

LA MEDECINE NUCLEAIRE

Denis MARIANO-GOULART
Département de médecine nucléaire
CHRU de Montpellier
<http://scinti.edu.umontpellier.fr>



Imagerie médicale

ANATOMIQUE

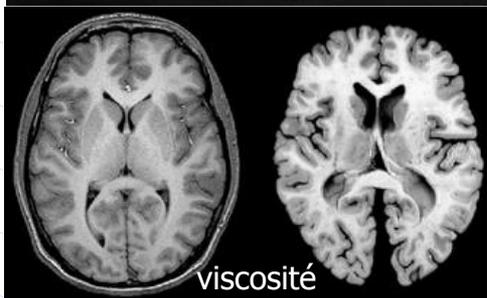
Echographie



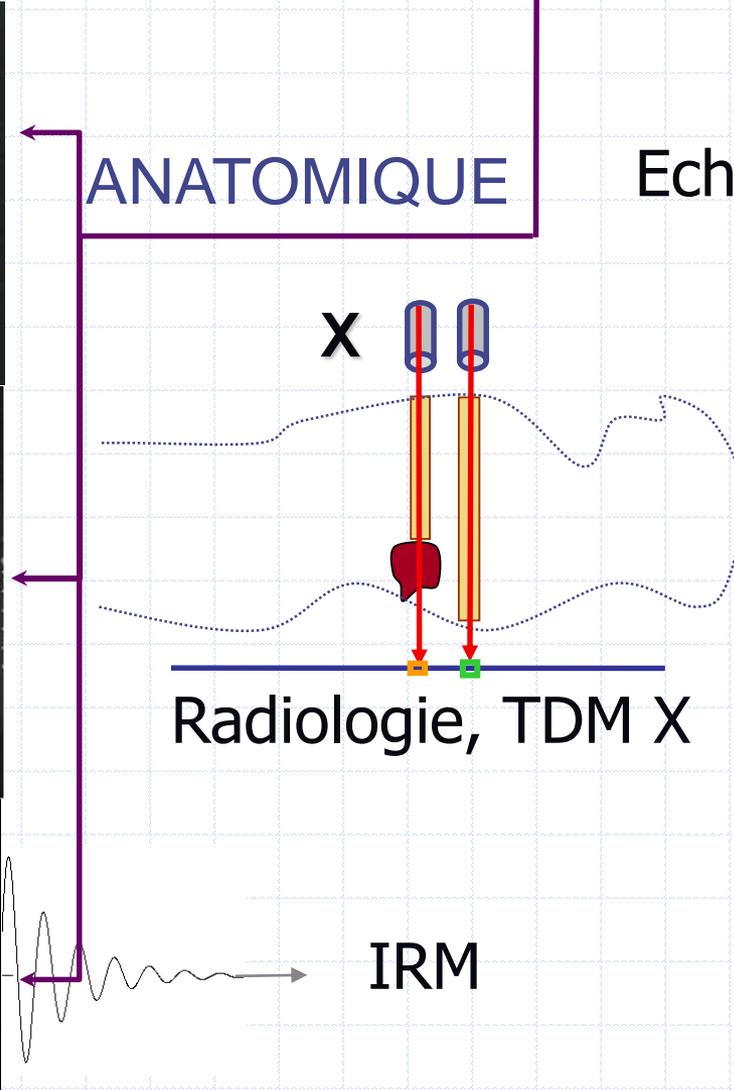
densité



densité



viscosité

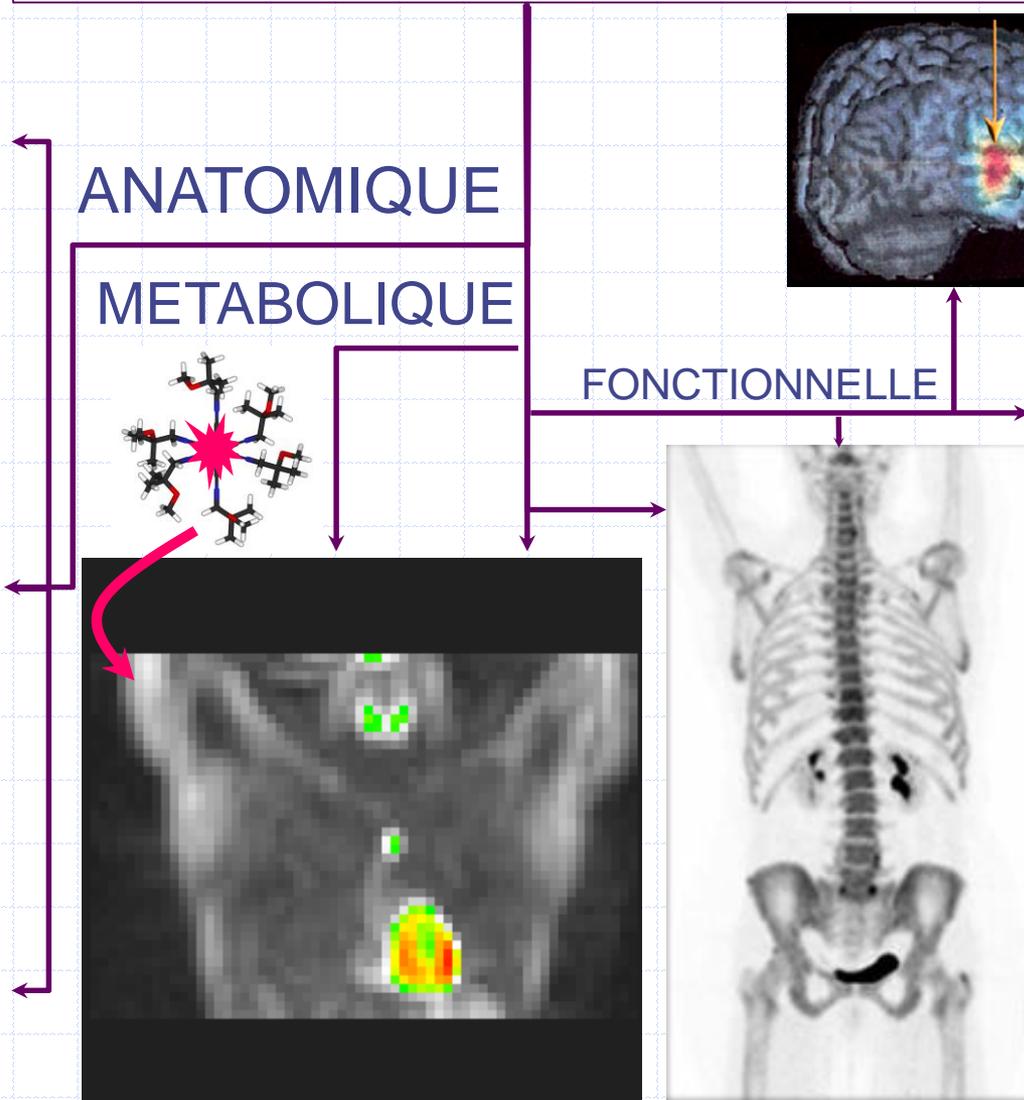
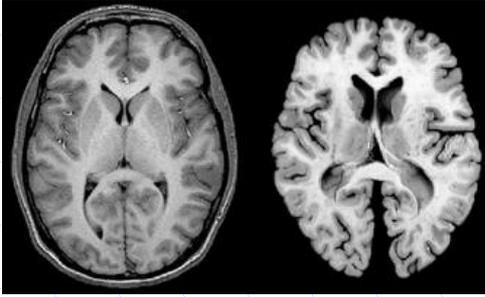
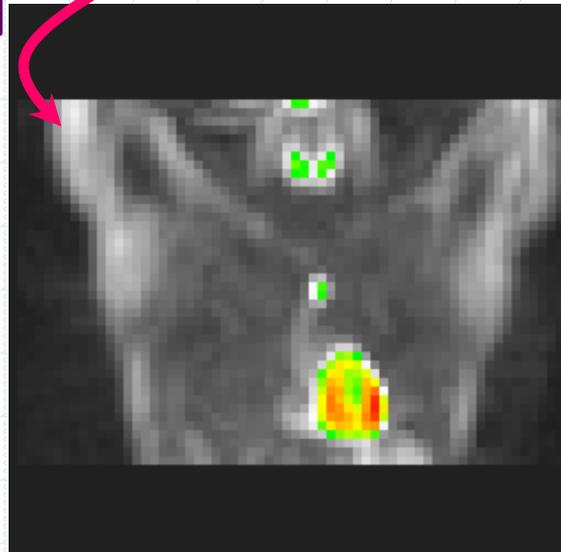
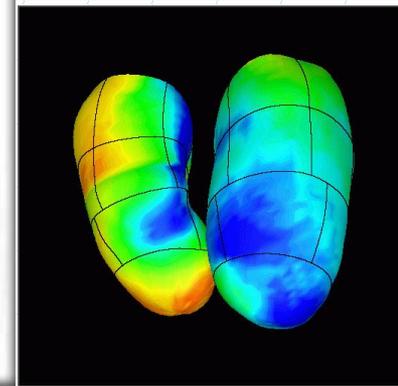
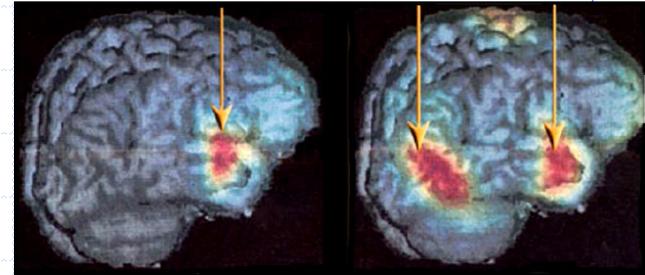
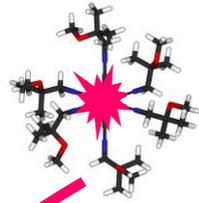


