European guidelines and diagnostic flow charts for infection imaging

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Inflammation/Infection Committee
of the European Association of Nuclear Medicine (EANM)
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- Standardization
- Education

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Publications - Guidelines

The guidelines are under the auspices of the bodies of the European Association of Nuclear Medicine (EANM).

Inflammation and Infection

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J. Martin-Comin, SPAIN

Procedural guidelines

Eur J Nucl Med. 1998 Jul;25(7):797-9.

A consensus protocol for white blood cells labelling with technetium-99m hexamethylpropylene amine oxime. International Society of Radiolabeled Blood Elements (ISORBE)

Roca M, Martín-Comín J, Becker W, Bernardo-Filho M, Gutfilen B, Moisan A, Peters M, Prats E, Rodrigues M, Sampson C, Signore A, Sinzinger H, Thakur M.

Eur J Nucl Med Mol Imaging (2010) 37:835–841
DOI 10.1007/s00259-010-1393-5

GUIDELINES

Guidelines for the labelling of leucocytes with ^{111}In-oxine

Manel Roca · Erik F. J. de Vries · Francois Jamar · Ora Israel · Alberto Signore

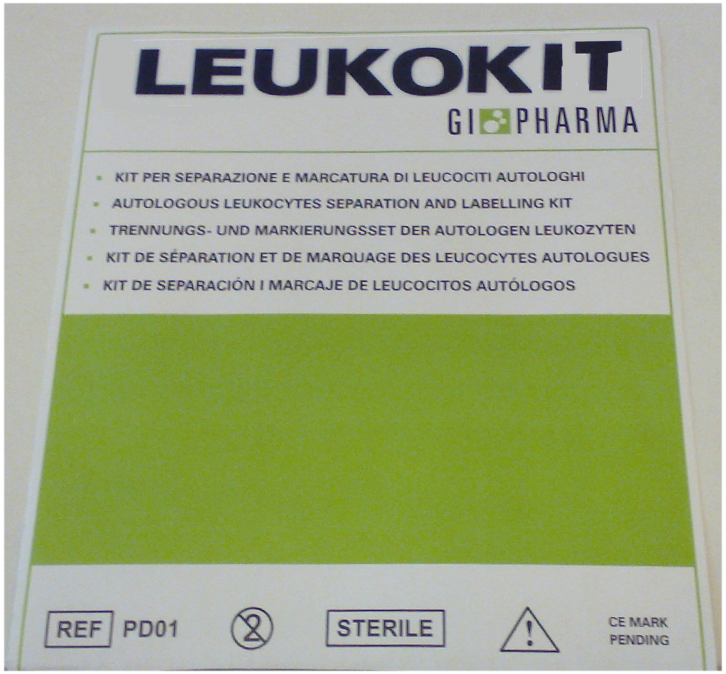
Eur J Nucl Med Mol Imaging (2010) 37:842–848
DOI 10.1007/s00259-010-1394-4

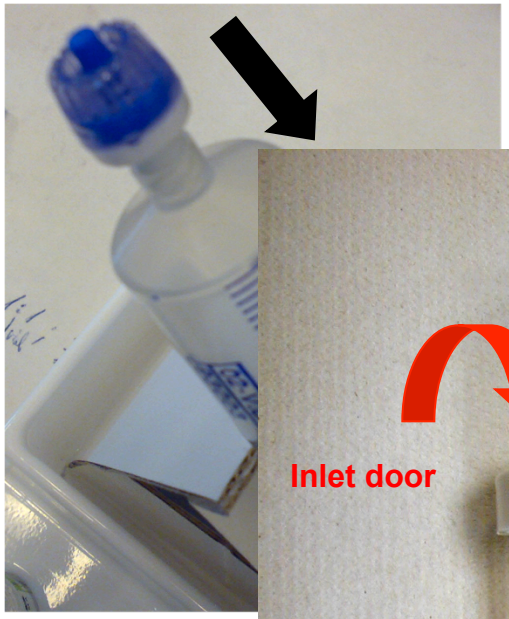
GUIDELINES

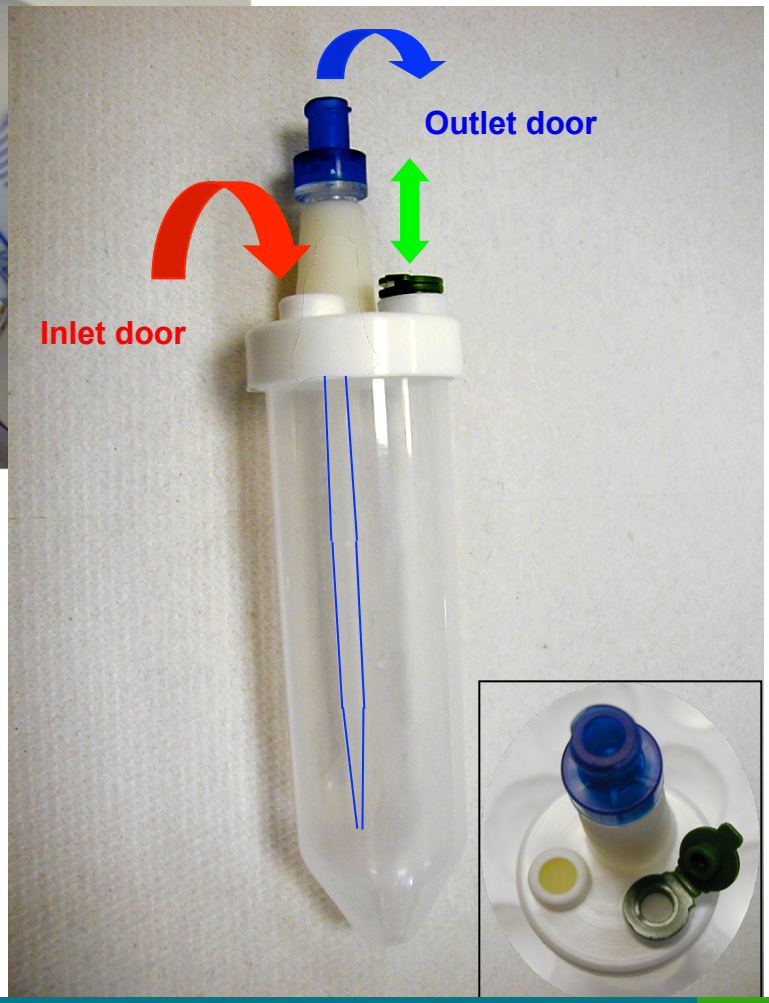
Guidelines for the labelling of leucocytes with ^{99m}Tc-HMPAO

