

Imagerie infectieuse non conventionnelle

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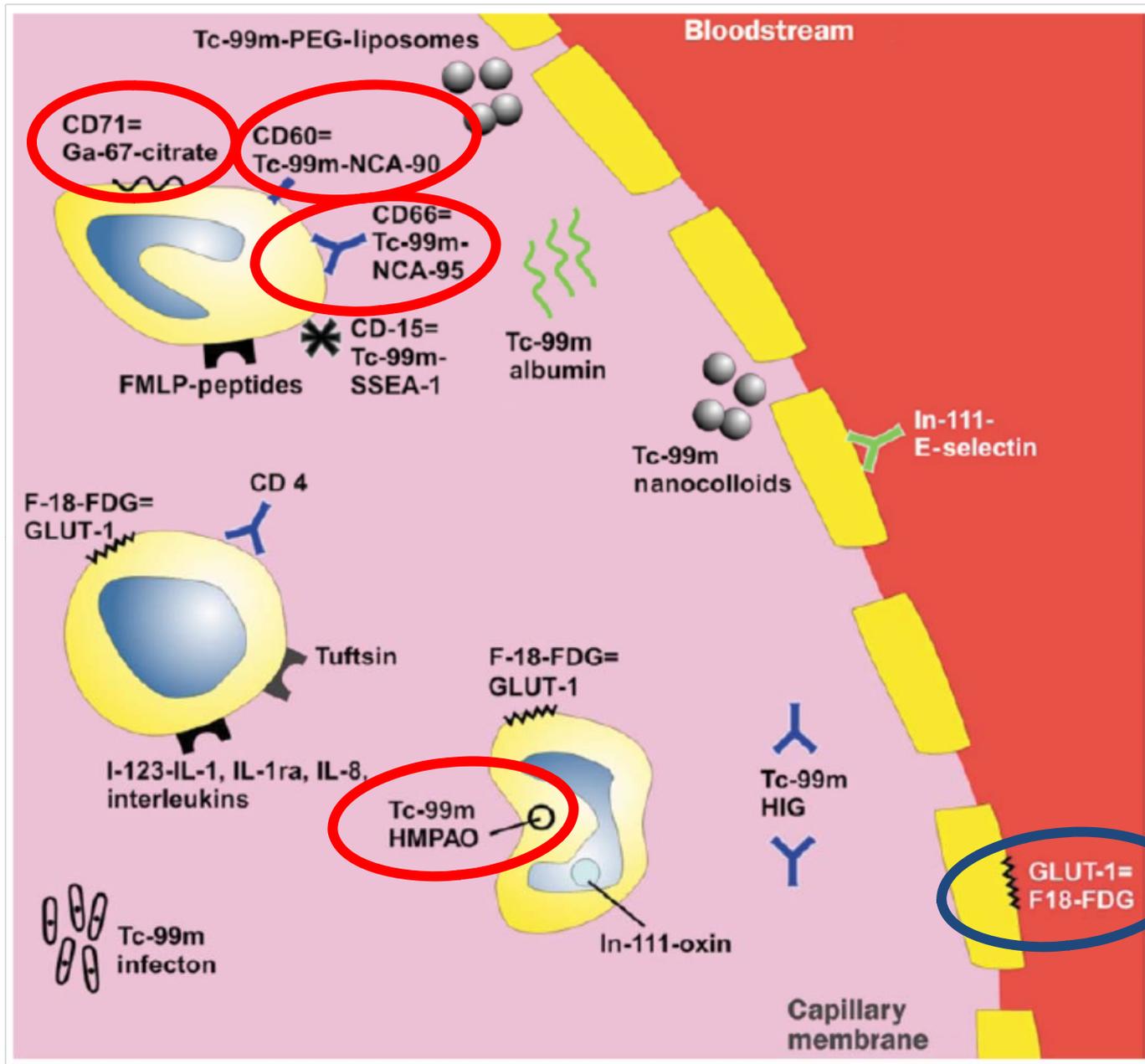


Non conventionnelle ?



Non conventionnelle = ?

- Non IRM
- Non TDM
- Non Echographique
- Non spectrométrique ?

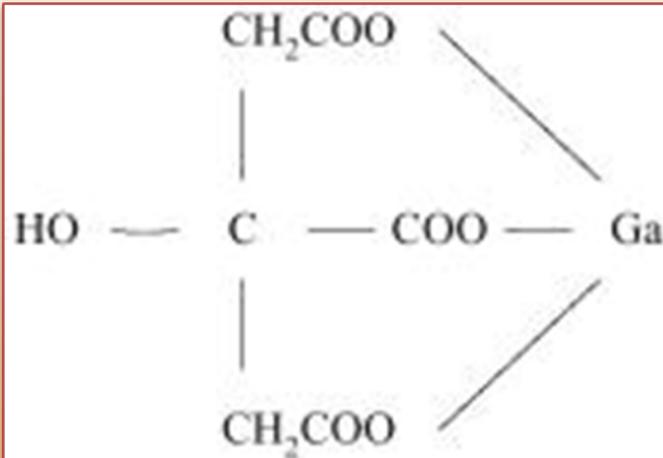


W Becker and J Meller, The Lancet infectious disease 2001.

Radiopharmaceutical	Physical characteristics		Uptake mechanism
	Half-life	Energy	
⁶⁷ Ga citrate	78 h	93, 185, 300, and 394 keV	Transferrin receptor binding Lactoferrin receptor binding
^{99m} Tc-nanocolloids	6 h	140 keV	Non-specific via capillary permeability/active uptake in activated endothelial cells
^{99m} Tc/ ¹¹¹ In-labelled human immunoglobulin (HIG)	6 h 67 h	140 keV/173 and 247 keV	Non-specific via increased capillary permeability
¹¹¹ In oxine/ ^{99m} Tc-HMPAO labelled leucocytes	67h/6h	173 and 247 keV/140 keV	Specific chemotactic activation
^{99m} Tc-labelled granulocyte	6 h	140 keV	Increased capillary antibodies permeability and specific binding or uptake as antibody labelled granulocytes
¹⁸ F-FDG	1.8 h	511 keV	Upregulated GLUT-1 in activated granulocytes, lymphocytes and monocytes

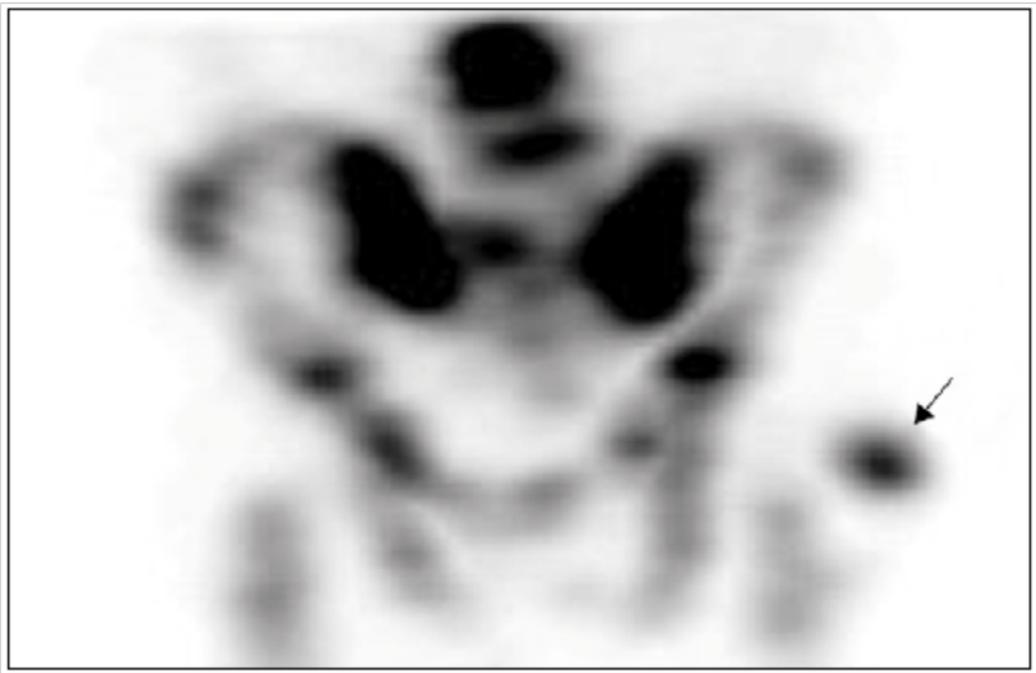
Indication	Proposed radiopharmaceutical
Fever of unknown origin	^{18}F -FDG ^{67}Ga citrate $^{99\text{m}}\text{Tc}$ -labelled granulocyte antibodies
Osteomyelitis	^{18}F -FDG
Peripheral bone	$^{99\text{m}}\text{Tc}$ -labelled granulocyte antibodies $^{99\text{m}}\text{Tc}$ -labelled white blood cells
Spine	^{18}F -FDG ^{67}Ga citrate $^{99\text{m}}\text{Tc}/^{111}\text{In}$ -HIG
Lung infection	^{67}Ga citrate
Heart valve endocarditis	$^{99\text{m}}\text{Tc}$ -labelled white blood cells $^{99\text{m}}\text{Tc}$ -labelled granulocyte antibodies
Vascular prosthetic infection	$^{99\text{m}}\text{Tc}$ -labelled white blood cells $^{99\text{m}}\text{Tc}$ -labelled granulocyte antibodies
Abdominal infection/inflammation	$^{99\text{m}}\text{Tc}$ -labelled white blood cells $^{99\text{m}}\text{Tc}$ -granulocyte antibodies
Assessment of disease activity in CIBD	^{111}In -labelled white blood cells
Kidney infection/transplant infection	^{111}In -labelled white blood cells
Chronic infection (eg, tuberculosis, sarcoidosis)	^{67}Ga citrate
CIBD=chronic inflammatory bowel disease	

La préhistoire (1971) !



Le Citrate de Gallium

L'accumulation du gallium au niveau des structures tumorales et des foyers inflammatoires est imputée à la similitude de son comportement à celui du fer. Il a été démontré in vivo que le Gallium se lie à la transferrine, la ferritine et à la lactoferrine.



