



BNS | ENGIE | SCK•CEN Technical Workshop on BR2 past and future

The beneficial use of Radiations in medical applications: a Belgian approach

Roland HUSTINX

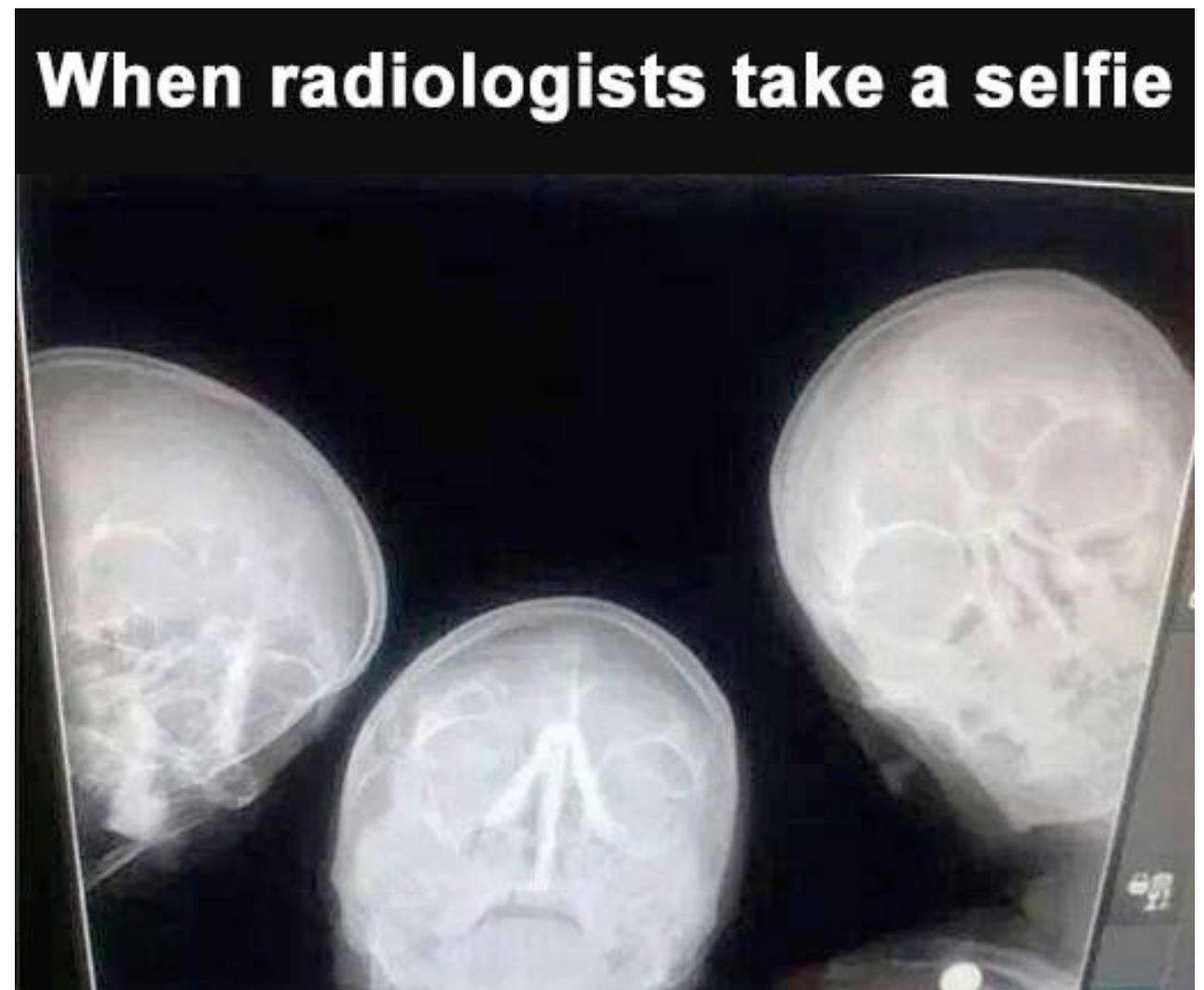


Université
de Liège



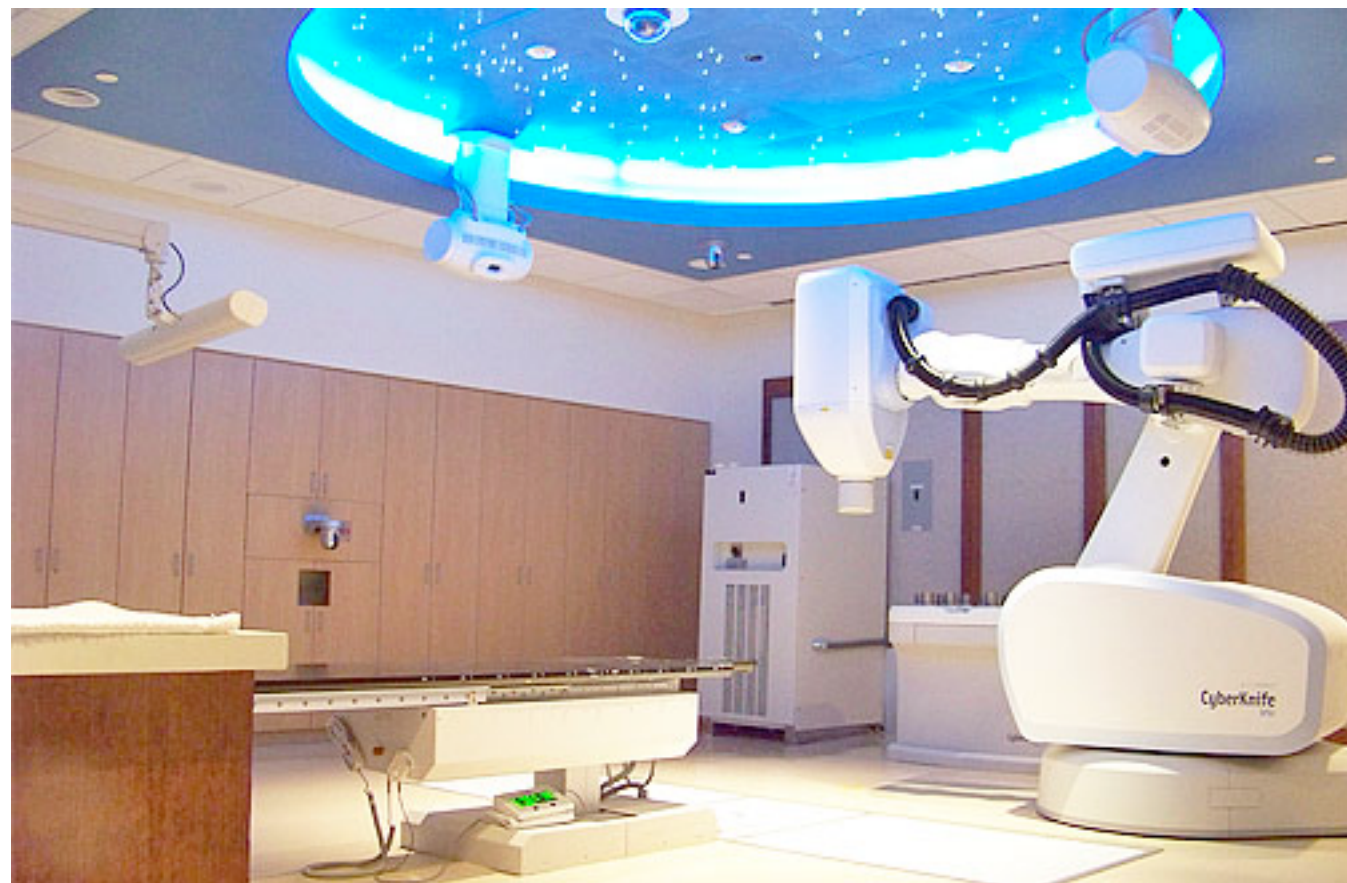
Radiations in medicine

- X rays
- Radiology (& NM)
- Cardiology
- Dental medicine
- & many more



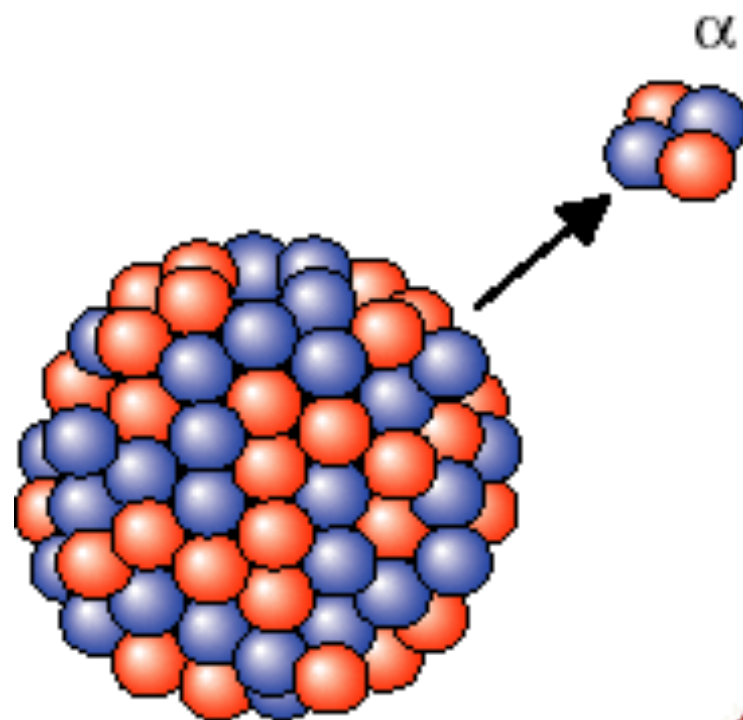
Radiations in medicine

Radiation oncology: X, β , γ rays, particles

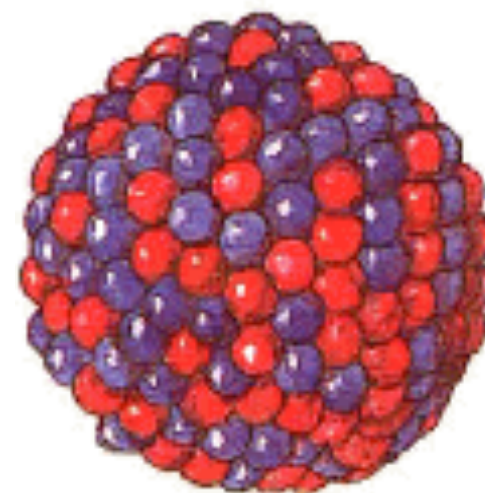
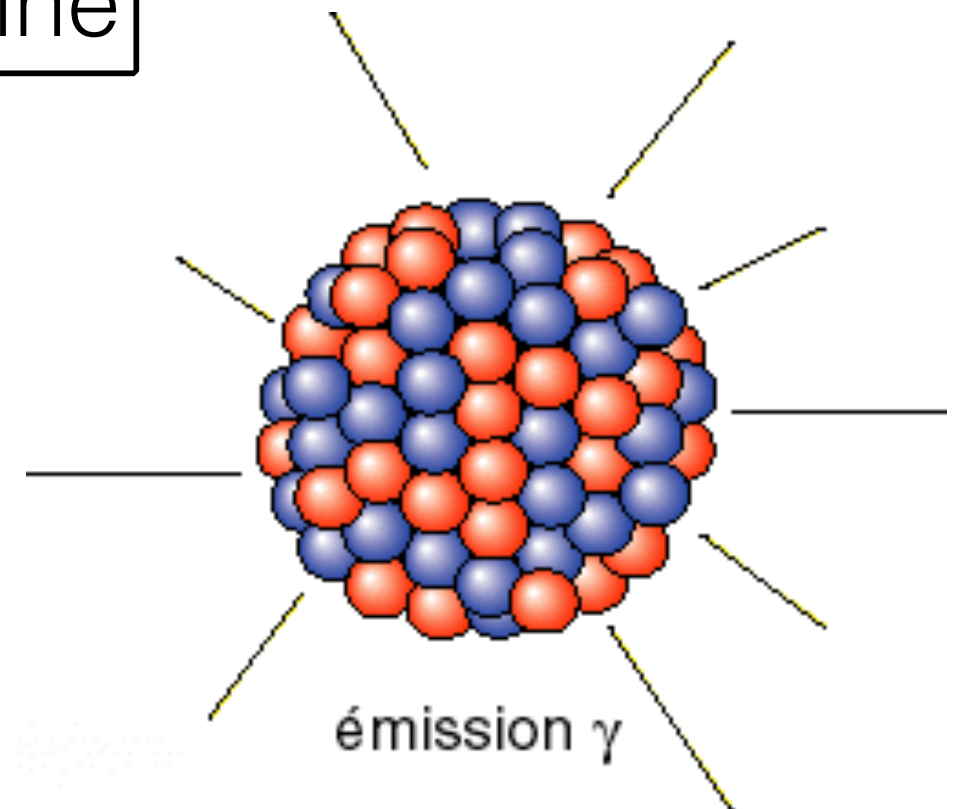