Erik F. J. de Vries · Manel Roca · Francois Jamar · Ora Israel · Alberto Signore

Labelling of WBC with “Leukokit”®







WBC washing solution

10% Haes Steryl

10ml of ACD-A

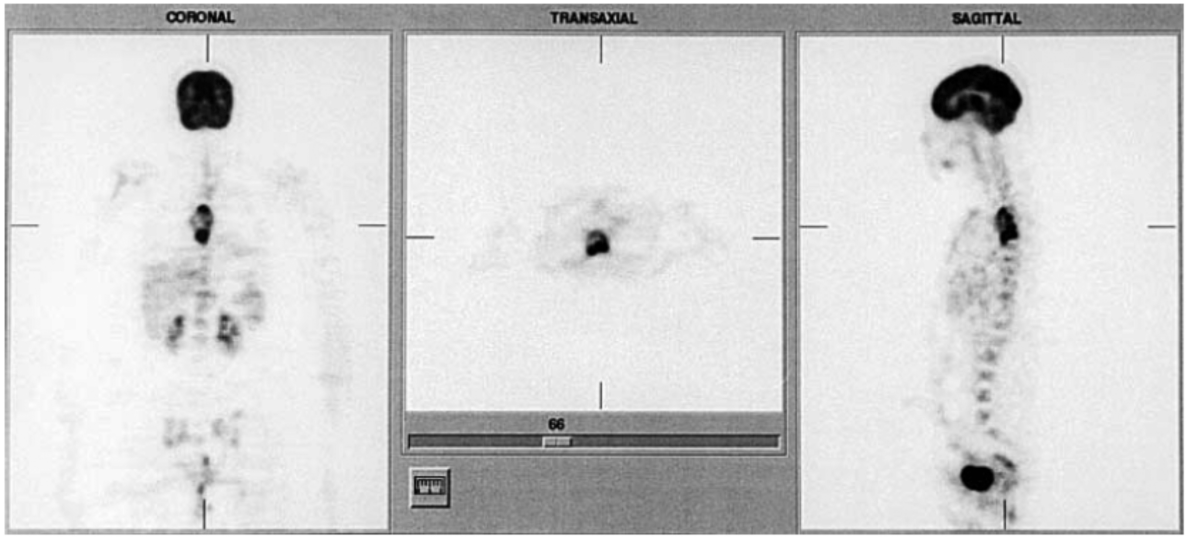
Labelling of WBC with “WBC Marker Kit”®

celltech

Quality controls of labelled WBC

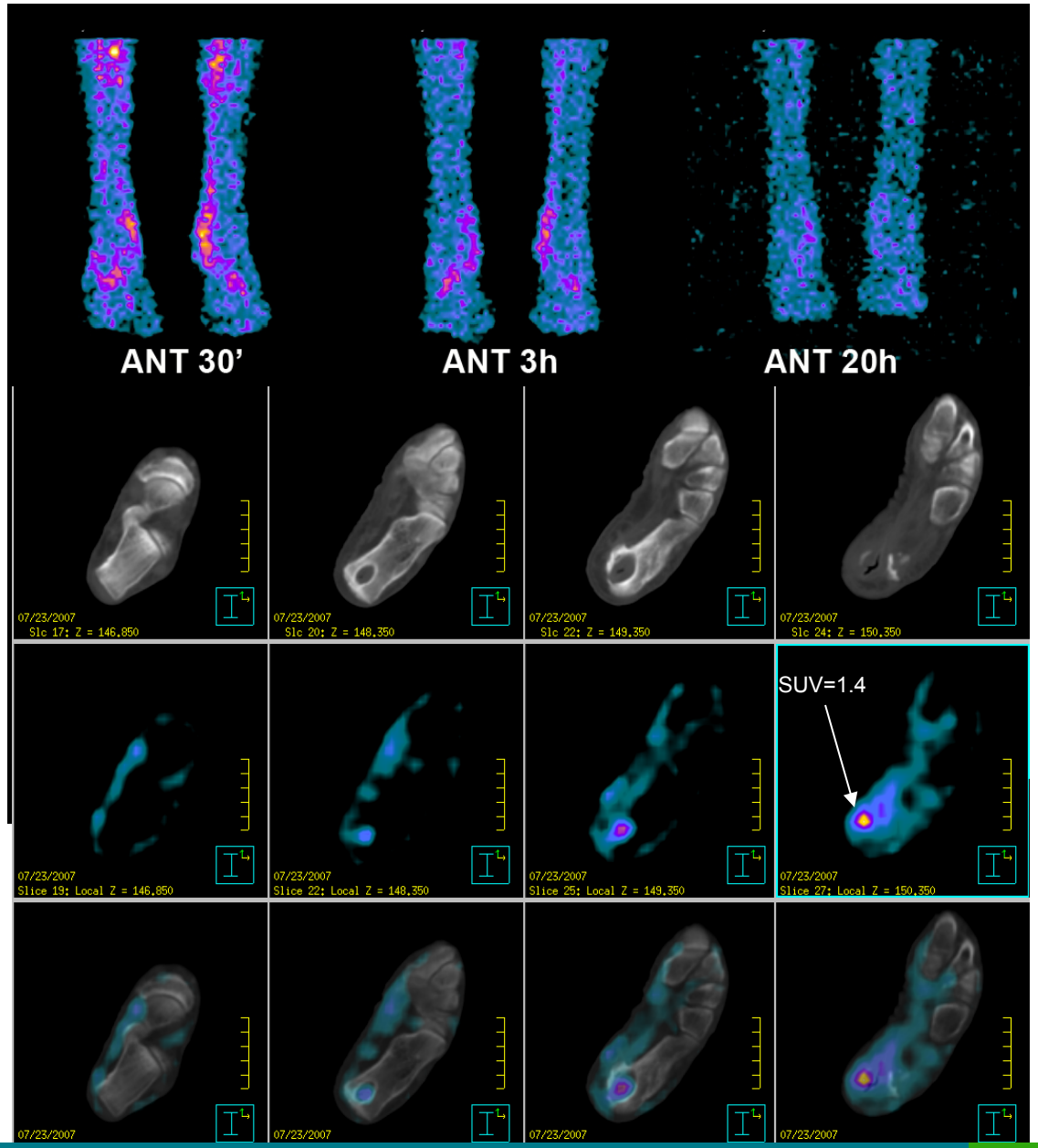
- **Initial validation**
  - 3 consecutive labellings with the following QC:
    - visual inspection
    - calculation of labelling efficiency
    - sterility test on final preparation (media fill)
    - Trypan blue exclusion test
    - cell subset recovery test
    - measurement of cell efflux of isotope over 24h
- **Yearly re-validation**
  - 1 labelling with the following QC:
    - visual inspection
    - calculation of labelling efficiency
    - sterility test on final preparation (media fill)
    - Trypan blue exclusion test
- **Routine quality controls**
    - visual inspection
    - calculation of labelling efficiency
    - In vivo evaluation of lung, liver and spleen uptake

FDG-PET in spondylodiscitis



Patient	Sex	Age	Vertebral fracture	Diagnosis in MRI	FDG-PET (score 0–4)[a]	PET evaluation	SUV max.	Bone scan (score 0–4)[a]
1	m	57	T5	Osteoporosis	1/1	True-negative	1.8	4/4
2	w	76	L2	Osteoporosis	0/0	True-negative	1.2	3/3
3	w	64	L1	Osteoporosis	1/1	True-negative	2.1	3/3
4	w	63	T11	Osteoporosis	1/1	True-negative	1.2	3/3
5	m	57	T6	Osteoporosis	2/3	False positive	2.9	4/4
6	w	57	L1	Osteoporosis	0/0	True-negative	1.5	4/4
7	m	57	L4	Osteoporosis	1/1	True-negative	2.2	3/3
8	w	63	T12	Osteoporosis	1/1	True-negative	2.4	3/3
9	w	83	L1	Osteoporosis	0/0	True-negative	1.8	2/2
10	w	84	L4	Osteoporosis	1/1	True-negative	1.7	3/3
11	w	75	T11	Osteoporosis	1/1	True-negative	1.9	3/3
12	m	32	L3	Osteoporosis	0/0	True-negative	1.4	3/3
13	w	71	L1	Osteoporosis	0/0	True-negative	1.1	3/3
14	w	79	L3	Tumour	4/4	True-positive	8.1	3/3
15	w	64	T12	Spondylodiscitis	3/3	True-positive	3.8	3/3
16	m	59	L5	Spondylodiscitis	4/4	True-positive	9.8	3/3
17	w	85	L1	Spondylodiscitis	4/4	True-positive	4.2	3/3