Imagerie médicale

ANATOMIQUE

METABOLIQUE

FONCTIONNELLE



Médecine Nucléaire

Utilisation de **marqueurs radioactifs** pour tracer le devenir d'un **vecteur** dans un but diagnostique ou thérapeutique

IMAGERIE
DIAGNOSTIQUE
METABOLIQUE

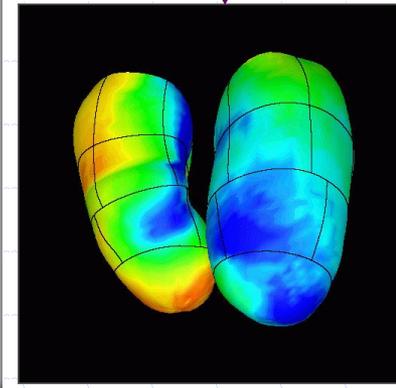
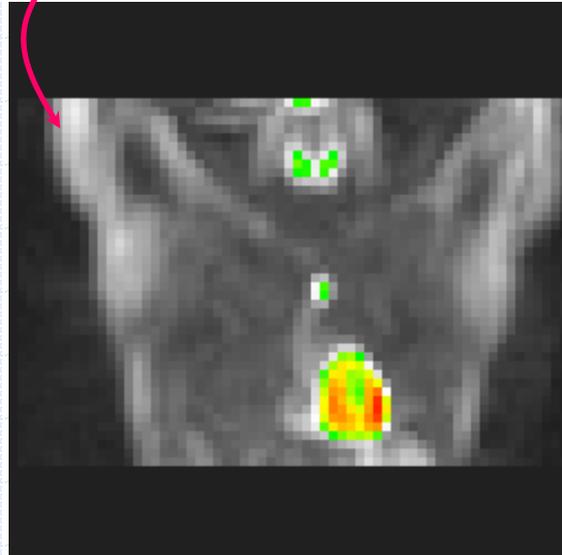


RADIOTHERAPIE METABOLIQUE
VECTORISEE

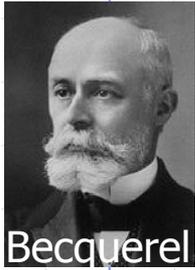
DETECTION PER-OPERATOIRE

DOSAGES RADIOIMMUNOLOGIQUES

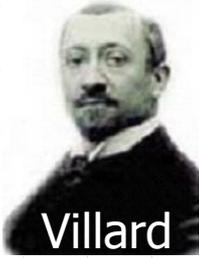
IMAGERIE DIAGNOSTIQUE FONCTIONNELLE



UN PEU D'HISTOIRE



Becquerel



Villard

Radioactivité

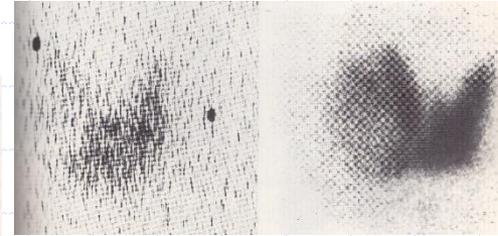
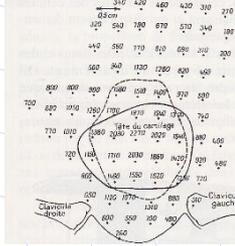
α

γ



Anger

détecteur à scintillation



Traceurs cliniques γ



CZT

1896

1900

1934

1940

1950

1956

1970

1979

2000 2005



P & M Curie

Radium
Polonium

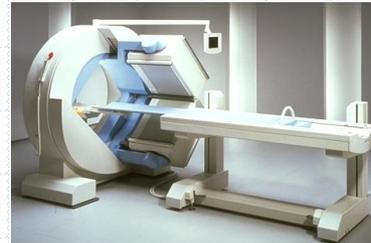


Joliot-Curie

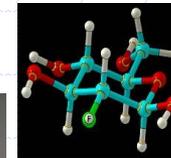
Radioactivité
artificielle et β^+

détecteur à coïncidence

γ -caméra



FDG
TEMP



TEMP-TDM
TEP-TDM

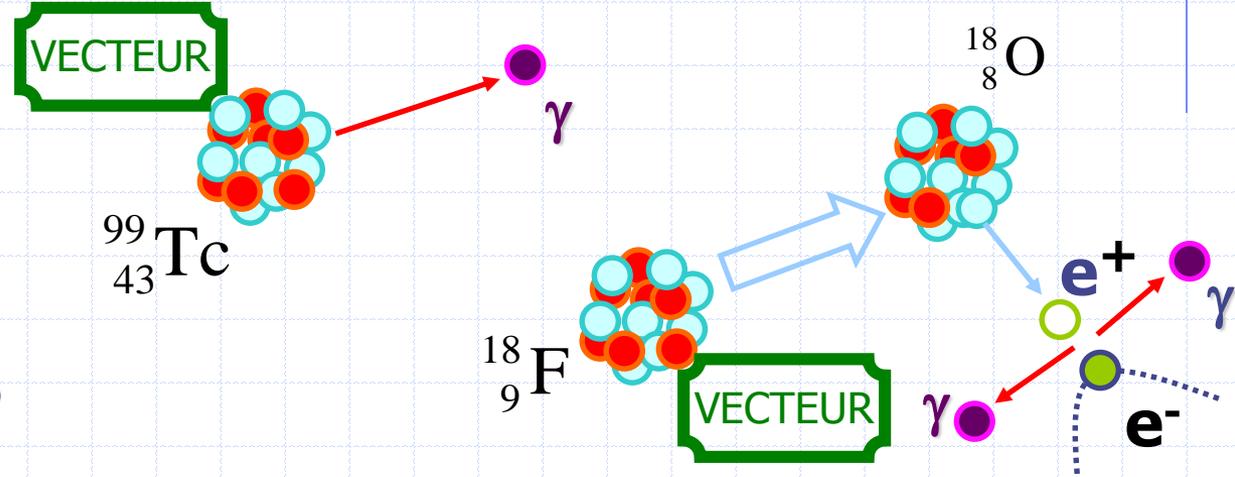


LES RADIOACTIVITES UTILES

• IMAGERIE

• GAMMA

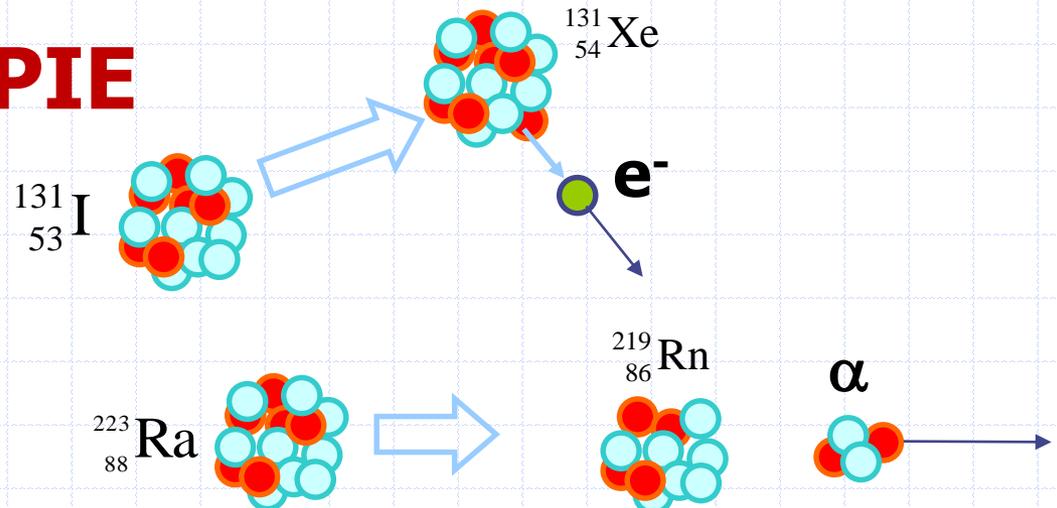
• BETA PLUS



• RADIOTHERAPIE

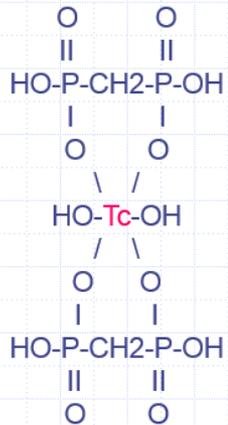
• BETA MOINS

• ALPHA

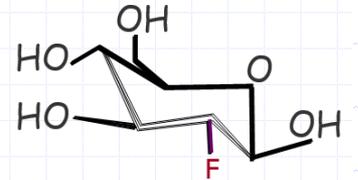
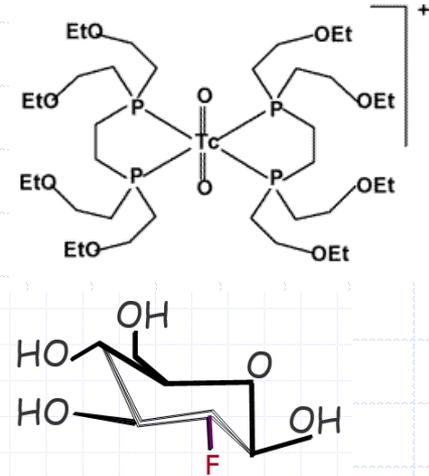


LES RADIOTRACEURS UTILES

- Atomes ou molécules, dont la fixation est liée une :



- **perfusion** :
cérébrale, pulmonaire, rein, myocardique
- **fonction cellulaire**:
os, surrénale, thyroïde, cerveau, cancers
- **excrétion**: rénale, hépato-biliaire, salivaire



- Gaz et aérosols : Ventilation pulmonaire

$^{81}_{36}\text{Kr}$

- Cellules

- globules rouges : fonction cardiaque, hémorragies
- polynucléaires : infection
- Plaquettes : fonction splénique, séquestration

