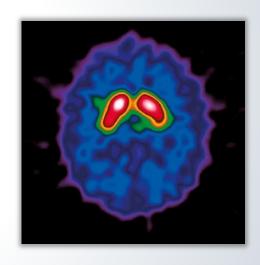
MASTER PhyMed

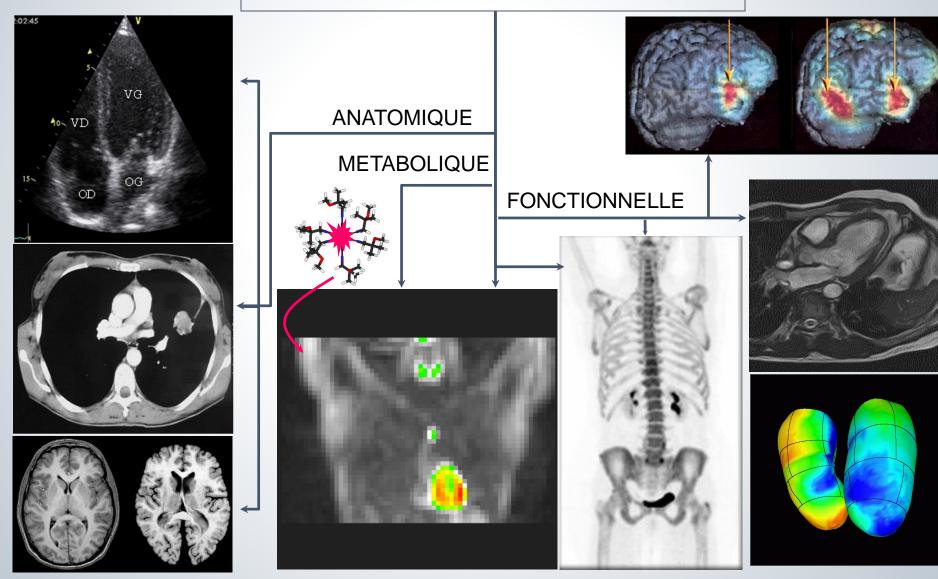
GMPH112 – Problématiques de Santé

EXPLORATIONS ISOTOPIQUES



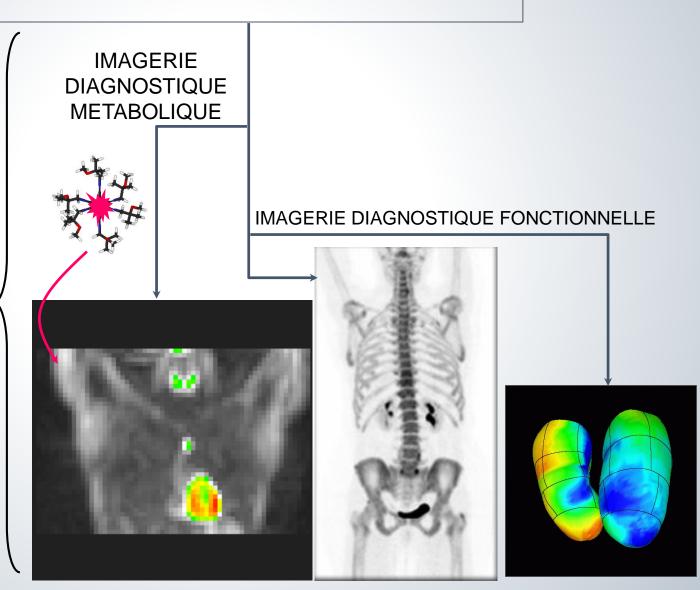


Imagerie médicale



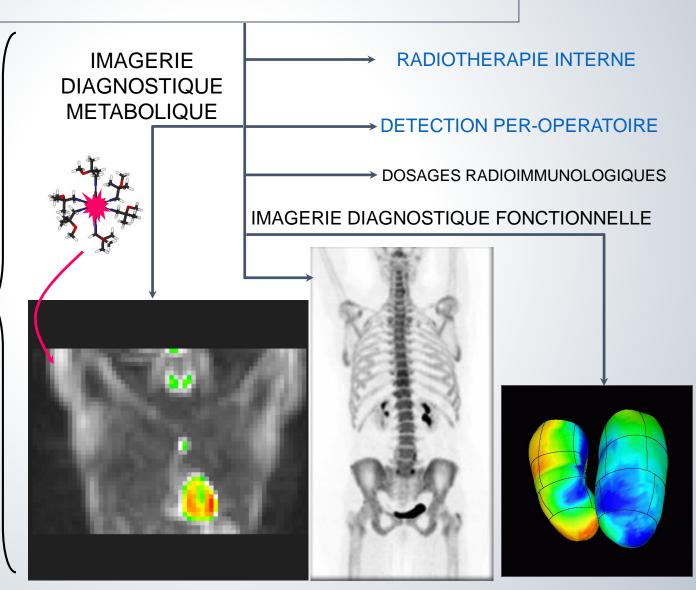
Médecine Nucléaire

Utilisation de marqueurs radioactifs pour tracer le devenir d'un vecteur (atome, molécule, cellule) dans un but diagnostique



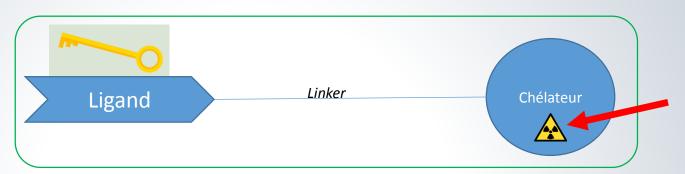
Médecine Nucléaire

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



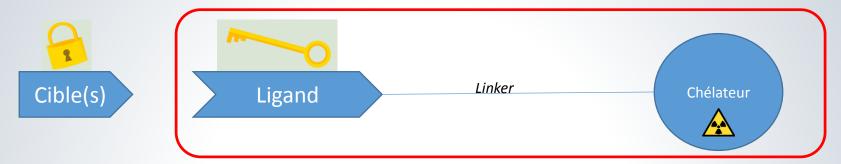
TRACEUR = marqueur + vecteur





	ISOTOPE	RADIO PROTECTION	PROPRIETES
DIAGNOSTIC	EMETTEURS DE PHOTONS PENETRANTS PEU DIFFUSES $\Rightarrow \beta^+$ ou γ \Rightarrow IONISANTS	PEU IRRADIANTS ⇒ T courtes : sec – h ⇒ ISOTOPES ARTIFICIELS	(RENDUS) SPECIFIQUES D'UN METABOLISME ⇒ MARQUAGE
THERAPIE	EMETTEURS DE PARTICULES IRRADIANTES	PARCOURS COURTS $\Rightarrow \alpha \text{ ou } \beta$ $\Rightarrow T \text{ assez courtes : jour}$ $\Rightarrow ISOTOPES \text{ ARTIFICIELS}$	(RENDUS) SPECIFIQUES D'UNE PATHOLOGIE ⇒ MARQUAGE

TRACEUR = marqueur + vecteur



Simples isotopes radioactifs

Molécules

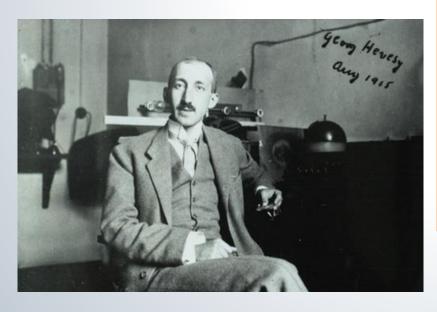
- HMPAO, ECD : perfusion cérébrale
- MIBI, TETROFOSMINE / Albumine : perfusion cœur / poumon
- MIBG, Cholestérol, Octréotide, FDG: cancers (principalement)
- BIPHOSPHONATES: maladies des os
- MAG3, DTPA, DMSA: rein
- Anticorps monoclonaux, récepteurs mb. : infection, thérapie

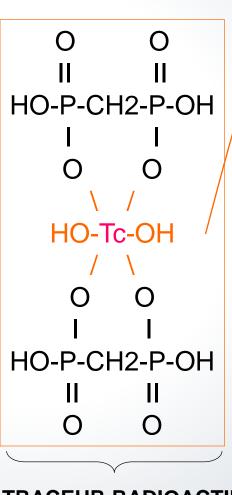
Cellules

- globules rouges : fonction cardiaque
- polynucléaires : infection

SCINTIGRAPHIE

Le marqueur est utilisé pour rendre radioactive une molécule vectrice spécifique d'un métabolisme d'intérêt.
La cartographie de radioactivité mesurée est appelée scintigraphie



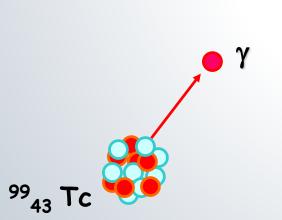




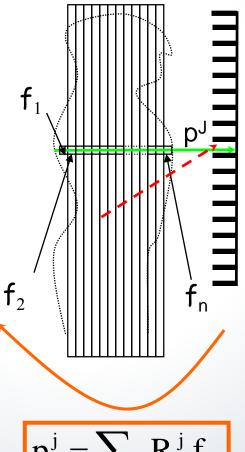


SCINTIGRAPHIE γ (SPECT)

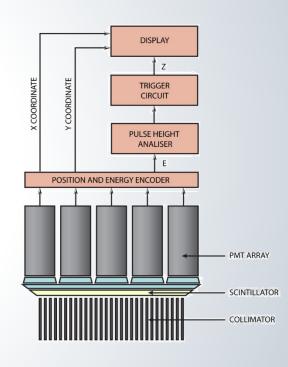




COLLIMATEUR



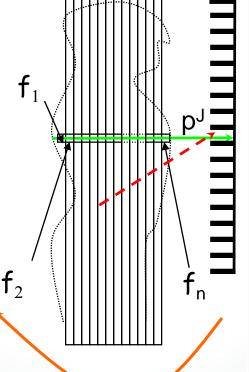




DOSIMETRIE

SCINTIGRAPHIE γ (SPECT)