Radiations in medicine

Nuclear Medicine

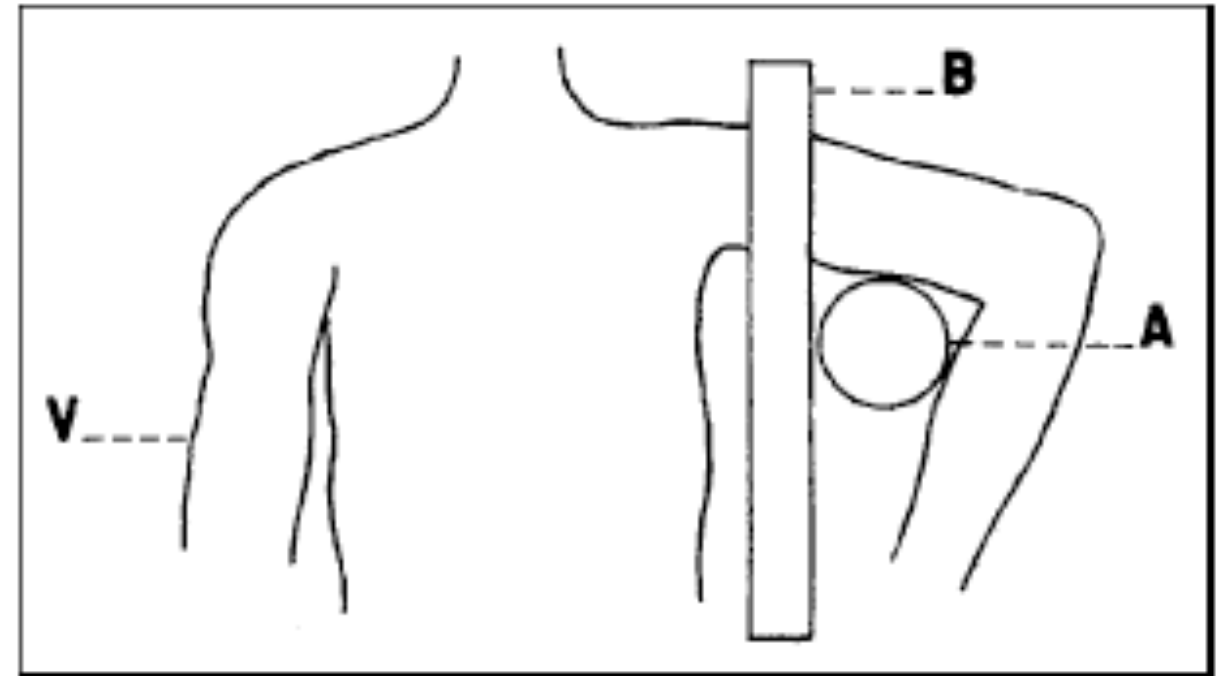


émission α



électron ou
positron

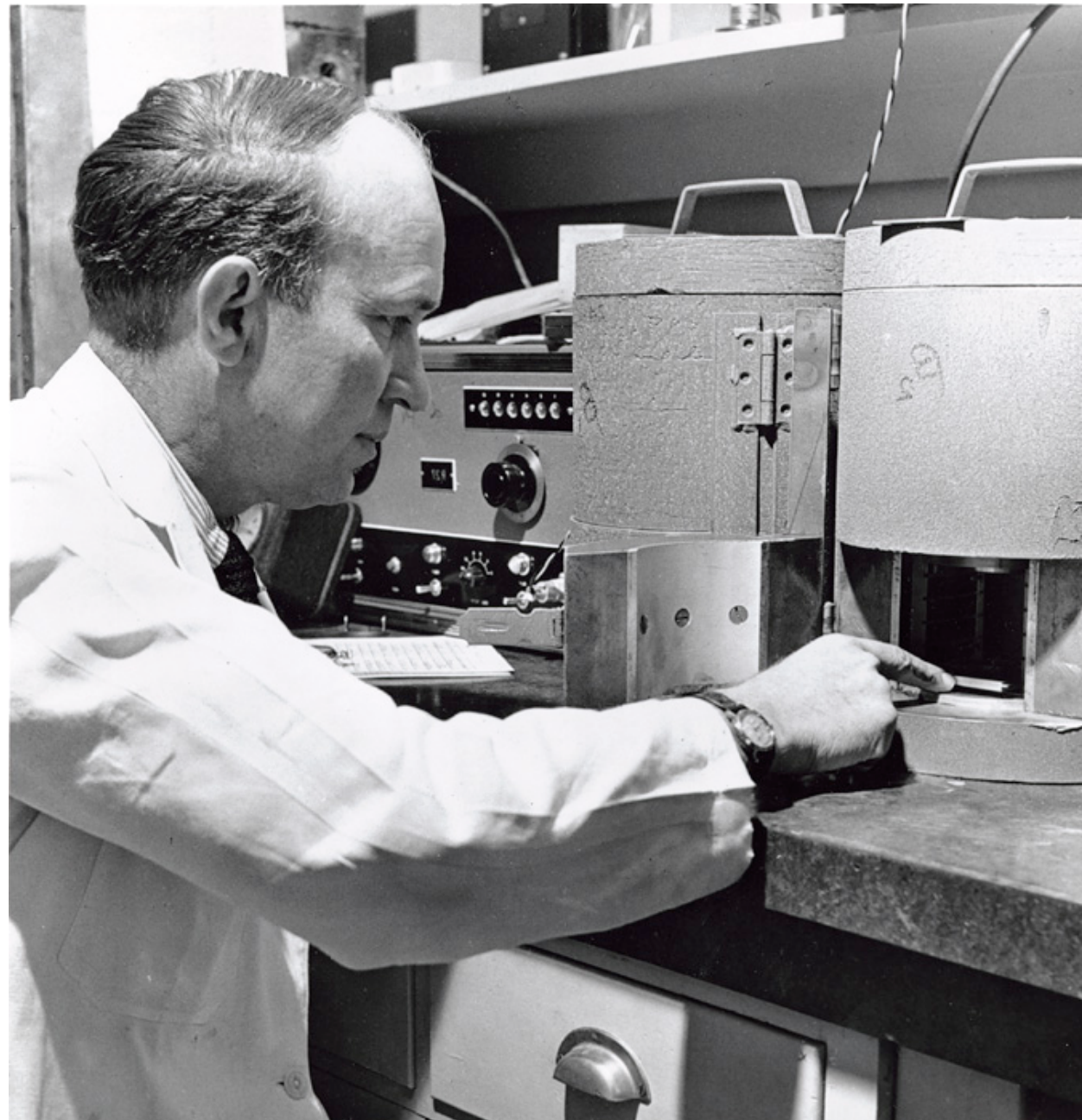
February 1925: Birth of Nuclear Medicine



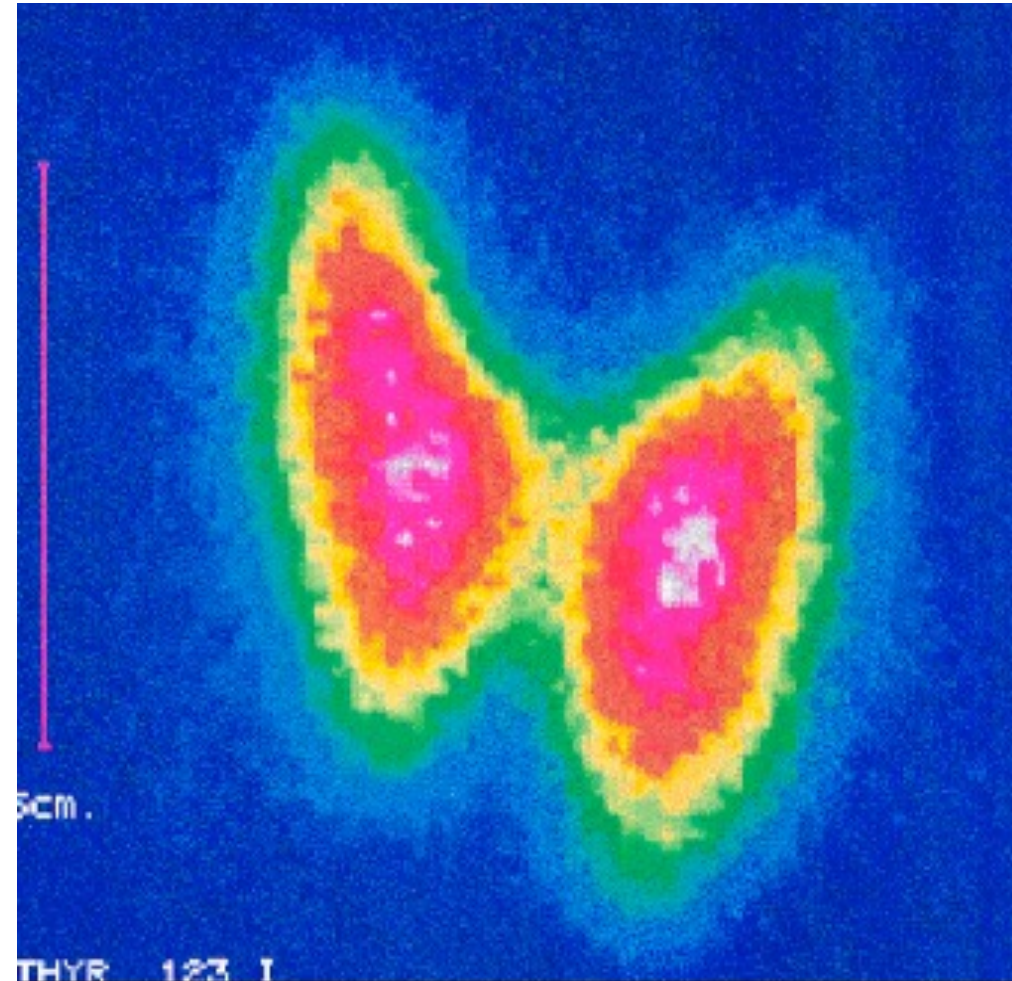
Blumgart & Yens perform the first diagnostic test using radio-isotopes in man (Pb-214 and Bi-214)

Patton, J Nucl Med 2003; 44:1362–1365,
Blumgart HL, Yens OC. J Clin Invest. 1926;4:1–13.

24/12/1936: John H. Lawrence performs the first therapeutic administration of an artificial radio-isotope (P-32)



Nuclear medicine is theranostics from the start:
Combination of the corresponding diagnostic and
therapeutic entities



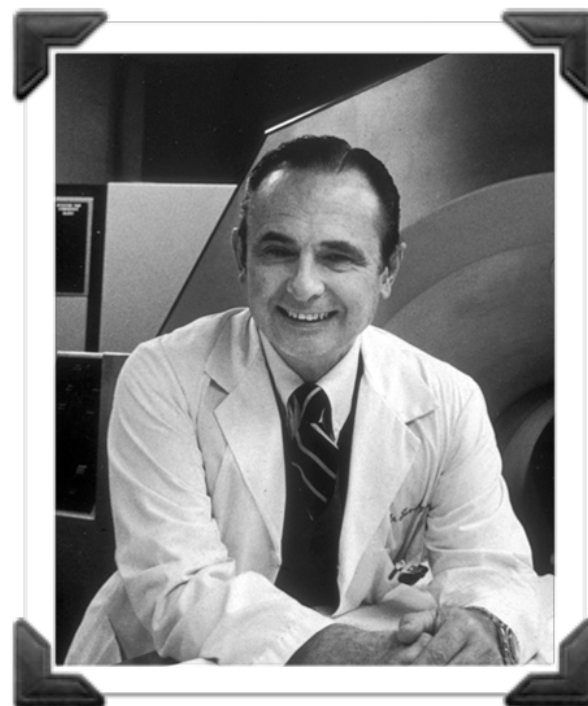
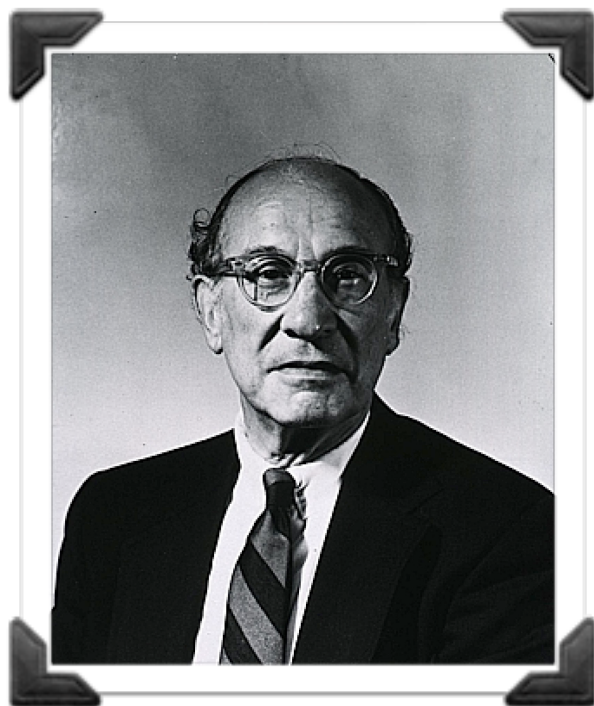
On March 31 1941, Saul Hertz performs the
first treatment for hyperthyroidism with ^{131}I
(and ^{130}I)

1948: Lucien Brüll & Georges Merchie perform
the first thyroid survey using ^{131}I in Belgium



The PET Hall of Fame

L. Sokoloff
M. Ter-Pogossian
D. Kuhl
A. Alavi
M. Phelps
E. Hoffmann



Nuclear Medicine in Belgium: now & tomorrow

- Conventional NM
- PET
- Therapy

Nuclear Medicine in Belgium: now & tomorrow

- Conventional NM
- PET
- Therapy

- Hybrid Imaging
 - SPECT/CT
 - PET/CT
 - (PET/MR)

Conventional Nuclear medicine: Scintigraphy

- Few new tracers
- Technological improvements:
 - SPECT/CT
 - CZT detectors
 - Cardiac imaging
 - Whole-body imaging

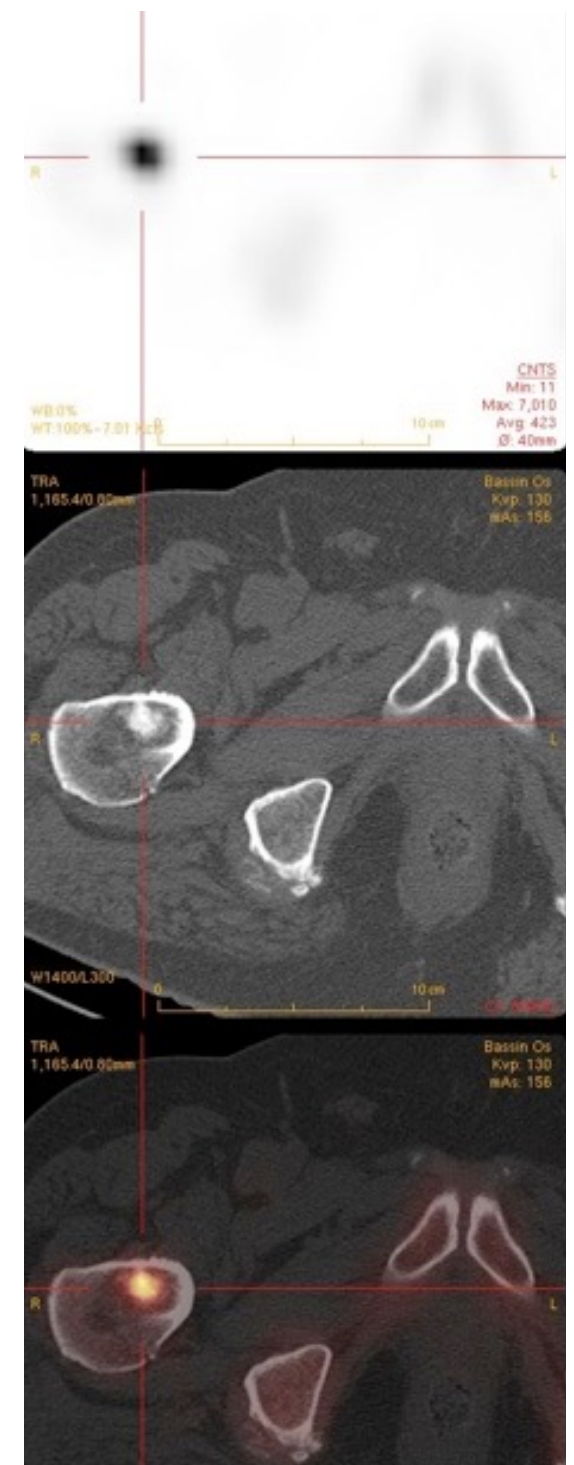
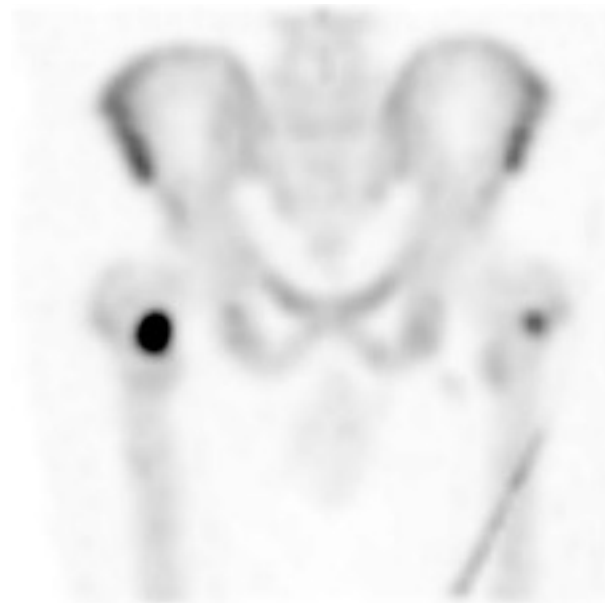
SPECT/CT : 1 + 1 = 3