Hématome surinfecté

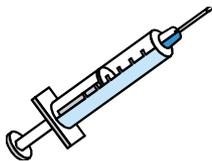
Sarcoïdose



Scintigraphie au Gallium

(véhiculé par la transferrine)

48 heures post IV :
Images tardives



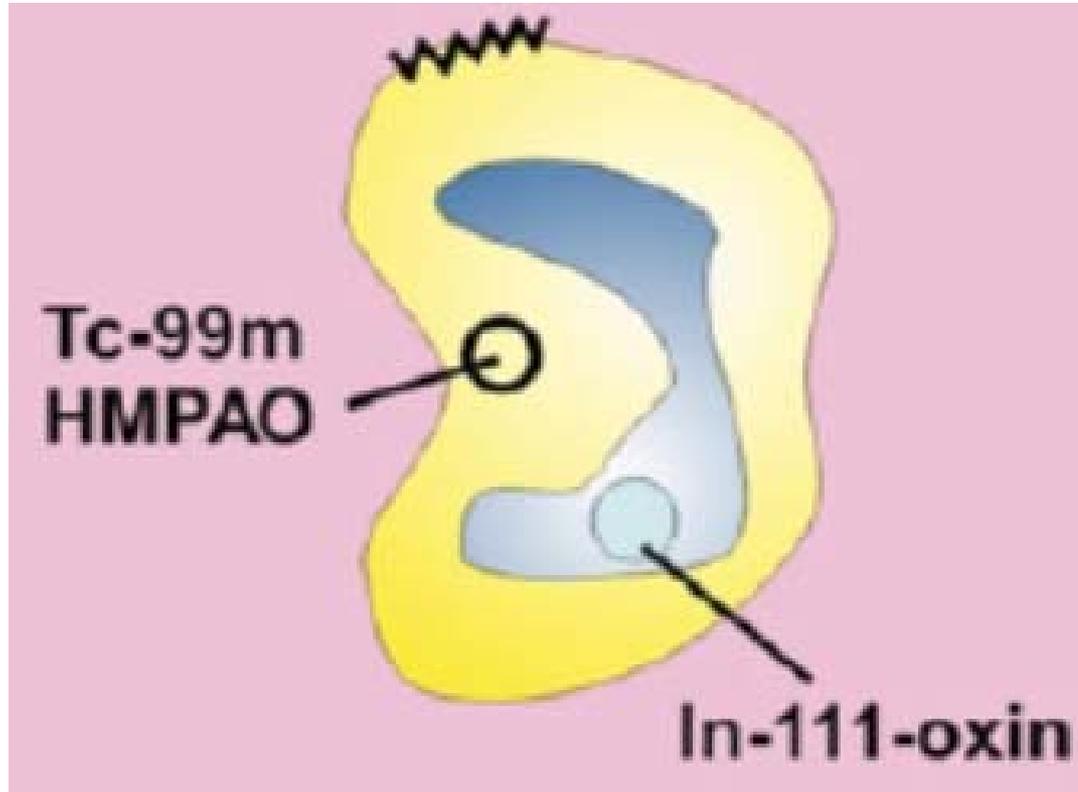
Avantages :

- permet le suivi.
- (200 €)

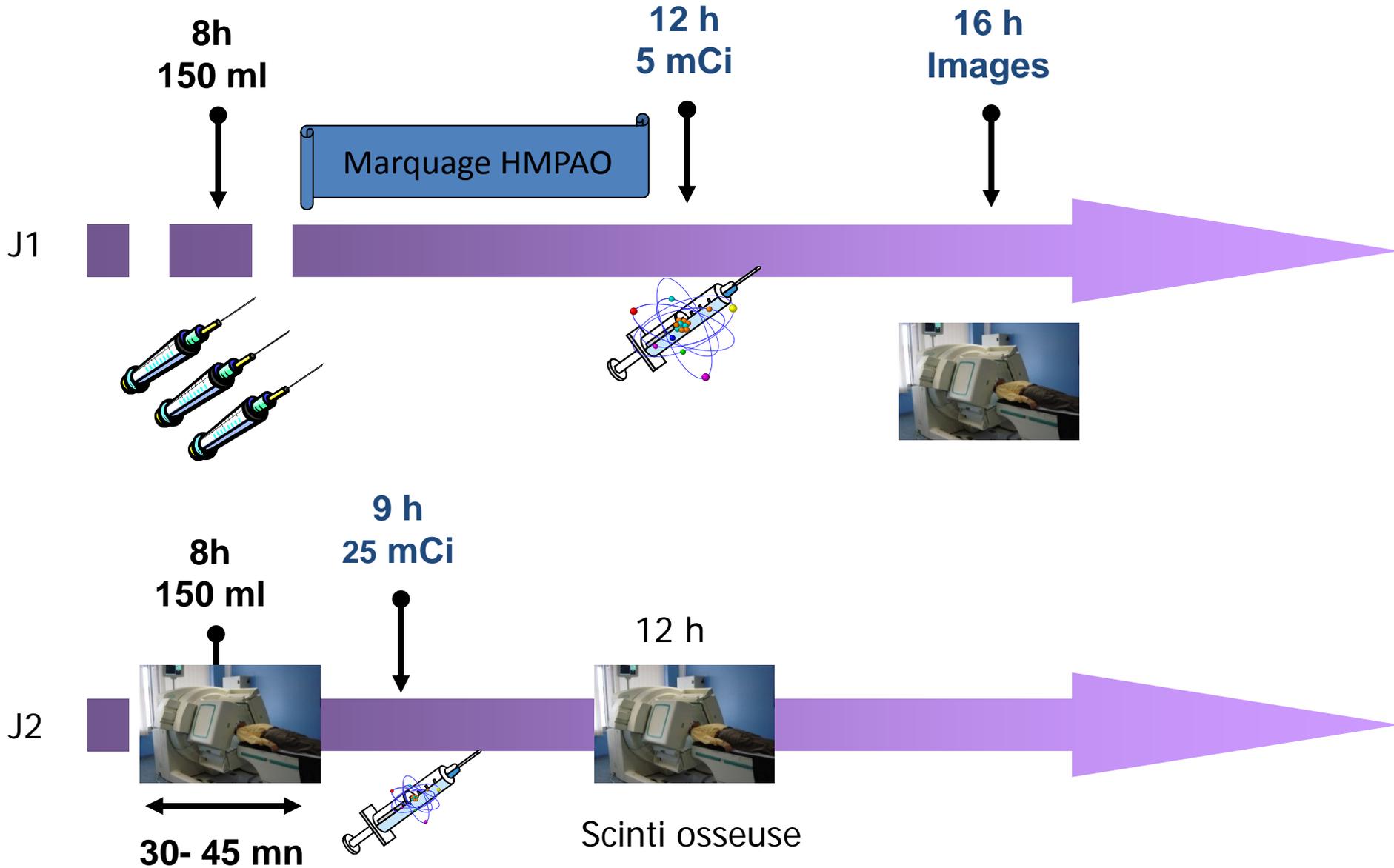
Inconvénients

- Mauvaise qualité des images.
- Collimateur haute énergie
- Délai
- Dosimétrie (1/2 vie 78 heures)
- Se et Sp (60-100%)

Leucocytes marqués



Réalisation pratique de l'examen.



En Pratique

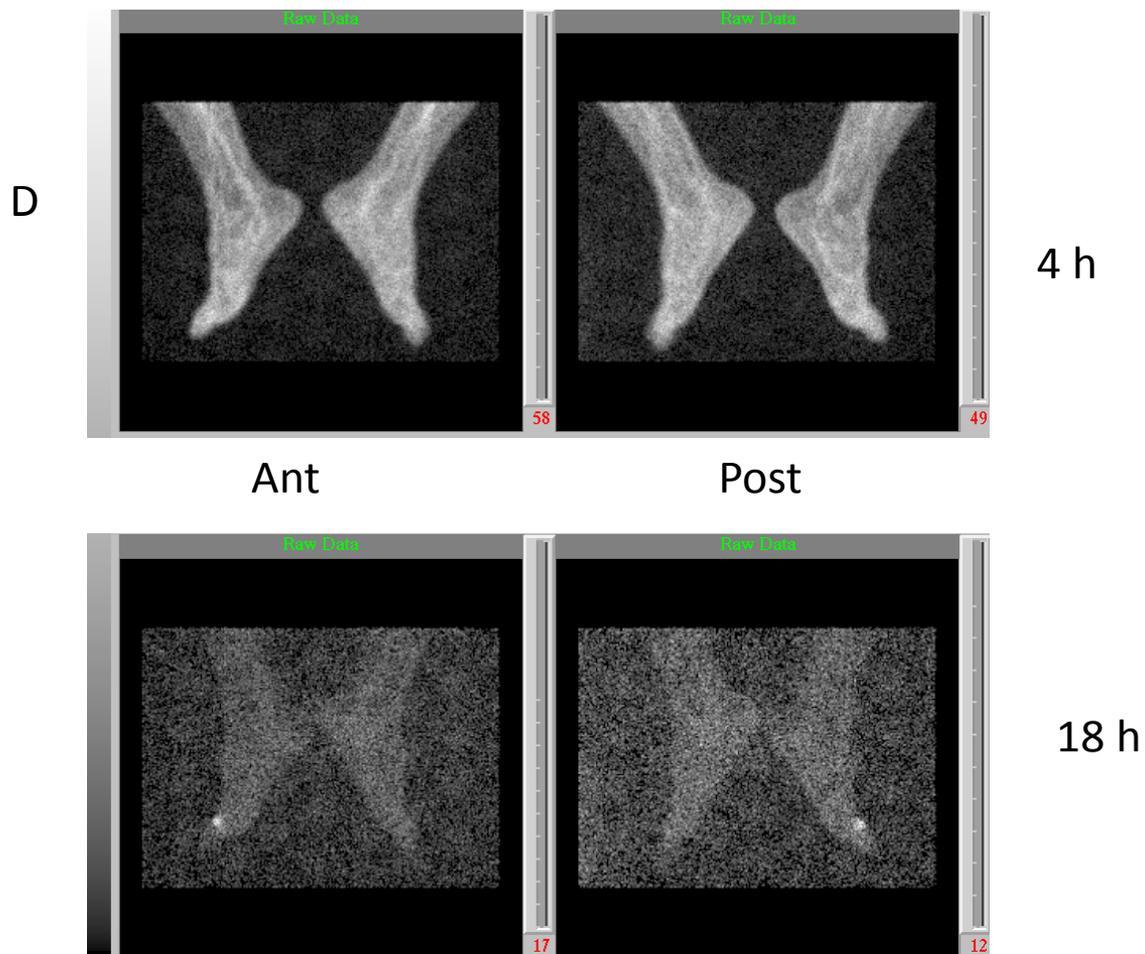
- Pour le patient : aucune préparation
 - Contre indications : Allergie à l'héparine, grossesse.
- Déroulement de l'examen :
 - prélèvement de 150 ml (3 seringues).
 - centrifugations et lymphoprep
 - polynucléaires marqués à ^{99m}Tc -l'HMPAO
 - contrôle de viabilité cellulaire (trypan+lame)
 - réinjection au patient (3-10 mCi)
- Images précoces (3-4 h post prélèvement)
- Images tardives (18 heures)