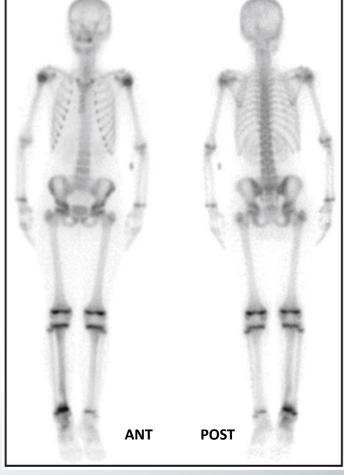




COLLIMATEUR

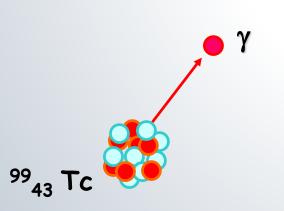




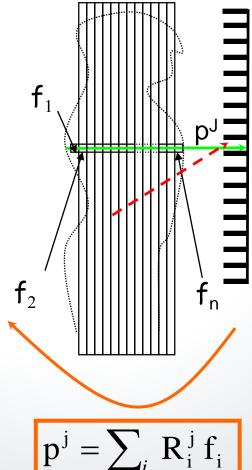


SCINTIGRAPHIE γ (SPECT)

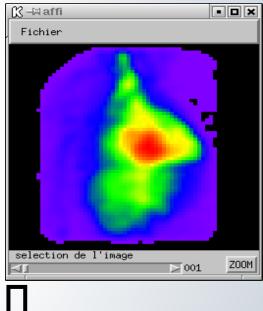




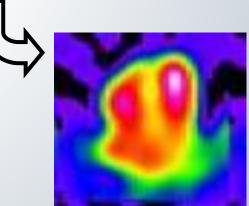
COLLIMATEUR



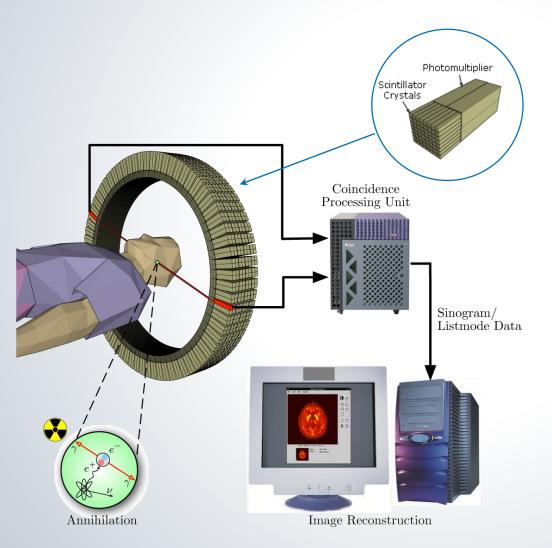
$$p^{j} = \sum_{i} R_{i}^{j} f_{i}$$



DOSIMETRIE

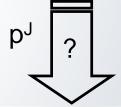


SCINTIGRAPHIE β + (PET)







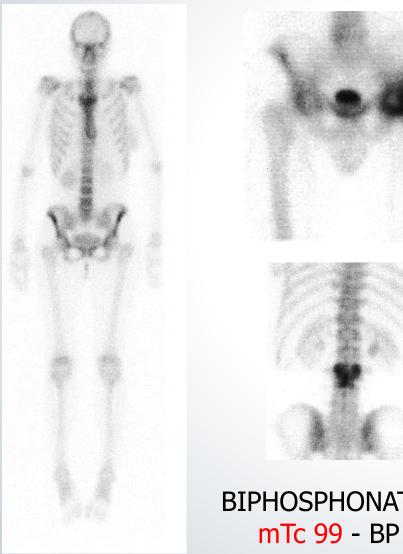




Quelques exemples de scintigraphies diagnostiques

TRACEURS RADIOACTIFS SCINTIGRAPHIE DIAGNOSTIC **IMAGERIE** THERAPIE RIA DOSIMETRIE

REMODELAGE OSSEUX



BIPHOSPHONATE

REMODELAGE OSSEUX



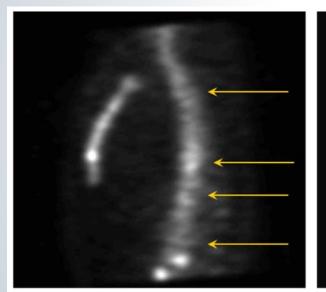




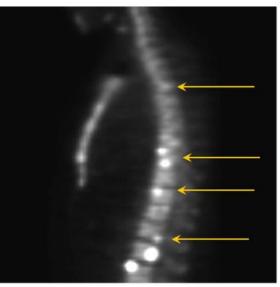


F 18 - Na

REMODELAGE OSSEUX



BIPHOSPHONATE mTc 99 - BP

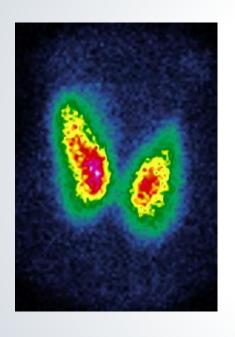


F 18 - Na

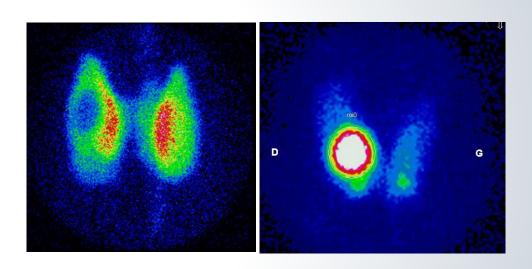


F 18 - Na

NODULES THYROIDIENS



mTc 99 - O₄-

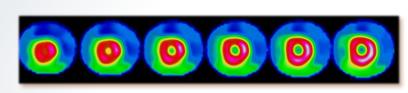


cancers \Rightarrow froid

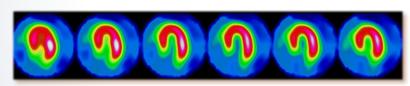
Principale indication: bilan des hyperthyroïdies