SPECT:
γ-camera

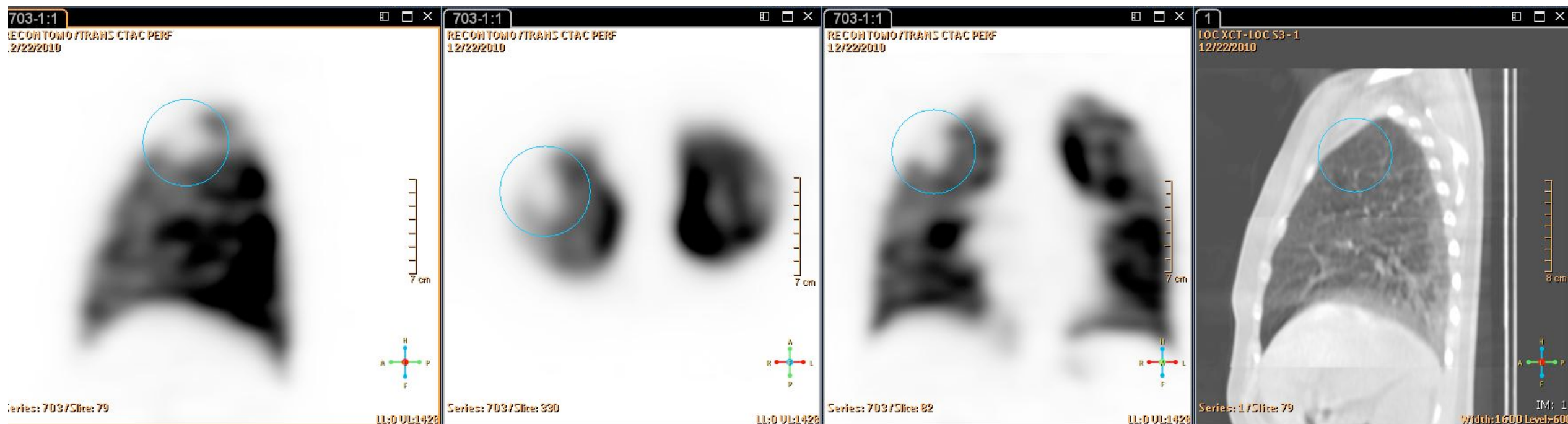
CT scanner

Old radiotracer, new study

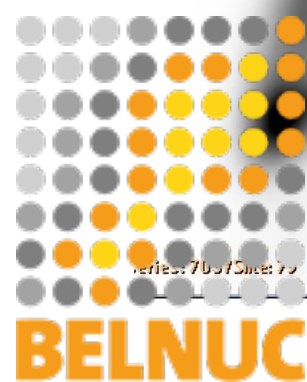
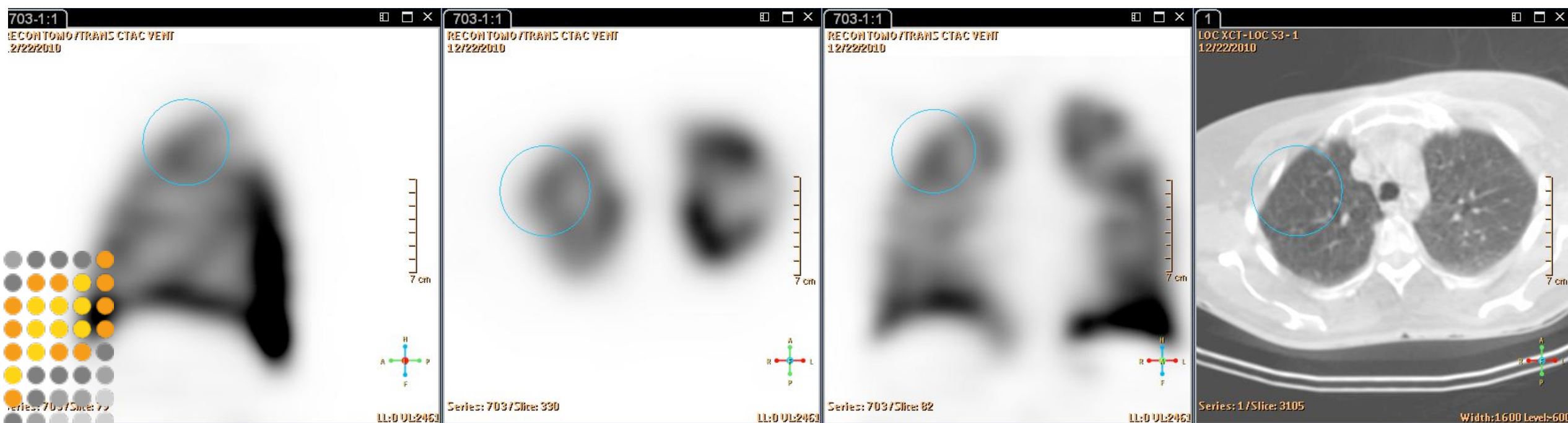


The Resurrection of Lazarus

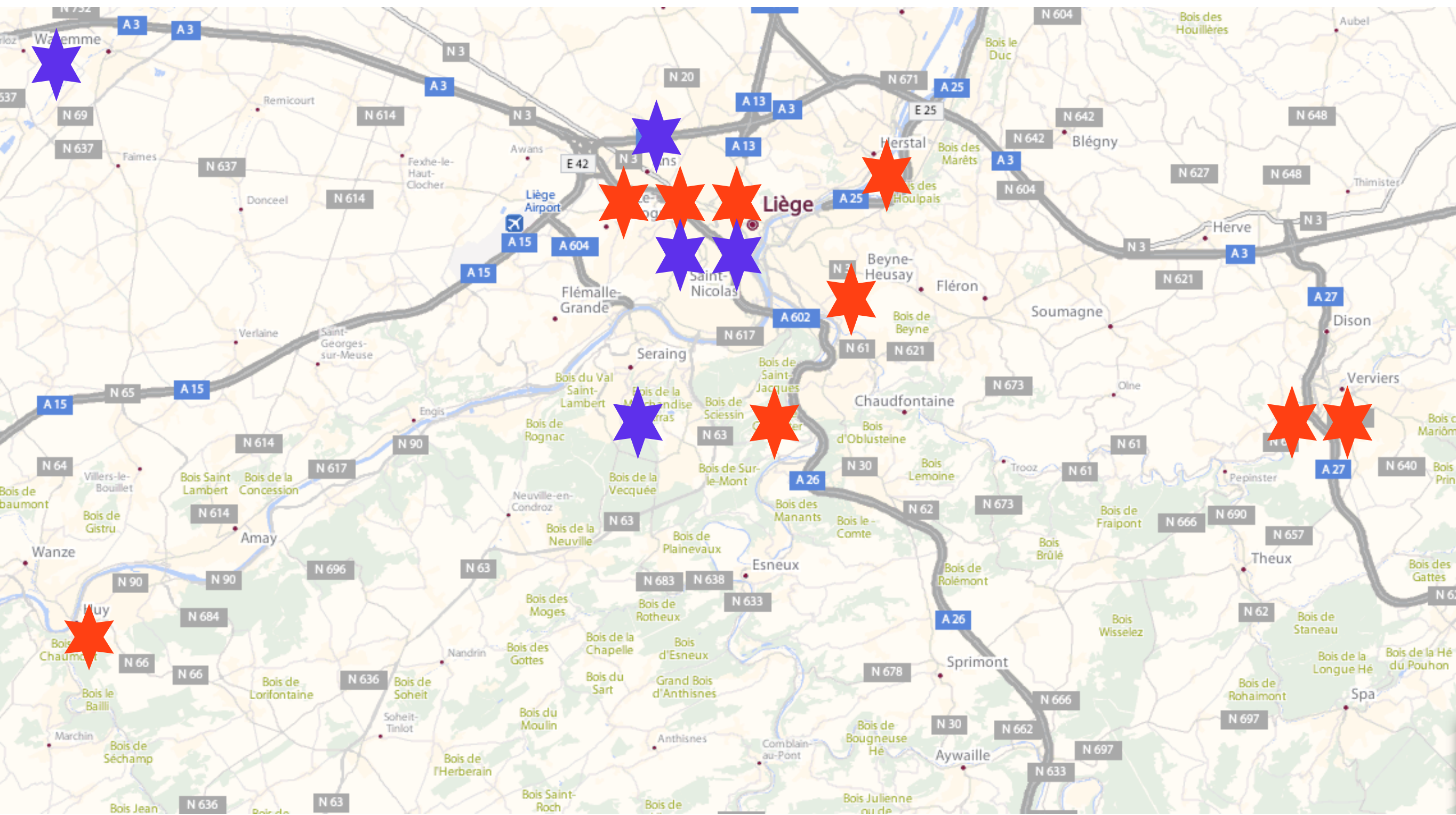
P



V



SPECT/CT Vs SPECT



Relationship NM - Radiology



Relationship NM - Radiology



Strong collaboration

Distinct specialties

No dual certification

No dual training

No cross-over

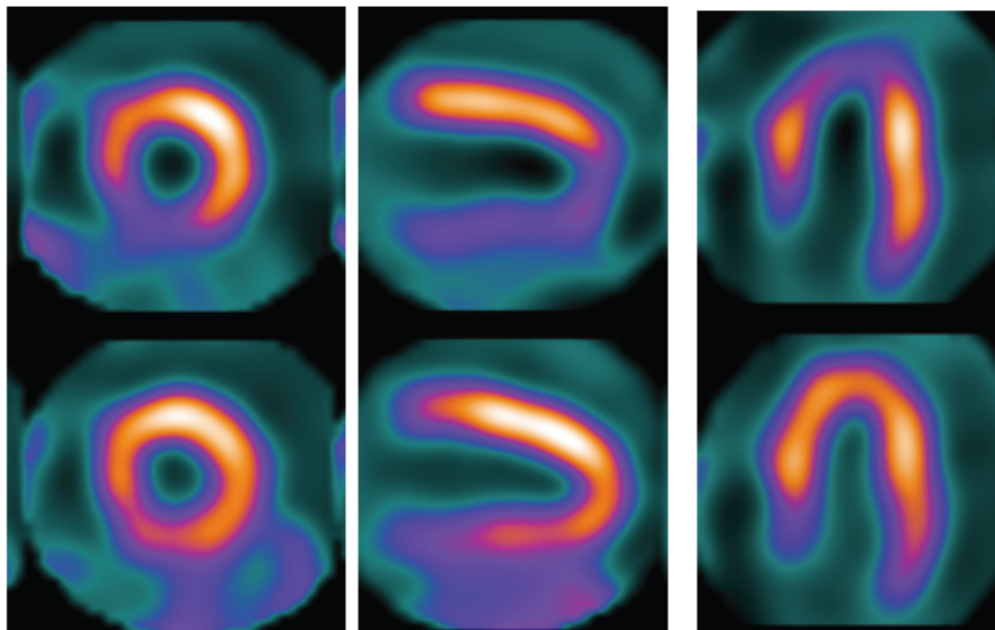
CZT systems: High spatial resolution, fast, low radiation exposure