En Pratique (suite)

- Dosimétrie.
 - 4 à 6 mSv (irradiation naturelle 2,7 mSv)
- Coût de l'examen :
 - Leucocytes : 300 € Os : 200 €

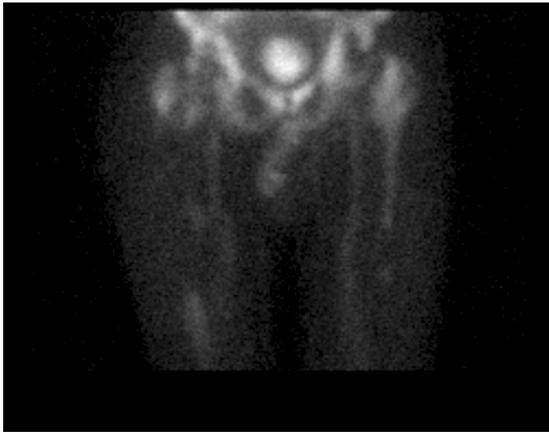
	¹¹¹ In leucocytes mSv / MBq	^{99m} Tc HMPAO leucocytes mSv / MBq
rate	6,3	0,2
foie	1	0,32
poumons	0,4	0,014
moelle osseuse	0,18	0,0089
ovaires	0,038	0,0043
testicules	0,0078	0,0032
corps entier	0,12	0,0046

Mr C, fracture du calcaneum gauche operée.
Douleurs persistantes à 6 mois : leucocytes marqués

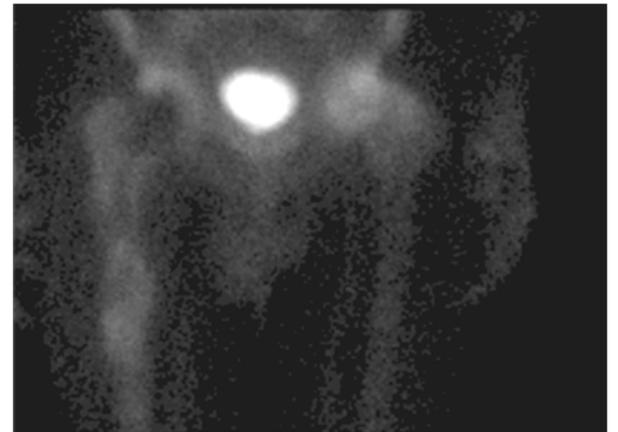


Mr D, 55 ans. Infection PTH D.

D



Leucocytes

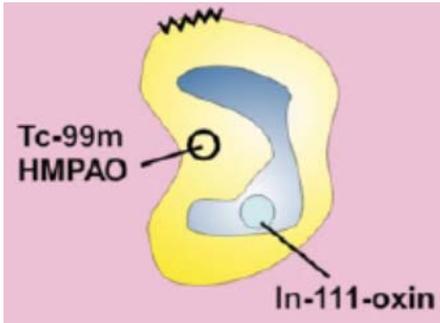


Os

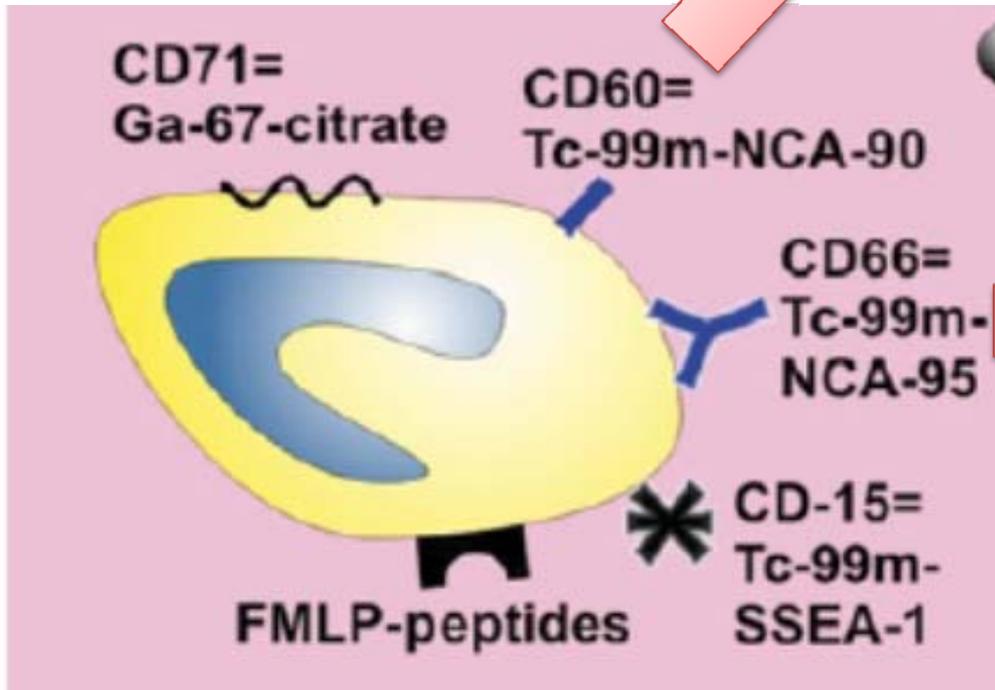
Performances :

- Paakkinen et al: . 1987
 - L > Ga os et articulations (Se 95% vs 90%)
- Moragas et al, 1991
 - Prothèses (25 hanches et 5 genoux)
 - Délai intervention-L : Se 81% Sp 94%
- Devillers et al, 1995 : (n=116, Se 95%, Sp 90%)
 - 74 avec implants : Se 97% , Sp 89 %.
 - 24 avec ostéomyélites : Se 100%, Sp 100%
 - 18 avec arthrites septiques : Se 80%, Sp 83%

Leucocytes marqués (2)

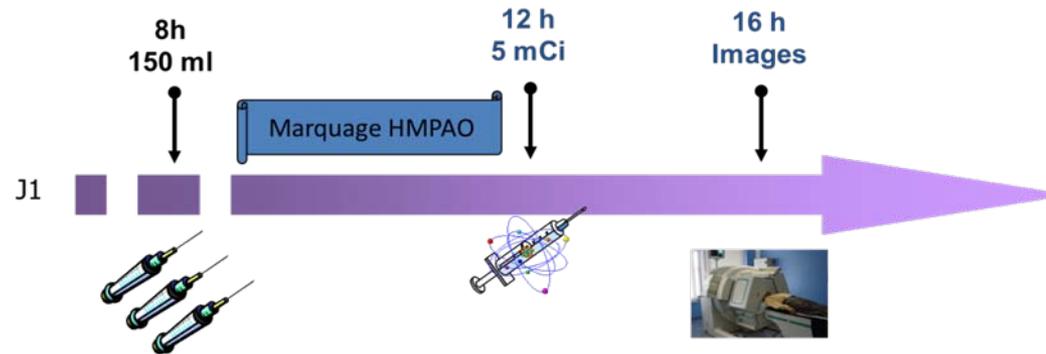


Sulesomab (Leukoscan[®])



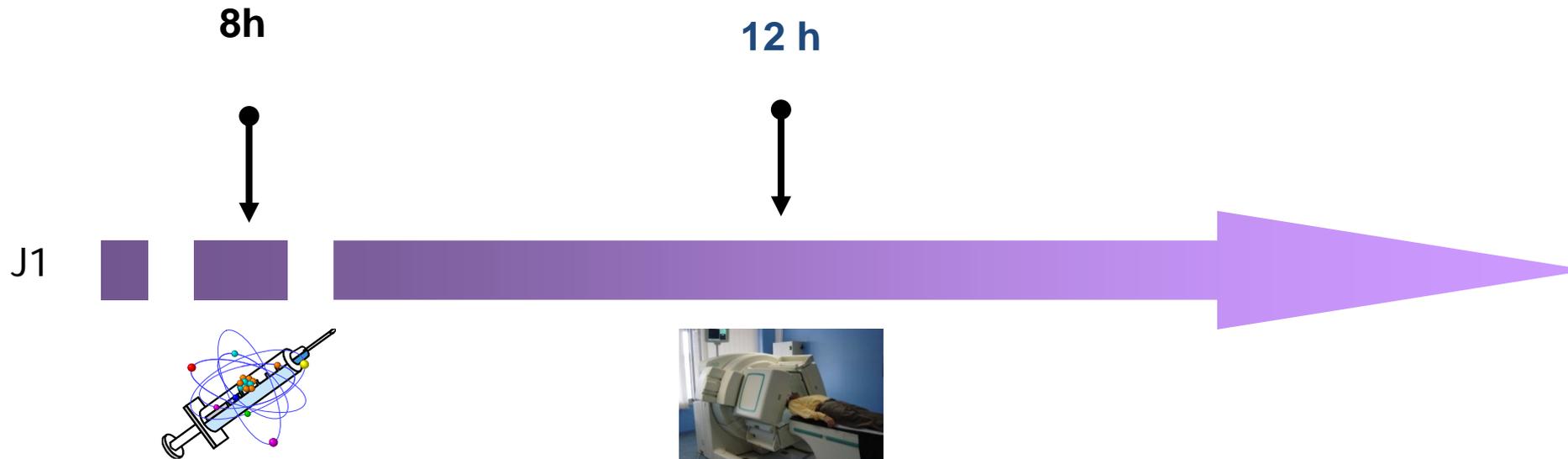
Besilesomab (Scintimun[®])

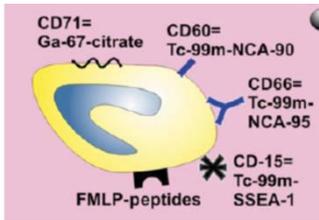
Avantage : Réalisation pratique de l'examen.