PERFUSION MYOCARDIQUE

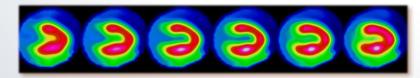




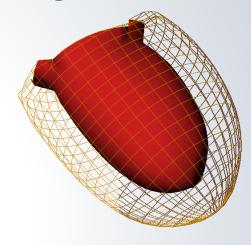


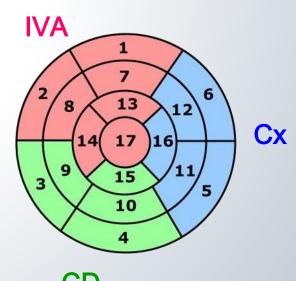






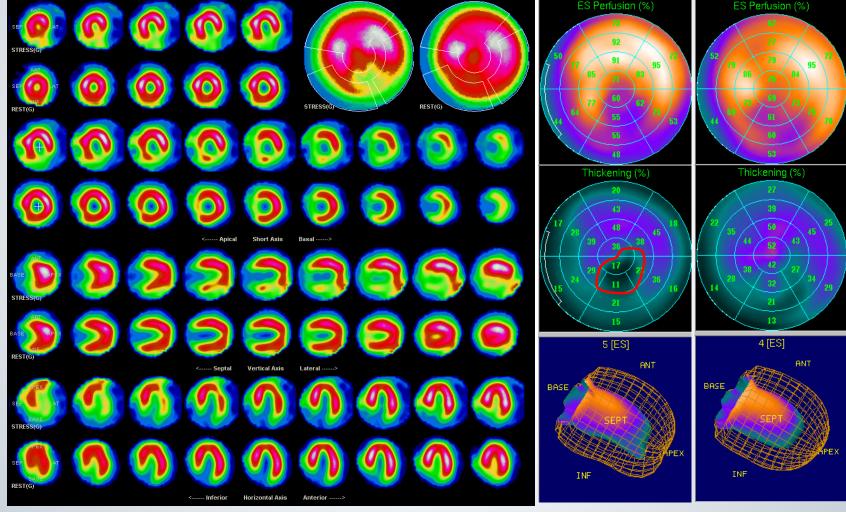






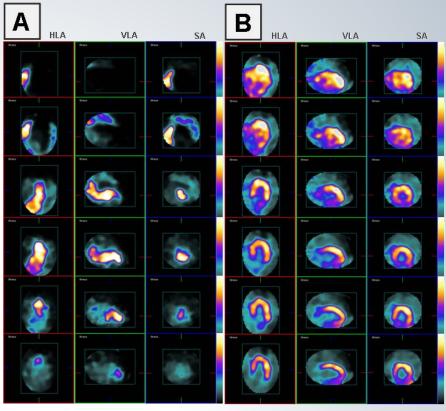
IMAGERIE

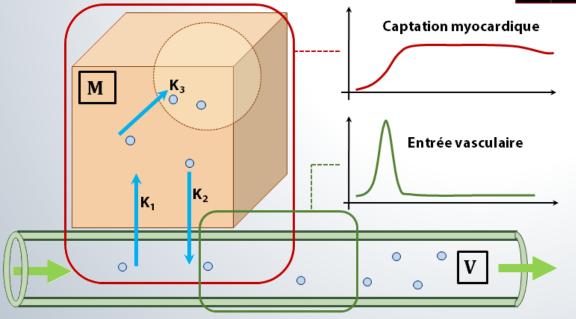
PERFUSION MYOCARDIQUE

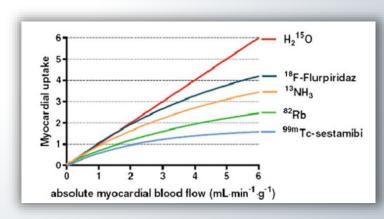


CATION LIPOPHILE - mTc 99 ou Tl 201

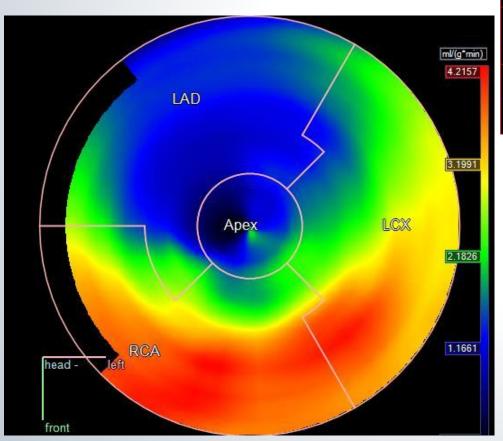
PERFUSION QUANTIFICATION ABSOLUE

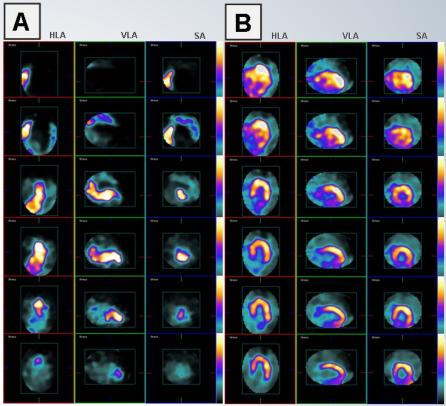


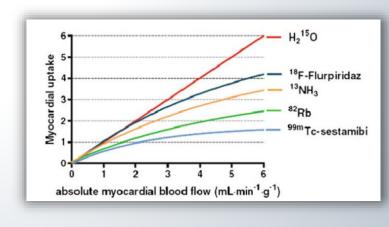




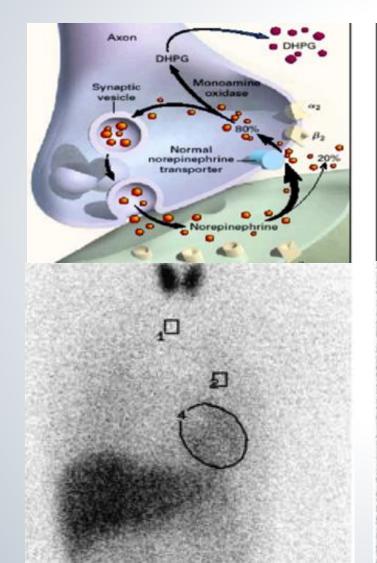
PERFUSION QUANTIFICATION ABSOLUE

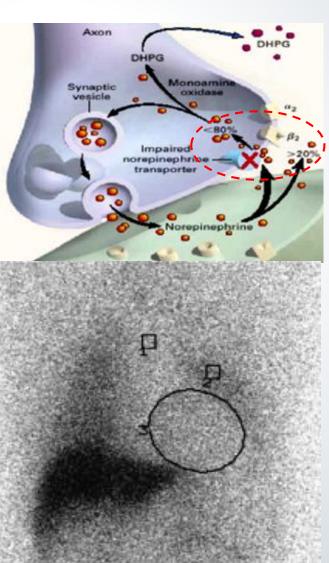




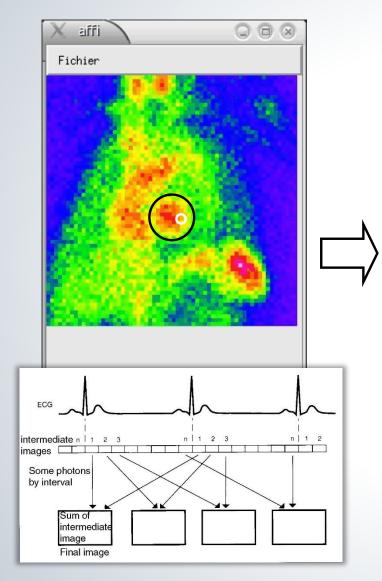


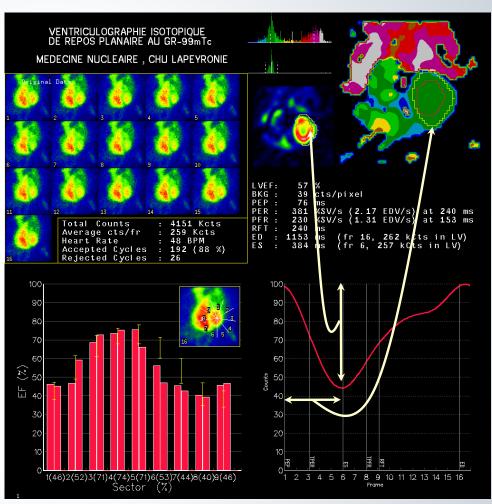