CZT

Stress
2 min

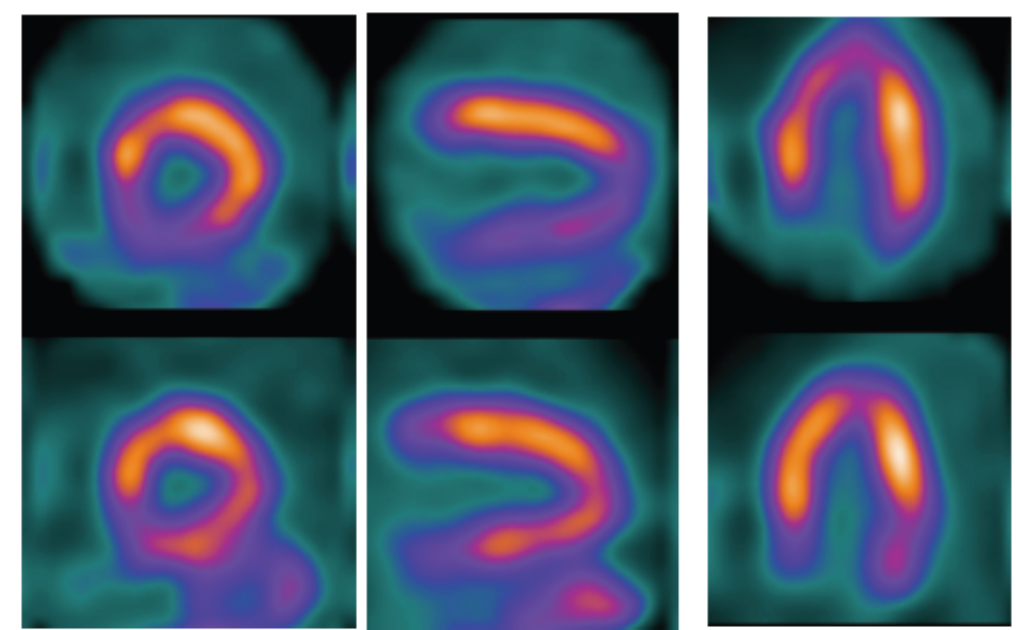


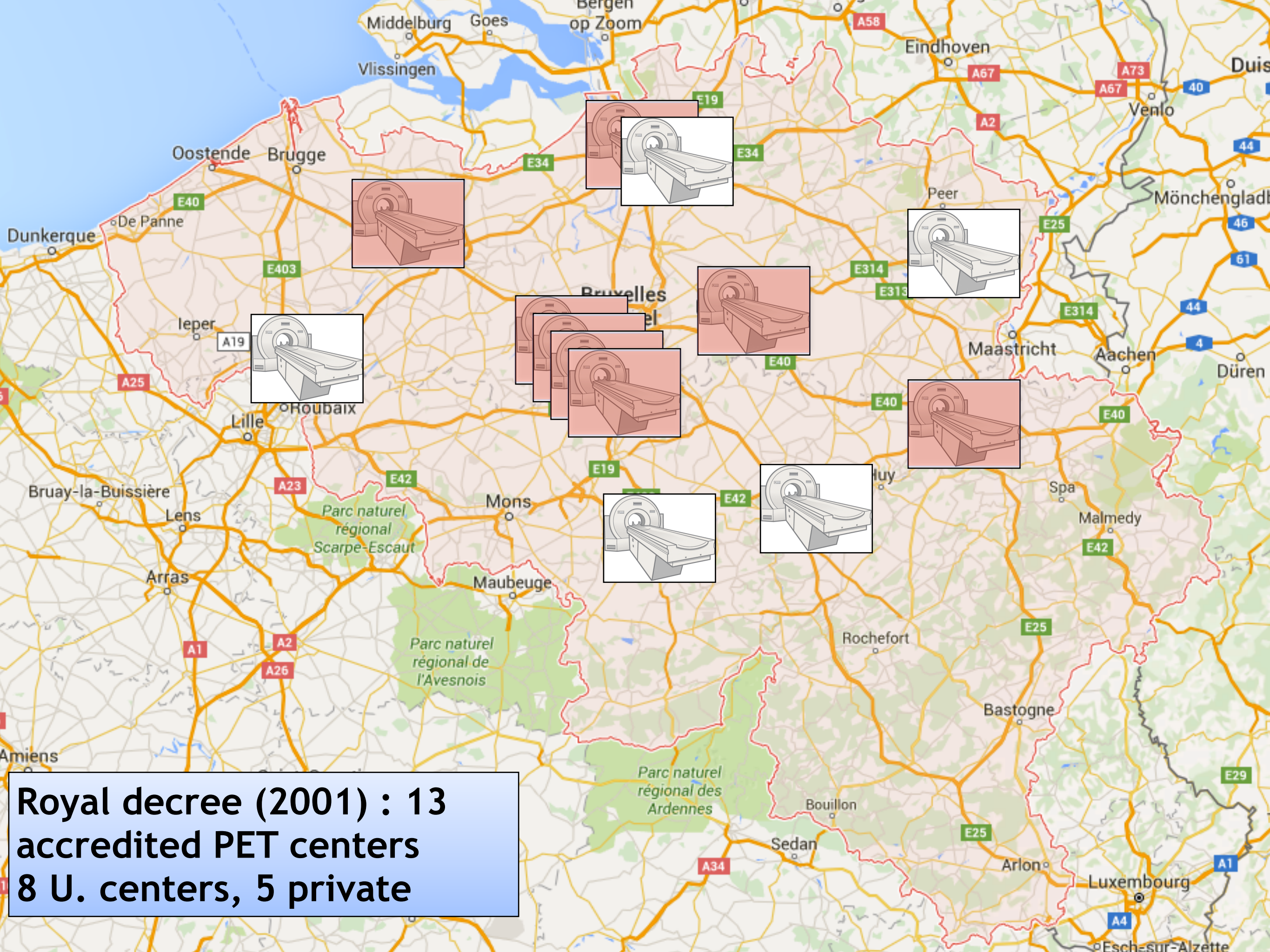
inferior wall & apical ischemia



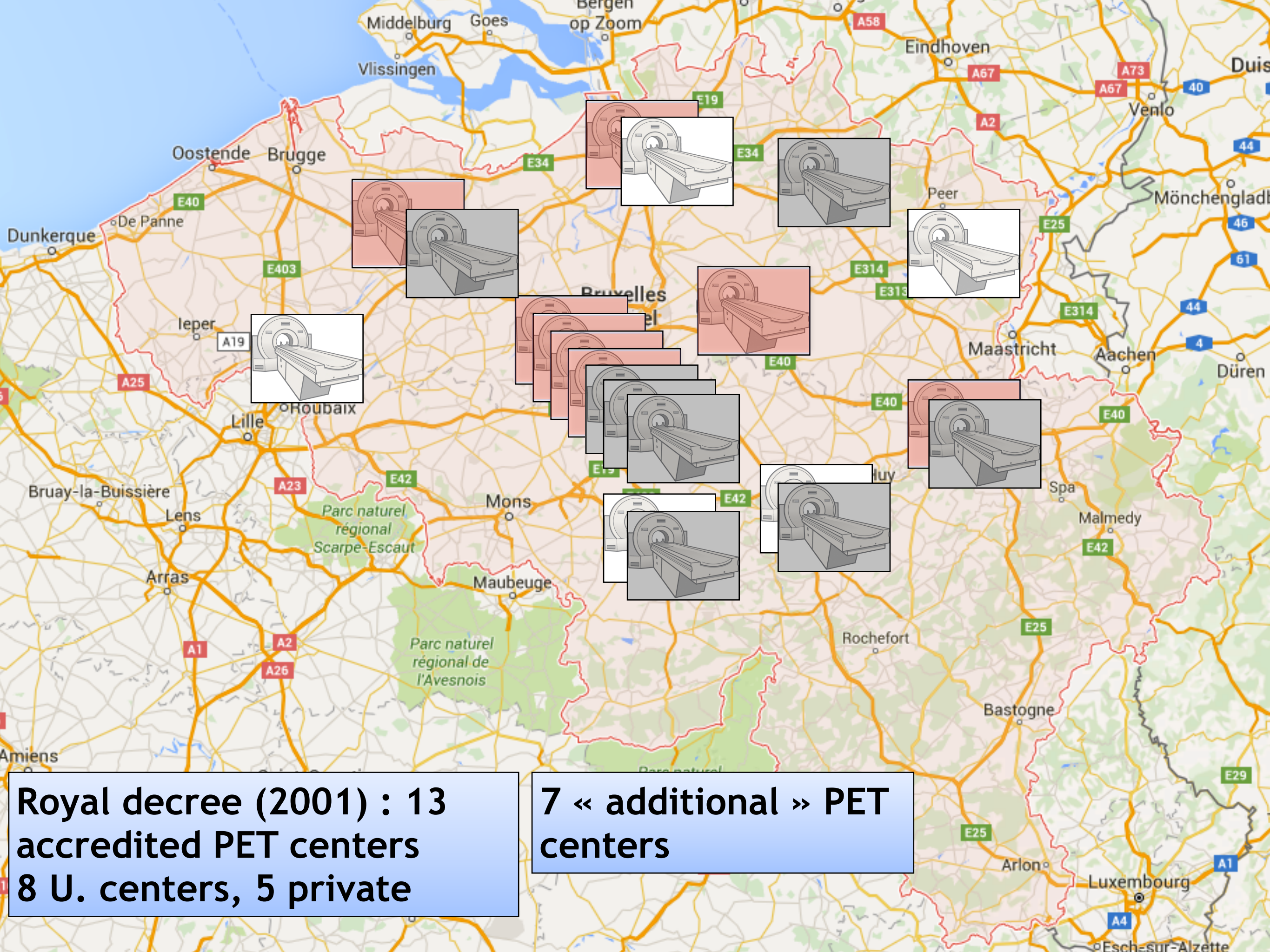
Conventional

Stress
11 min



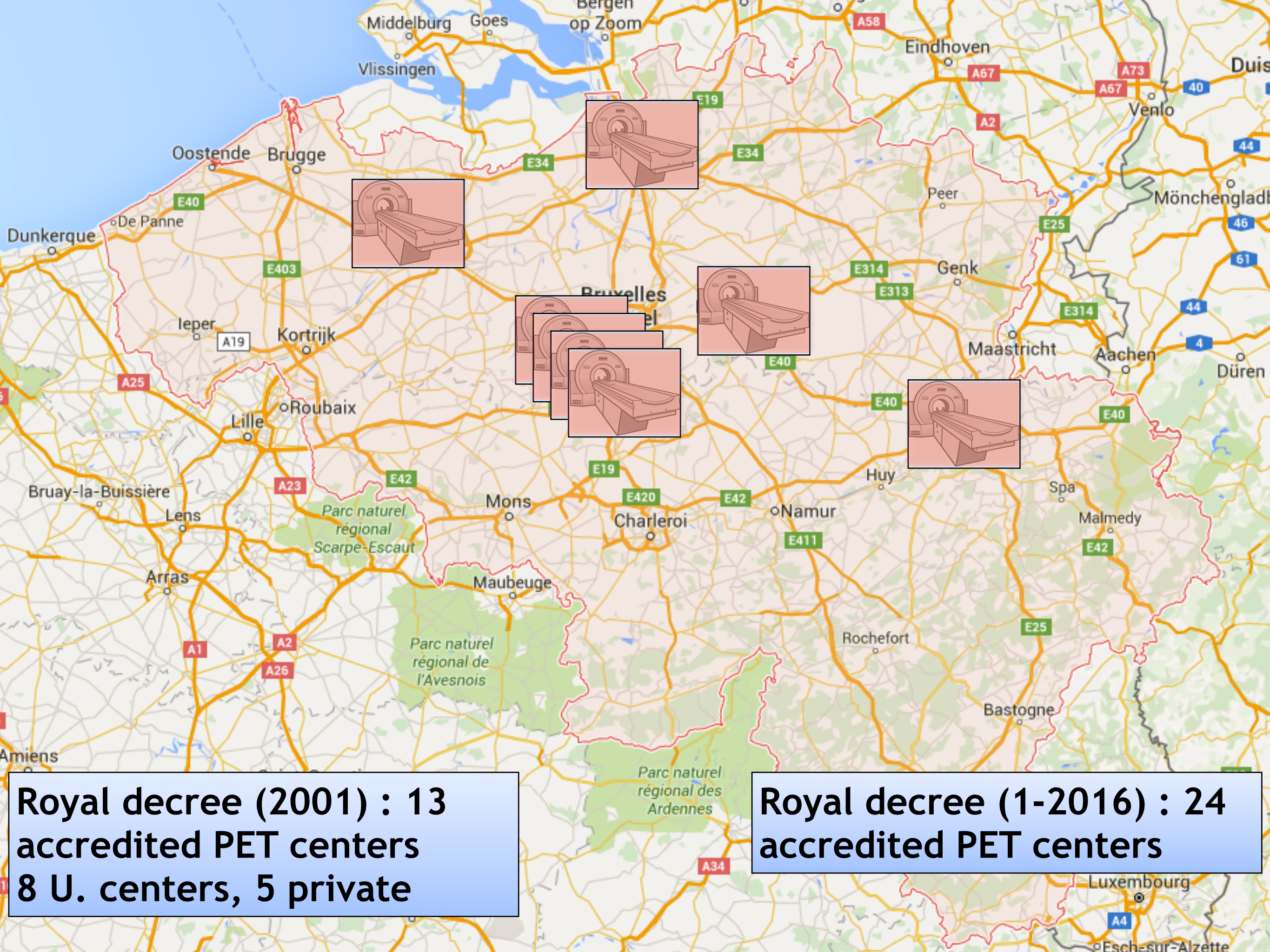


**Royal decree (2001) : 13
accredited PET centers
8 U. centers, 5 private**



**Royal decree (2001) : 13
accredited PET centers
8 U. centers, 5 private**

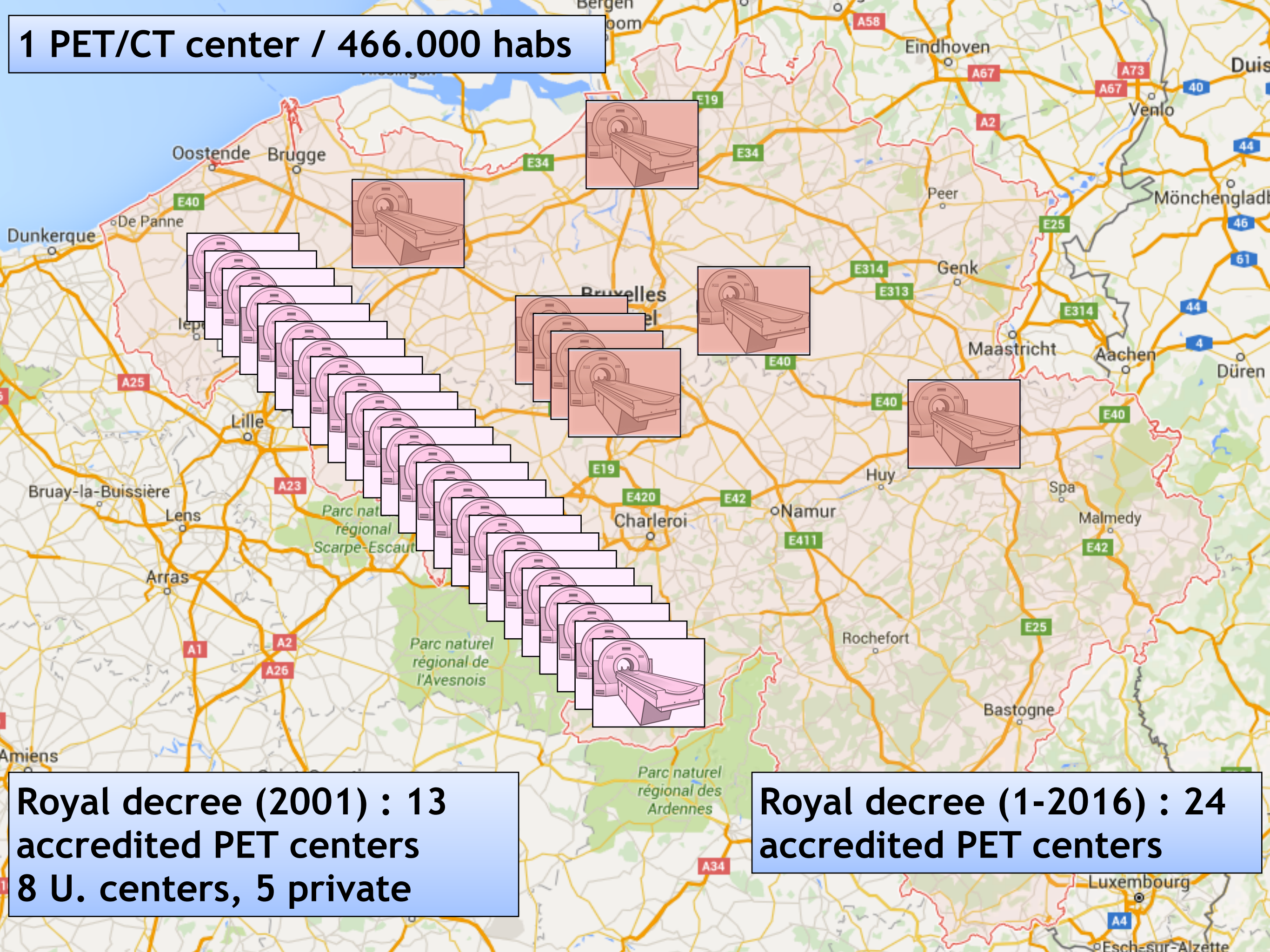
**7 « additional » PET
centers**



**Royal decree (2001) : 13
accredited PET centers
8 U. centers, 5 private**

**Royal decree (1-2016) : 24
accredited PET centers**

1 PET/CT center / 466.000 habs



**Royal decree (2001) : 13
accredited PET centers
8 U. centers, 5 private**

**Royal decree (1-2016) : 24
accredited PET centers**

PET/CT: FDG

The NEW ENGLAND JOURNAL *of* MEDICINE

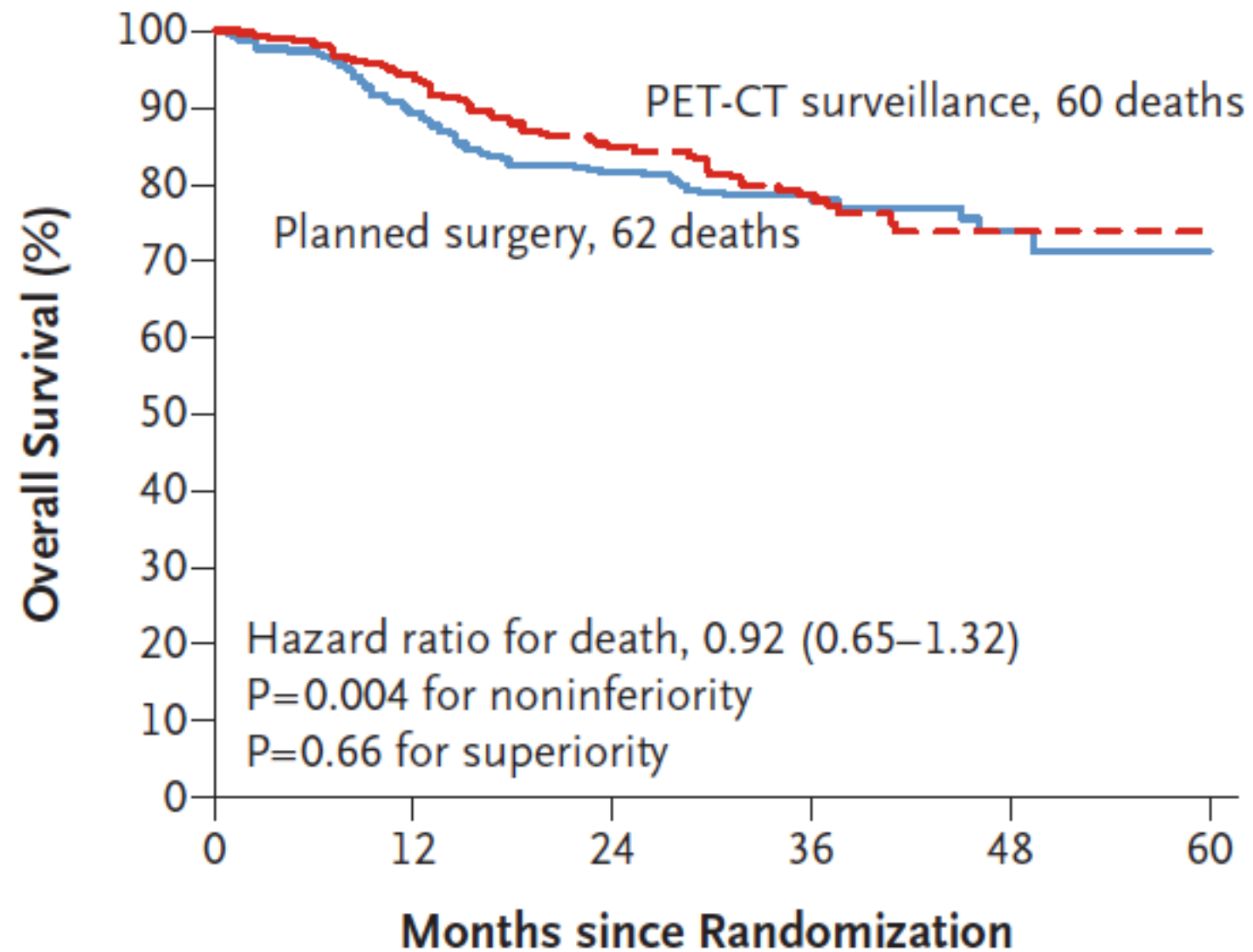
ORIGINAL ARTICLE

PET-CT Surveillance versus Neck Dissection in Advanced Head and Neck Cancer

Hisham Mehanna, Ph.D., Wai-Lup Wong, F.R.C.R.,
Christopher C. McConkey, Ph.D., Joy K. Rahman, M.Sc.,
Max Robinson, Ph.D., Andrew G.J. Hartley, F.R.C.R., Christopher Nutting, Ph.D.,