Besilesomab (Scintimun[®])

Sulesomab (Leukoscan[®])





Avantages/Inconvénients

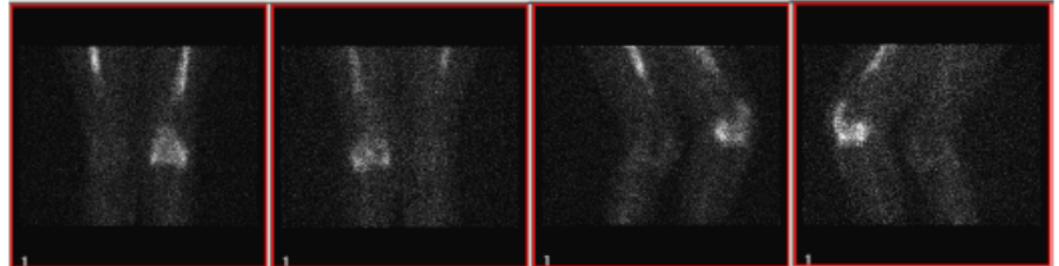
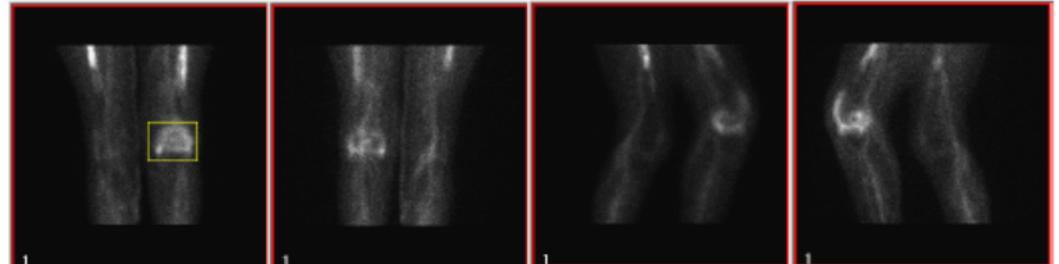
- Pas d'autotransfusion.
 - Pas de prélèvements sanguins.
 - Pas de risques de contaminations
 - Pas de marquage cellulaire « ex vivo »

Mais

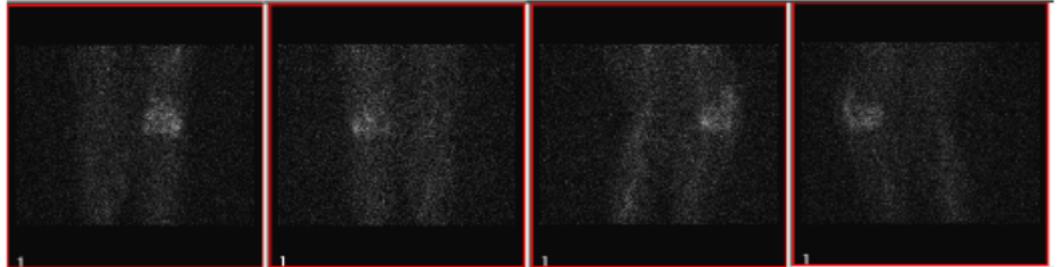
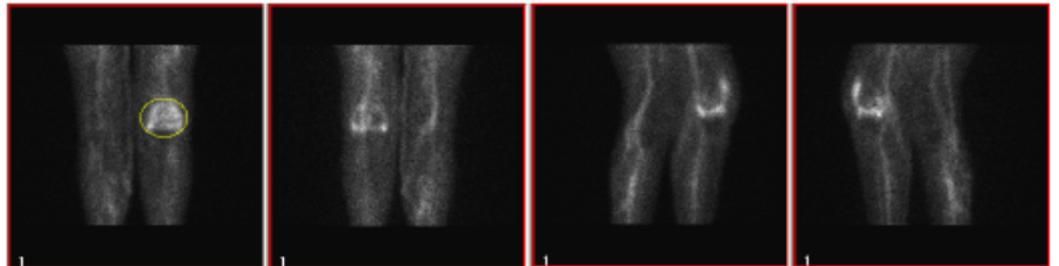
- Immunoscintigraphie !
 - Détection positive d'anticorps humains anti-souris (HAMA).
 - 14% des patients après une administration unique

Performances

SCINTIMUN



WBC



ROIs drawn by blinded reader

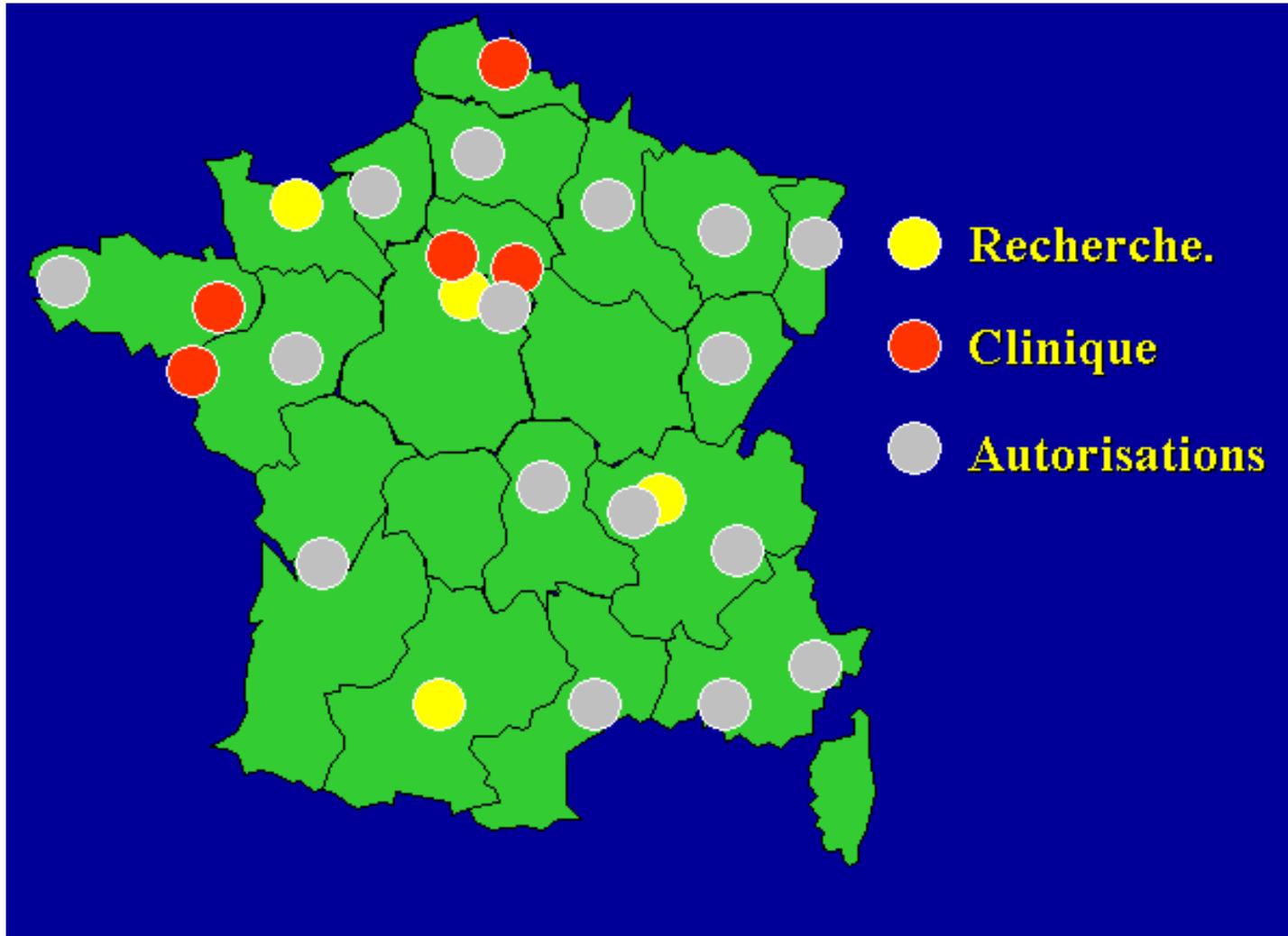
AG-PH3 (6/06 – 01/08)	phase III	120	Randomized, open-label, randomized, intra-individual comparison with labeled WBCs; patients with osteomyelitis
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	SCINTIMUN		Tc-99m WBCs	
	Sensitivity	[95% CI]	Sensitivity	[95% CI]
Reader 1	0.770	[0.674; 0.867]	0.703	[0.598; 0.808]
Reader 2	0.757	[0.658; 0.855]	0.514	[0.399; 0.628]
Reader 3	0.716	[0.613; 0.820]	0.554	[0.440; 0.668]
Across readers	0.748	[0.666; 0.829]	0.590	[0.497; 0.683]
	Specificity	[95% CI]	Specificity	[95% CI]
Reader 1	0.641	[0.575; 0.861]	0.667	[0.517; 0.817]
Reader 2	0.795	[0.667; 0.923]	0.897	[0.801; 0.994]
Reader 3	0.718	[0.575; 0.861]	0.821	[0.699; 0.943]
Across readers	0.718	[0.594; 0.842]	0.795	[0.703; 0.887]