INNERVATION MYOCARDIQUE





CONTRACTION CARDIAQUE



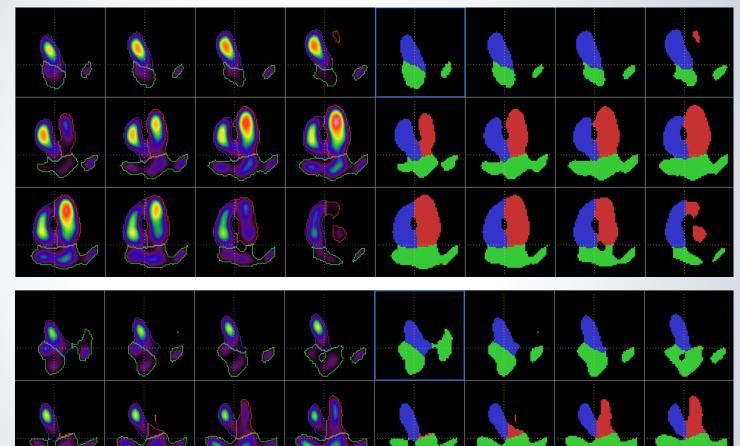


HEMATIE - mTc 99

Tomo-ventriculographie

SEGMENTATION

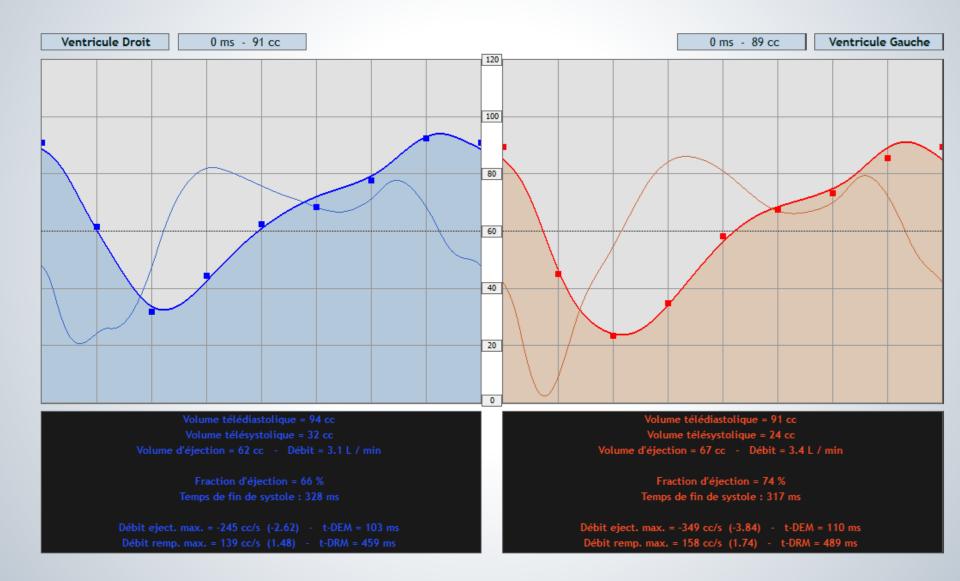






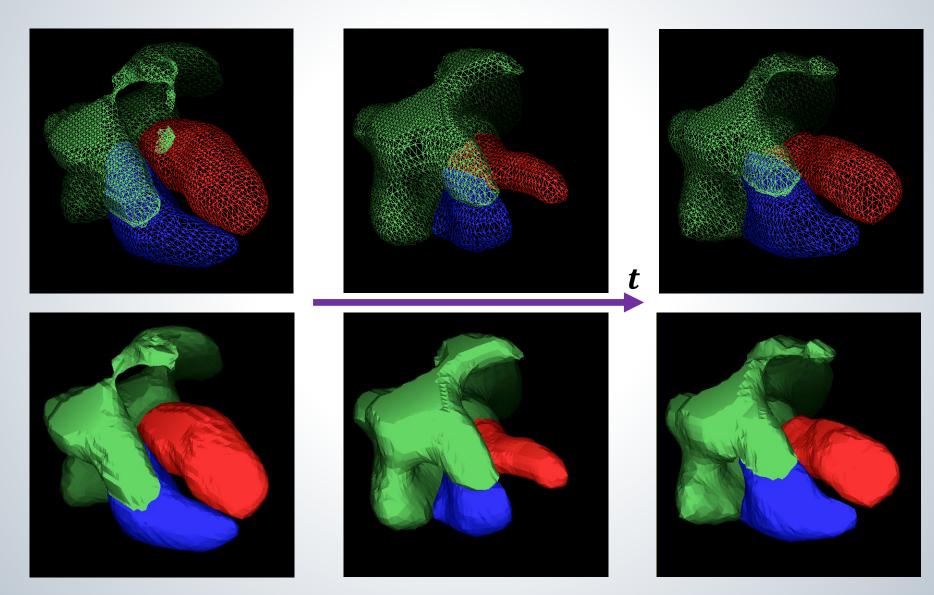
Tomo-ventriculographie

CINETIQUE GLOBALE



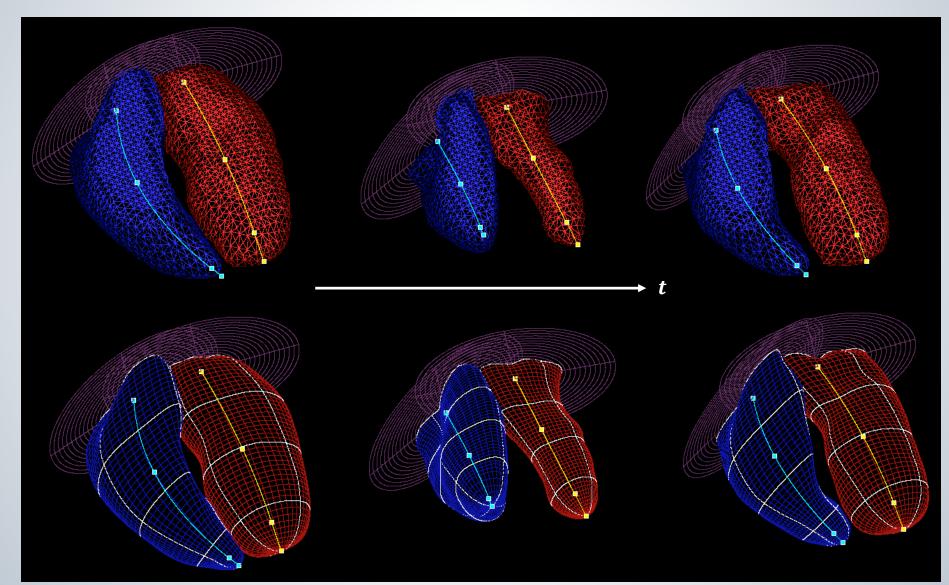
Tomo-ventriculographie

PARAMETRISATION 3D



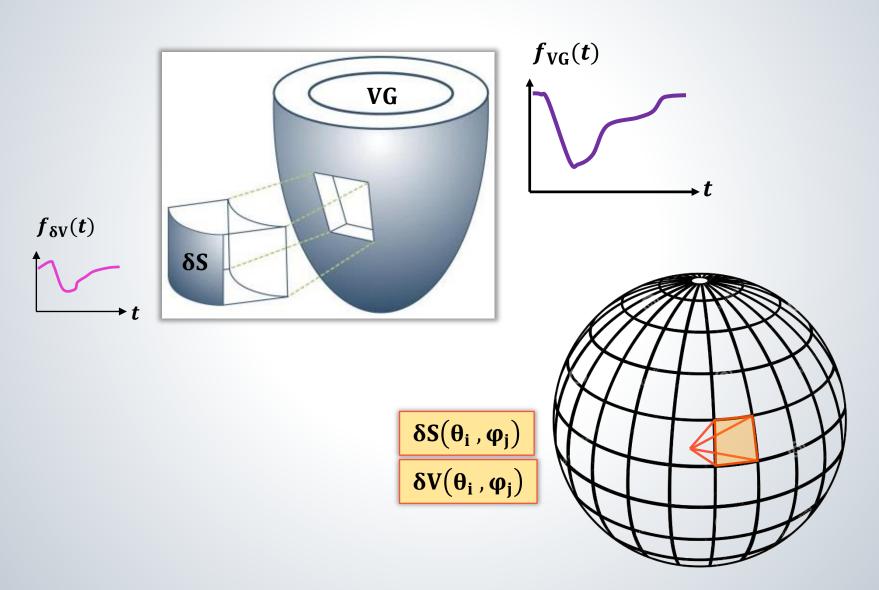
Tomo-ventriculographie

PARAMETRISATION 3D



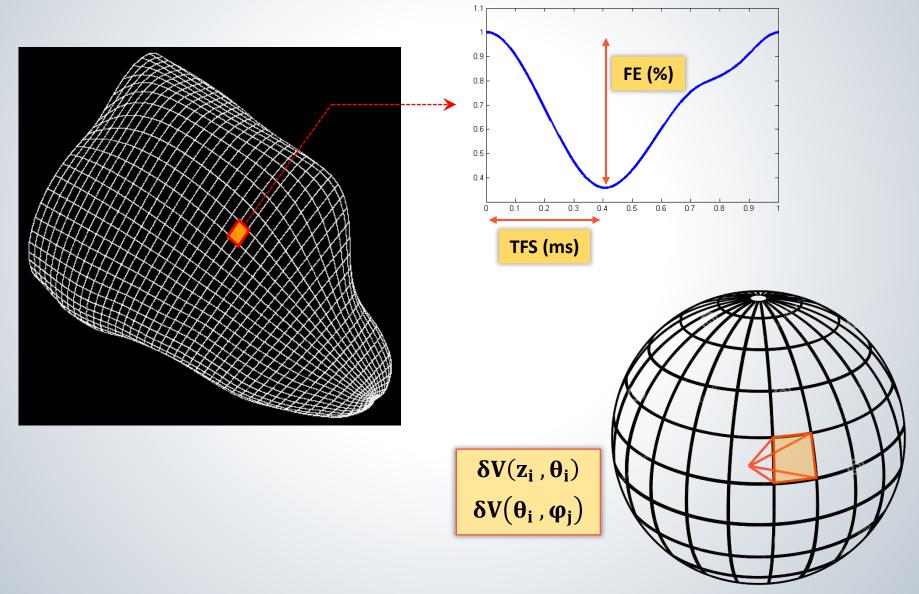
Tomo-ventriculographie

CINETIQUE LOCALE



Tomo-ventriculographie

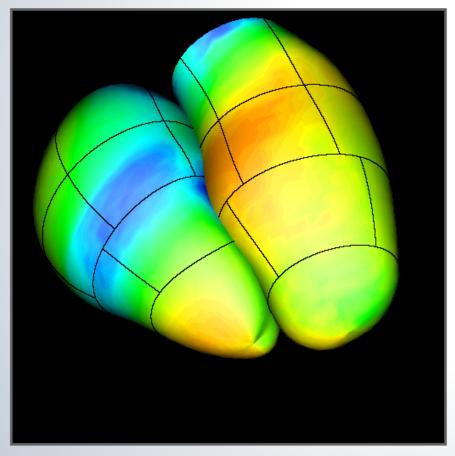
CINETIQUE LOCALE



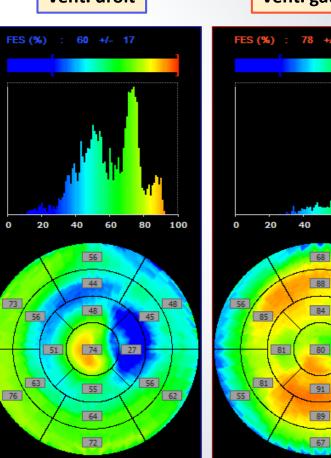
Tomo-ventriculographie

CINETIQUE LOCALE

Fraction d'éjection systolique (%)