Ned Powell, Ph.D., Hoda Al-Booz, F.R.C.R., Martin Robinson, F.R.C.R.,
Elizabeth Junor, F.R.C.R., Mohammed Rizwanullah, F.R.C.R.,
Sandra V. von Zeidler, Ph.D., Hulya Wiesmann, F.R.C.R., Claire Hulme, Ph.D.,
Alison F. Smith, M.Sc., Peter Hall, Ph.D., Janet Dunn, Ph.D.,
for the PET-NECK Trial Management Group*

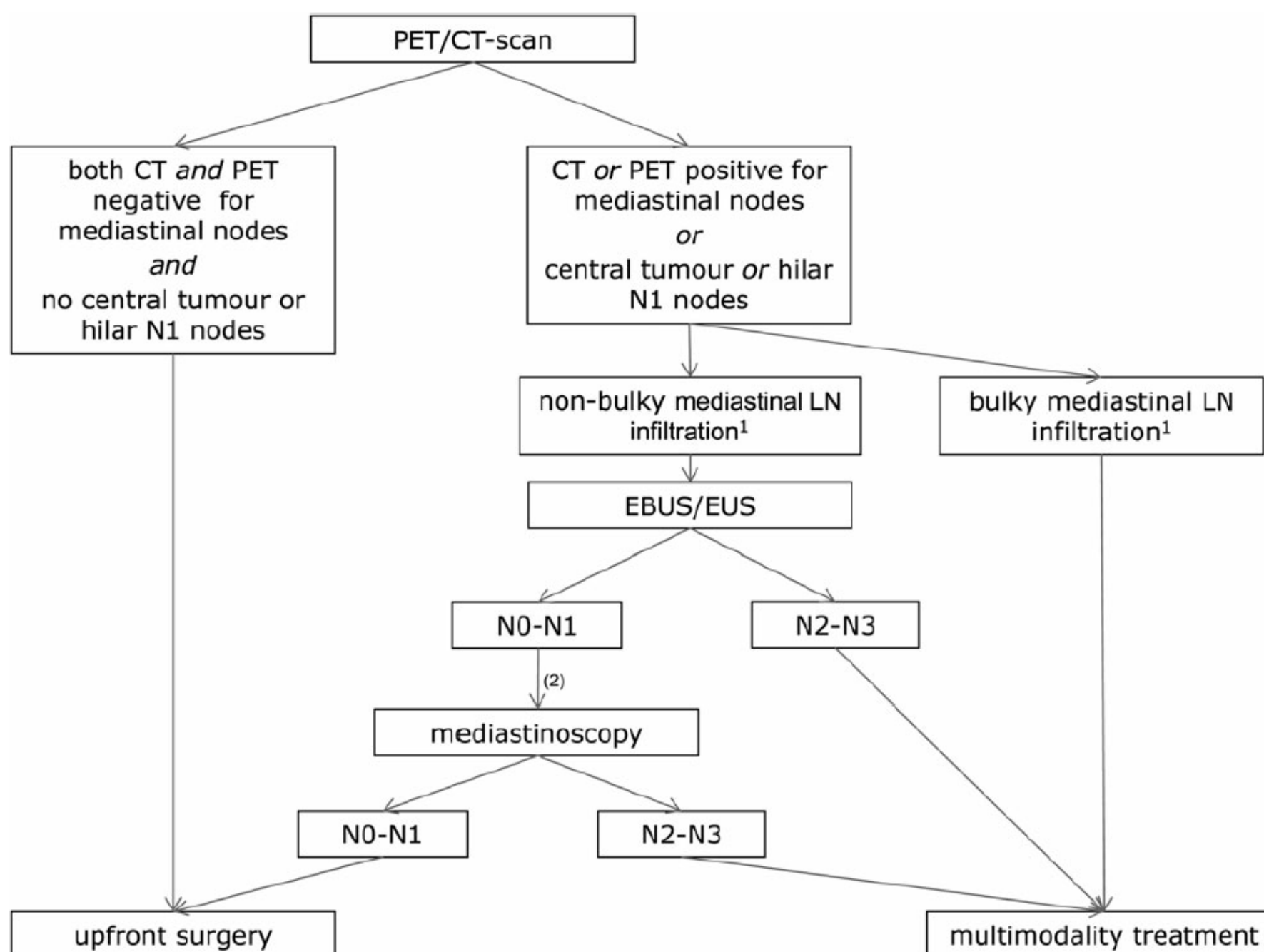


PET-CT Surveillance vs. Planned Neck Dissection, All Patients

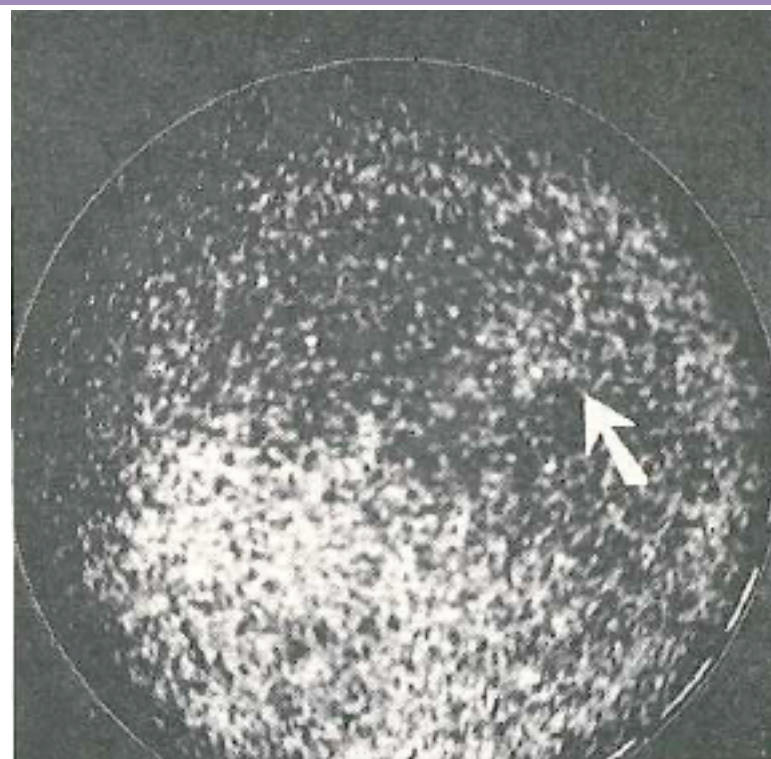


Early and locally advanced non-small-cell lung cancer (NSCLC): ESMO Clinical Practice Guidelines for diagnosis, treatment and follow-up[†]

J. Vansteenkiste¹, D. De Ruysscher², W. E. E. Eberhardt³, E. Lim⁴, S. Senan⁵, E. Felip⁶ & S. Peters⁷,
on behalf of the ESMO Guidelines Working Group*



PET/CT: Recent trends



Gallium Edetate ^{68}Ga Experiences in Brain-Lesion Detection With the Positron Camera

Leonard R. Schaer, MD, Hal O. Anger, and Alexander Gottschalk, MD

JAMA, Nov 21, 1966 • Vol 198, No 8

PET/CT: Recent trends



The #1 song on the UK Singles Chart on November 21, 1966
Good Vibrations - The Beach Boys



Gallium-67 and Gallium-68 Experiences
Brain-Lesion Detection
with the Positron Camera