Schmitz A. Osteoporos Int 13:755;2002

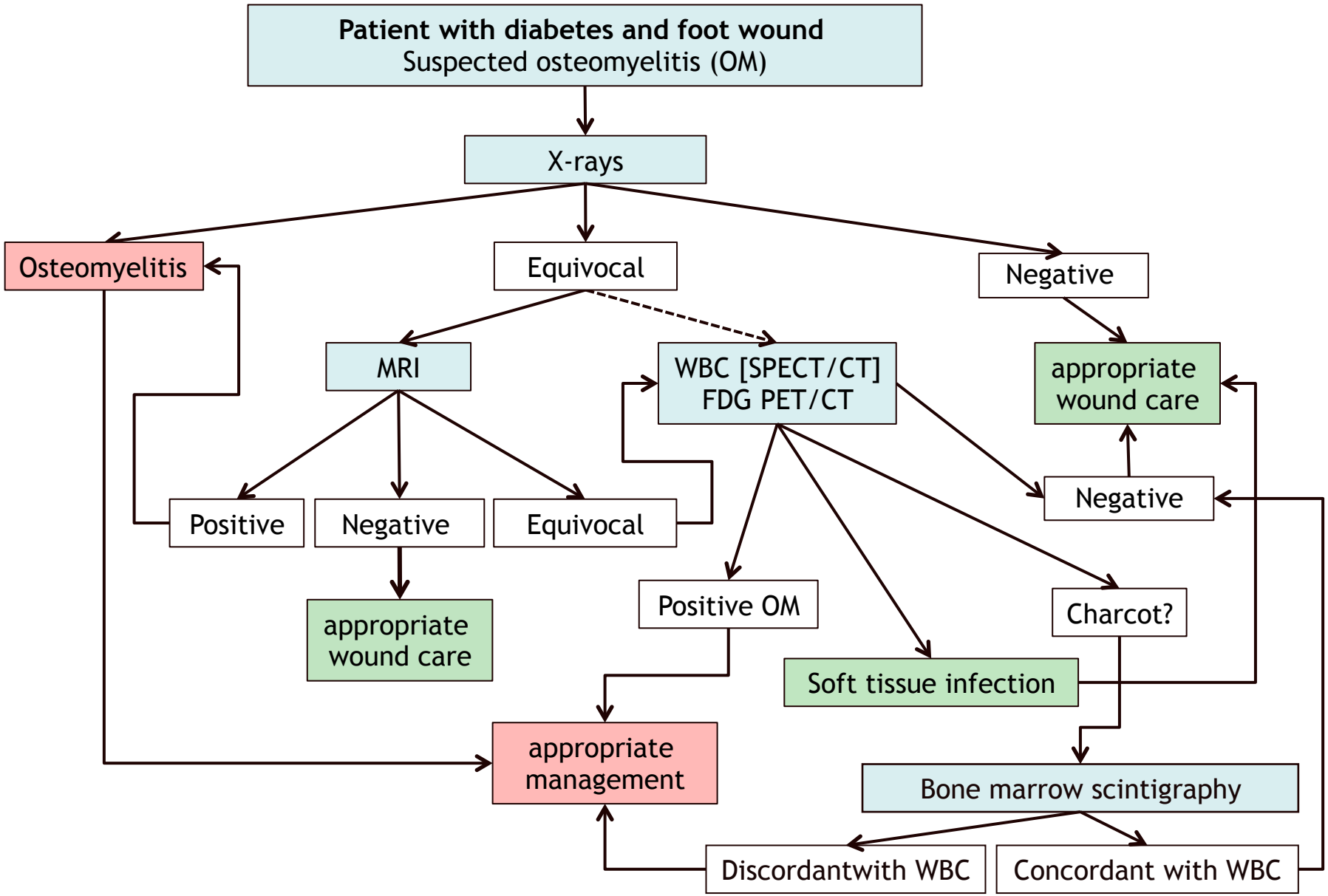


Bone exposed (OM?)

WBC-

FDG/PET+ (low SUV)

Familiari D. et al. J Nuc Med. 52(7):1012-9 2011


Patient with diabetes and foot wound
Suspected osteomyelitis (OM)
X-rays
Osteomyelitis
Equivocal
Negative
MRI
WBC [SPECT/CT]
FDG PET/CT
appropriate
wound care
Positive
Negative
Equivocal
Negative
appropriate
wound care
Positive OM
Charcot?
Soft tissue infection
appropriate
management
Bone marrow scintigraphy
Discordantwith WBC
Concordant with WBC