Vent. droit



Vent. gauche

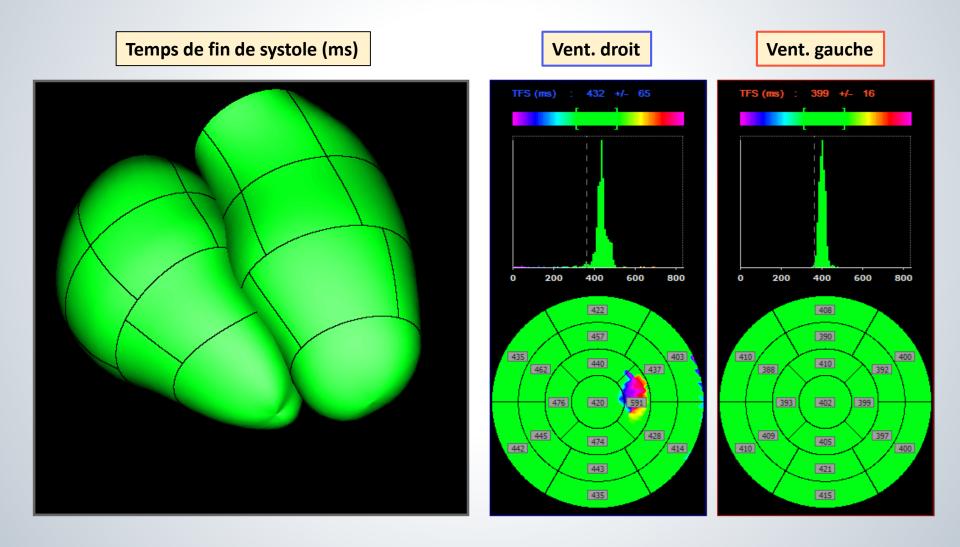
76

72

80

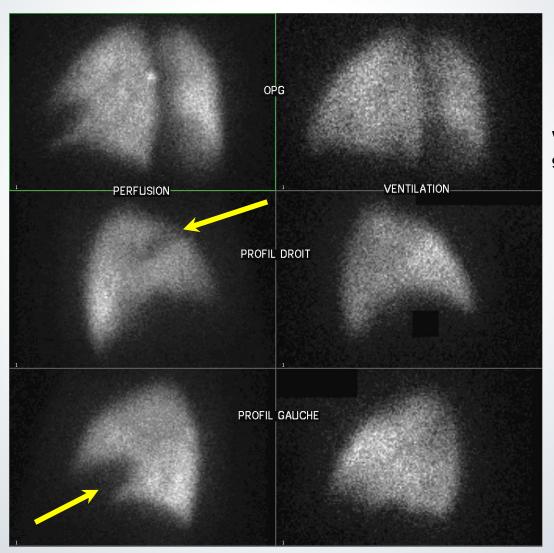
Tomo-ventriculographie

CINETIQUE LOCALE



VENTILATION ET PERFUSION PULMONAIRES

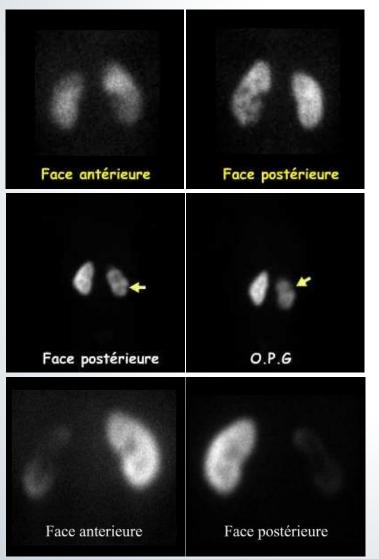
PERF
99mTc – Albumine



VENT

99mTc - Aérosol

SCINTIGRAPHIES RENALES



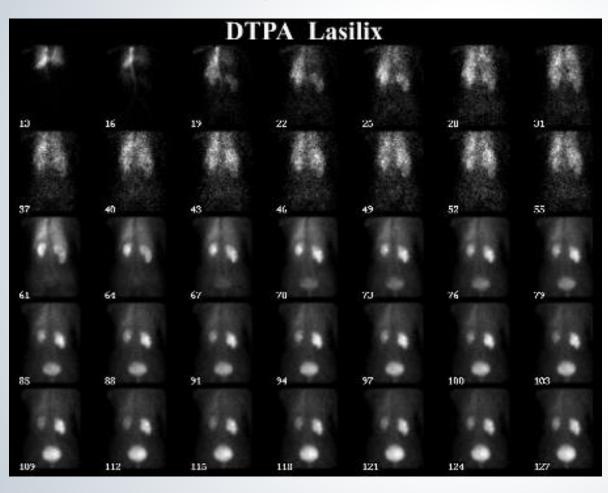
m99Tc-DMSA

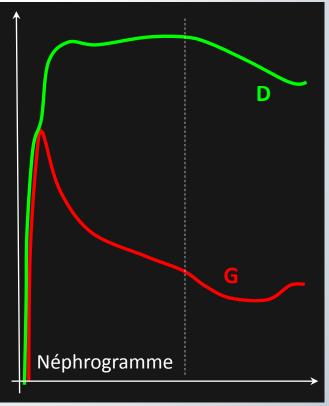
Pyélonéphrite aigue

Cicatrice sur IU à répétition

Syndrome de jonction

SCINTIGRAPHIES RENALES

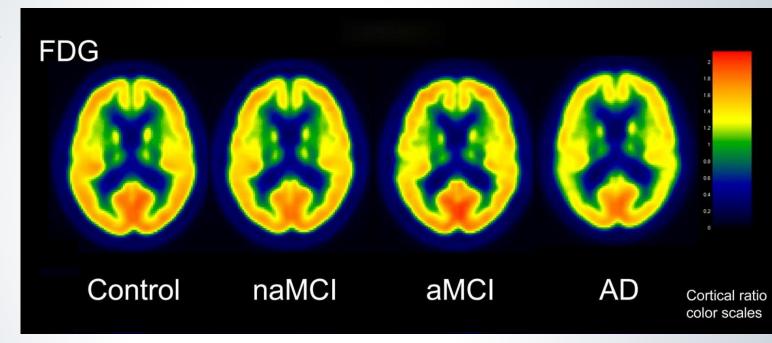




m99Tc-DTPA

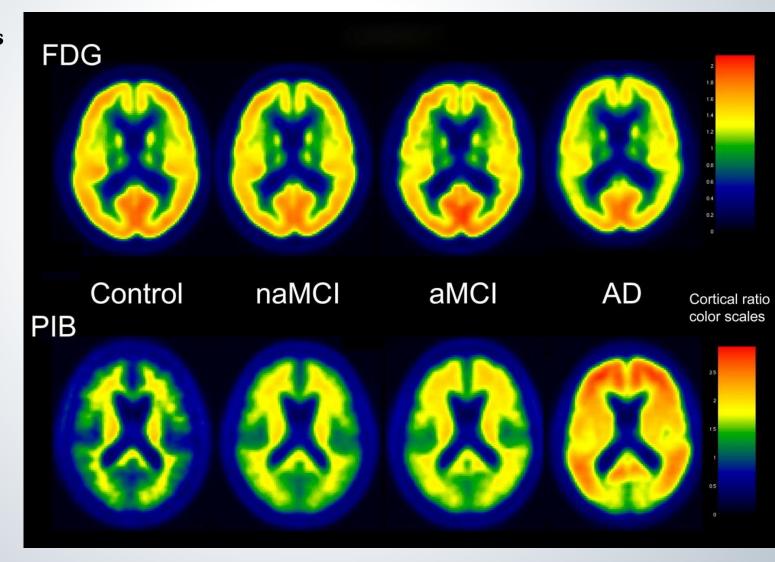
SCINTIGRAPHIES CEREBRALES

Démences



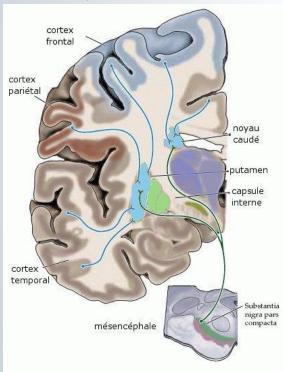
SCINTIGRAPHIES CEREBRALES

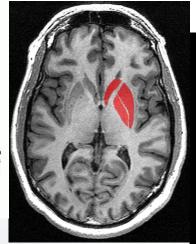
Démences



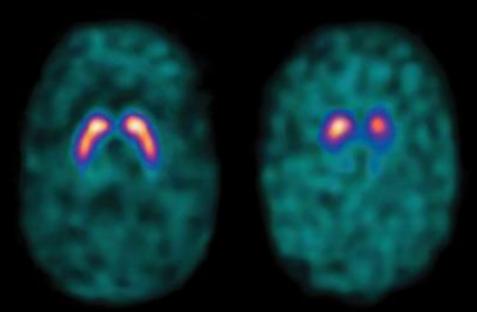
SCINTIGRAPHIES CEREBRALES

Syndromes PK

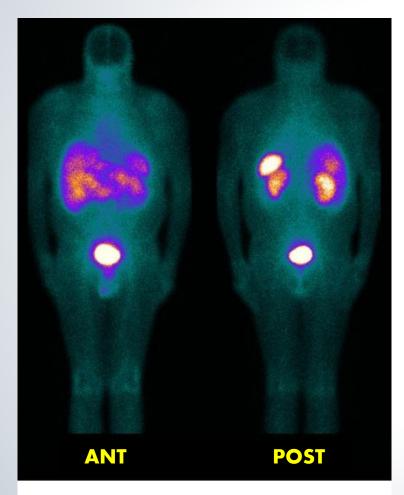




123 I - DatScan



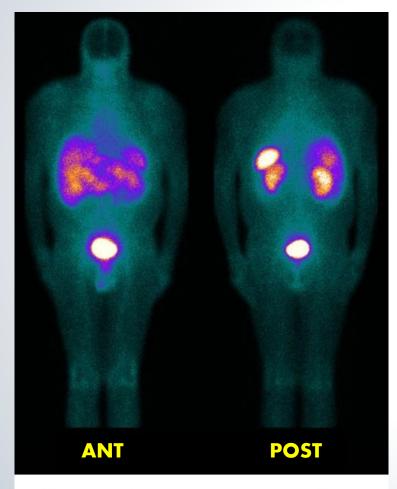
CANCERS



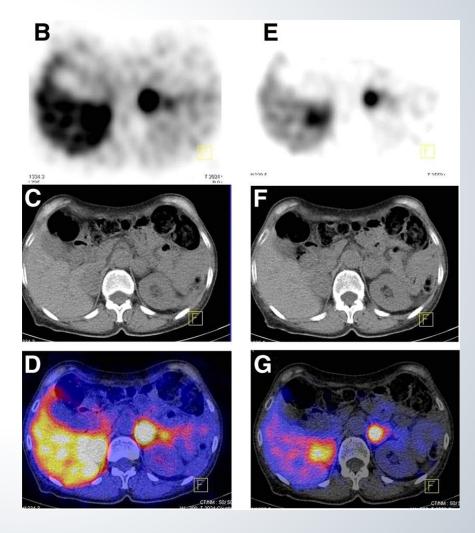
MR BT,56 YO WITH KNOWN CARCINOID. EXTENT OF THE DISEASE?. 24 H OCTREOSCAN PRESENTS MULTIPLE LESIONS IN THE LIVER AND NO EXTRAHEPATIC LESIONS. PHYSIOLOGICAL UPTAKE IN SPLEEN AND KIDNEYS.

OCTREOTIDE - In 111

CANCERS



MR BT,56 YO WITH KNOWN CARCINOID. EXTENT OF THE DISEASE?. 24 H OCTREOSCAN PRESENTS MULTIPLE LESIONS IN THE LIVER AND NO EXTRAHEPATIC LESIONS. PHYSIOLOGICAL UPTAKE IN SPLEEN AND KIDNEYS.