Leonard R. Schaer, MD, Hal O. Anger, and Alexander Gottschalk, MD

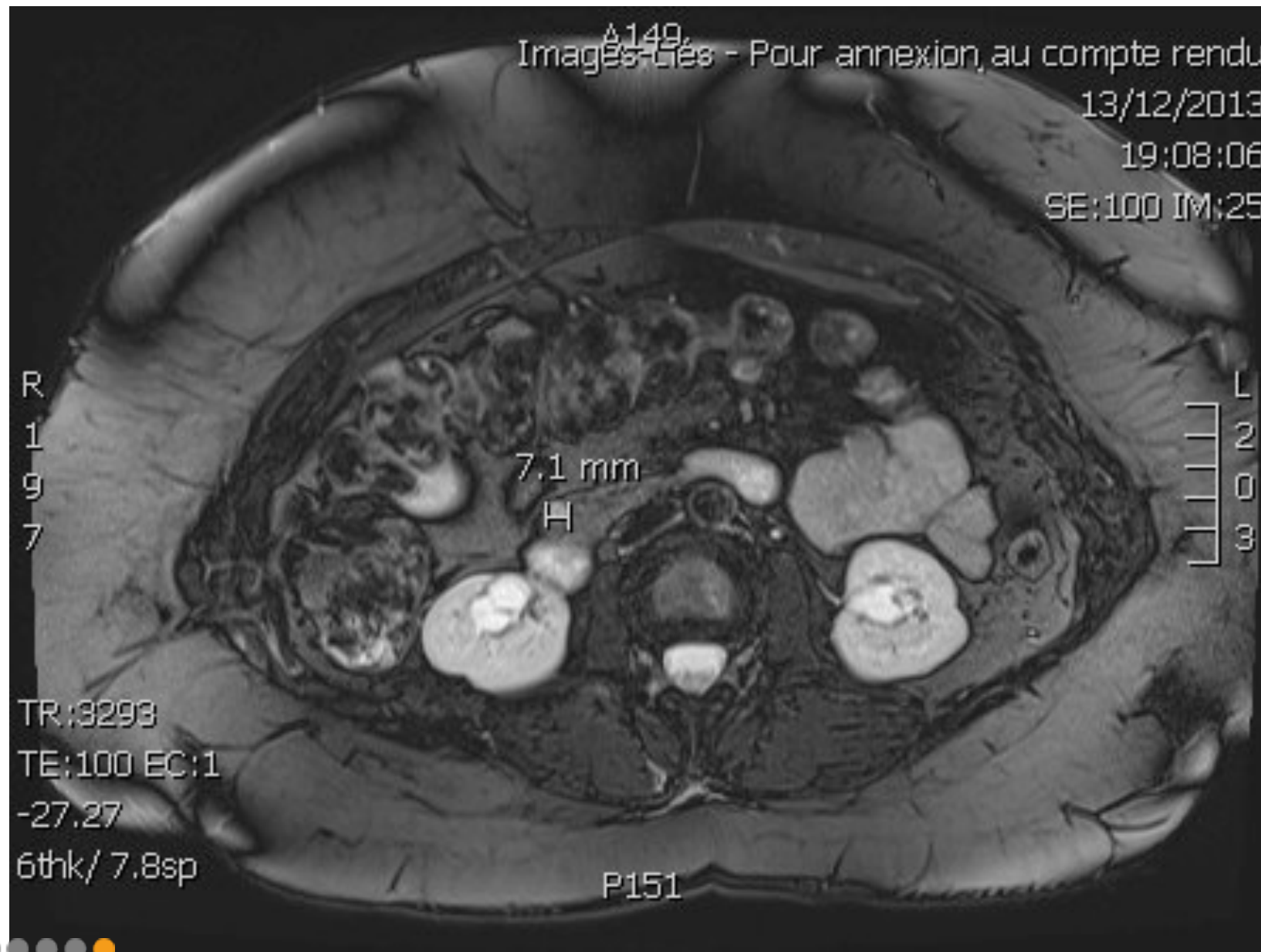
JAMA, Nov 21, 1966 • Vol 198, No 8



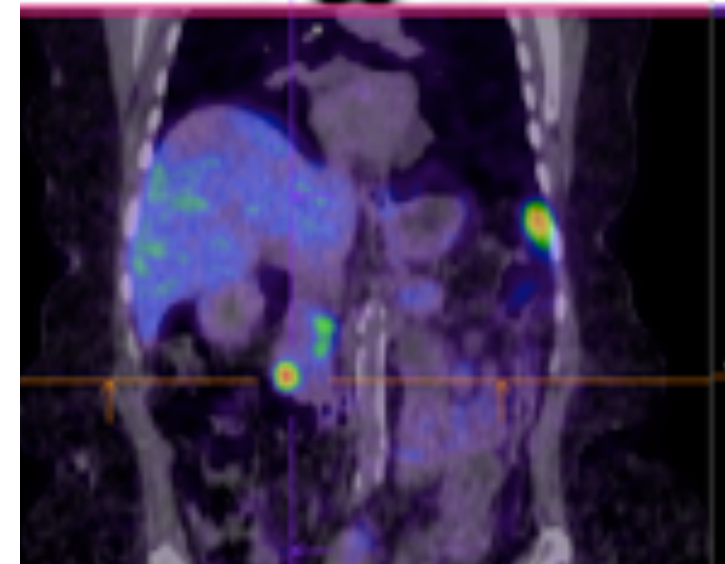
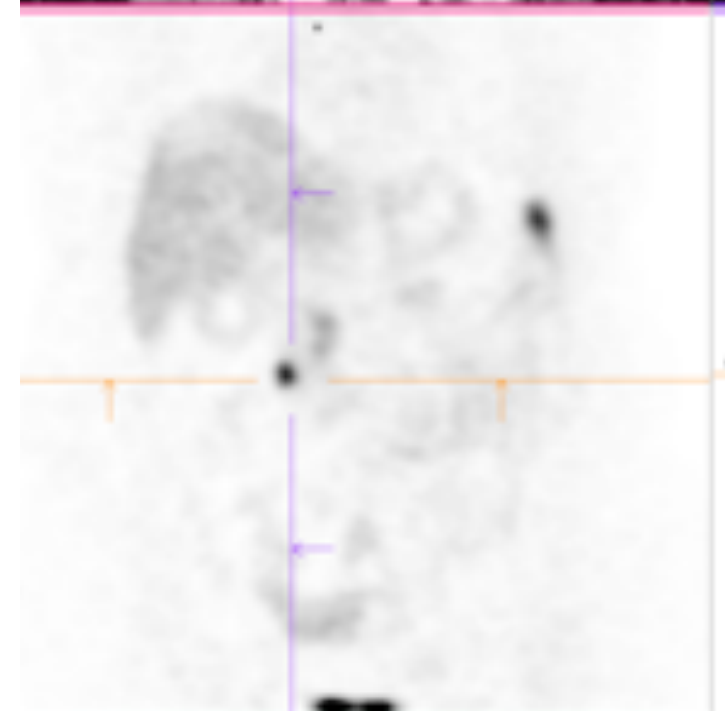
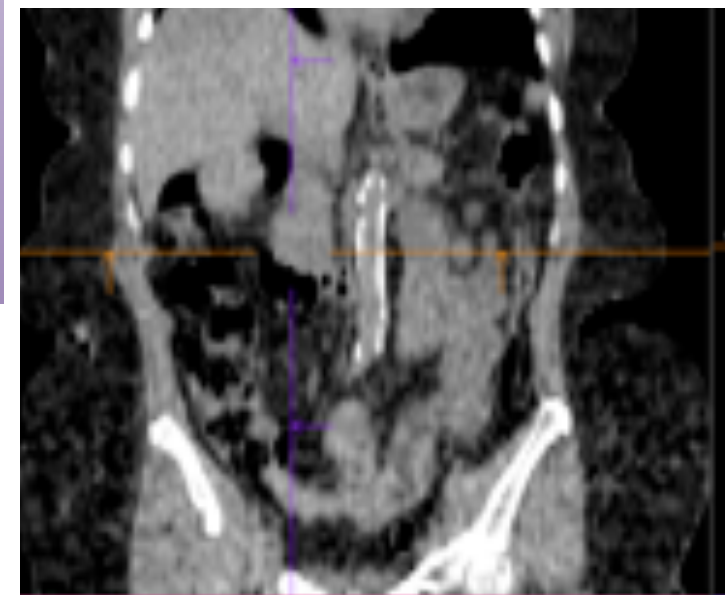
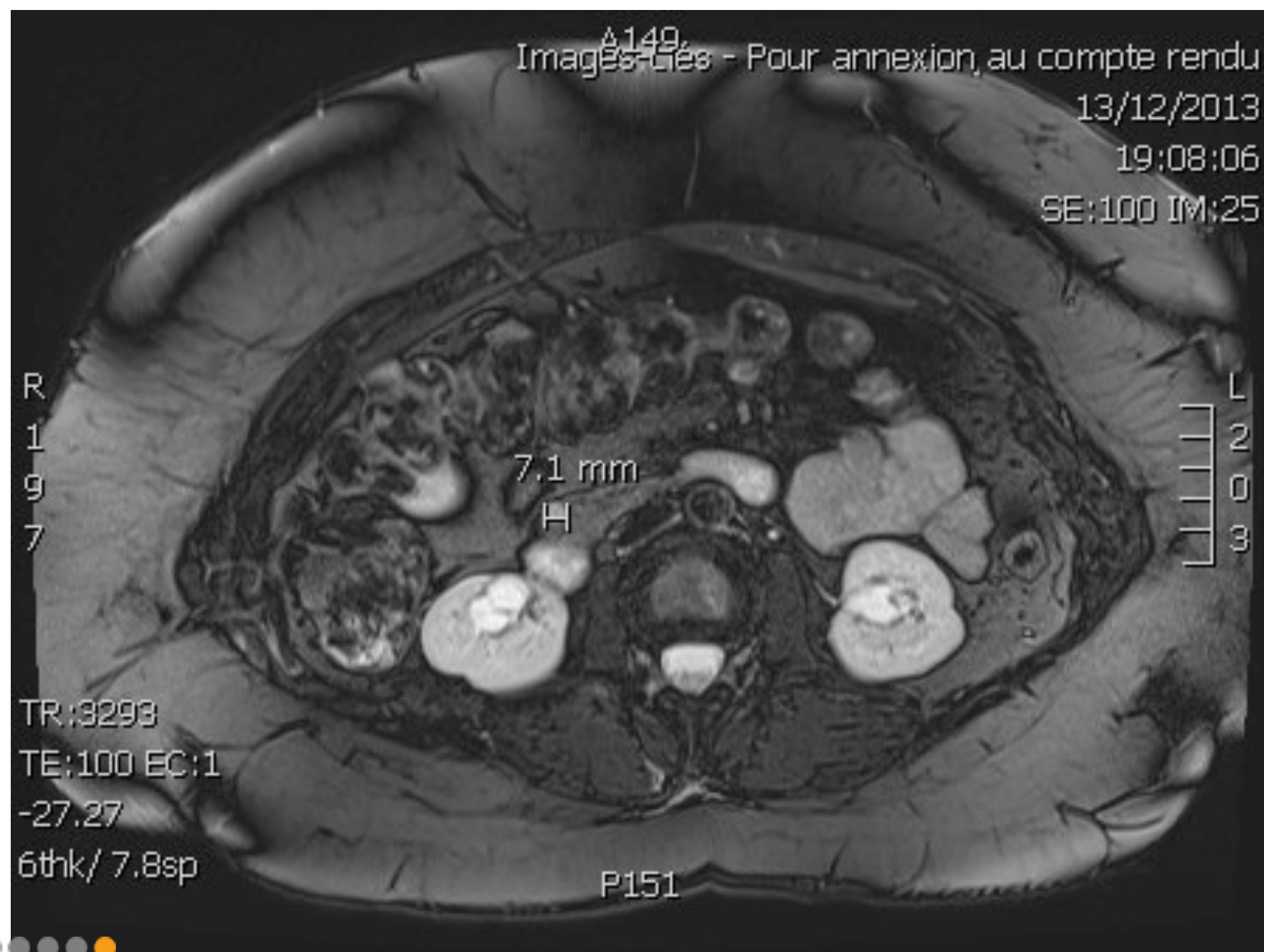
^{68}Ga -labeled compounds

- SSR analogues: DOTA-NOC, TOC, TATE
 - PSMA: prostate imaging
 - Highly active field of research !
- + Availability - chemistry - dosimetry
- Radiopharmacy - regulations - cost

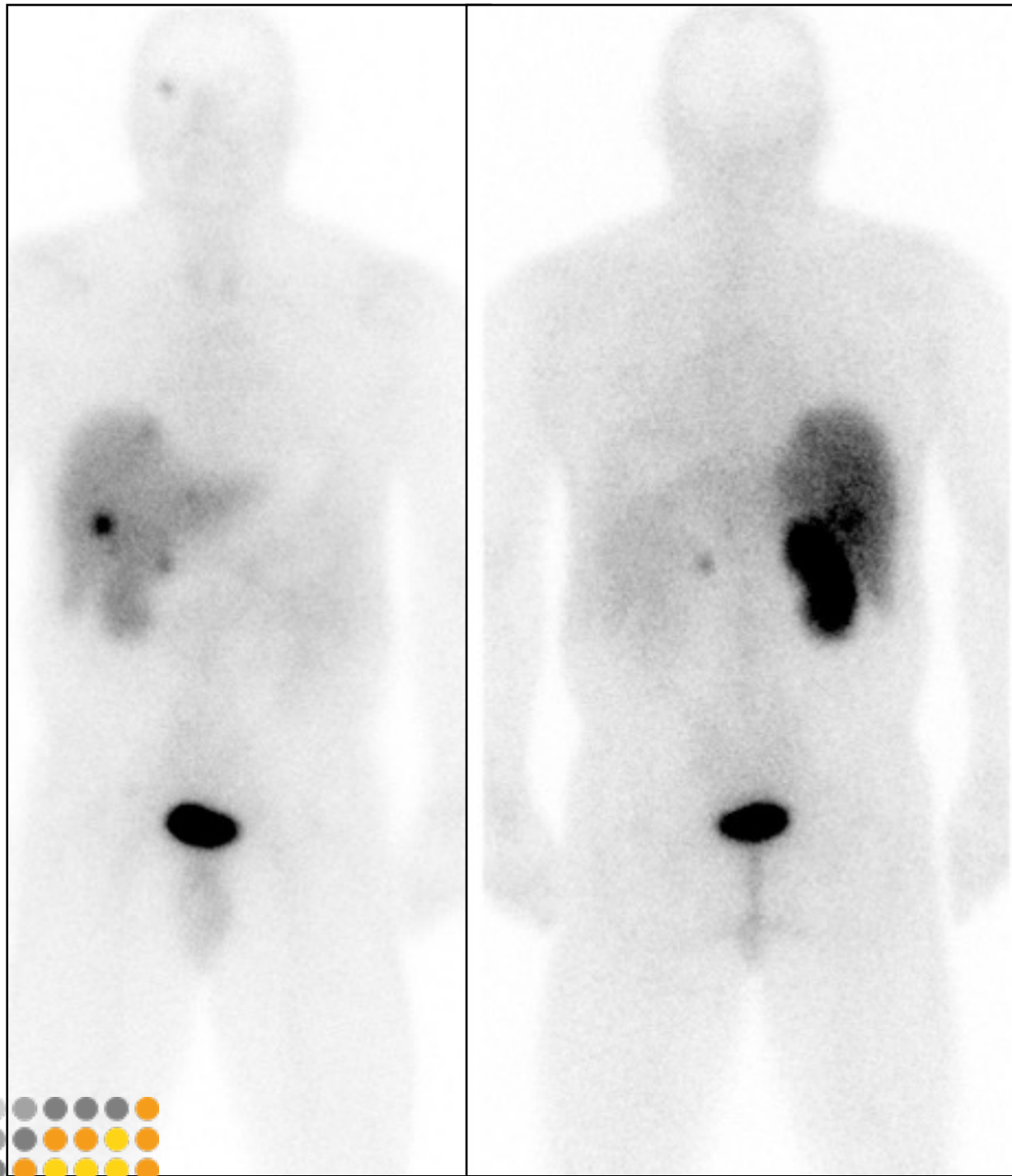
Pancreatic lesion, MR performed for evaluating a probable adrenal adenoma



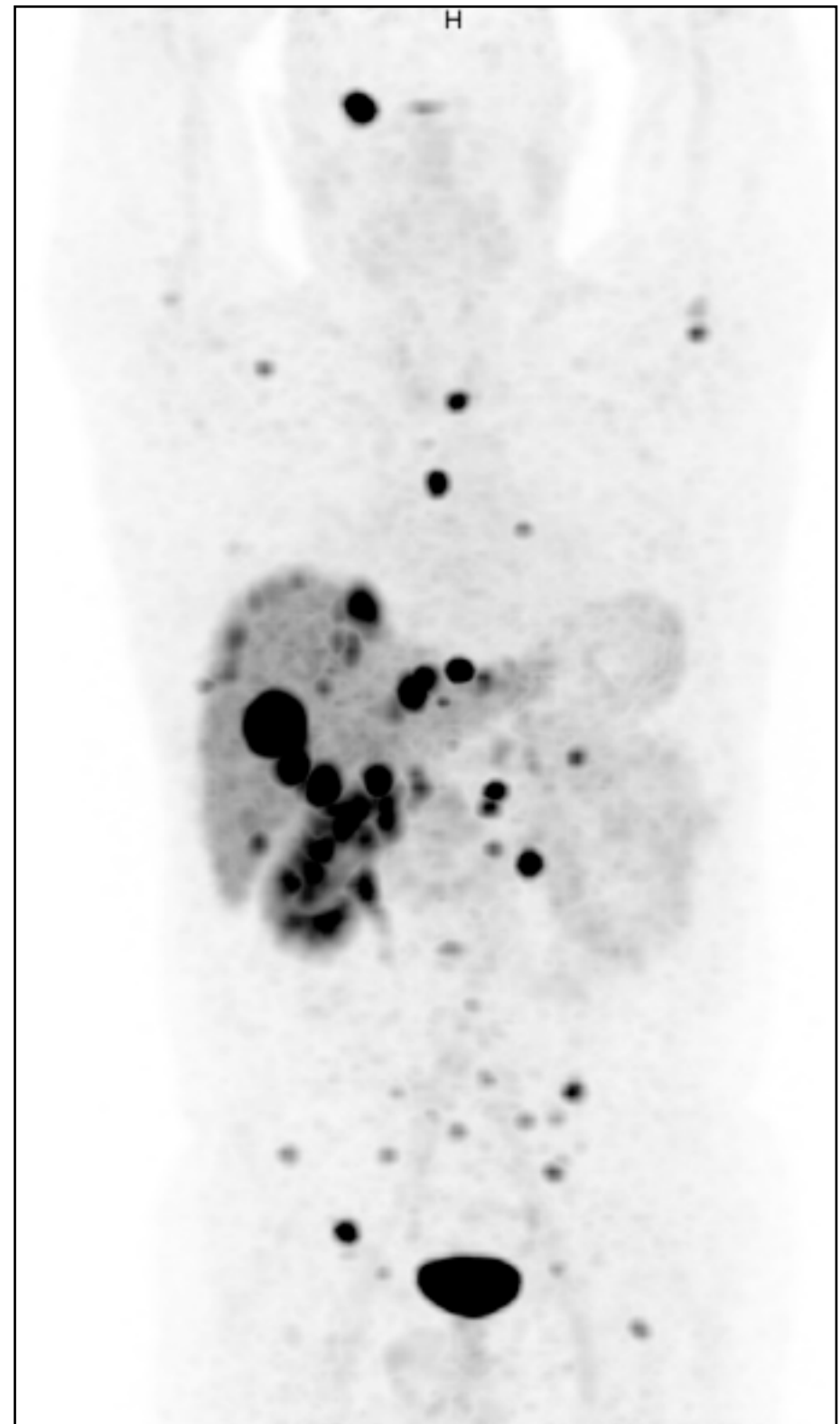
Pancreatic lesion, MR performed for evaluating a probable adrenal adenoma