Les étapes d'un examen



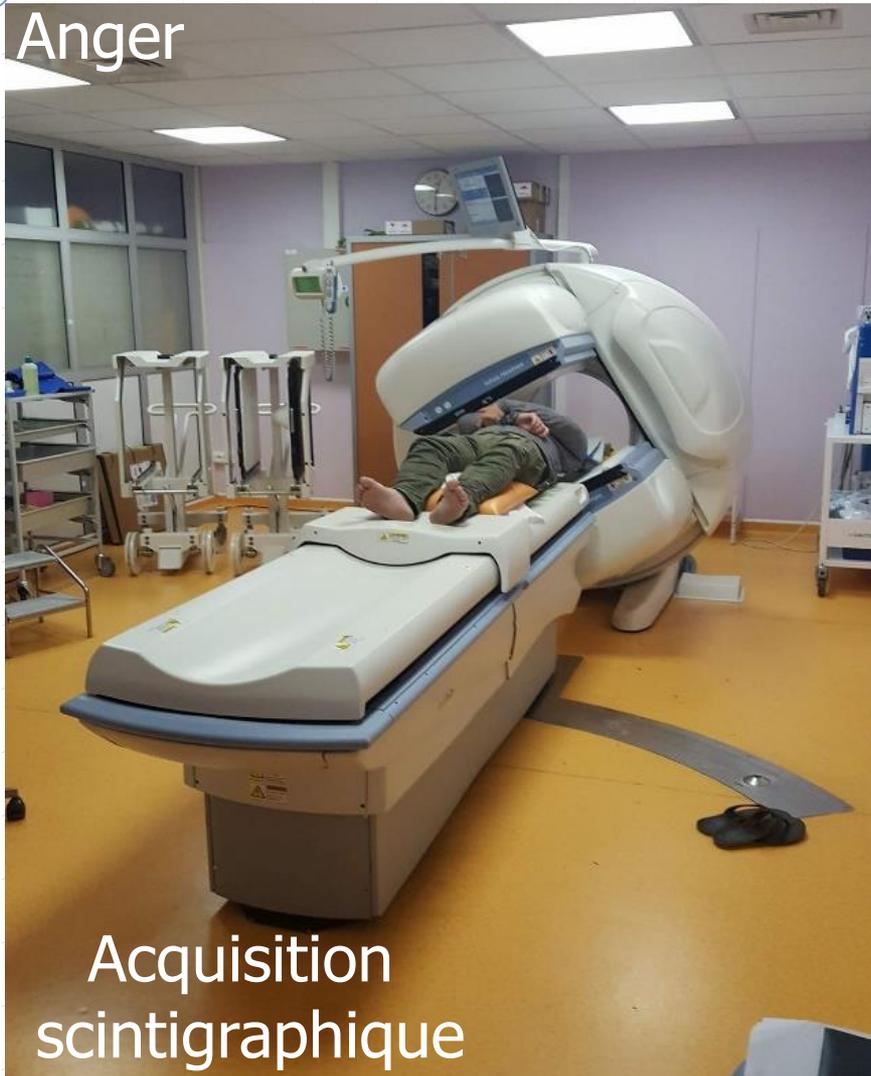
Marquage du vecteur par un isotope radioactif
Préparation de la seringue