Diagnosis of osteomyelitis by ^{18}F-FDG-PET

^{18}F-FDG

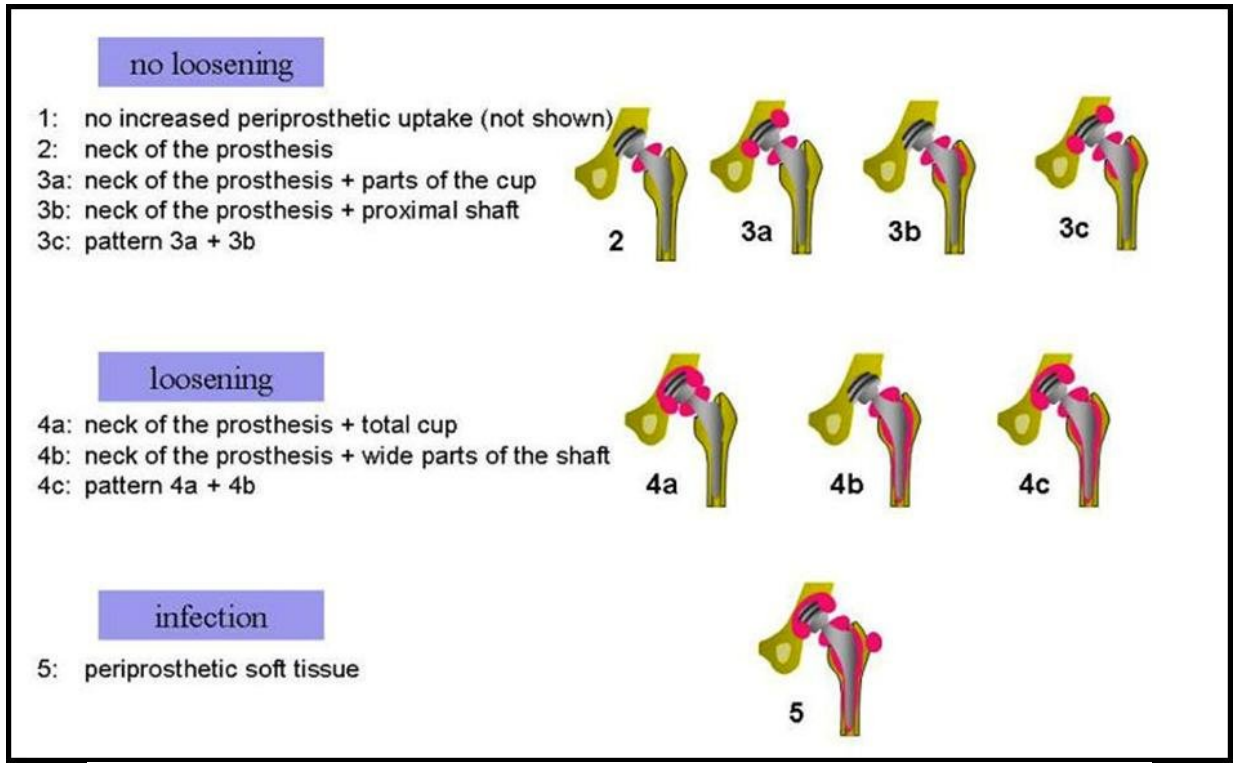
^{99m}Tc-MDP

^{67}Ga-citrate

FDG-PET and bone scan positive, Ga or WBC negative: aseptic loosening

Love C. Eur J Nucl Med 30:S231;2003

Imaging interpretation criteria using FDG



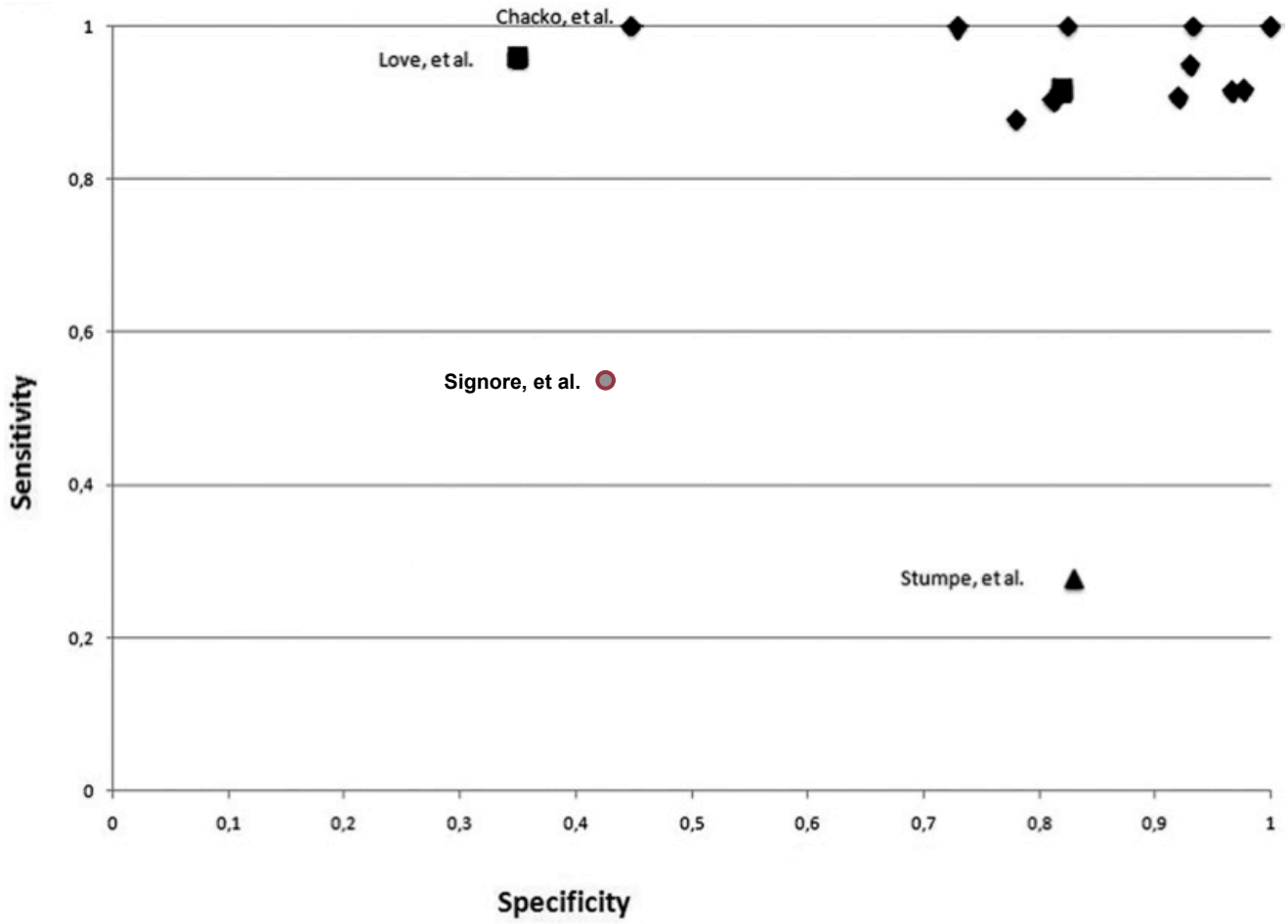
Parameter	Sensitivity	Specificity	Accuracy
PPA	1.00 (25/25)	0.09 (3/34)	0.47 (28/59)
FDG/Ma	0.96 (24/25)	0.35 (12/34)	0.61 (36/59)
BPI	0.52 (13/25)	0.44 (15/34)	0.47 (28/59)
T/B ratio	0.36 (9/25)	0.97 (33/34)	0.71 (42/59)
WBC/Ma	1.00 (25/25)	0.91 (31/34)	0.95 (56/59)

Reinartz P, et al. J Bone Joint Surg Br 2005;87-B:465
Love C, et al. J Nucl Med 2004; 45:1864-1871