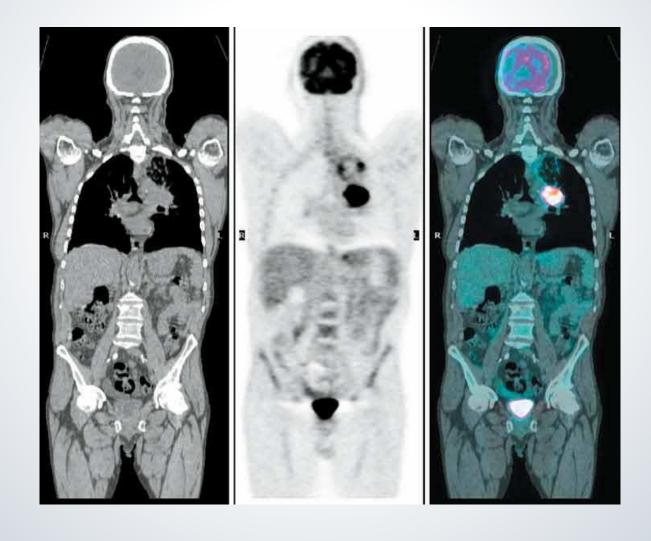


OCTREOTIDE - In 111

123 I –MIBG

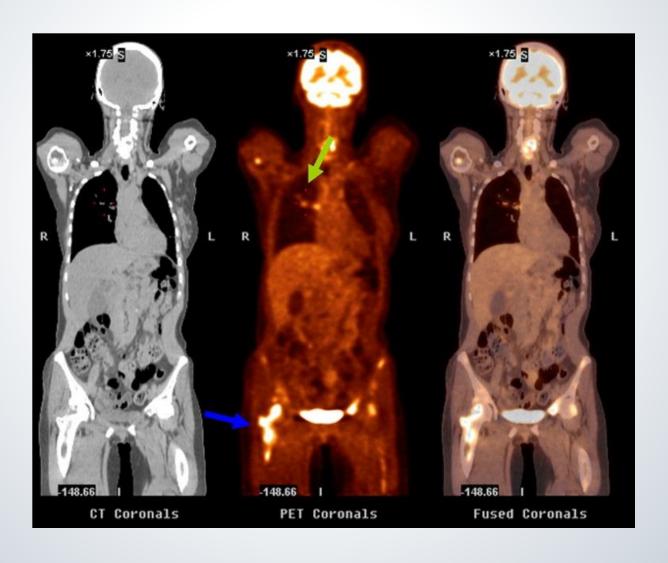
CANCERS

18 F -DG



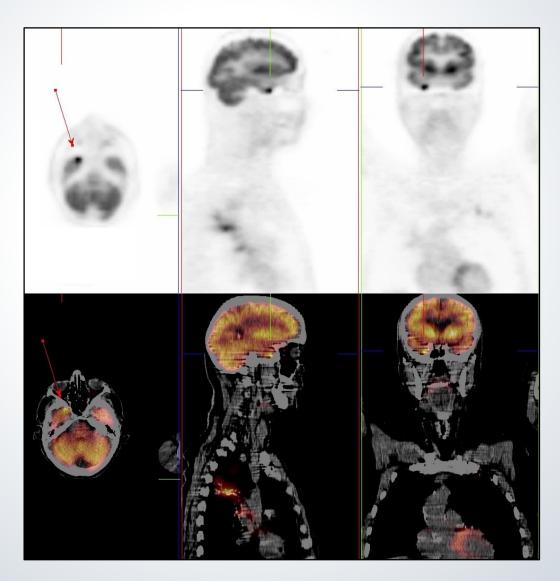
CANCERS

18 F -DG



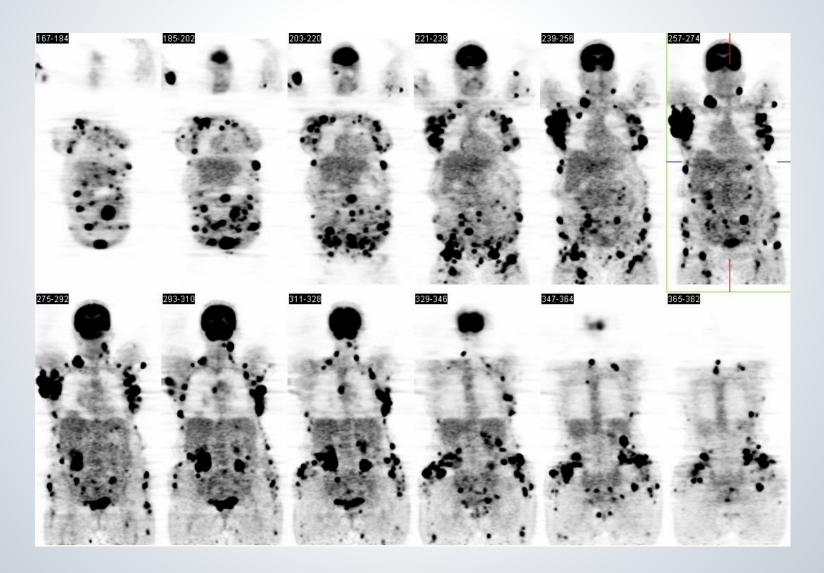
CANCERS

18 F -DG



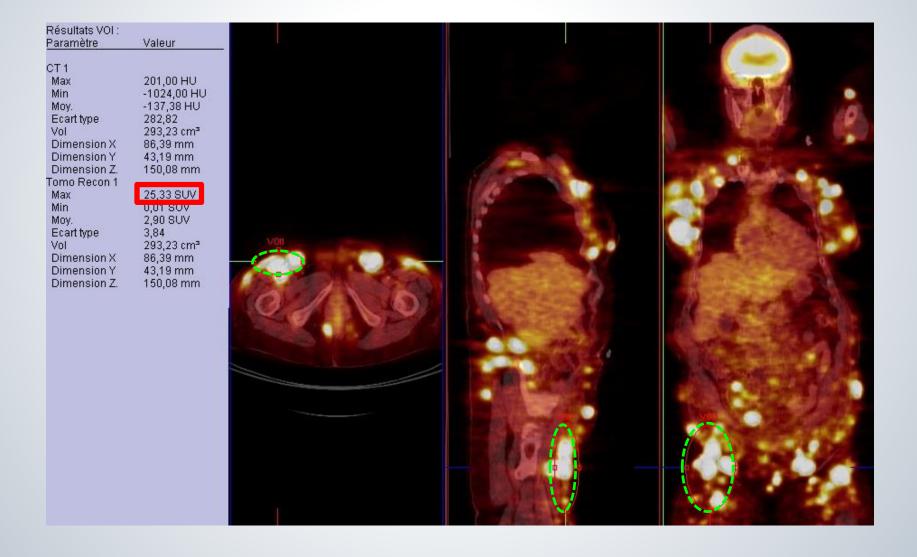
CANCERS

18 F -DG



CANCERS

18 F -DG

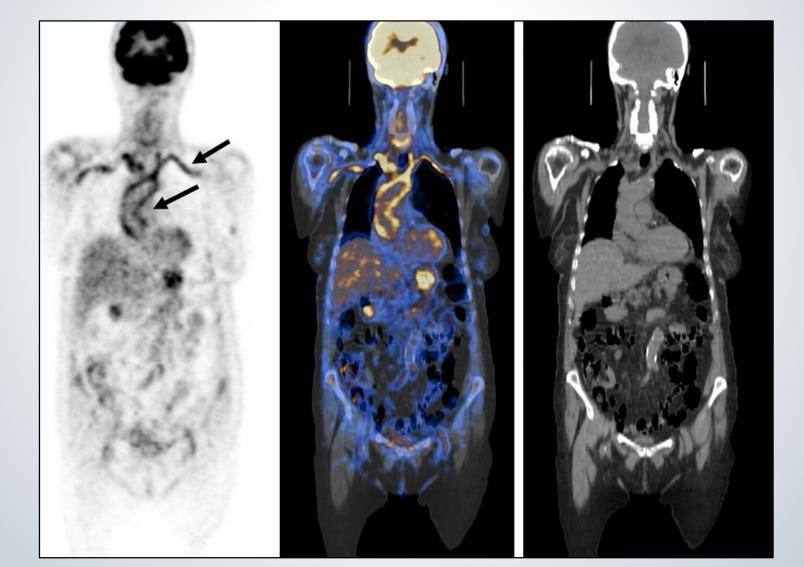


INFECTIONS

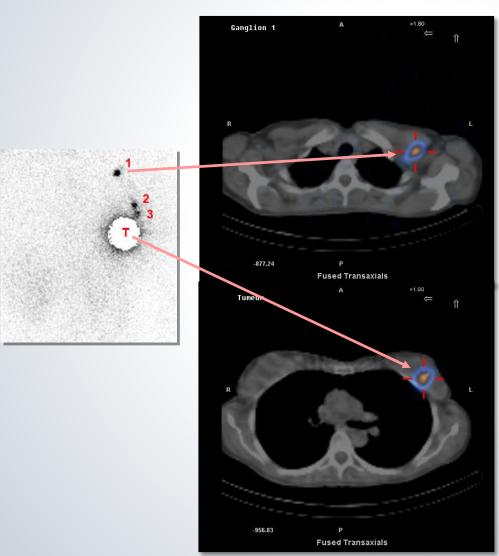


18 F -DG

INFLAMMATION



DETECTION PEROPERATOIRE







RADIOTHERAPIE INTERNE

Thyroïde: cancers, adénomes

Métastases osseuses

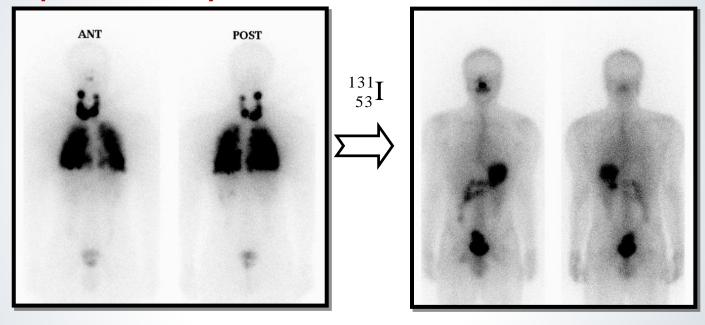
Lymphomes

Synoviorthèses