Les étapes d'un examen



Les étapes d'un examen

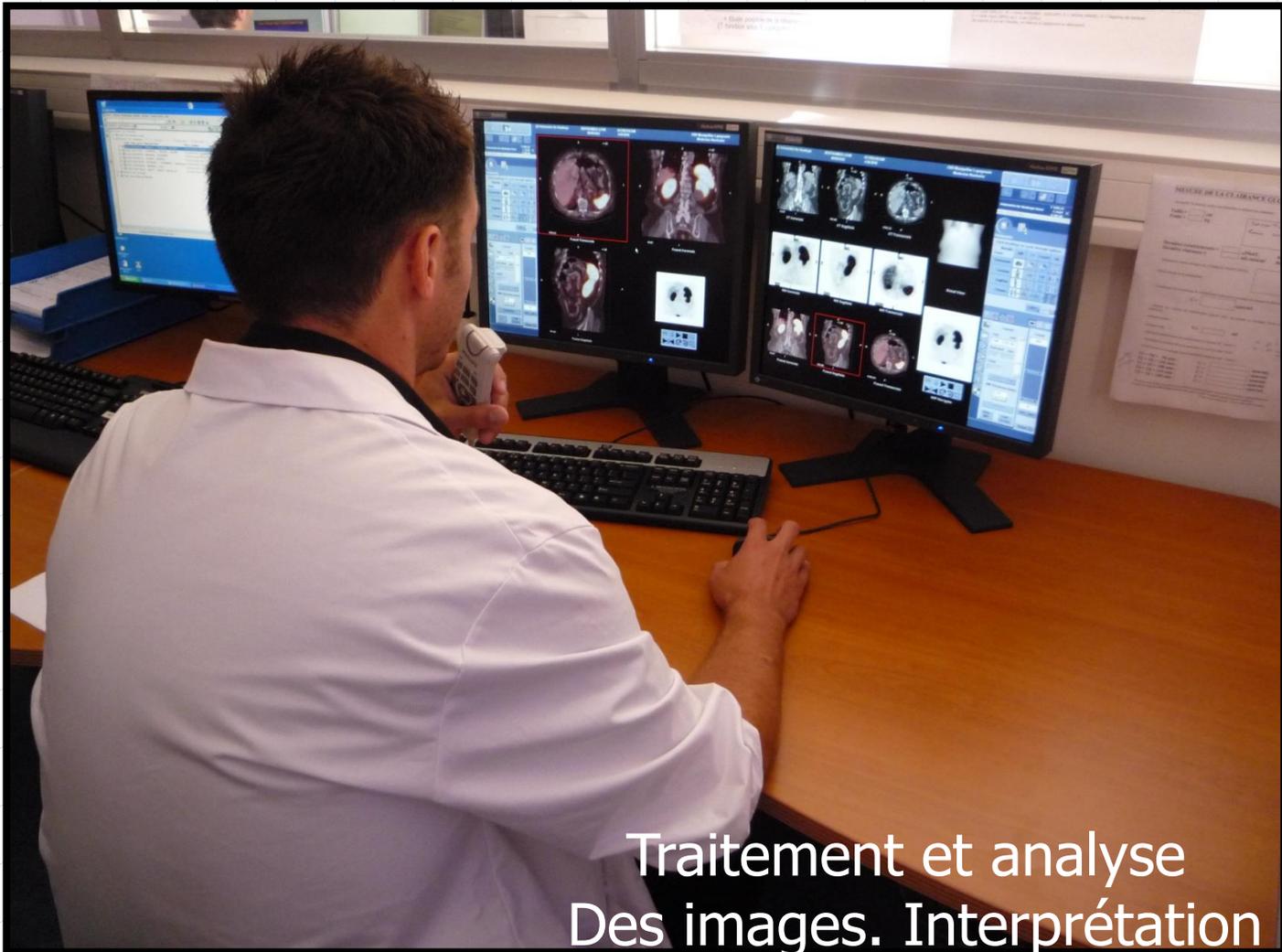
Anger



CZT

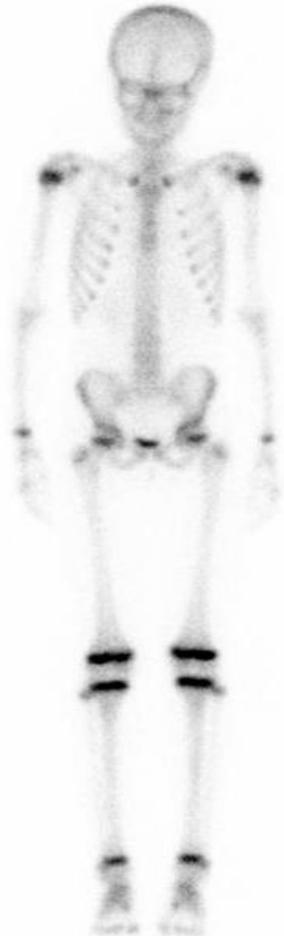


Les étapes d'un examen

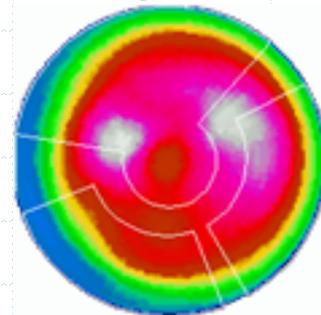
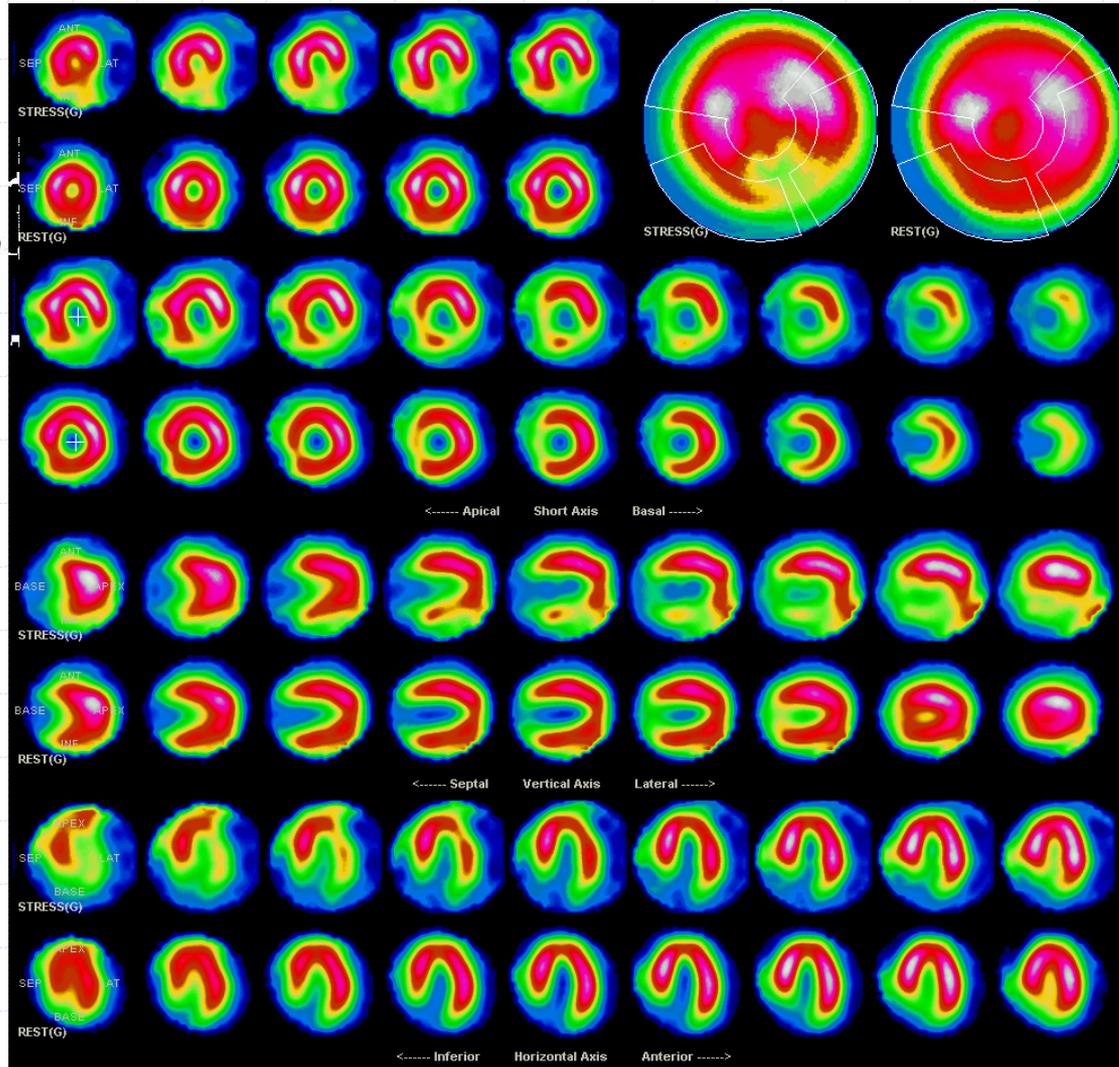
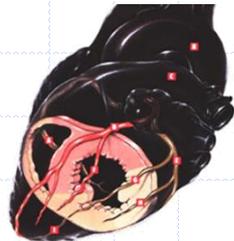


Traitement et analyse
Des images. Interprétation

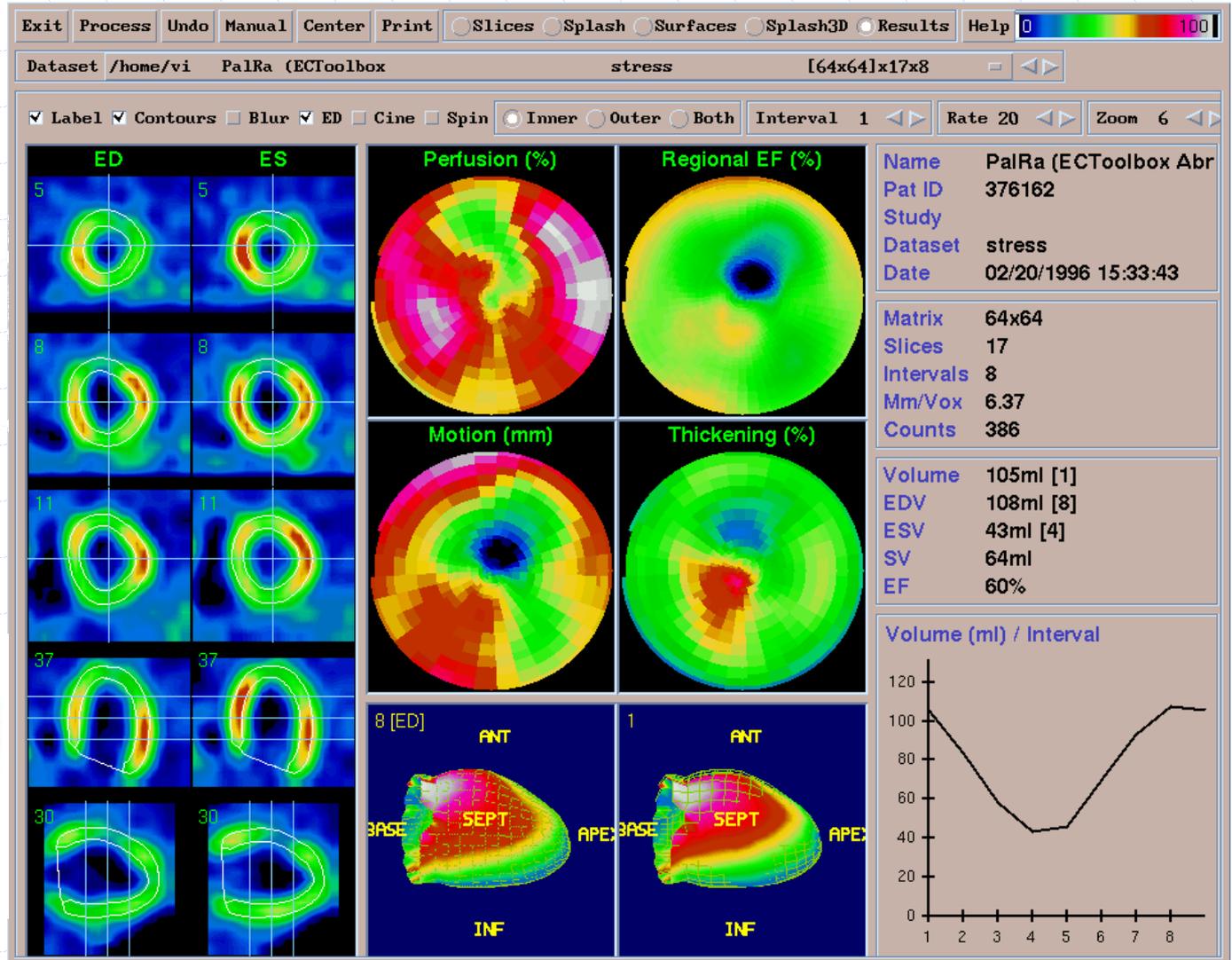
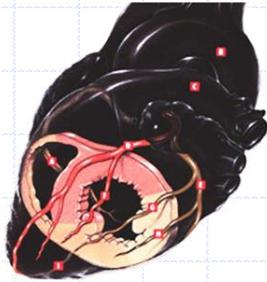
Métabolisme osseux (BP- ^{99m}Tc)



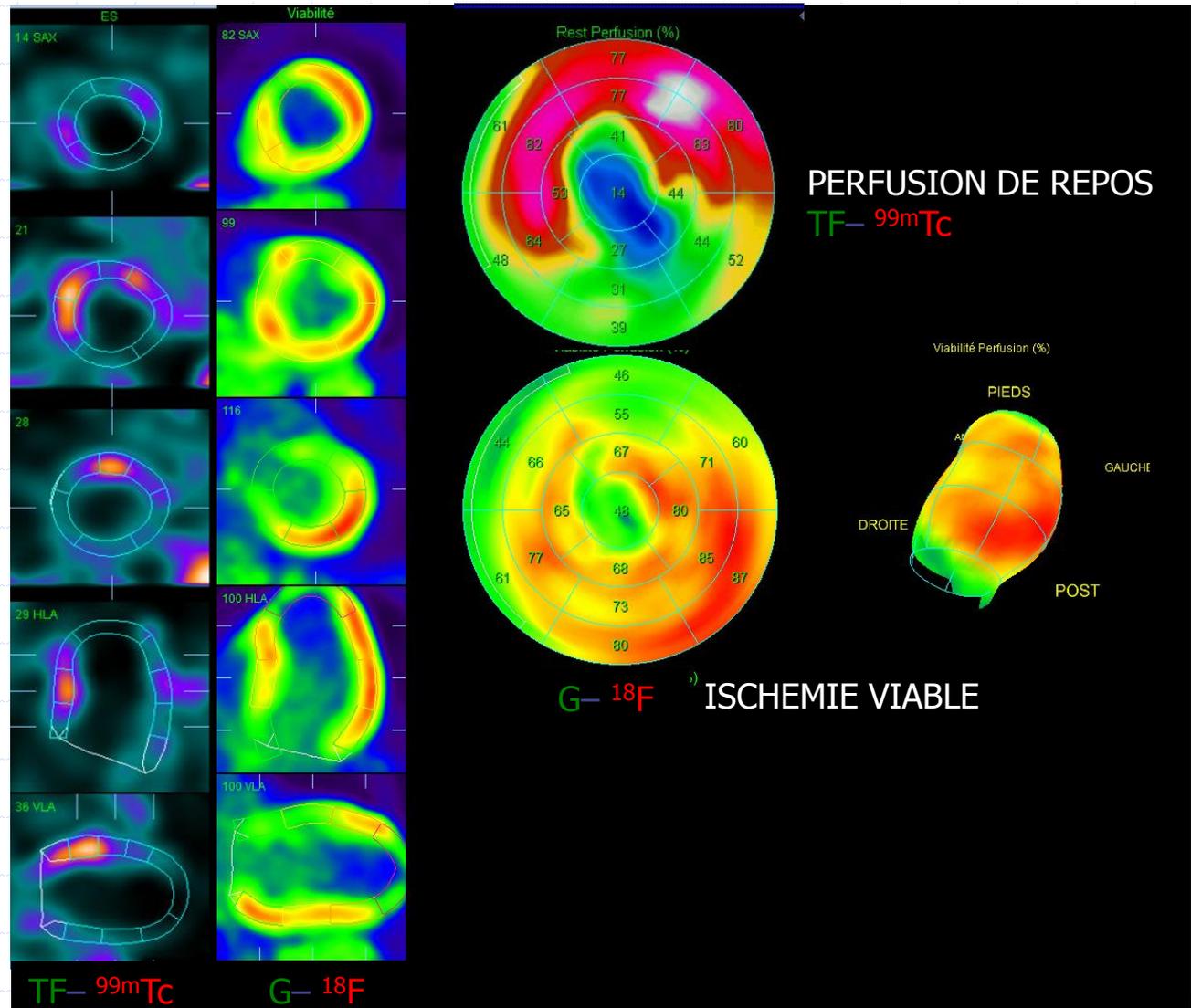
Perfusion myocardique (TF-^{99m}Tc)