FDG in joint prosthesis infection

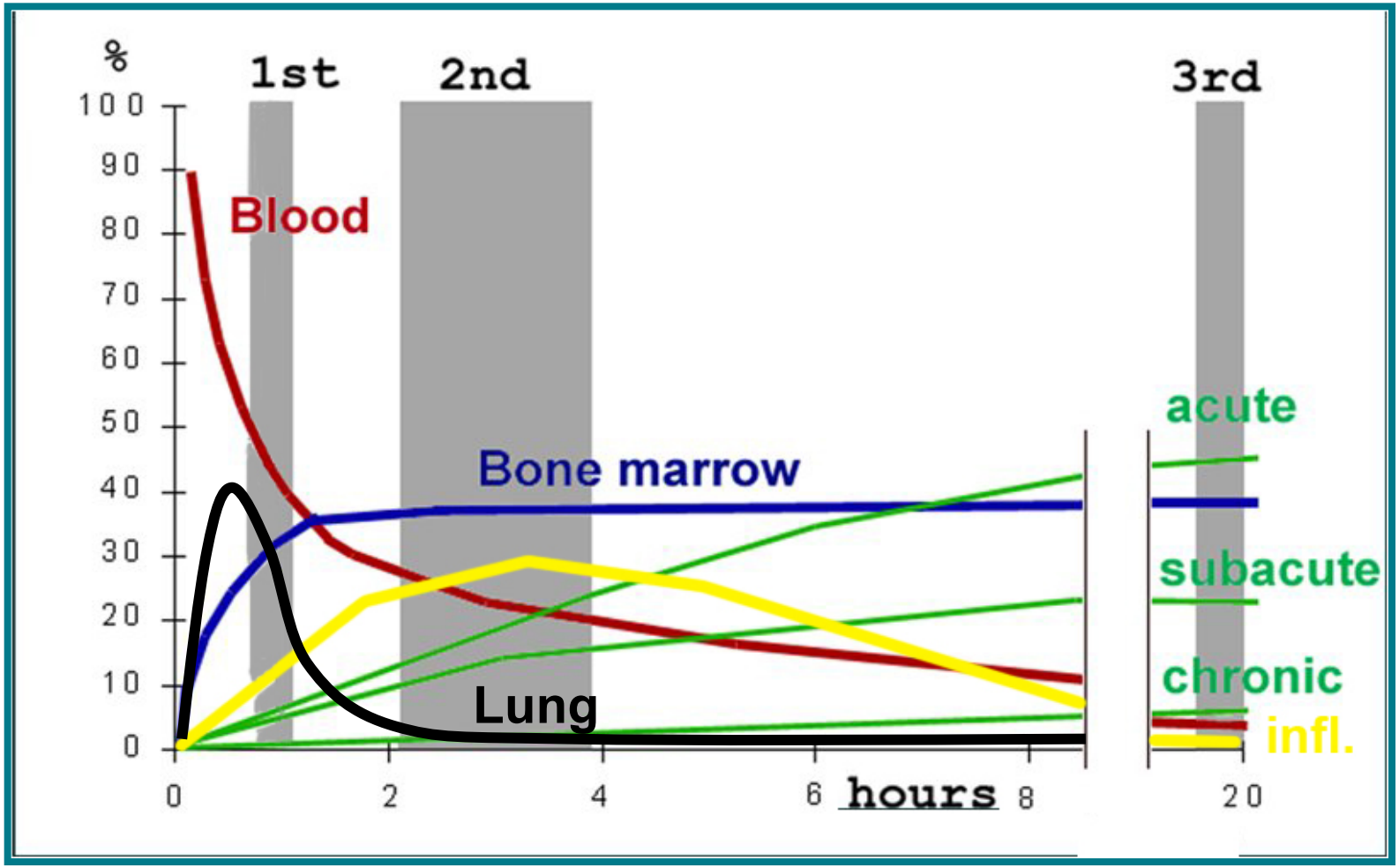
Sensitivity 28%-91% - Specificity 34%-97%

pooled data from 29 studies/1054 pts



Van der Bruggen W, Semin Nucl Med. 2010;40 (1):3-15
Glaudemans AW, EJNM&MI. 2010;37(10):1986-91
Dumarey N. QJNM&MI. 2009;53(1):89-94.

The accumulation of labelled WBC in infection sites is a dynamic process



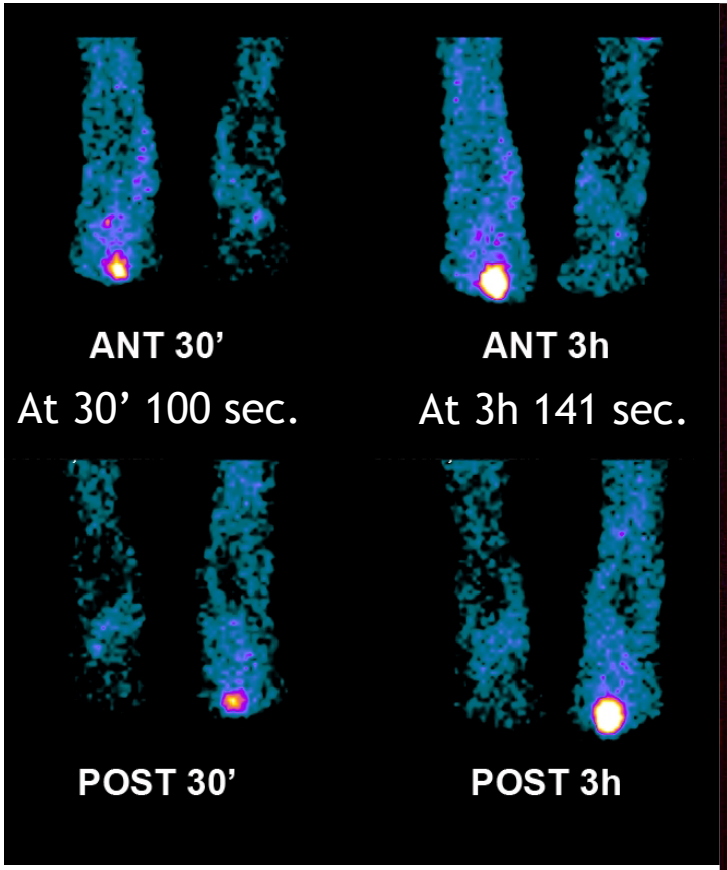
How to acquire WBC and anti-G images?

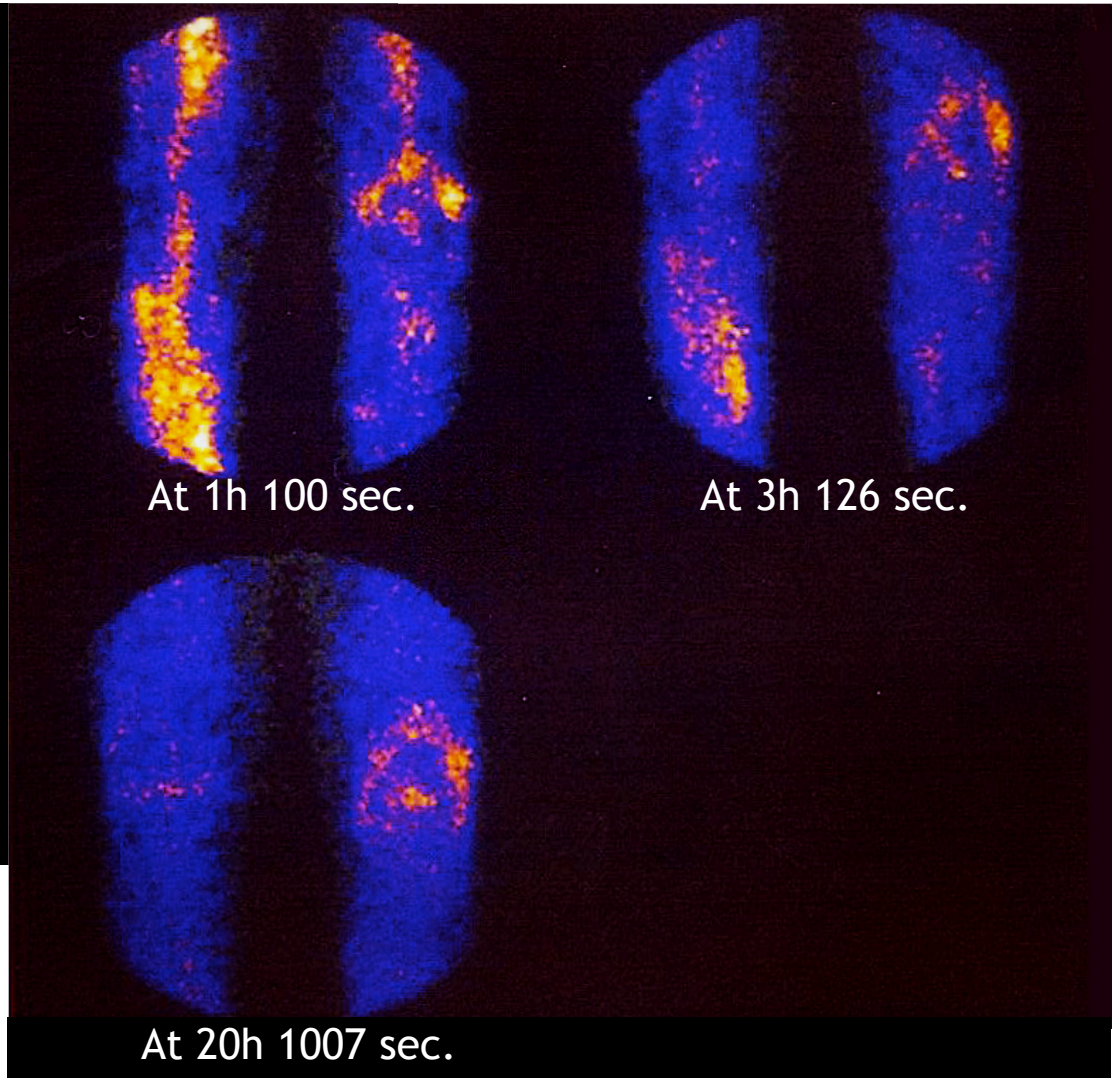
Acquisition time-table corrected for isotope decay