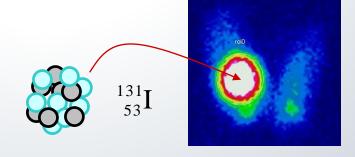
Tumeurs hépatiques

Tumeurs neuro-endocrines

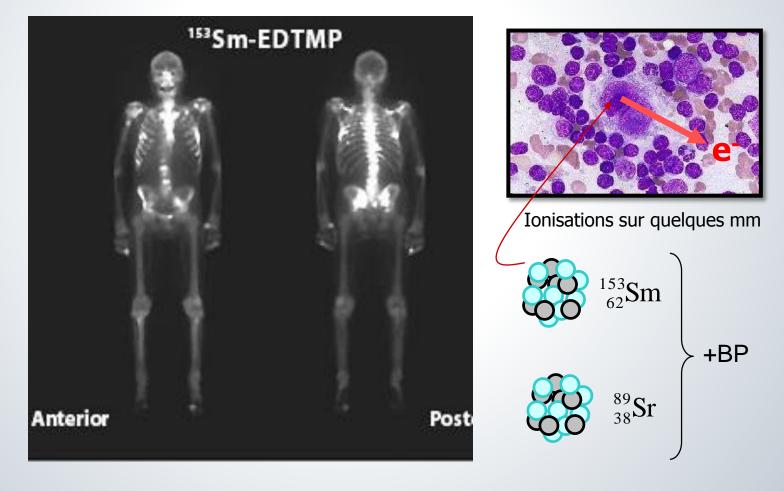
Néoplasies thyroïdiennes



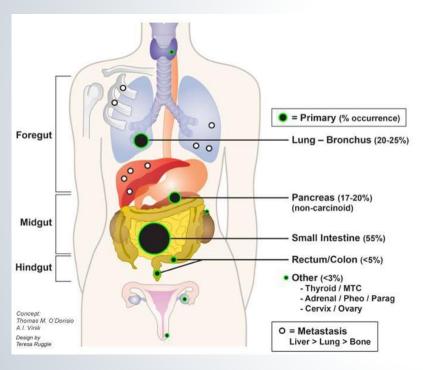
Hyperthyroïdies



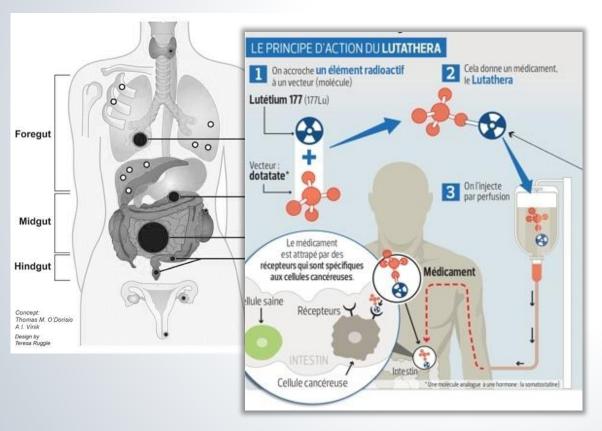
Antalgie de métastases osseuses



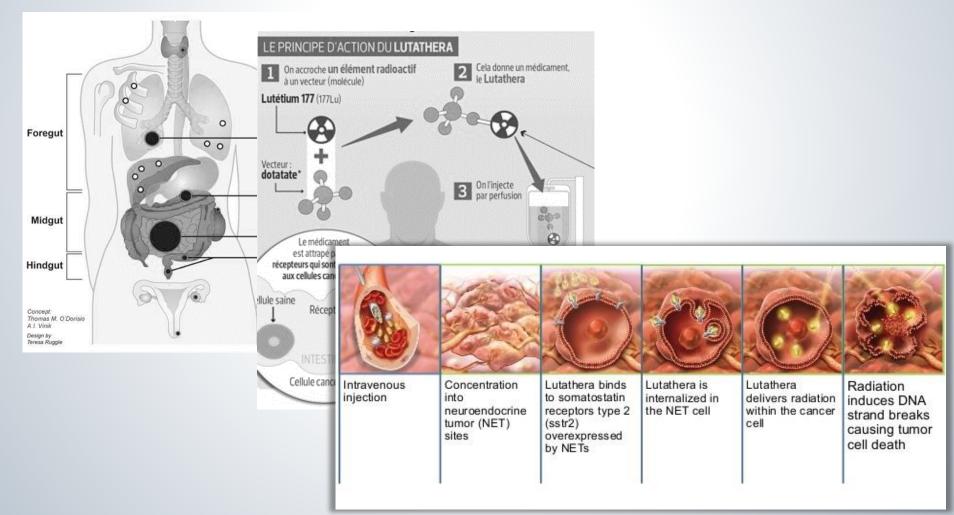
Tumeurs neuro-endocrines



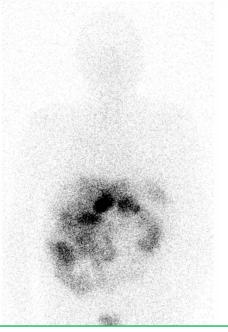
Tumeurs neuro-endocrines



Tumeurs neuro-endocrines



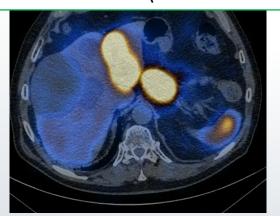
Approche théranostique



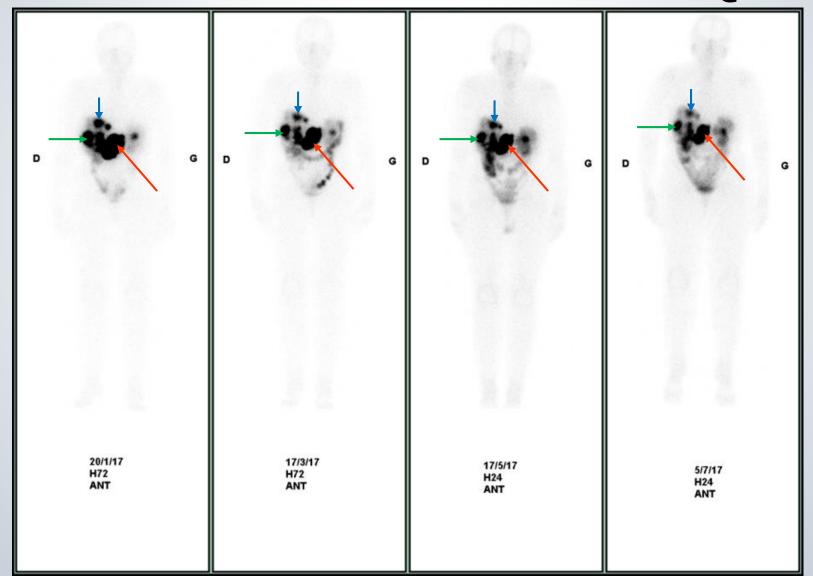
¹¹¹In-octreotide (Octreoscan©)



¹⁷⁷Lu-Dotatate (Lutathera©)