Perfusion myocardique (TF-^{99m}Tc)



Viabilité myocardique (^{18}F -DG)



Fonction contractile cardiaque

Fraction d'éjection systolique (%)

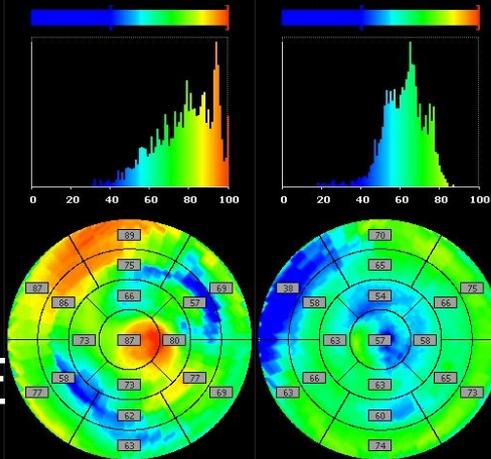
FES (%) : 78 +/- 15

FES (%) : 62 +/- 11

VD

VG

FE

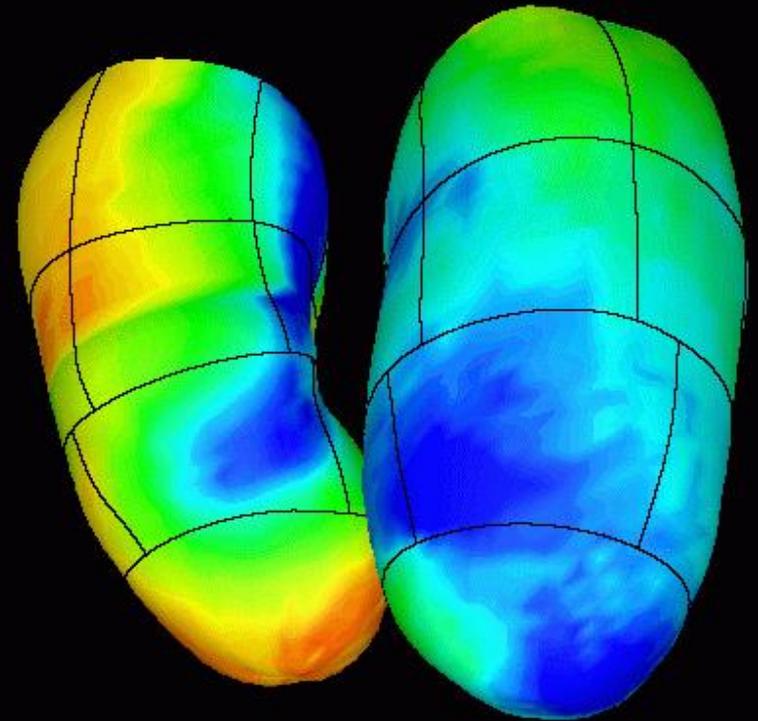
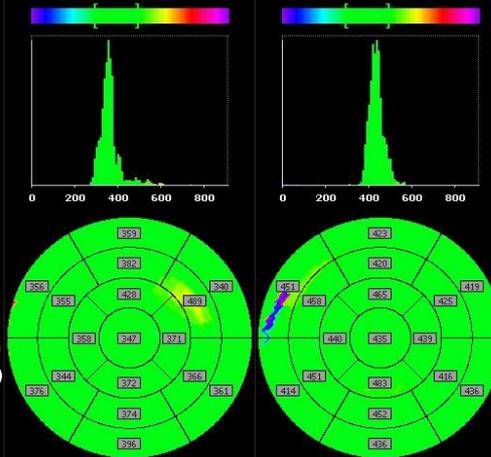


Temps de fin de systole (ms)

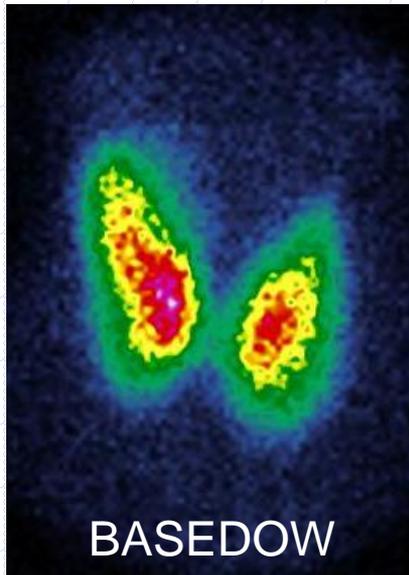
TFS (ms) : 358 +/- 50

TFS (ms) : 434 +/- 42

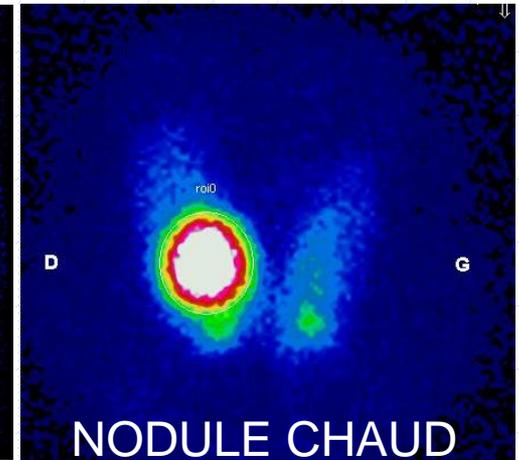
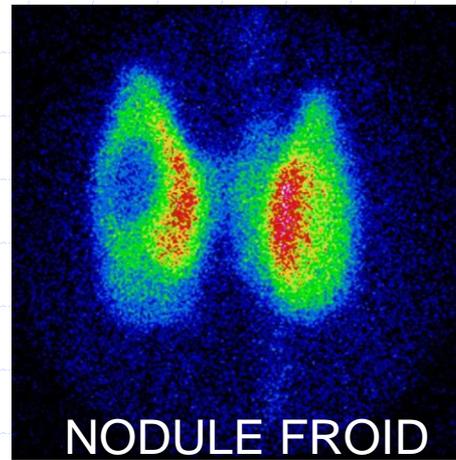
TES