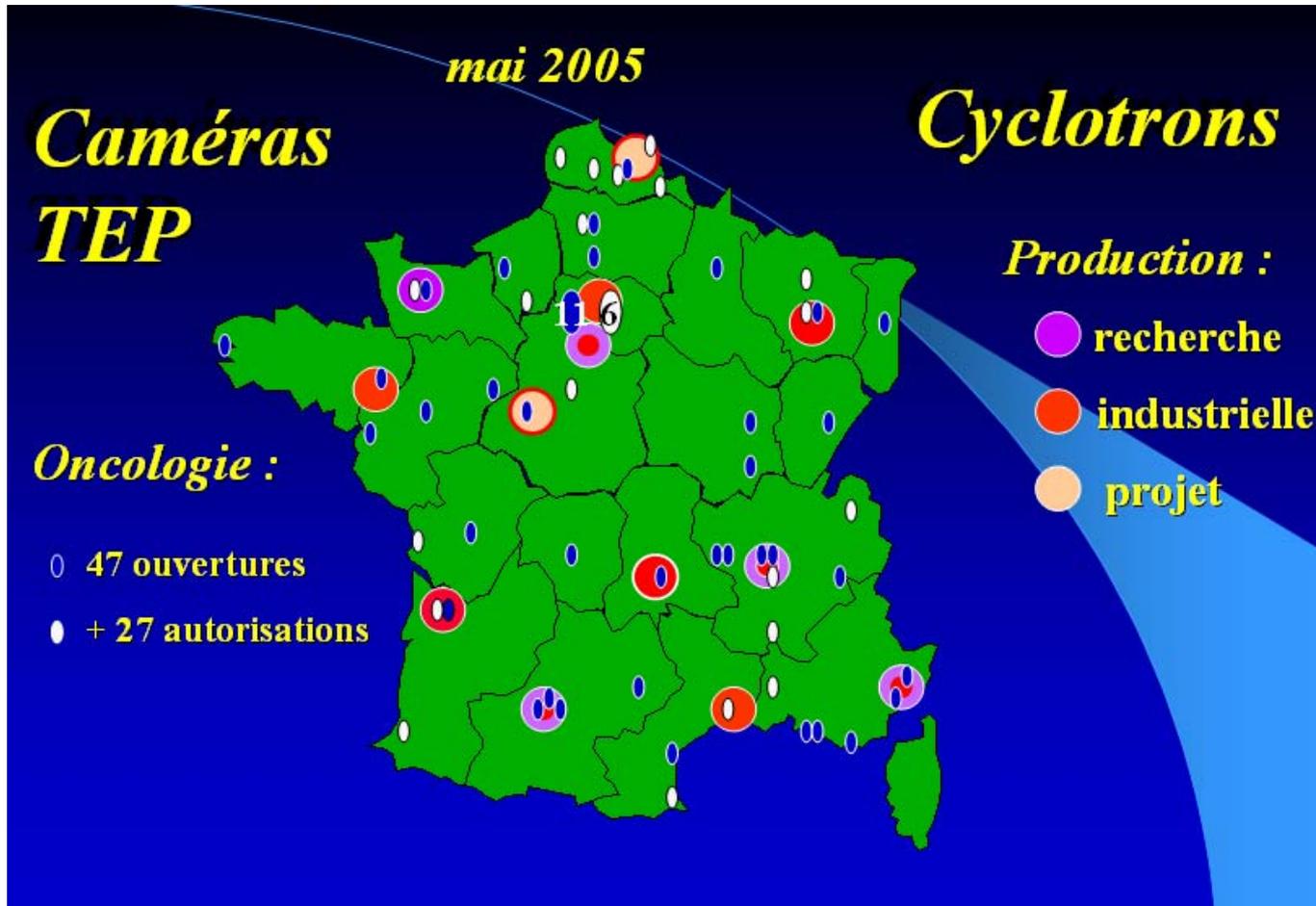
Scintimun detects more patients with osteomyelitis (higher sensitivity); however, also more false positives (lower specificity)

^{18}F - Fluoro-deoxyglucose

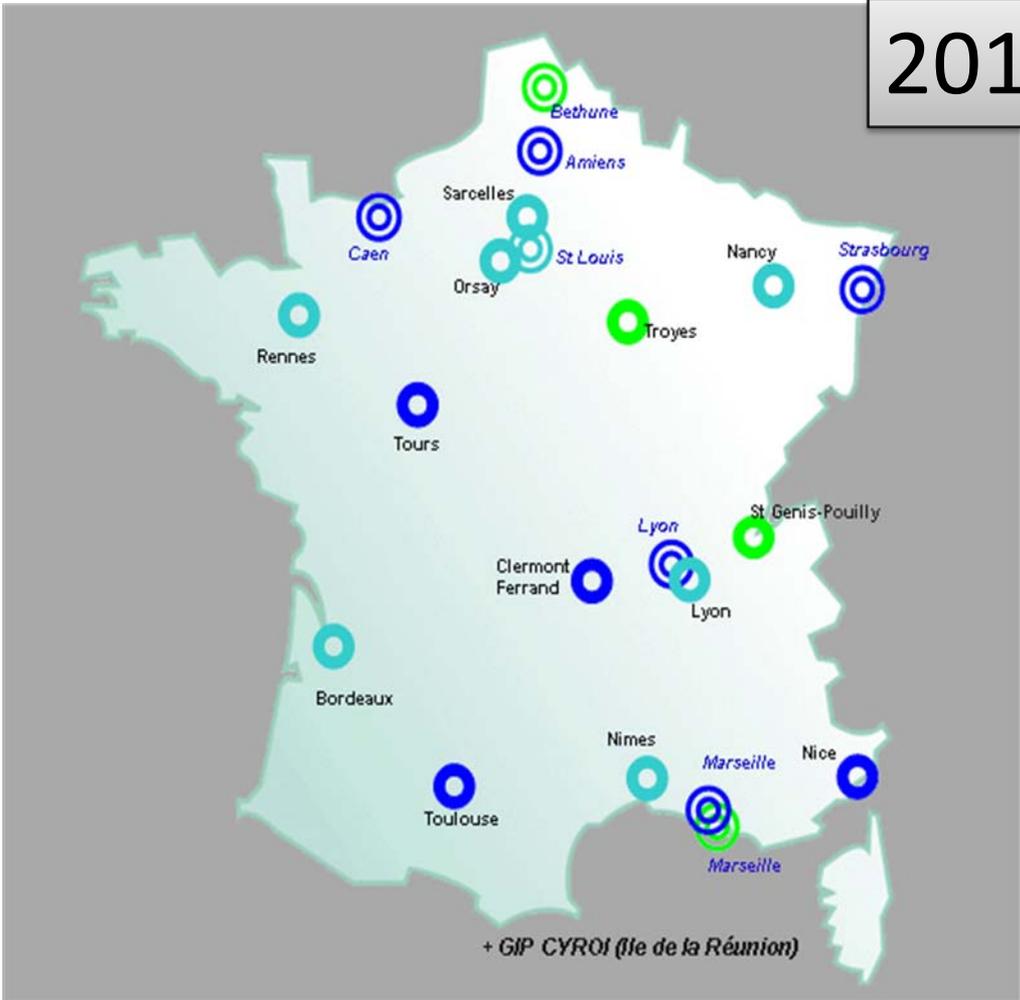
18F- Fluoro-deoxyglucose



En 2005 ...



2011



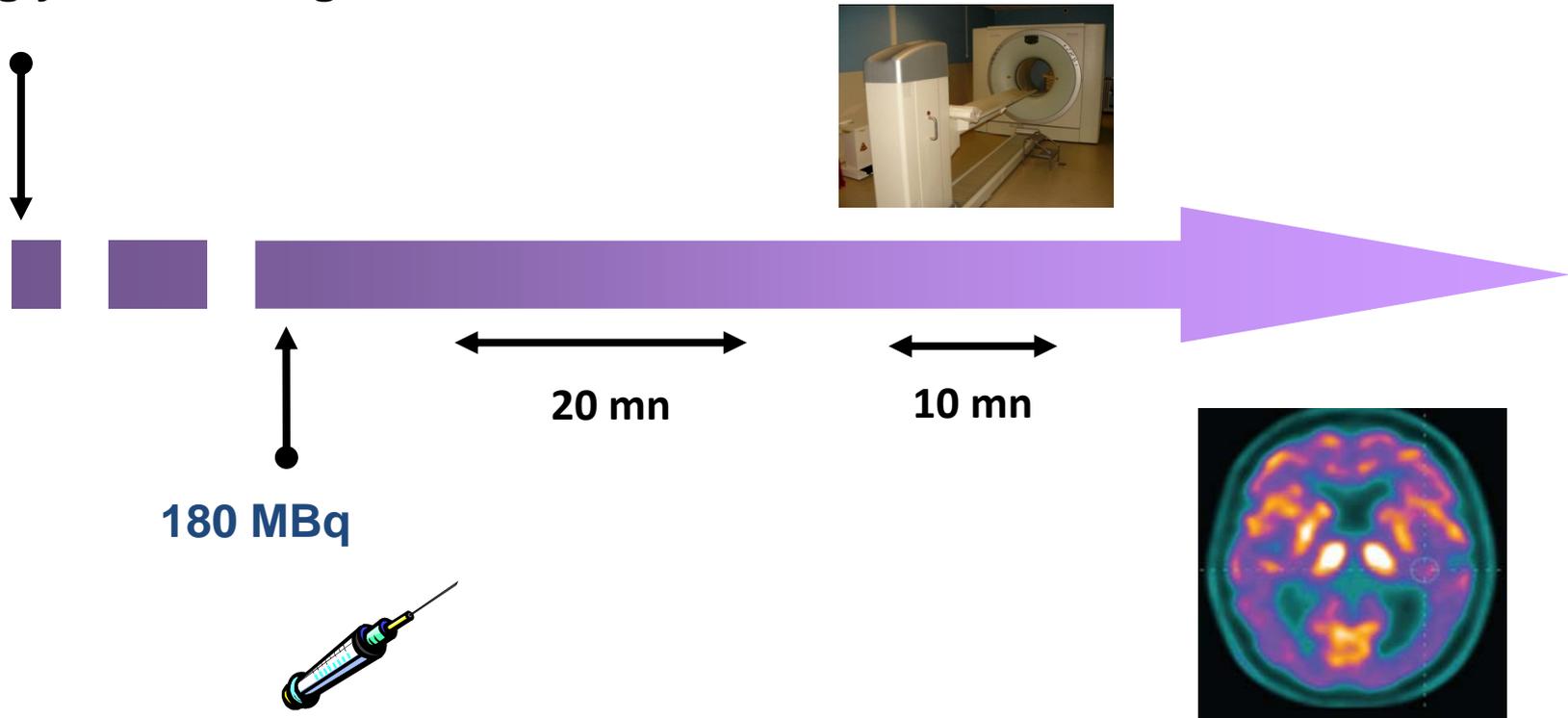
22 cyclotrons
75 caméras TEP

Effondrement du
prix du FDG.