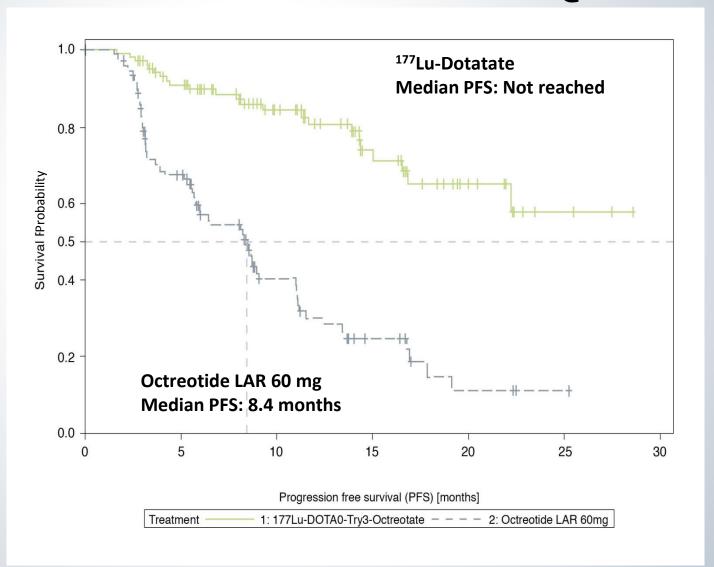


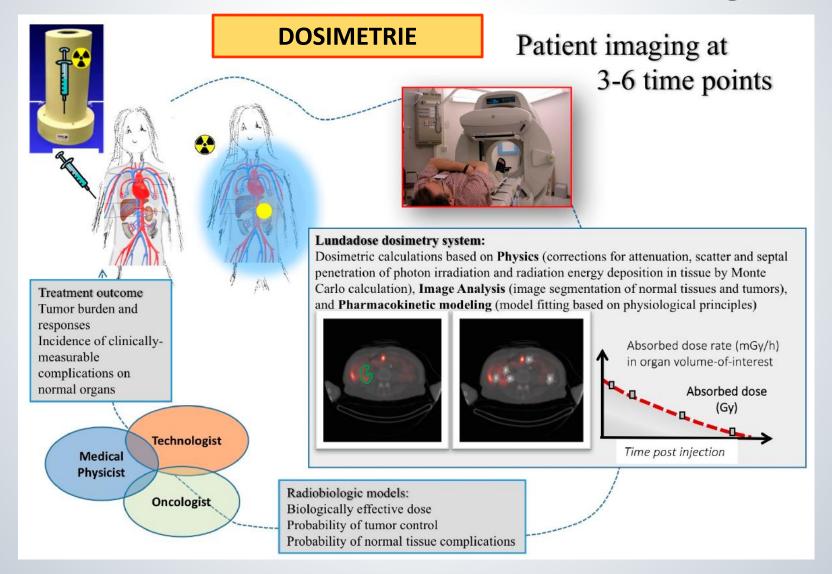




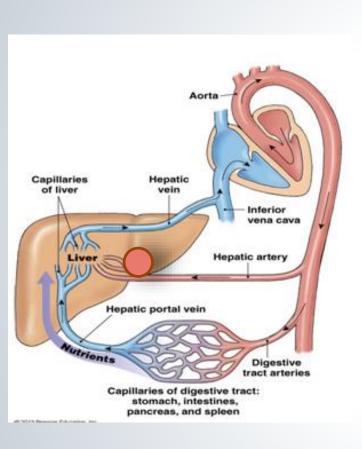
Survie sans progression

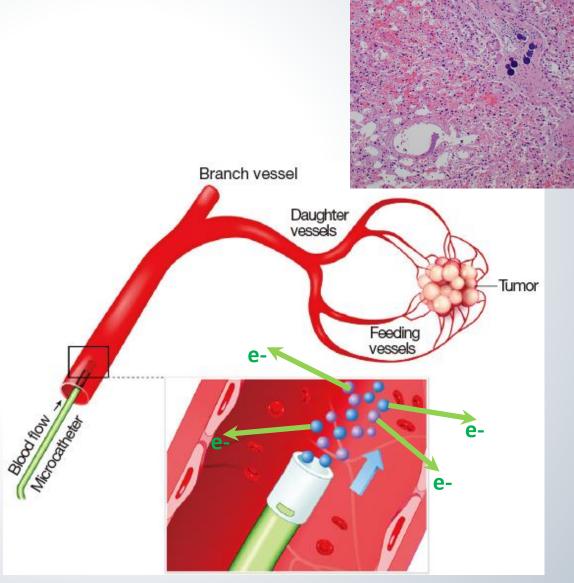
Strosberg J et al. N Engl J Med 2017



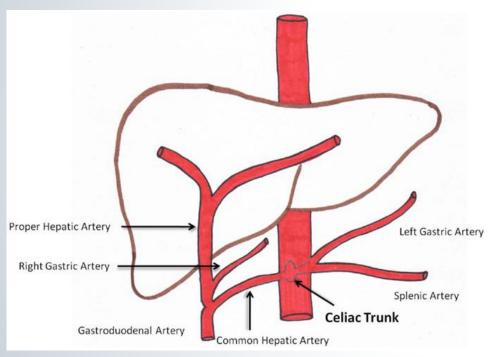


RADIOTHEAPIE INTERNE SELECTIVE



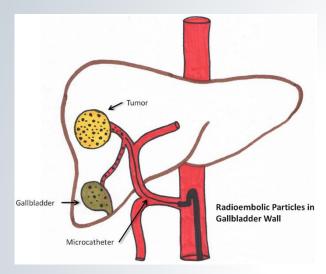


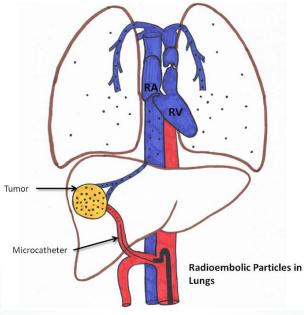
RADIOTHEAPIE INTERNE SELECTIVE

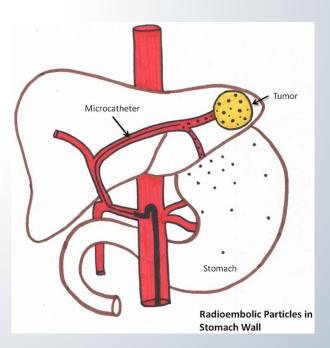




RADIOTHEAPIE INTERNE SELECTIVE

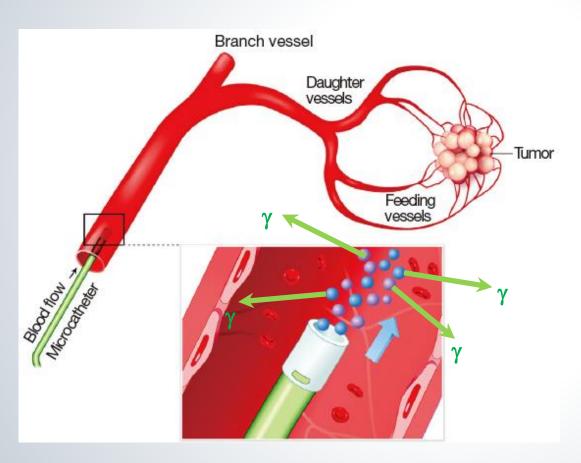






RADIOTHEAPIE INTERNE SELECTIVE

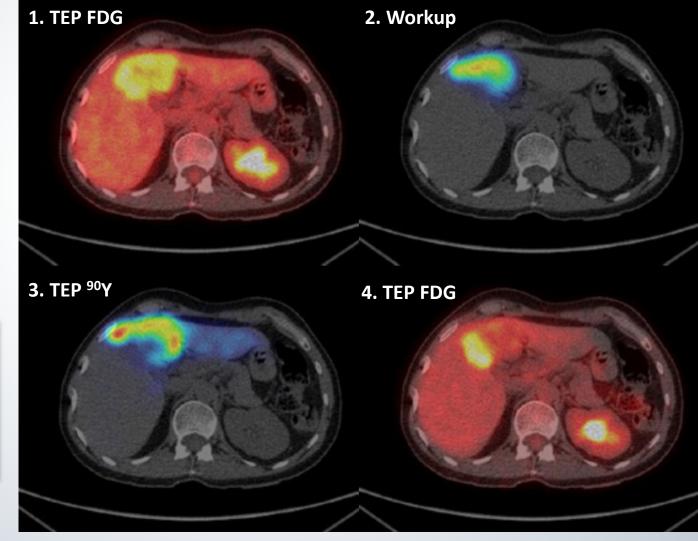
Workup – étude dosimétrique

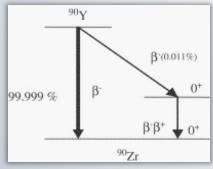




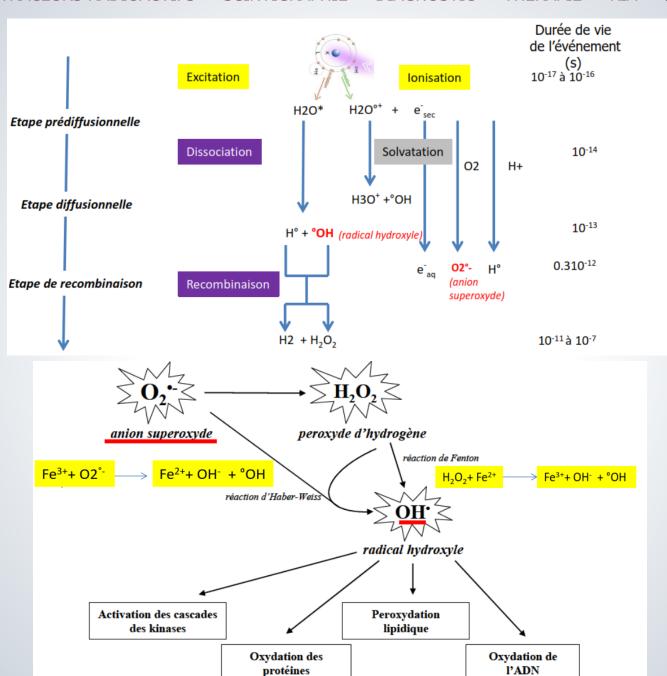
RADIOTHEAPIE INTERNE SELECTIVE

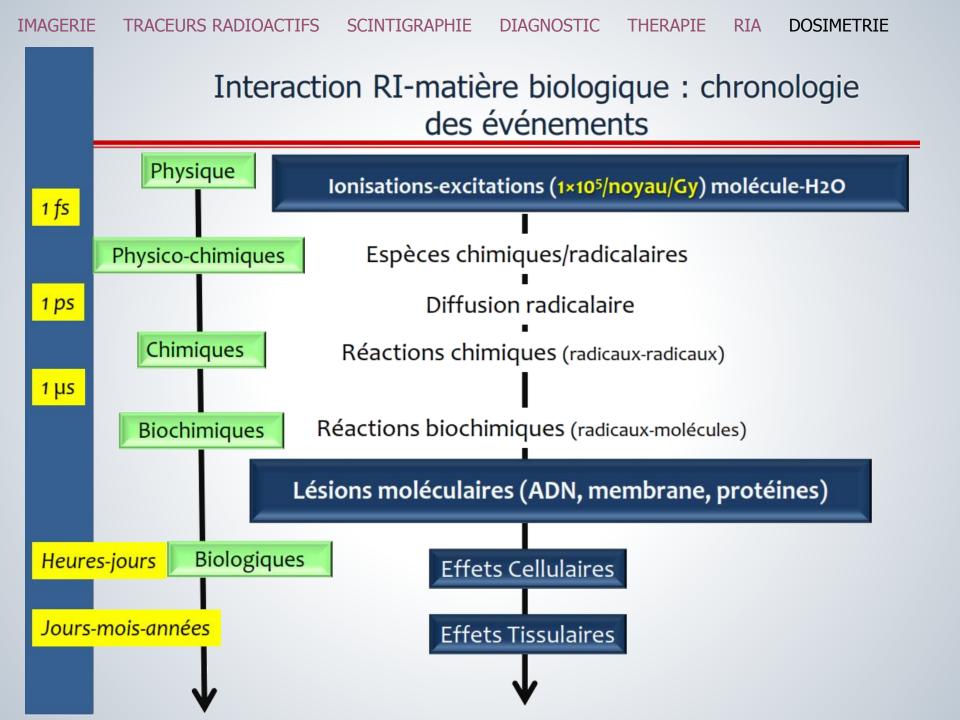
Workup – étude dosimétrique





RISQUE DOSIMETRIQUE





Irradiation
naturelle
moyenne
en France:
2,5 mSv / an
1-5 mSv / an

IMAGERIE

Ramsar (IRAN) : 250 mSv/an

Vol Paris-NY: 0,05 mSv

Procédé	Dose efficace (mSv)	■ Nb. radio thorax	≡ Expo n
Rayons X:			
Membres et articulations (sauf hanche)	<0,01	<0,5	<1,5 jour
Thorax (vue PA simple)	0,02	1	3 jours
Crâne	0,07	3,5	11 jours
Rachis dorsal	0,7	35	4 mois
Rachis lombaire	1,3	65	7 mois
Hanche	0,3	15	7 semaines
Bassin	0,7	35	4 mois
Abdomen	1,0	50	6 mois
UIV	2,5	125	14 mois
Déglutition barytée	1,5	75	8 mois
TOGD (transit oeso- gastro- duodénal)	3	150	16 mois
Transit du grêle	3	150	16 mois
Lavement baryté	7	350	3,2 ans
TDM crânienne	2,3	115	1 an
TDM thoracique	8	400	3,6 ans
TDM abdominale ou pelvienne	10	500	4,5 ans
Scintigraphie:			
Ventilation pulmonaire (Xe-133)	0,3	15	7 semaines
Perfusion pulmonaire (Tc-99m)	1	50	6 mois
Rein (Tc-99m)	1	50	6 mois
Thyroïde (Tc-99m)	1	50	6 mois
Os (Tc-99m)	4	200	1,8 an
Exploration dynamique			
cardiaque (Tc-99m), MIBG	6	300	2,7 ans
TEP pour crâne (18F-FDG)	5	250	2,3 ans
OCTREOSCAN	12	600	5,4 ans

CONCLUSION

- Imagerie fonctionnelle et métabolique :
- physiologique, non invasive et peu irradiante
- couvrant toutes les spécialités médicales
- * rôle essentiel dans le diagnostic et le traitement
- impliquant des équipes multidisciplinaires
 - paramédicaux, techniciens, médecins, pharmaciens,
 - physiciens, chimistes, informaticiens...

En fort développement :

Recherche : radio-traceurs, protocoles, caméras...

***** Économique :

200 centres, 550 médecins en France

+ 5% de patients pris en charge / an