Fonction thyroïdienne



$^{99m}\text{Tc} - \text{O}_4^-$
Traceur thyroïdien

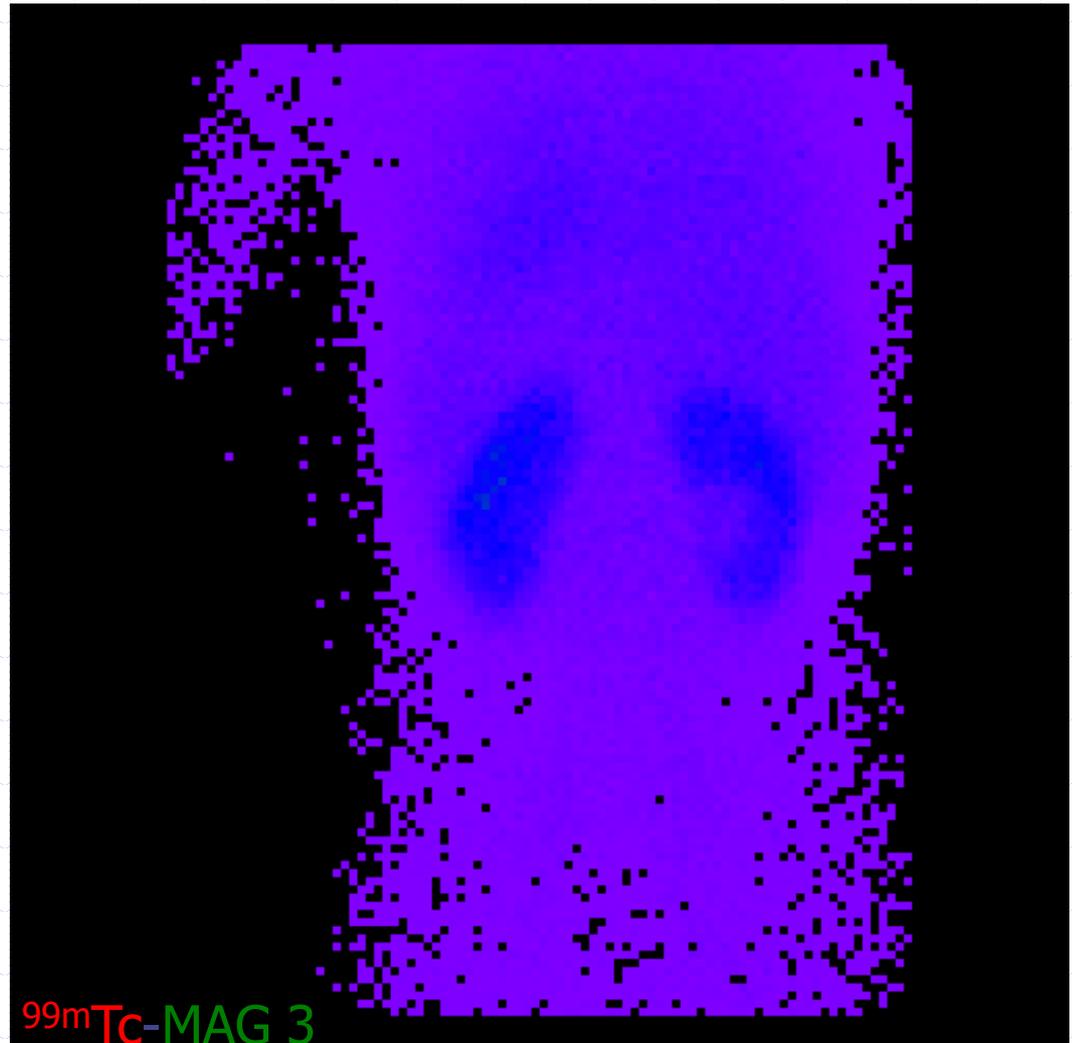


cancer \Rightarrow froid
chaud \Rightarrow bénin

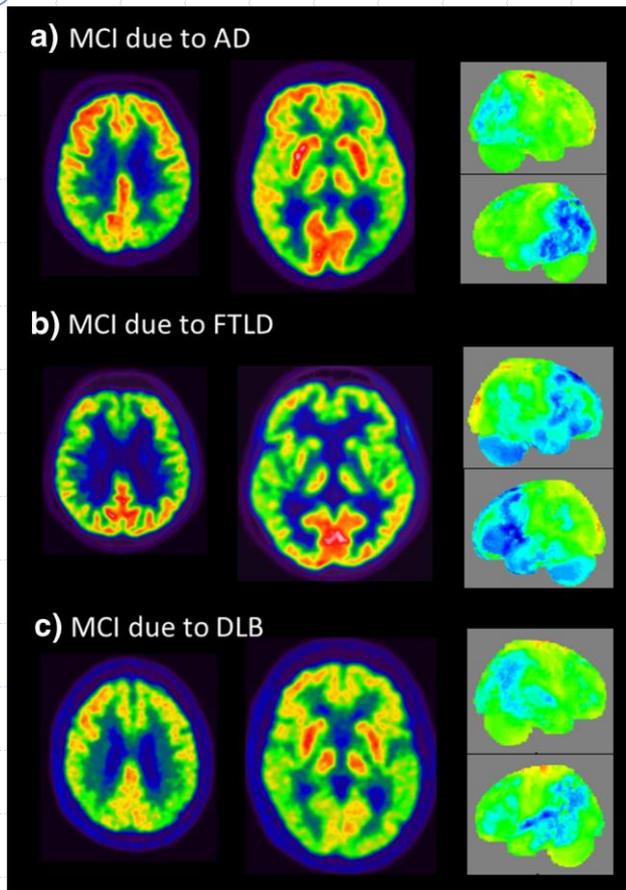
mais une ponction
sous échographie
est plus efficace

Indications : hyperthyroïdie (iodo-induite, toxique, Basedow), bilan de goitre

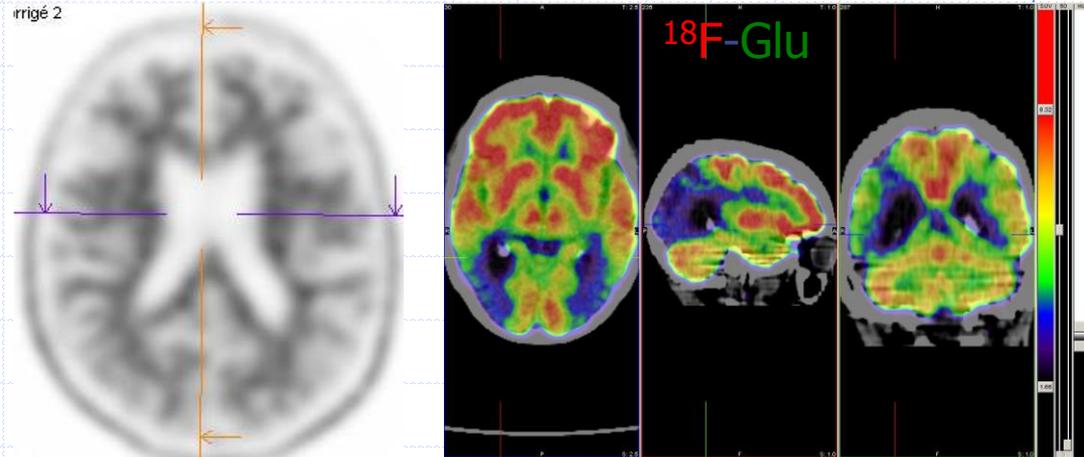
Fonction rénale



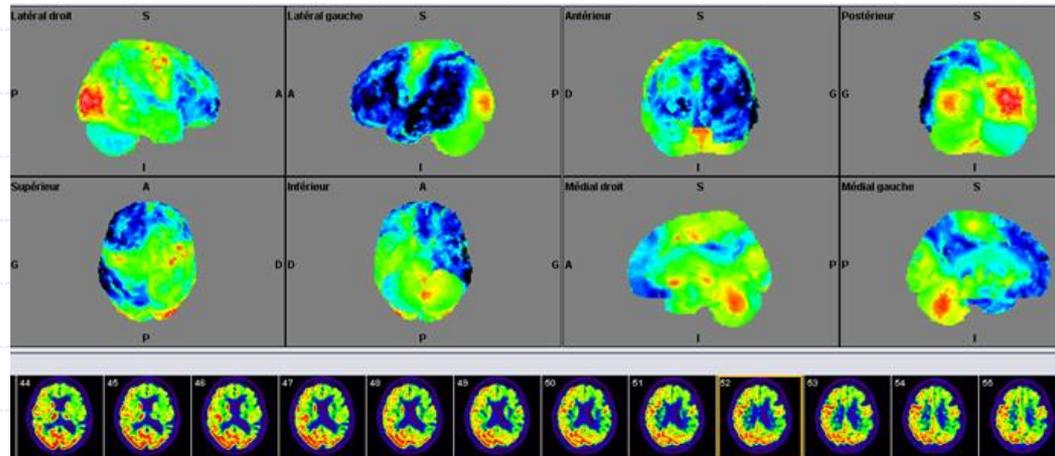
Scintigraphies cérébrales



DEMENCES ¹⁸F-Glu

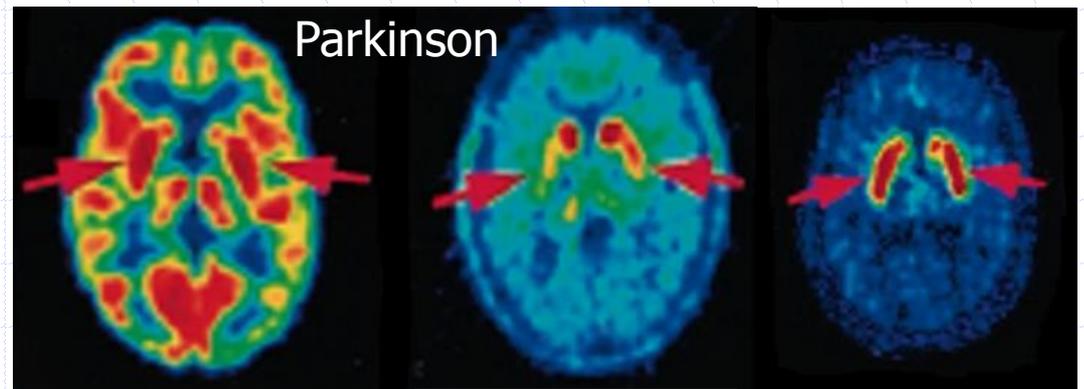
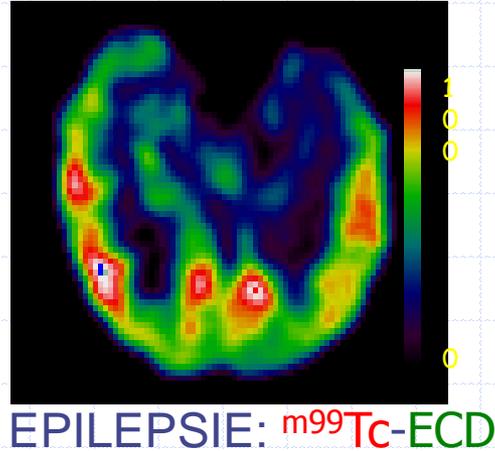
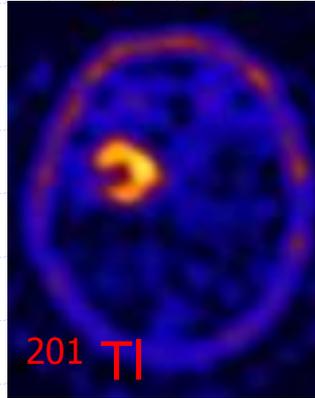