Sites de production du FDG

Réalisation pratique de l'examen TEP FDG.

- Patient à jeun au moins 6 h
glycémie < 1,6g/l



Performances

Committee for Medicinal Products for Human Use (CHMP) :



Figure 5. ^{18}F -FDG uptake in acute osteomyelitis of distal femur.

1. Localisation of abnormal foci to guide the aetiological diagnosis in the presence of fever of unknown origin (FUO)
2. Diagnosis of infection in: suspected chronic infection of bone and/or adjacent structures (osteomyelitis, spondylitis, discitis or osteitis including presence of metallic implants), diabetes with suspicion of Charcot's neuroarthropathy, osteomyelitis and/or soft tissue infection, painful hip prosthesis, vascular prosthesis, and fever in AIDS
3. Detection of the extent of inflammation in: sarcoidosis, inflammatory bowel disease, and vasculitis involving the great vessels
4. Therapeutic follow-up of unresectable alveolar echinococcosis, in which it may be used in the search for active localisations of the parasite during medical treatment and after treatment discontinuation





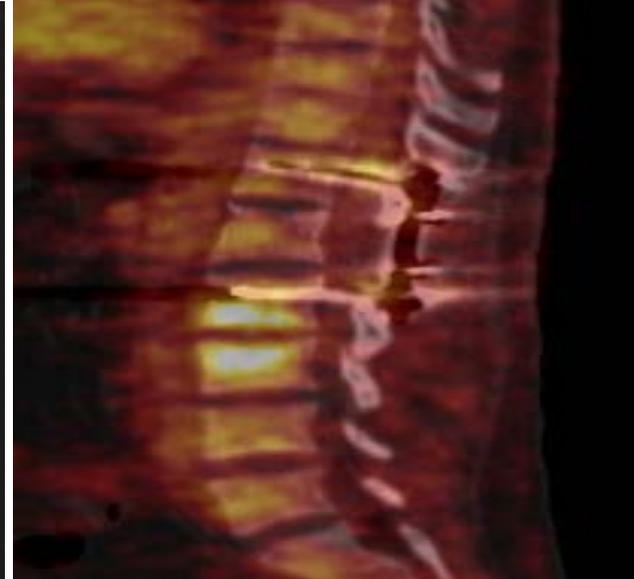
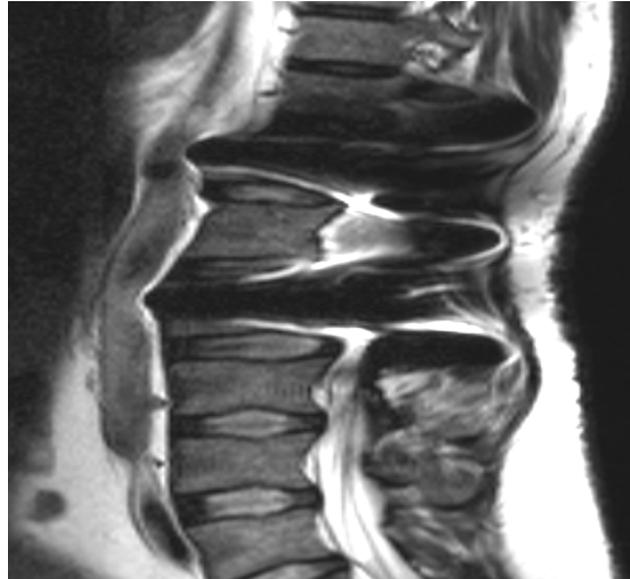
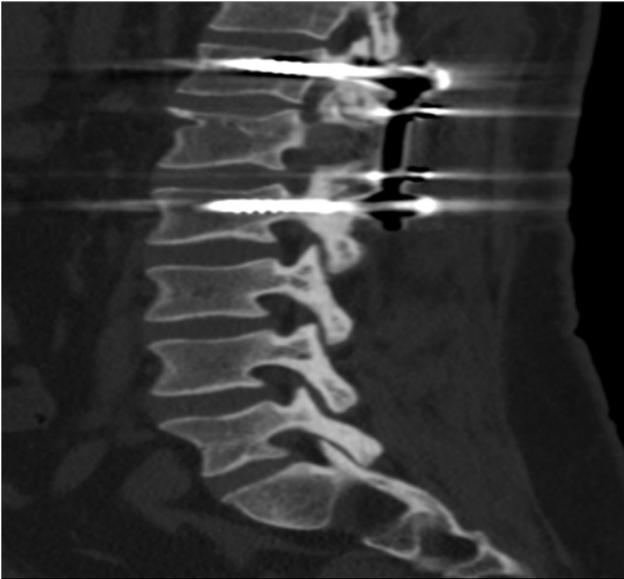
Non conventionnelle



conventionnelle



Indications non oncologiques





Imagerie Hybride



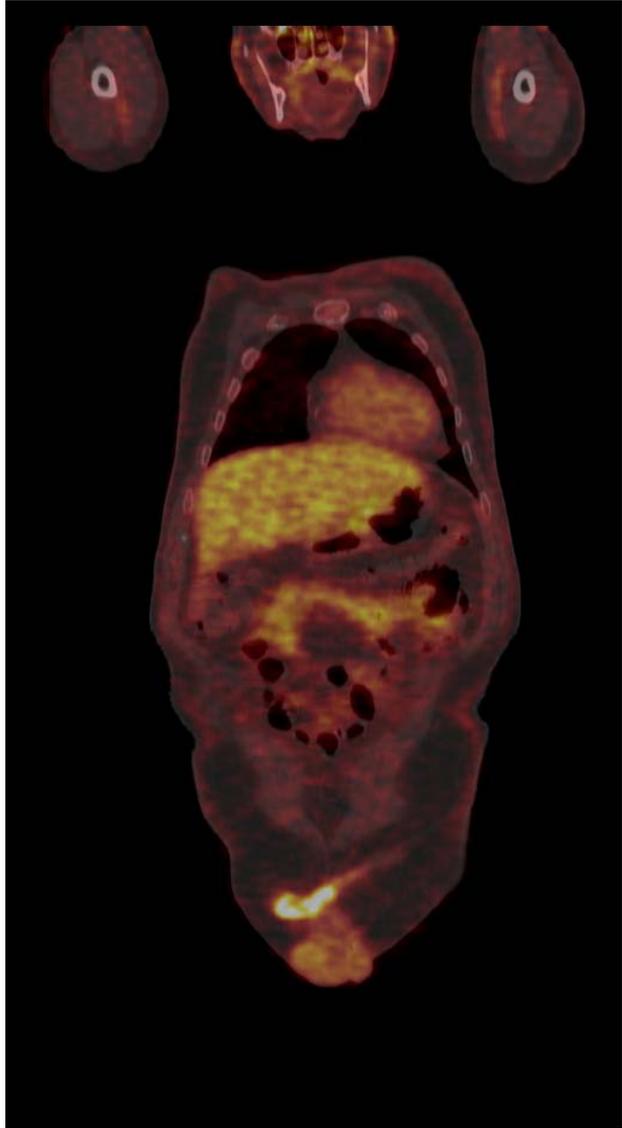
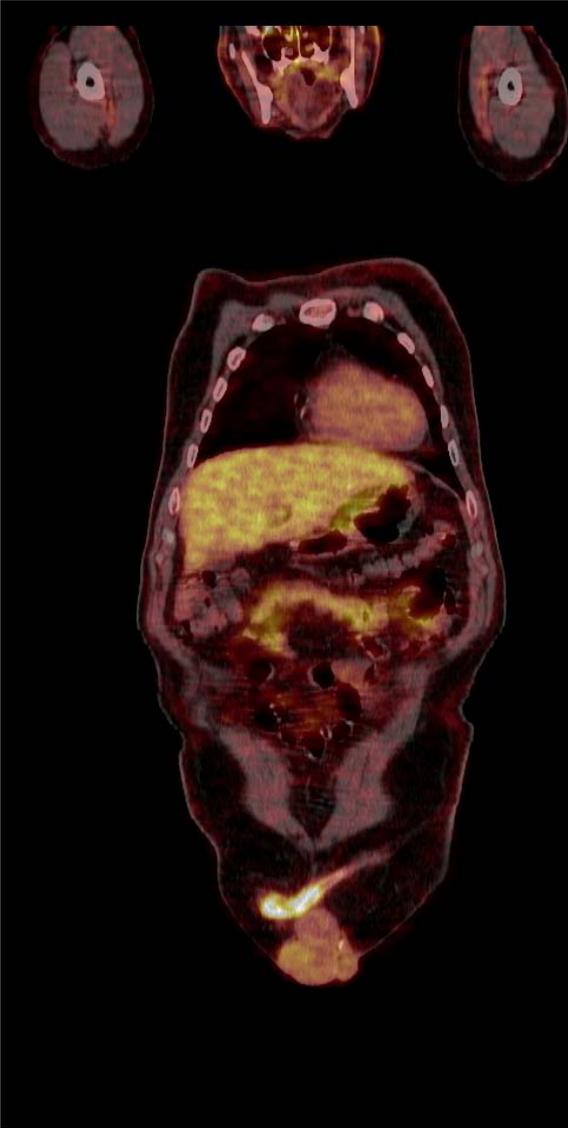
Le PET CT