Isotope	Min post 1st acq.	OHours post 1st acq.	1st acq. (sec)	Following acq. (sec)	1st acq. (sec)	Following acq. (sec)
99mTc	30	0,5	100	-	200	-
	60	1,0		112		224
T1/2 (min)	90	1,5		119		238
	120	2,0		126		252
360	180	3,0		141		283
	240	4,0		159		317
	300	5,0		178		356
	360	6,0		200		400
	420	7,0		224		449
	480	8,0		252		504
	1200	20,0		1007		2015
	1440	24,0		1599		3198

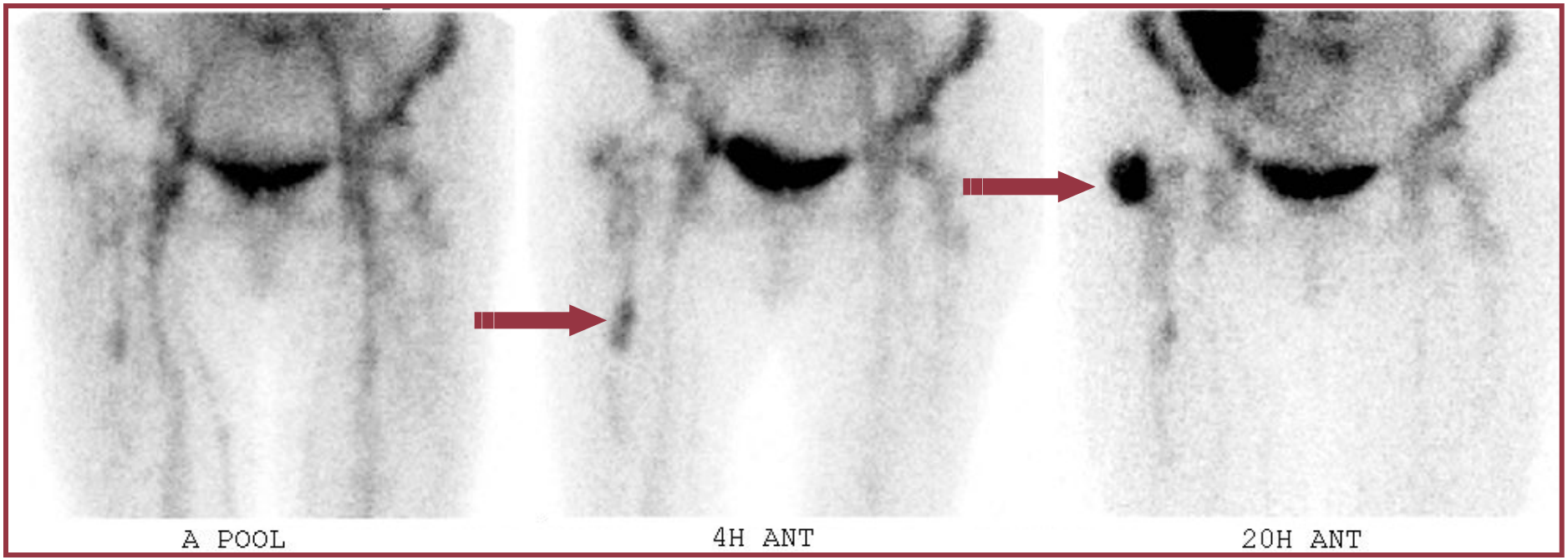
Signare A, Quintero AM.
Diagnostic imaging of infections and inflammatory diseases: a multidisciplinary approach
J. Wiley Pbl. 2013