TEP amyloïde normal Paralysie psychique du regard



Aphasie primaire progressive

Scintigraphies cérébrales



^{18}F -DG

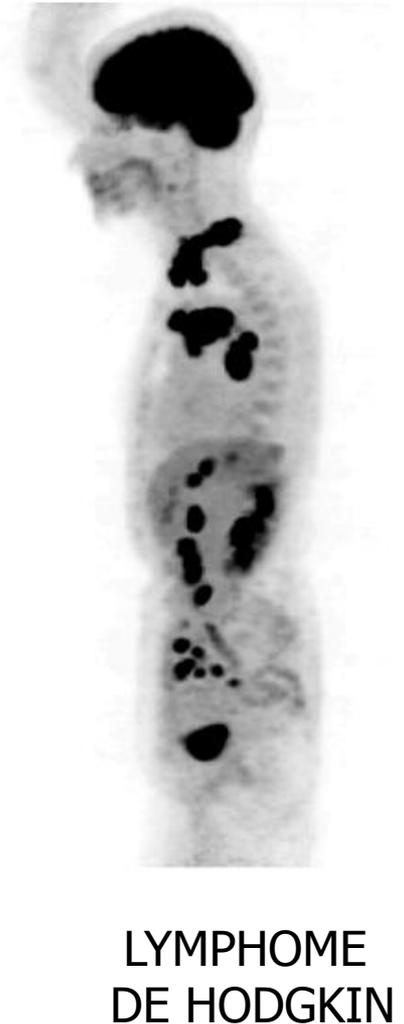
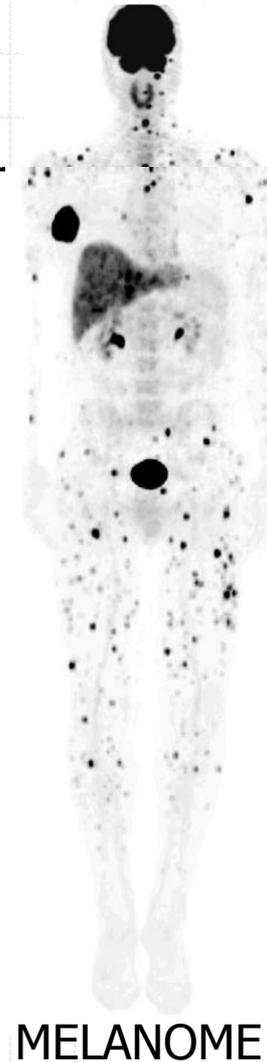
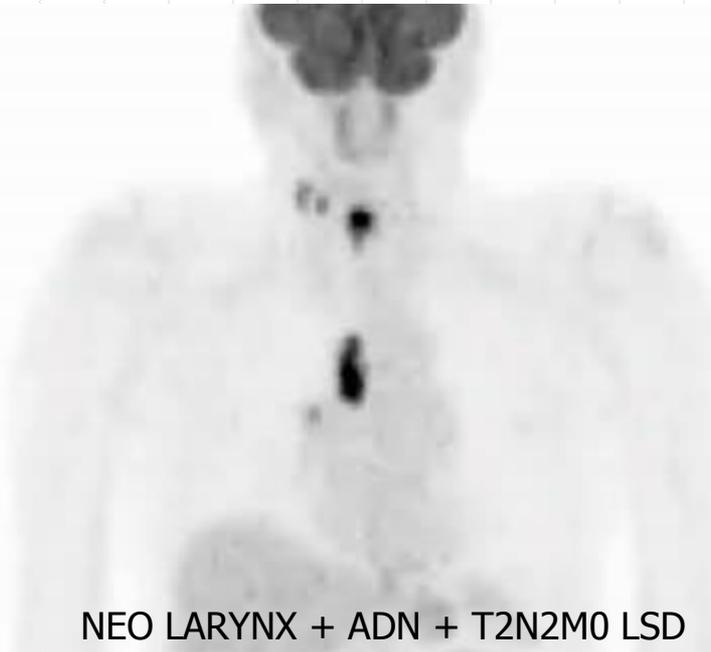
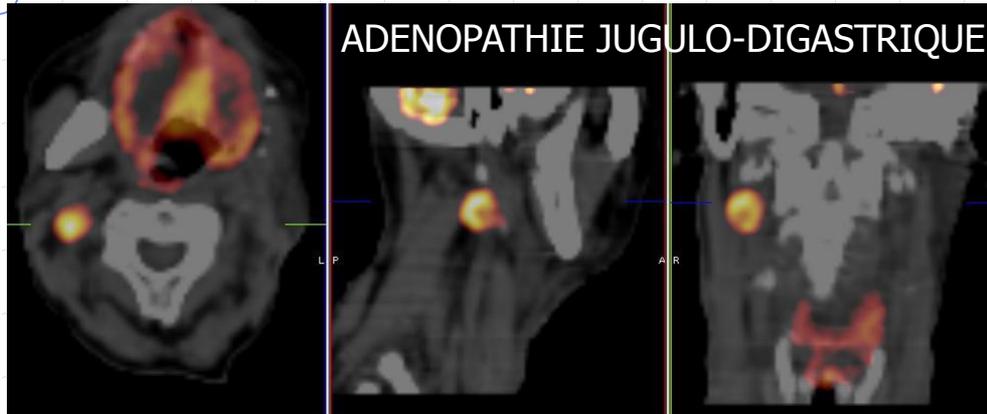
^{18}F -DOPA

Atteinte des Récep.
présynaptiques

^{18}F -Ethyl Spiperone

RD2 normaux

Diagnostic de cancers (^{18}F -DG)



Diagnostic de cancers



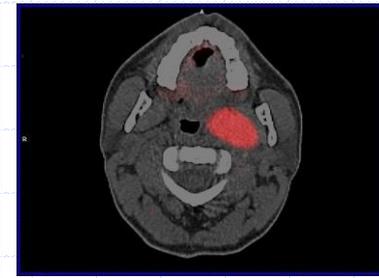
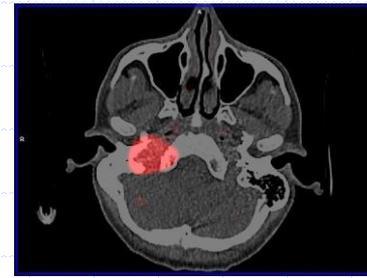
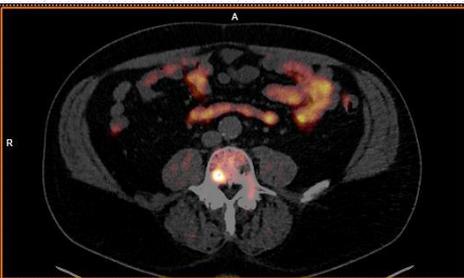
18F-CHOLINE



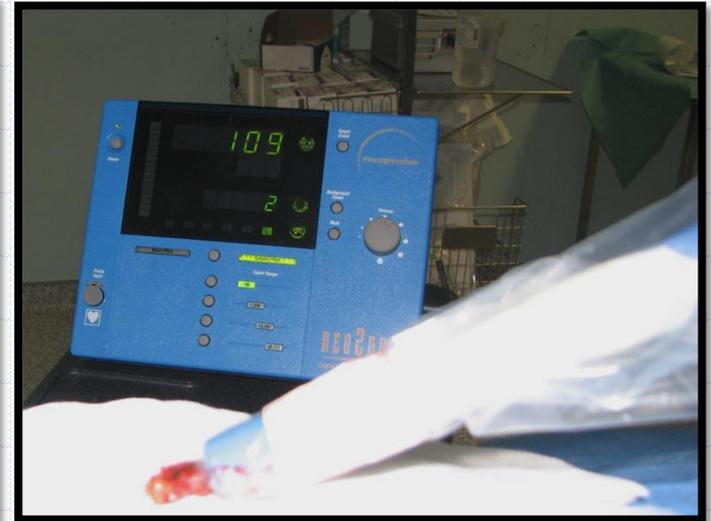
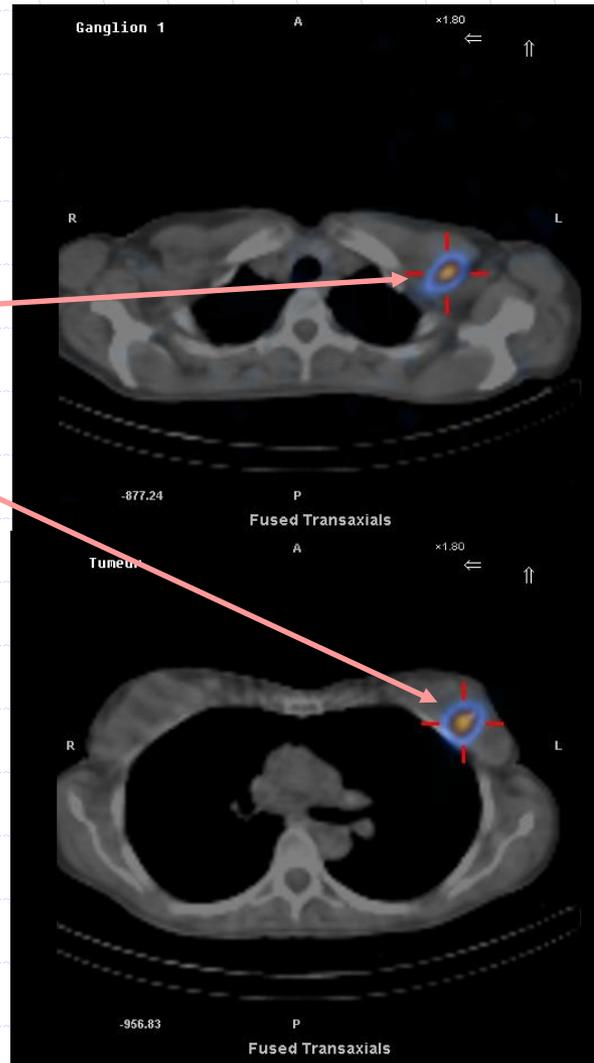
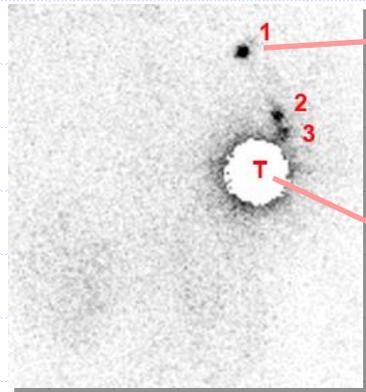
18F-FDOPA

18F-CHOLINE: AA traceur de division cellulaire (Mb)
Récidives de cancers de prostate, foie,...

