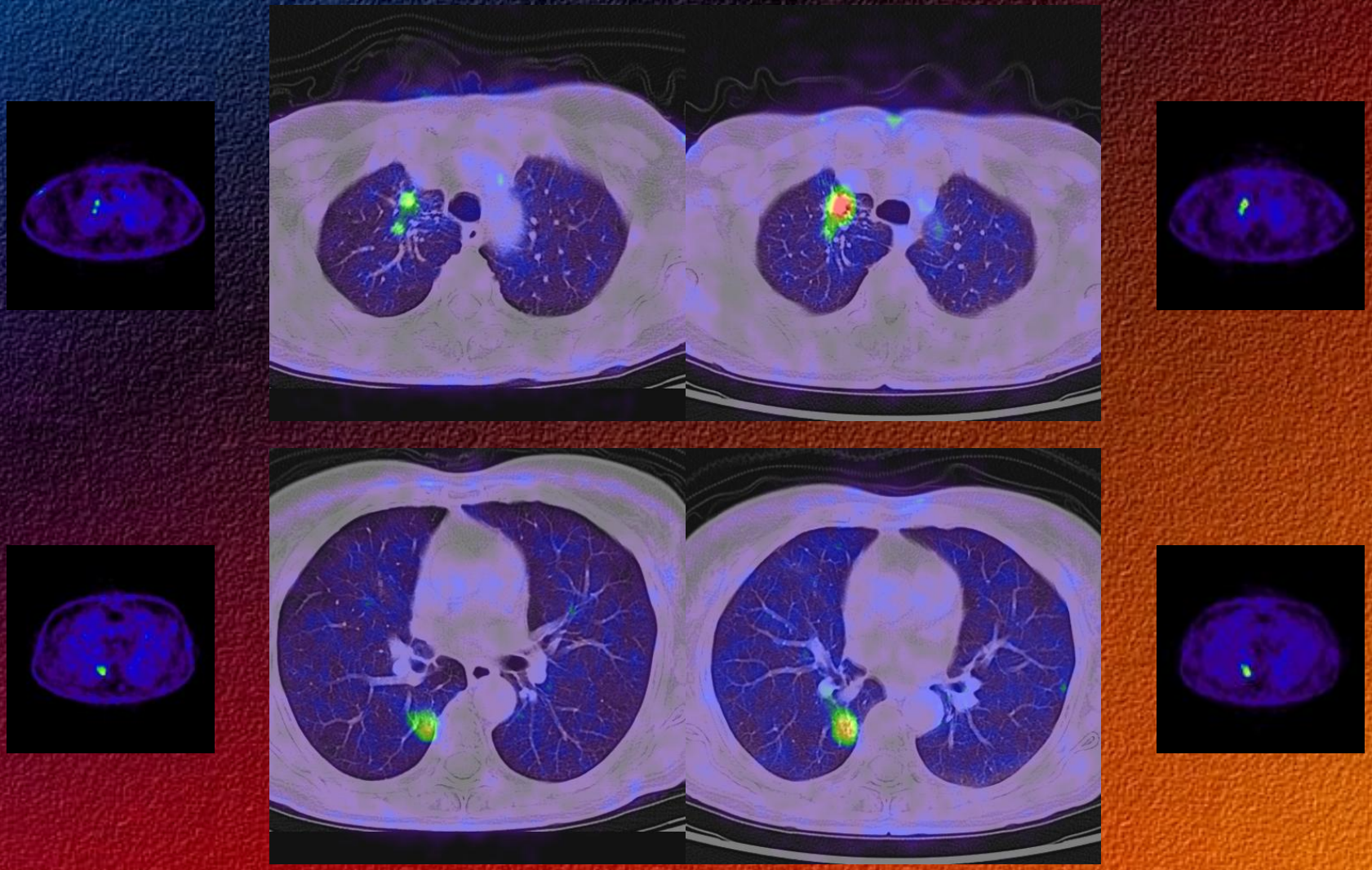
before therapy **after therapy**



Sigma tumour, liver matastases, after therapy (2. cycle)

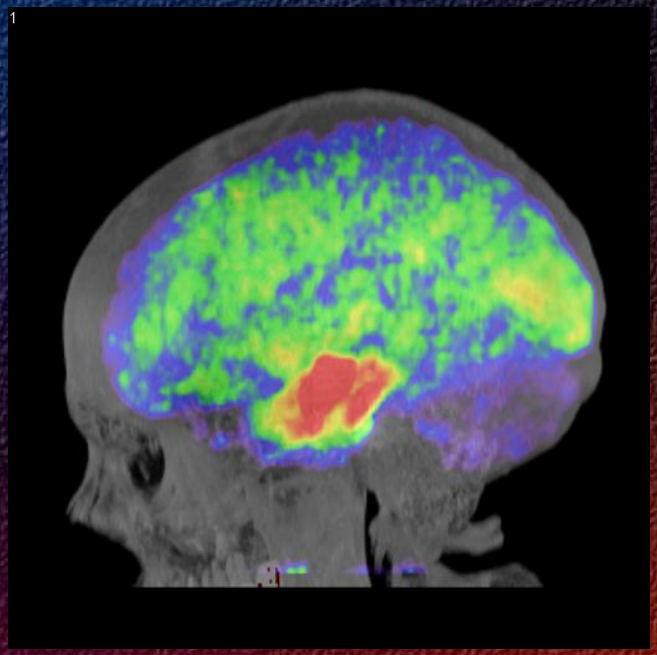
Monitorization of the effectiveness of treatment

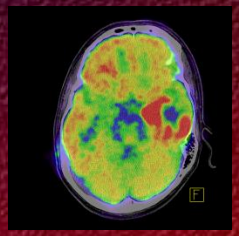
Before th. After th.