The accumulation of labelled WBC in infection sites is a dynamic process





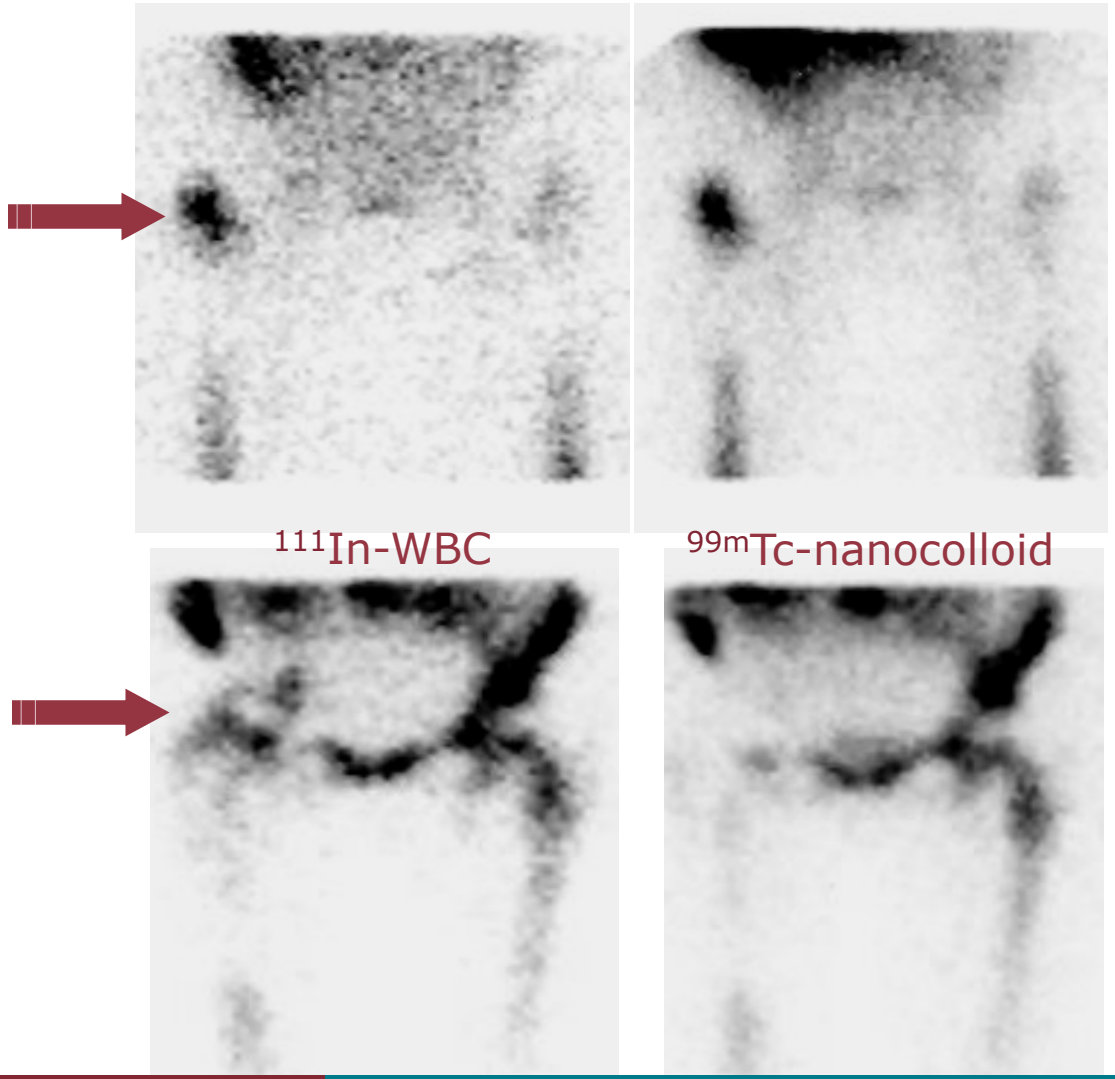
The accumulation of labelled WBC in infection sites is a dynamic process



Criteria for positivity:

- Any uptake with increase of activity with time
- Any uptake with increase of size with time

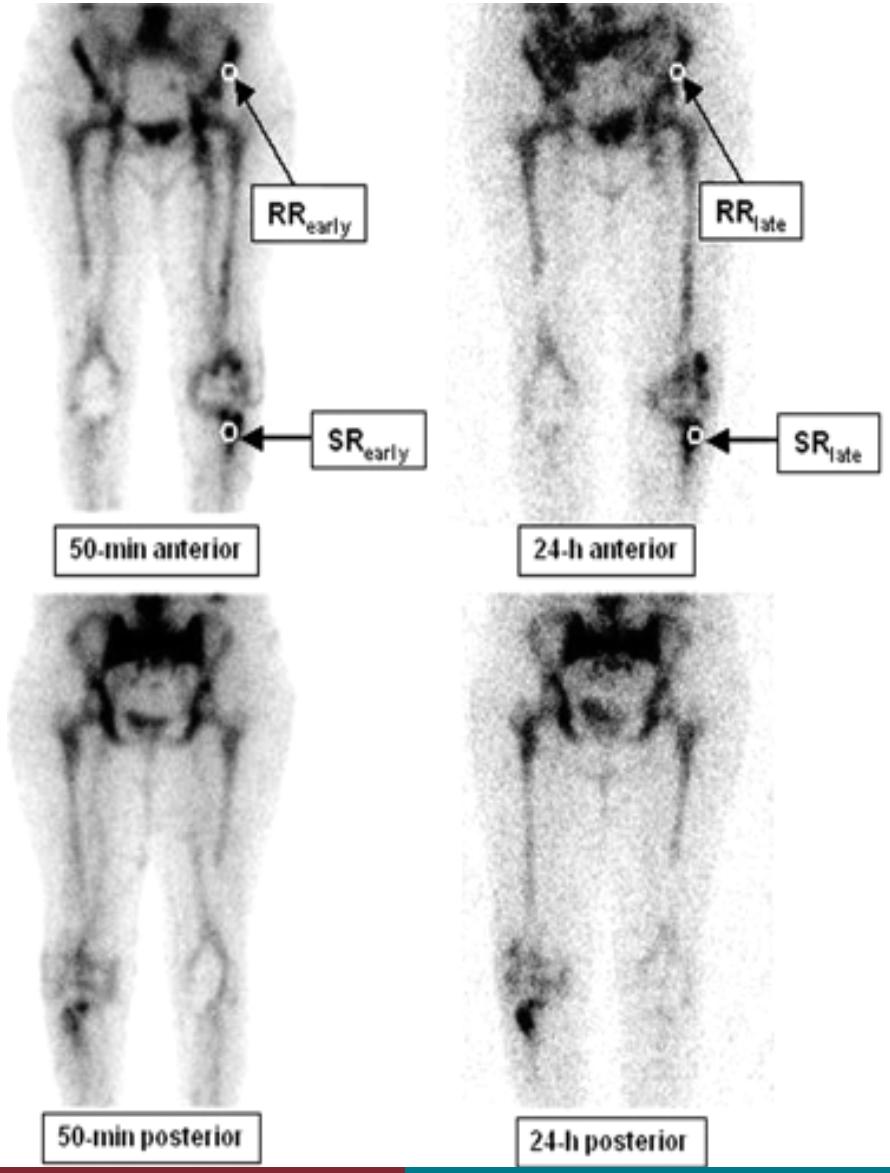
Bone Marrow imaging with ^{99m}Tc-nanocolloids



Non infected prosthesis

Infected prosthesis

Qualitative or semi-quantitative analysis?

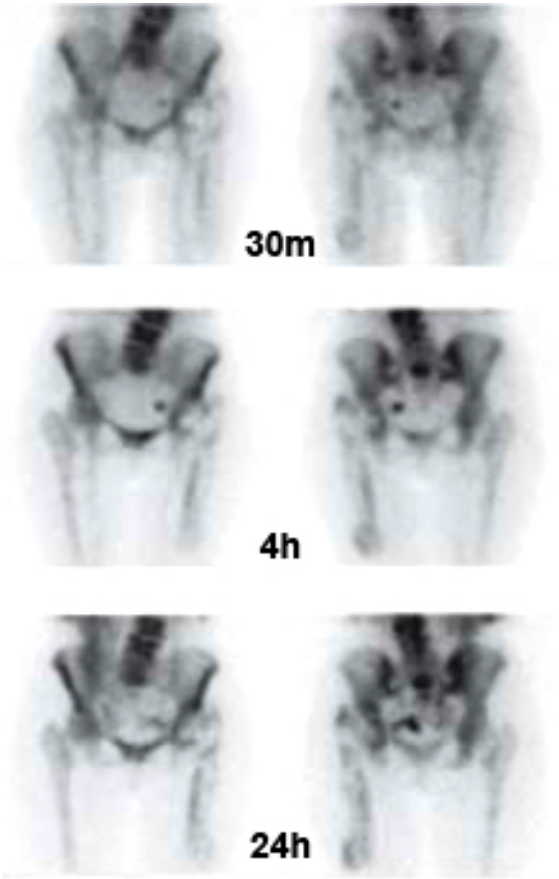


^{99m}Tc-HMPAO-leukocyte scintigraphy in a patient with bilateral knee prostheses and suspected left knee prosthesis infection.