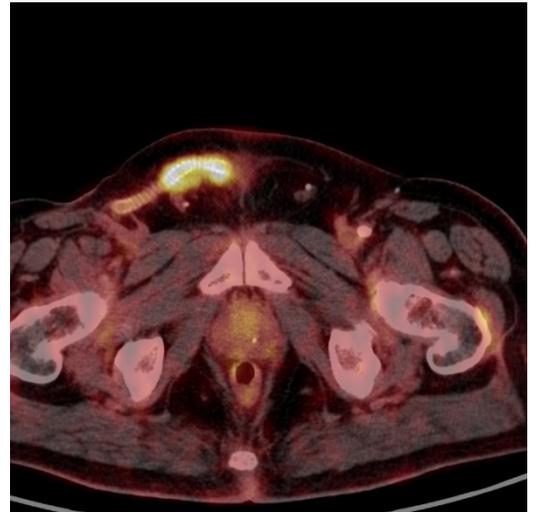
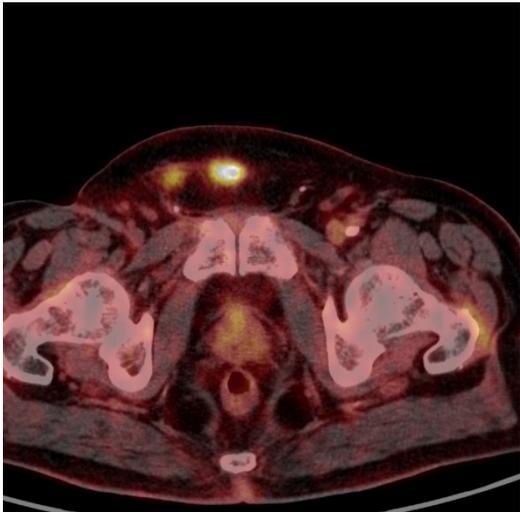
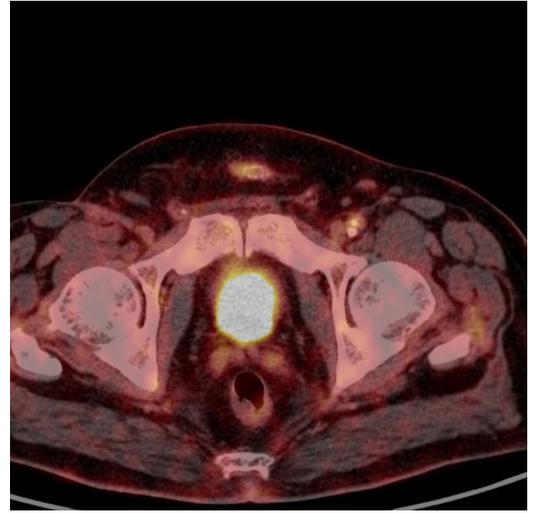
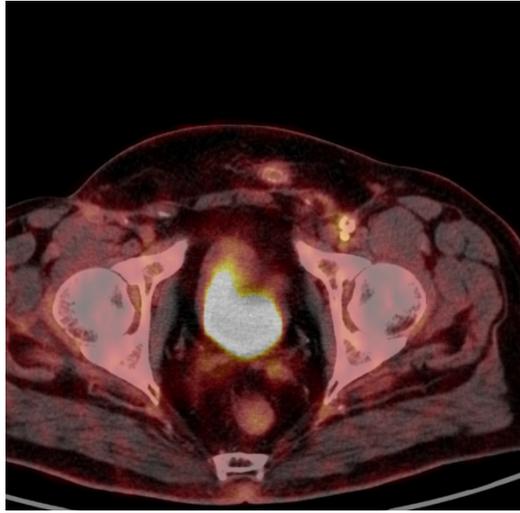
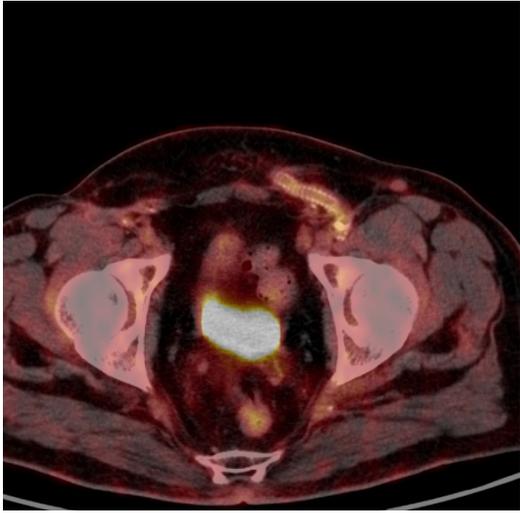
Le SPECT CT

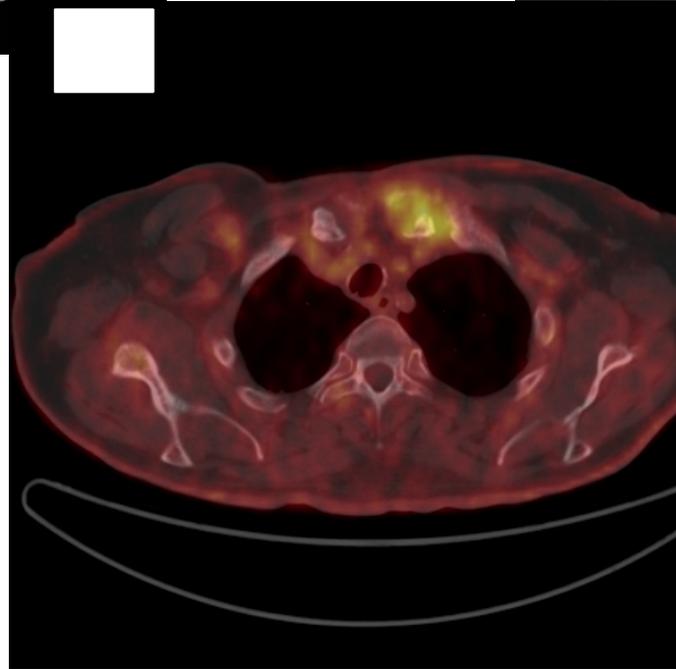
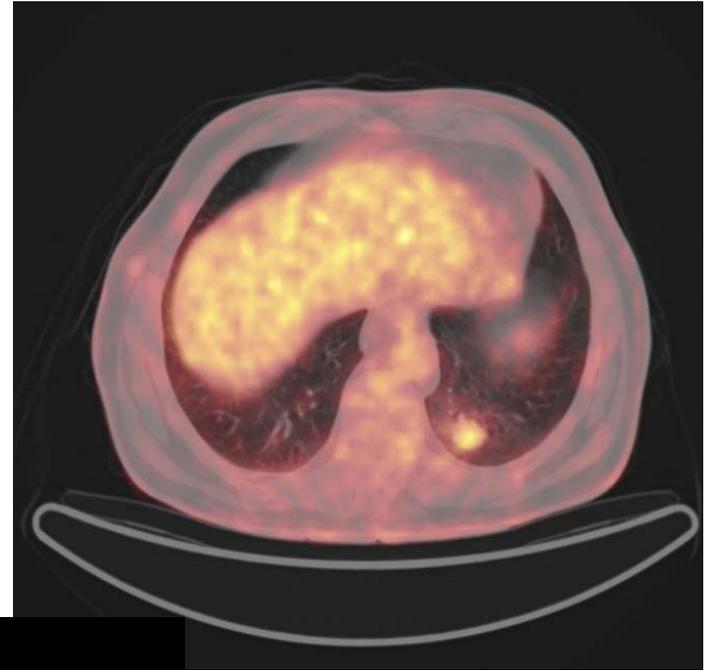
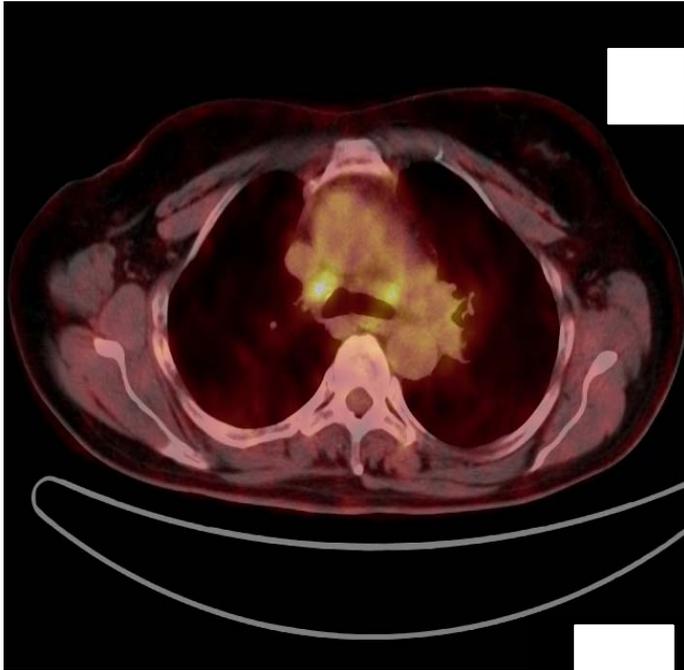
Cas clinique

- Patient de 64 ans
- Hospitalisé en Maladies Infectieuses
- Suspicion d'infection de pontage