Carcinoid

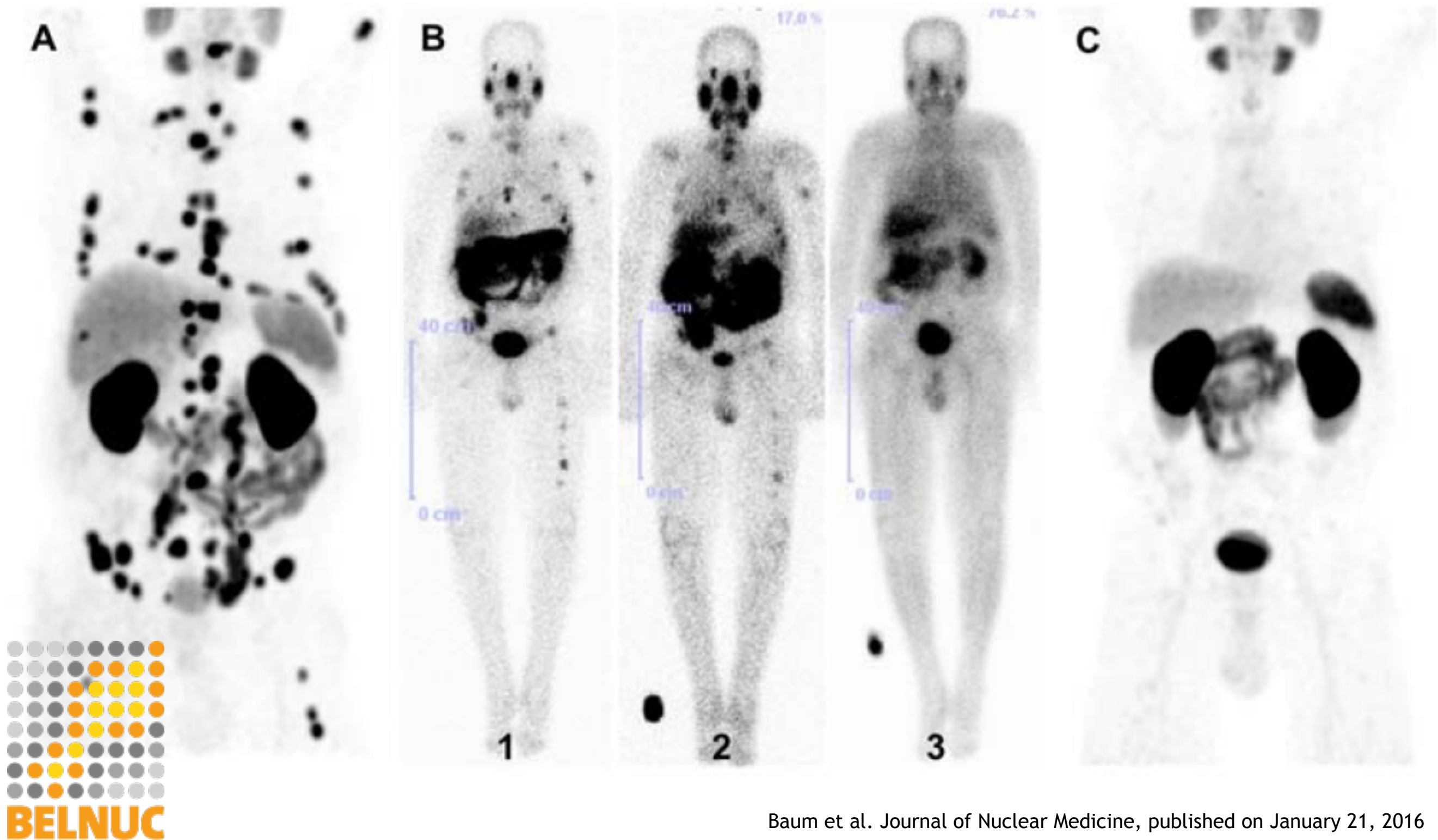


^{111}In -Octreoscan

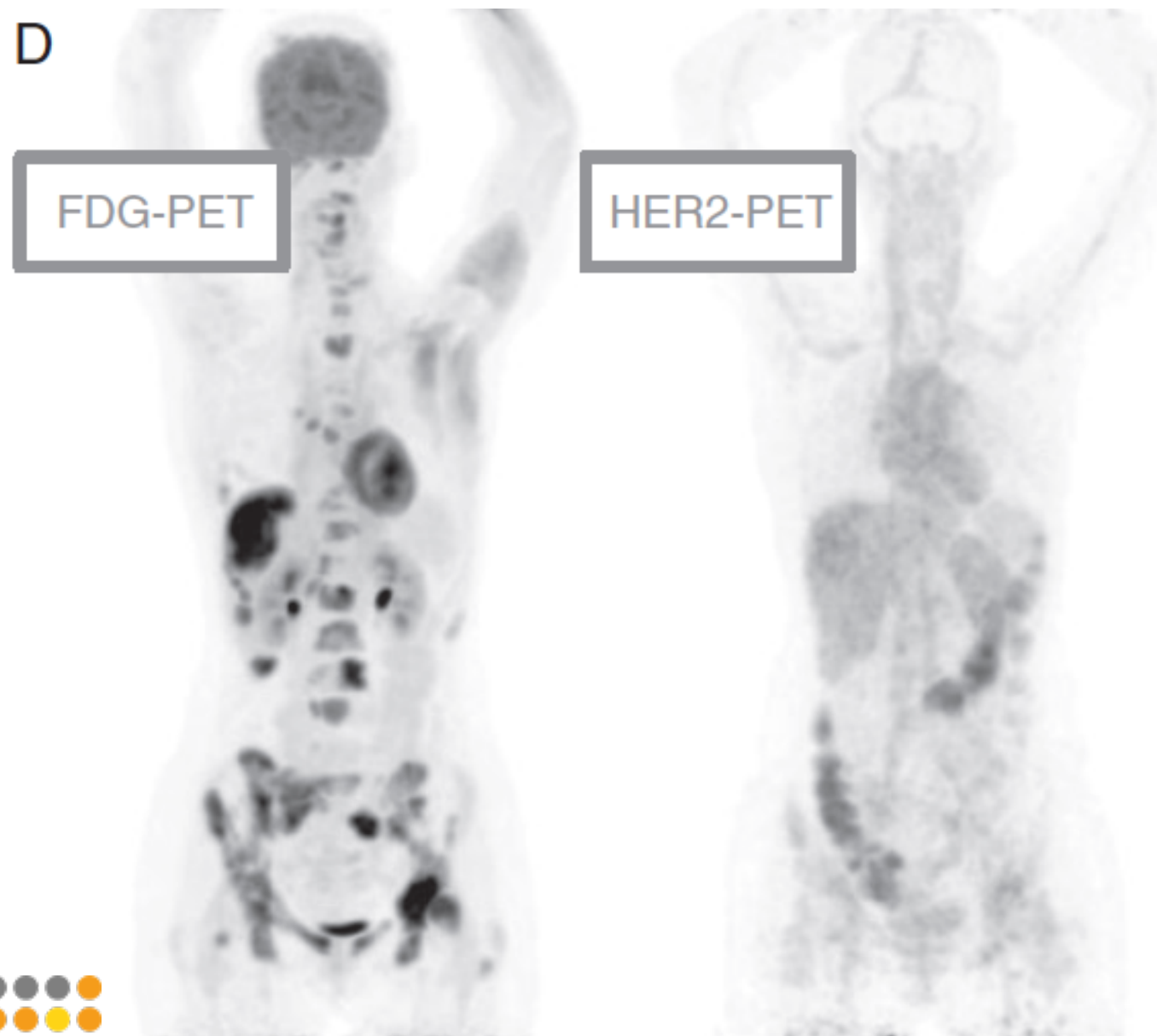


^{68}Ga -DOTANOC

Theranostics: PSMA labeled with ^{68}Ga (imaging-dosimetry) and ^{177}Lu (treatment) in prostate cancer



New targets: HER2 in breast cancer



^{89}Zr -trastuzumab

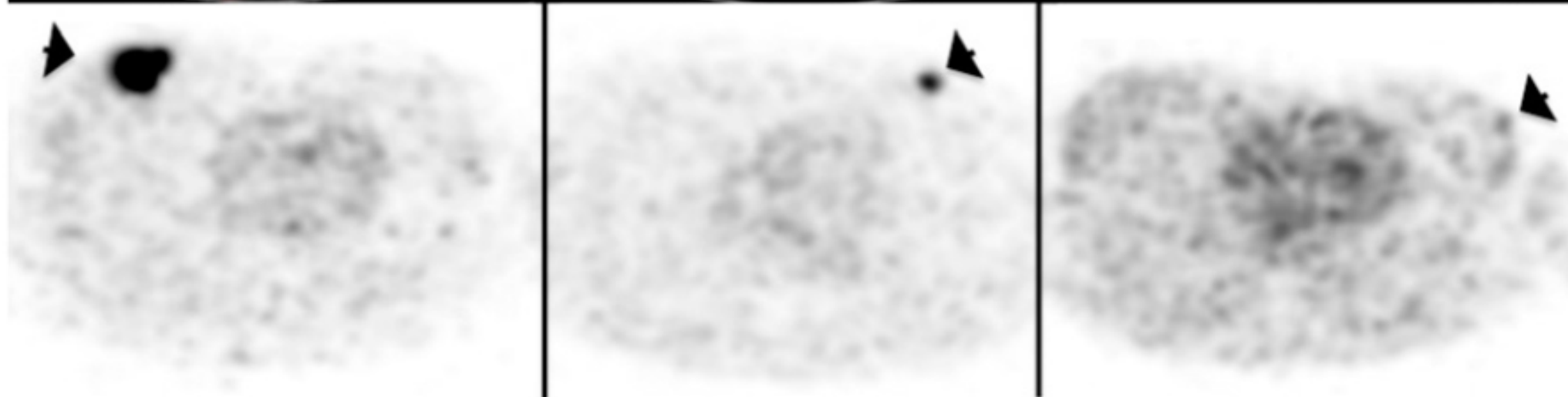
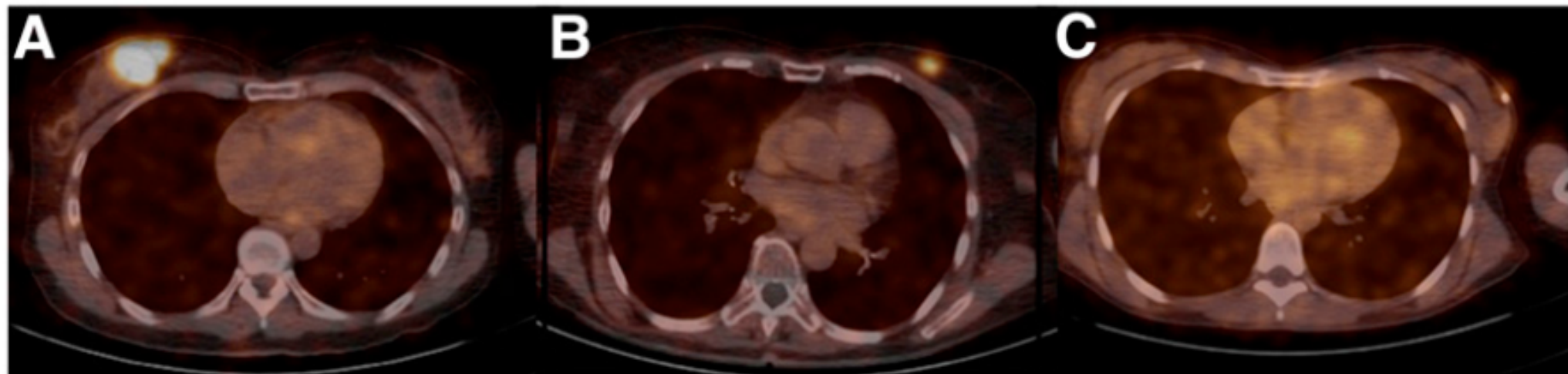
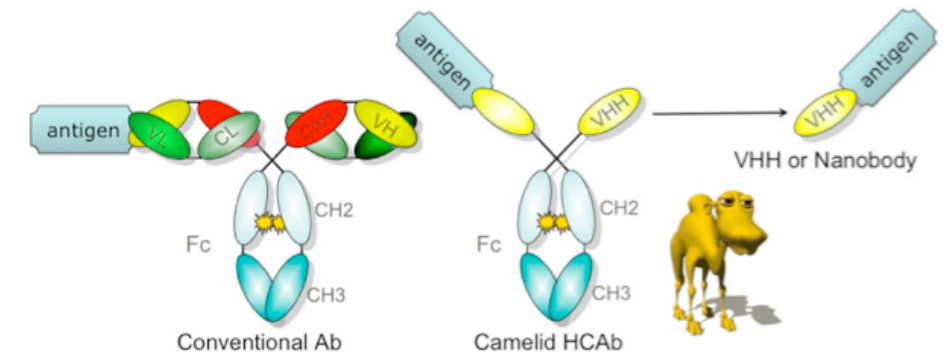
HER2:

- Overexpressed in 1/3 cases
- Improved survival with trastuzumab (Herceptine)
- Variations in expression between primary and metastases (40% of cases)
- Evolution of expression over time