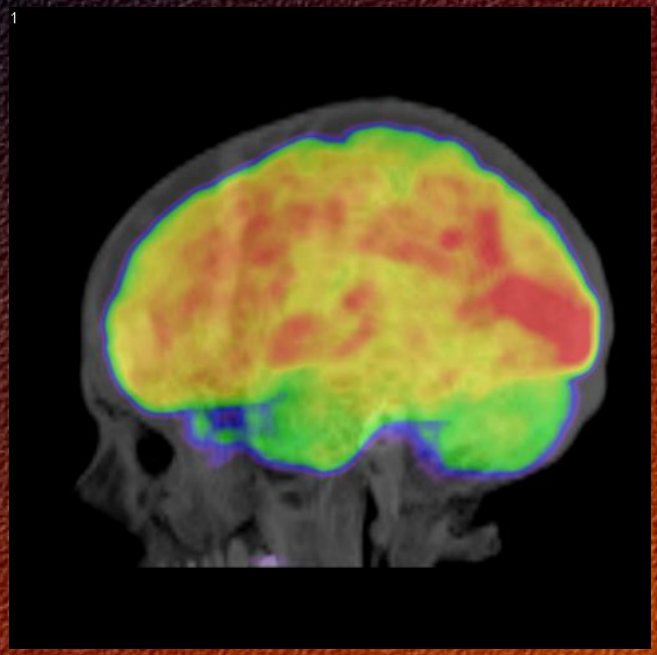
NSCLC

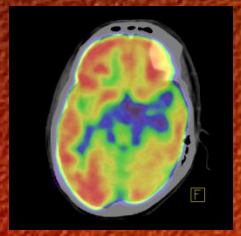
Monitorization of the effectiveness of treatment - NHL





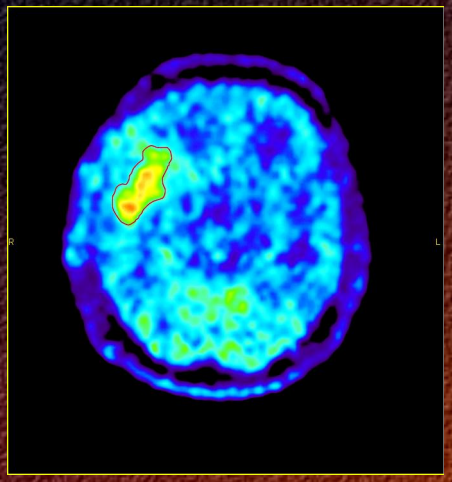
NHL -recurrence

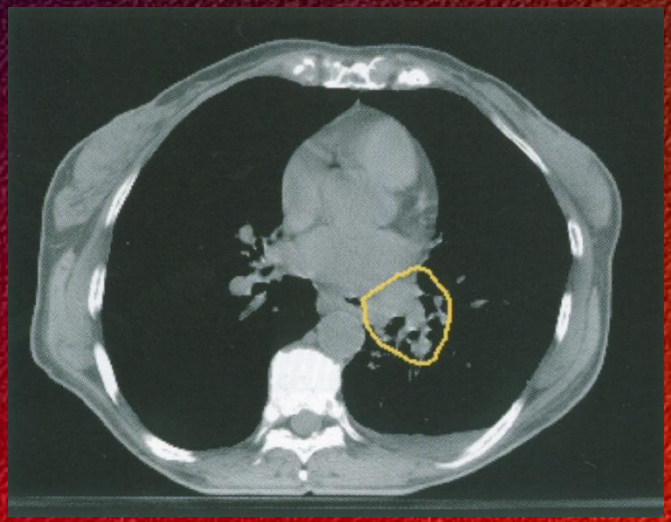


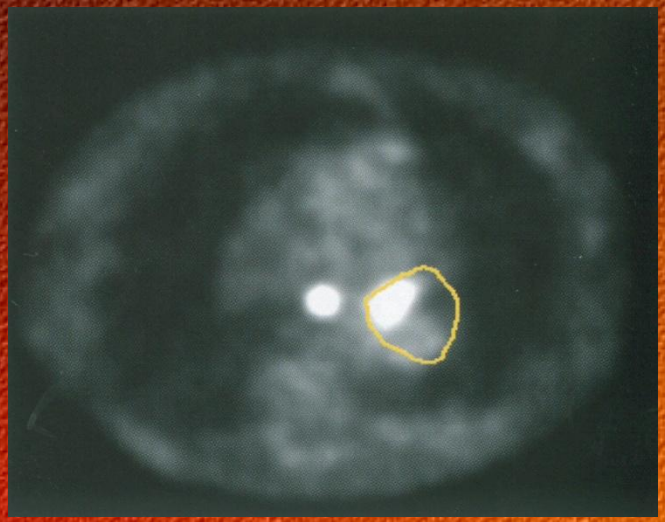


after chemotherapy and embryonic stem cell transplantation

Radiotherapy planning (correct focusing!)







THANKS!


Thanks for your attention!