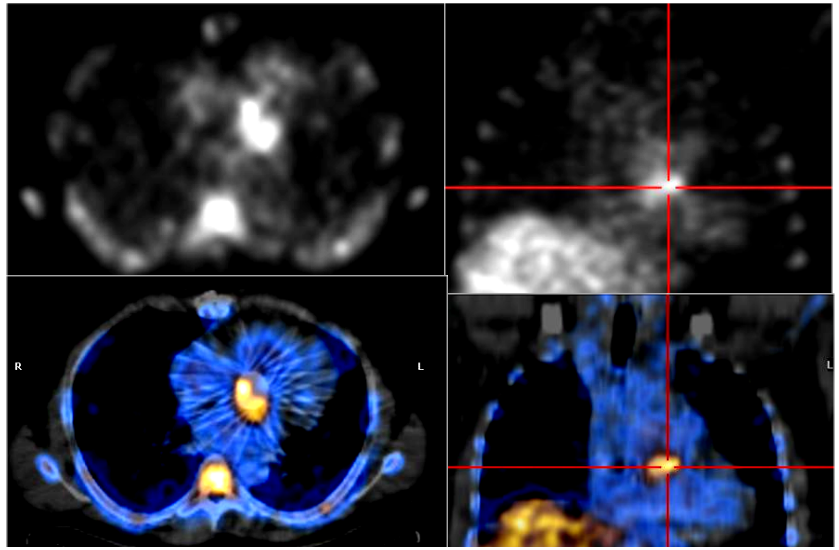
Quantitative analysis:
SR_{early} = 64.7; RR_{early} = 61.9;
SR_{late} = 28.1; RR_{late} = 13.7;

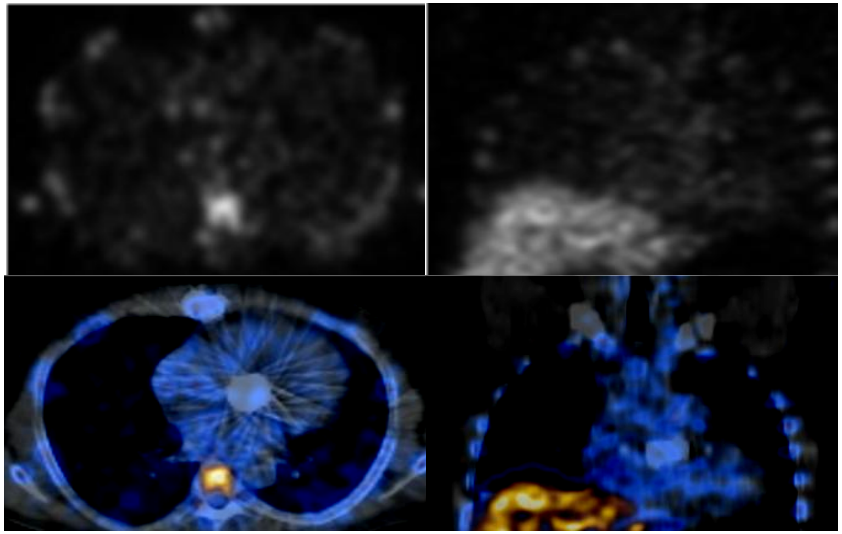
T/B_{early} = 1.05 T/B_{late} = 2.05

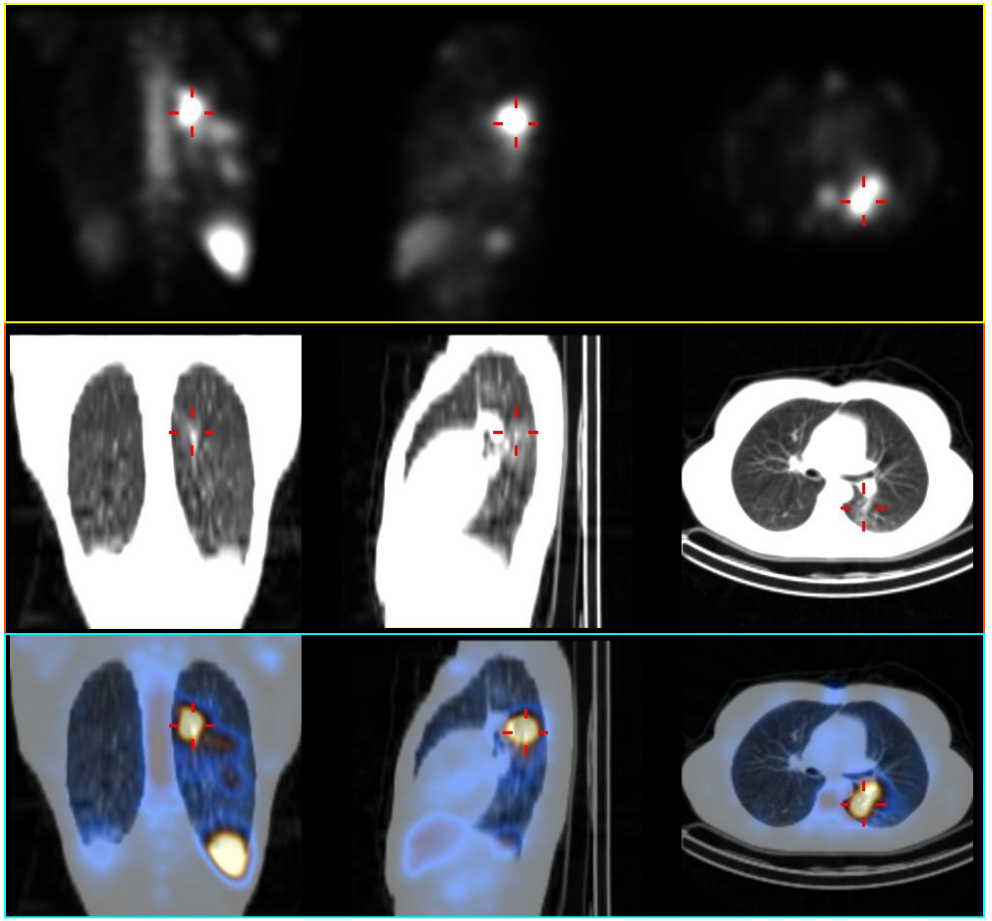
Is it any better to use SPECT/CT?



SPECT-CT with ^{99m}Tc-WBC in endocarditis







Erba PA. et al. J Nucl Med. 53(8):1235;2012

Conclusions

- ✓ It is crucial to standardize world wide the nuclear medicine procedures for imaging infections, particularly the technical aspects of cell labelling, the image acquisition modalities and the image interpretation criteria.
- ✓ A further standardization must be done with clinicians about the clinical indications of our techniques and their position in diagnostic flow-charts.
- ✓ The role of our scientific societies is crucial in this standardization process as well as in the education, training and divulgation of guide-lines.