- Bilan par TEP au FDG



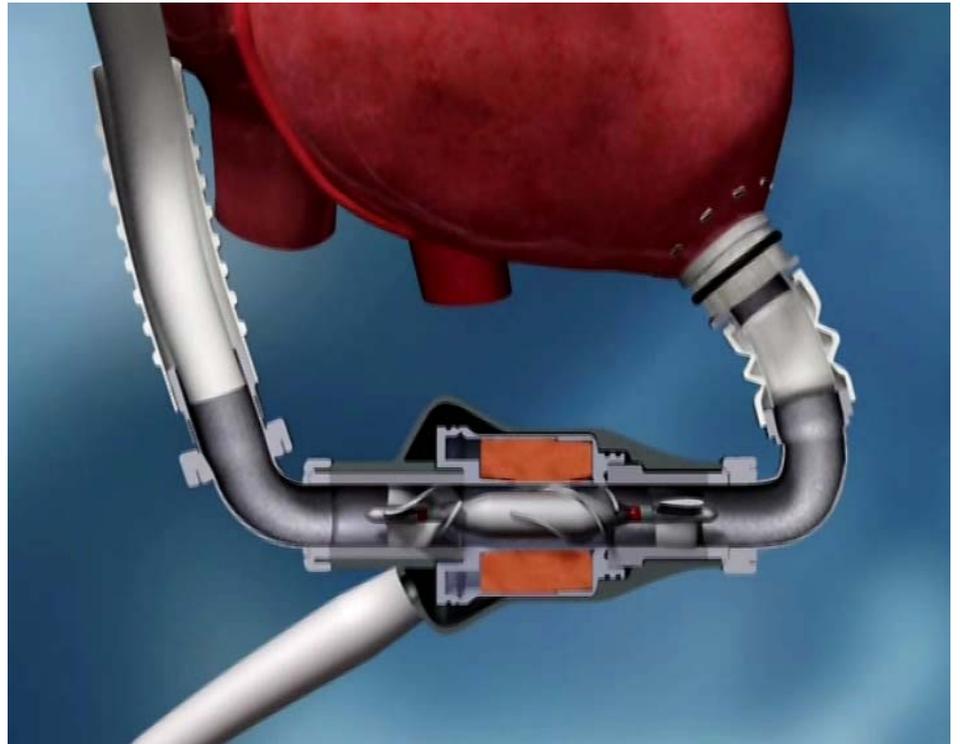
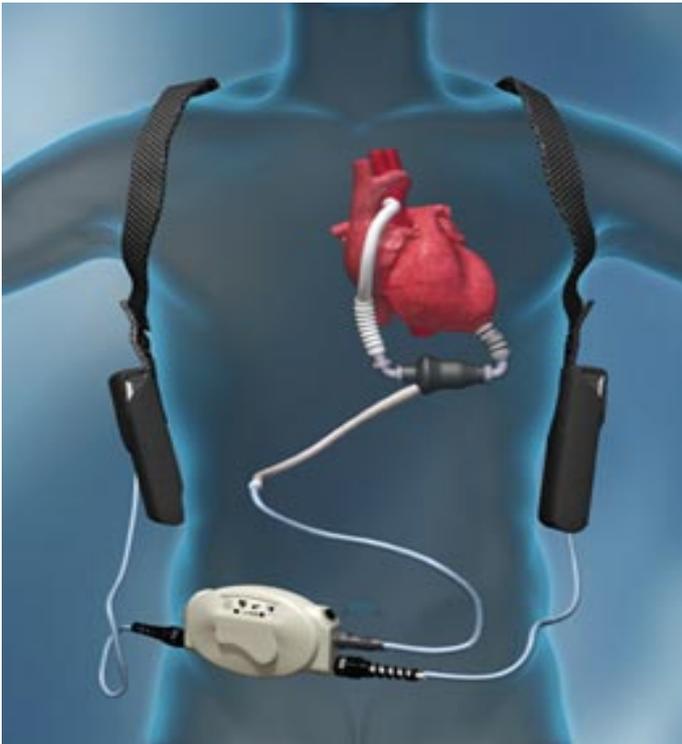






En SPECT-CT

Heartmate II®
130 x 45 mm

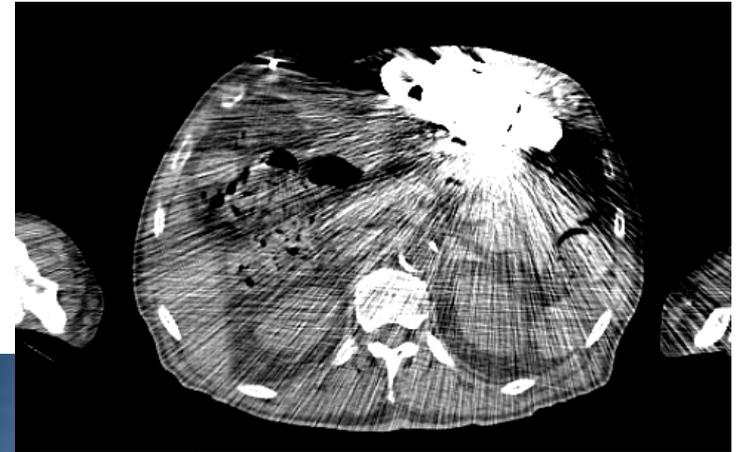


Problème : évaluer l'infection

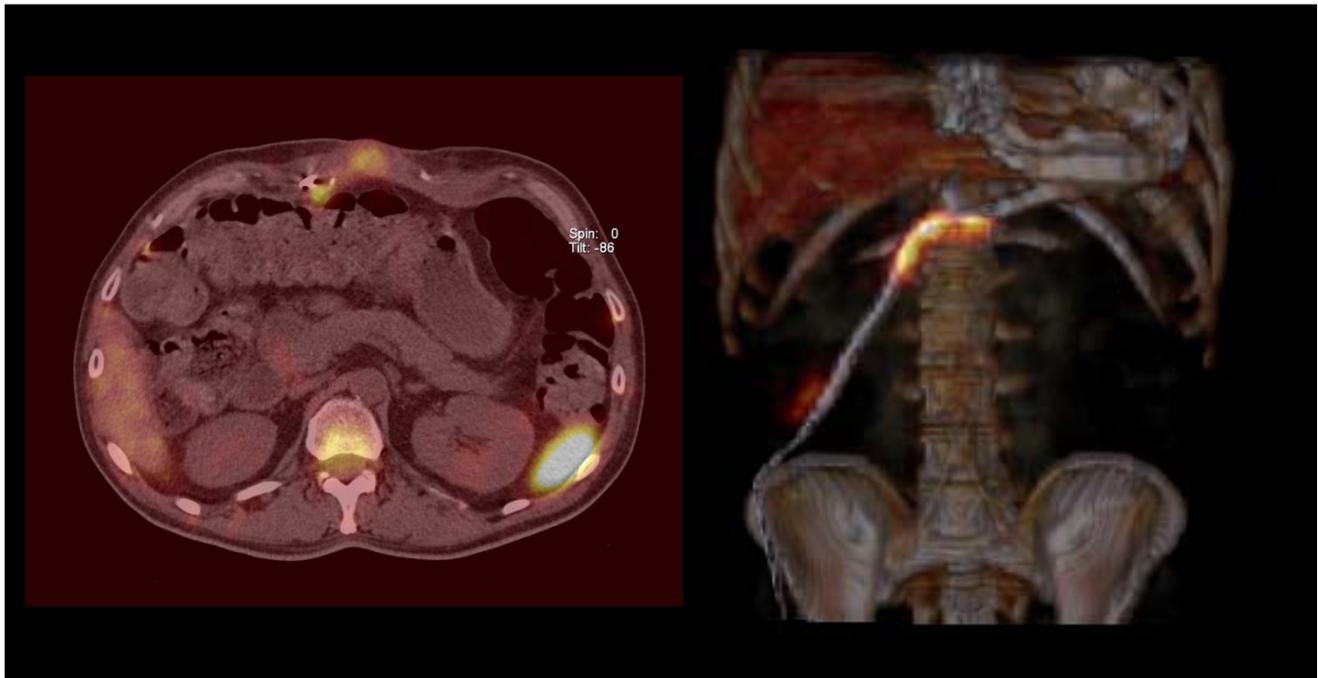
Bactériologie?



Imagerie morphologique?



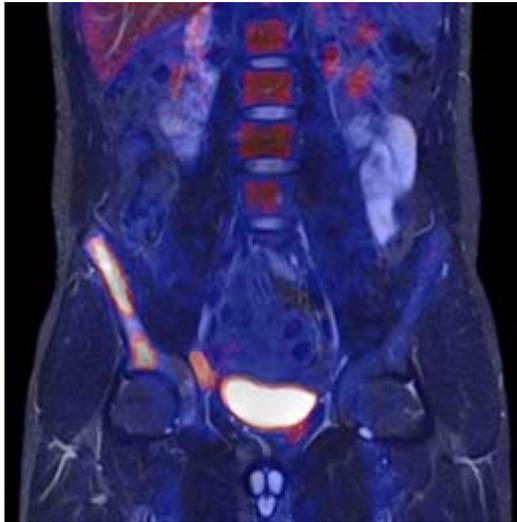
Scintigraphie aux leucocytes marqués ?



Apport de l'imagerie Hybride

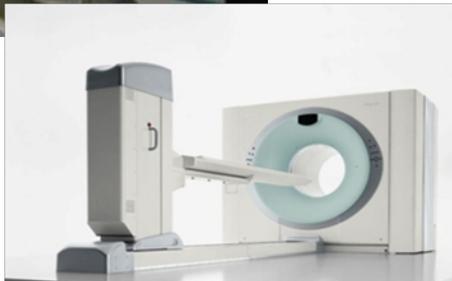
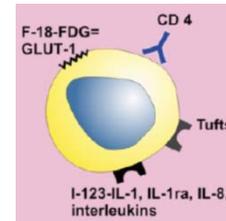
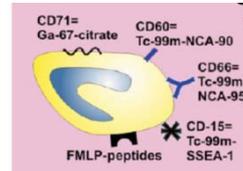
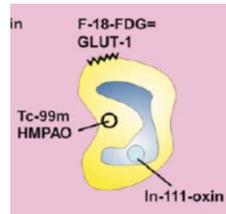
- TEMP-TDM aux leucocytes marqués
 - Faisable et interprétable malgré le matériel
 - Outil potentiel / aucun autre ex. diagnostique performant
 - Améliore la spécificité
- TEP-TDM FDG
 - En cours d'évaluation.

Le futur (proche)



TEP - IRM

Conclusion ?



Performances

Coûts

Irradiation

.../...

L'imagerie « non conventionnelle » ne doit pas le rester !