18F-DOPA : AA traçant le métabolisme de la DOPA
Paragangliomes, phéochromocytomes



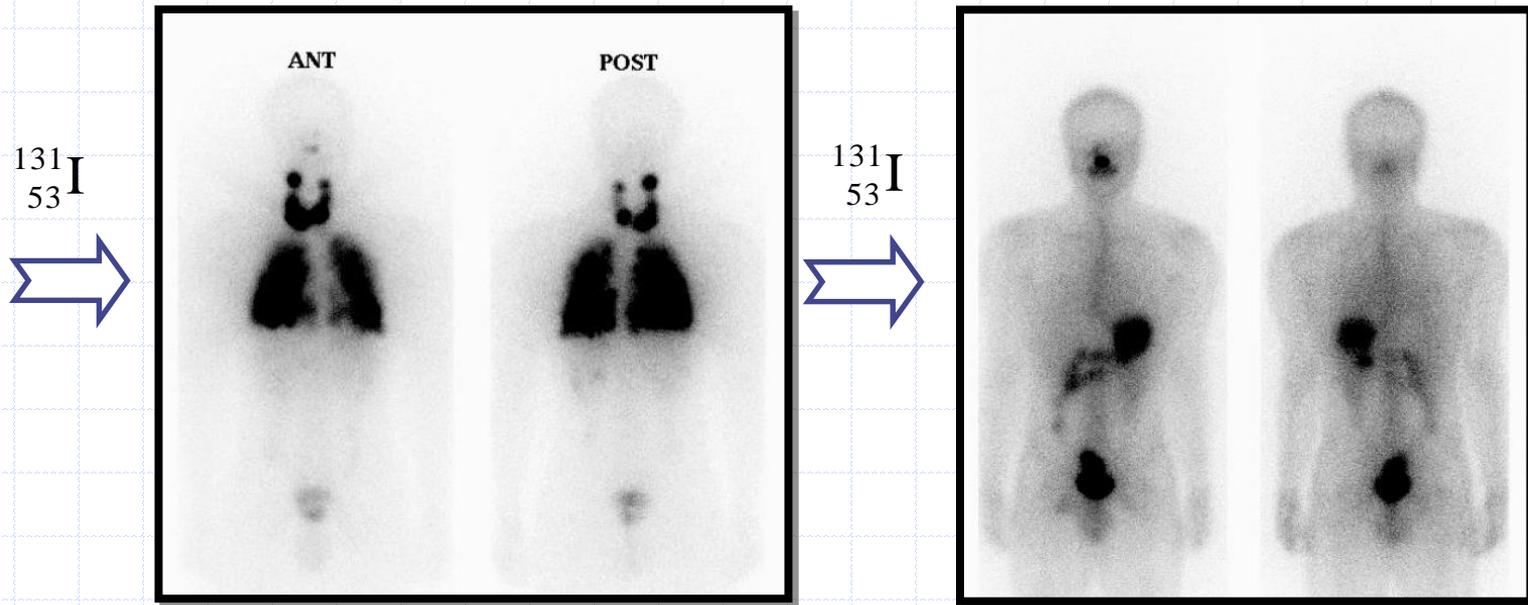
DETECTION PEROPERATOIRE



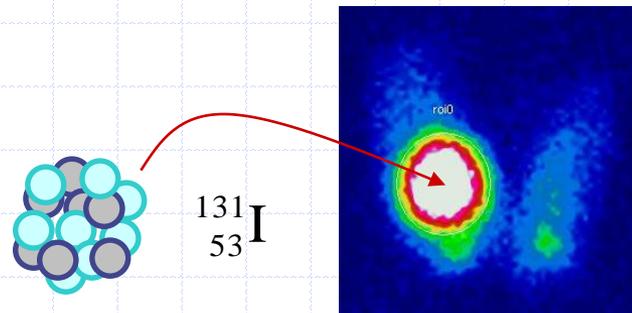
^{99m}Tc -nanocolloïde

RADIOTHERAPIE METABOLIQUE β^-

❖ Néoplasies thyroïdiennes

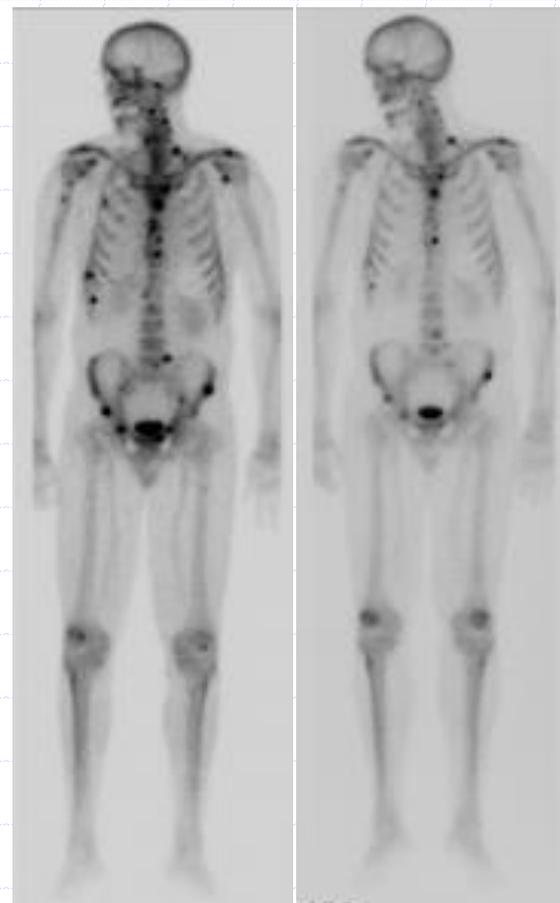


❖ Hyperthyroïdies



RADIOTHERAPIE METABOLIQUE α

❖ Traitement des métastases de cancers de prostate par le $^{223}_{88}\text{Ra}$ (α)



DOSAGES RADIOIMMUNOLOGIQUES

- Liaison Récepteur-Ligand* : spécifique
- Sensibilité < picomole
- 10-20 % des dosages:
 - Hormones (ACTH et cortisol, rénine et aldostérone, gastrine, PTH, ostéocalcine)
 - Vitamines (D), peptides, marqueurs tumoraux



DOSIMETRIE

Quelques références :

Irradiation naturelle moyenne :
2,5 mSv / an

France : 1-6 mSv

Ramsar (Iran) : 250 mSv/an

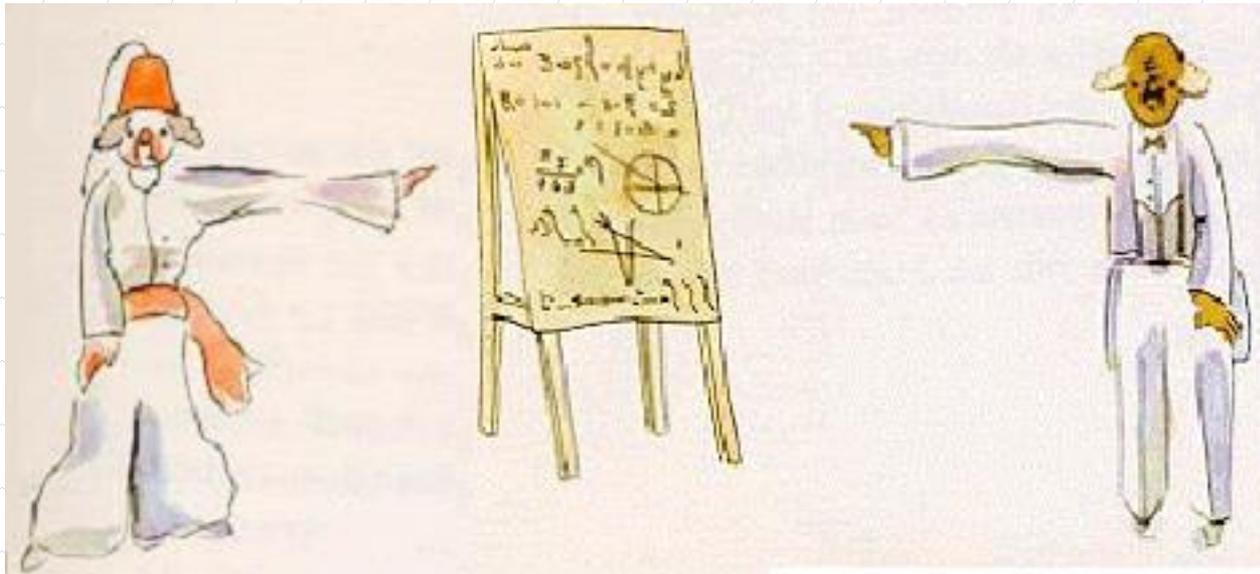
Vol Paris-New-York : 0,05 mSv

Au niveau mondial :

202 10^3 homme.Sv pour 33 . 10^6 scintigraphies (5 %)

4000 10^3 homme.Sv pour 3600 . 10^6 radiographies (95 %)

Procédé	Dose efficace (mSv)
Rayons X: 0,01 – 10 mSv	
Membres et articulations (sauf hanche)	<0,01
Thorax (vue PA simple)	0,02
Crâne	0,07
Rachis dorsal	0,7
Rachis lombaire	1,3
Hanche	0,3
Bassin	0,7
Abdomen	1,0
UIV	2,5
Déglutition barytée	1,5
TOGD (transit oeso- gastro-duodénal)	3
Transit du grêle	3
Lavement baryté	7
TDM crânienne	2,3
TDM thoracique	8
TDM abdominale ou pelvienne	10
TDM TAP non diagnostique	7
Scintigraphie:	0,3 – 20 mSv
Ventilation pulmonaire (Xe-133)	0,3
Perfusion pulmonaire (Tc-99m)	1
Rein (Tc-99m)	1
Thyroïde (Tc-99m)	1
Os (Tc-99m)	4
Exploration dynamique cardiaque (Tc-99m), MIBG	6
TEP pour crâne (18F-FDG)	5
OCTREOSCAN	12
Thallium, rubidium	20



Merci pour votre attention...