Gebhart et al. Annals of Oncology 00: 1-6, 2015

New targets: HER2 in breast cancer

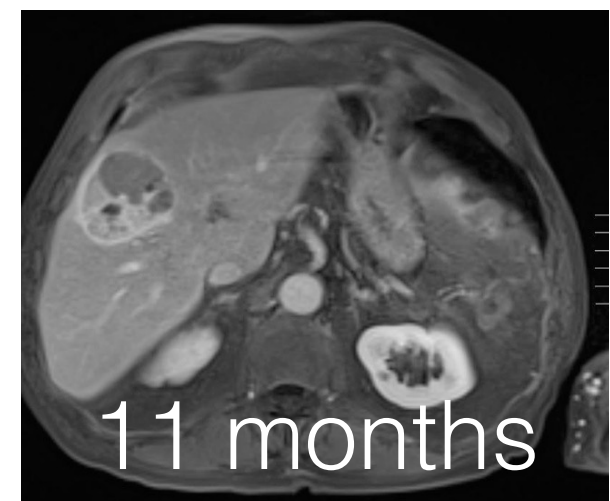
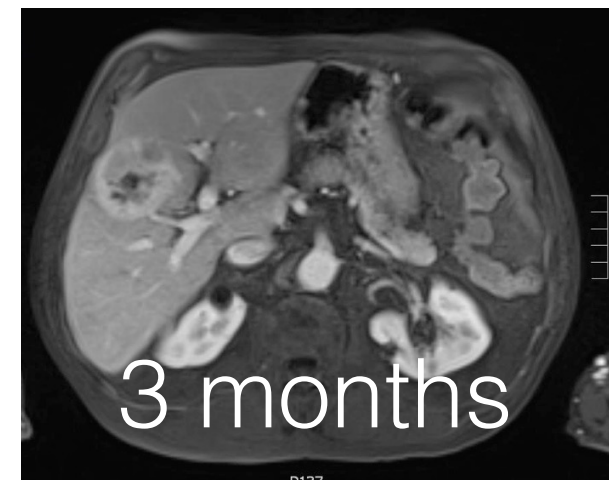
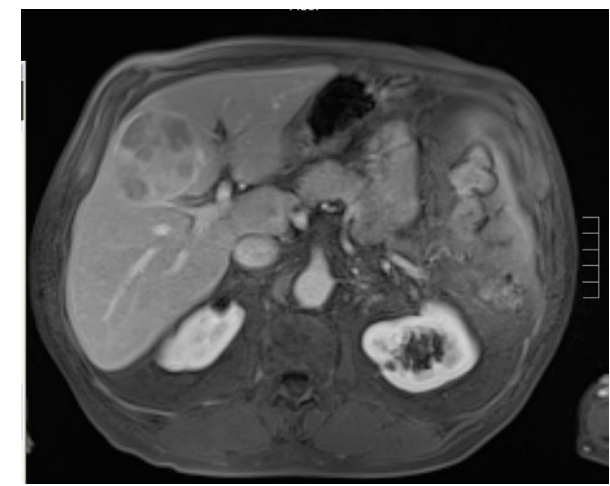
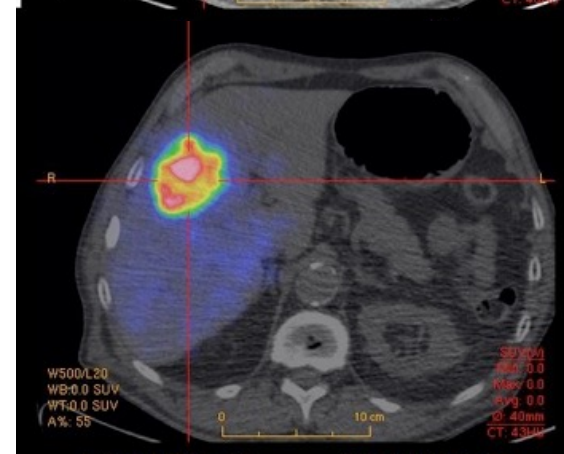
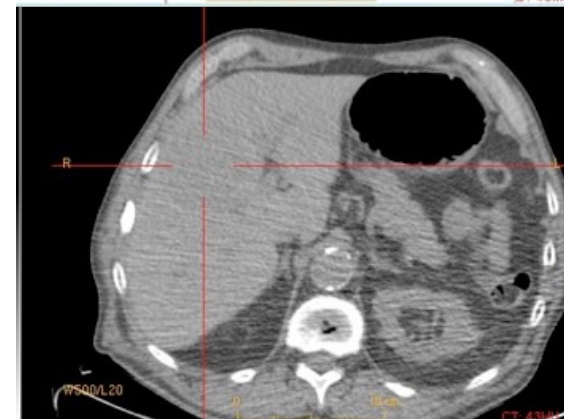
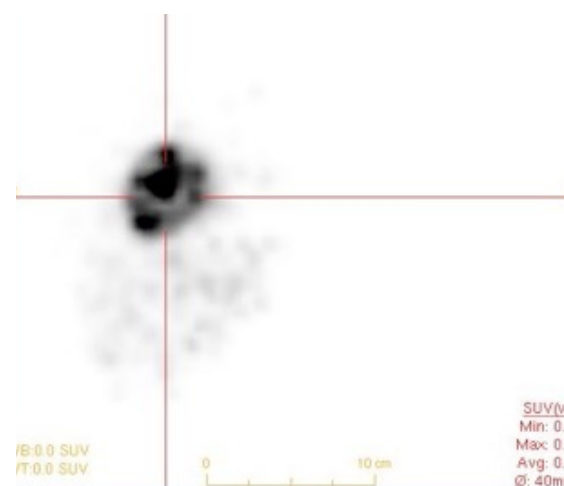
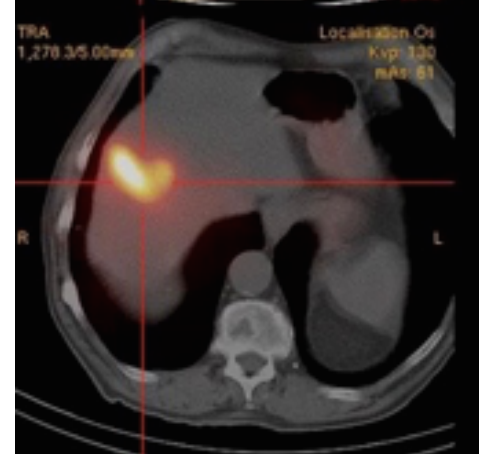
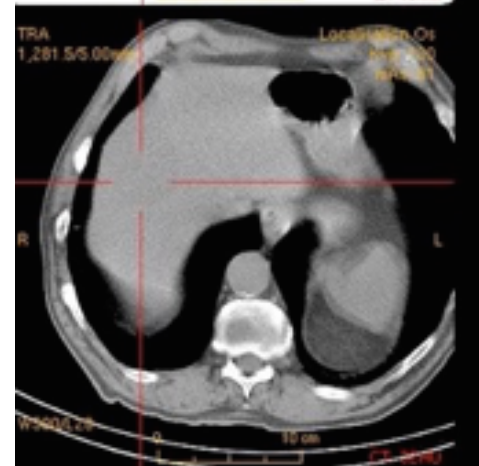
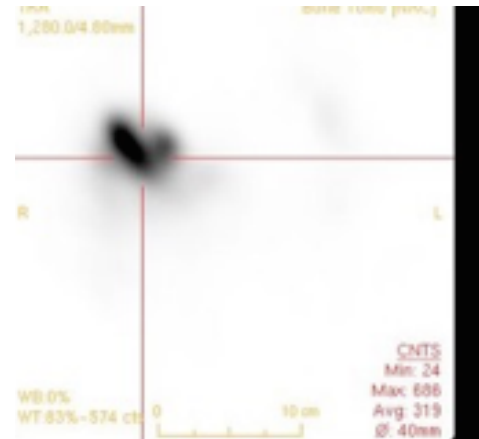
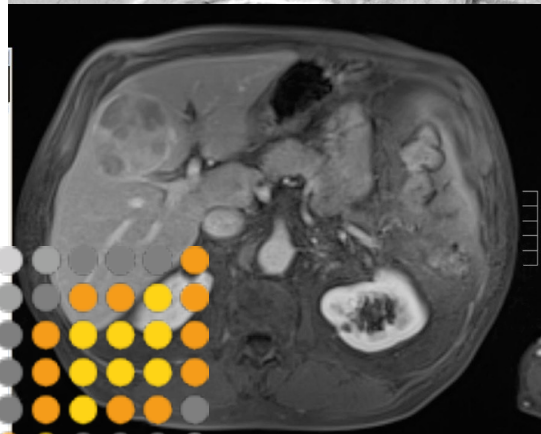
Nanobodies



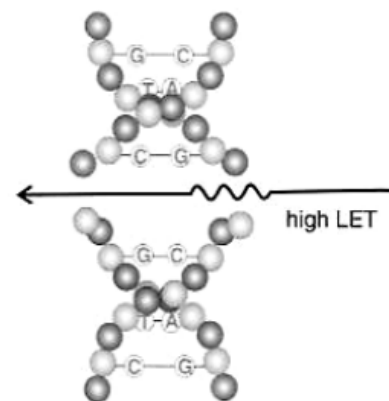
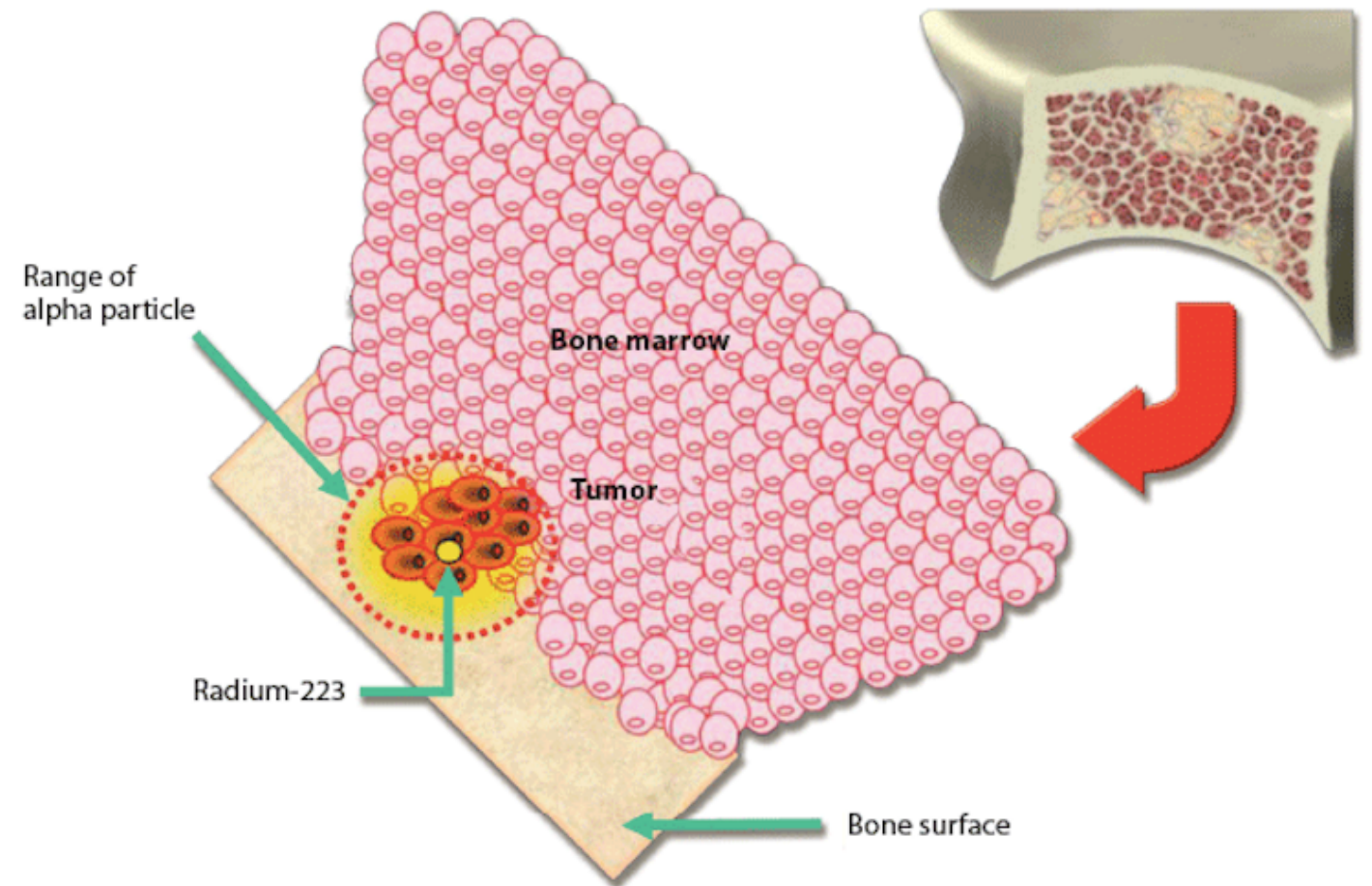
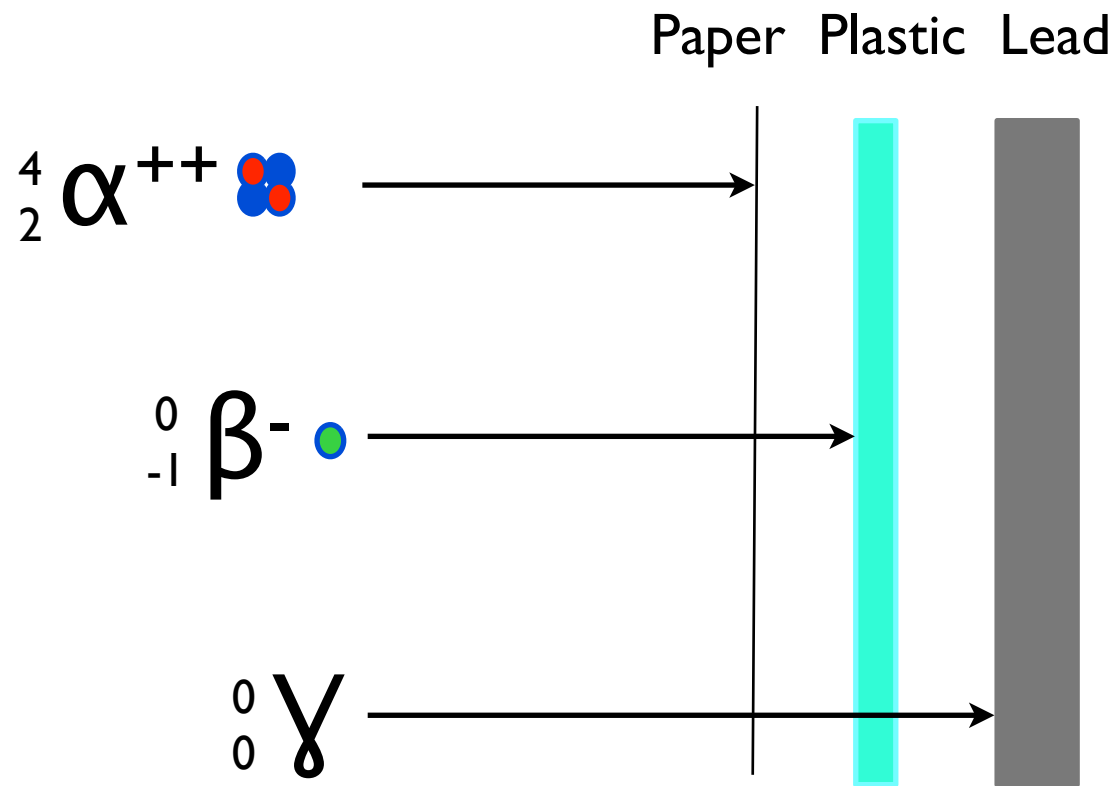
Keyarts et al. J Nucl Med 2016; 57:27-33

^{68}Ga -HER2-Nanobody

New treatments with β -emitters: radio-embolization

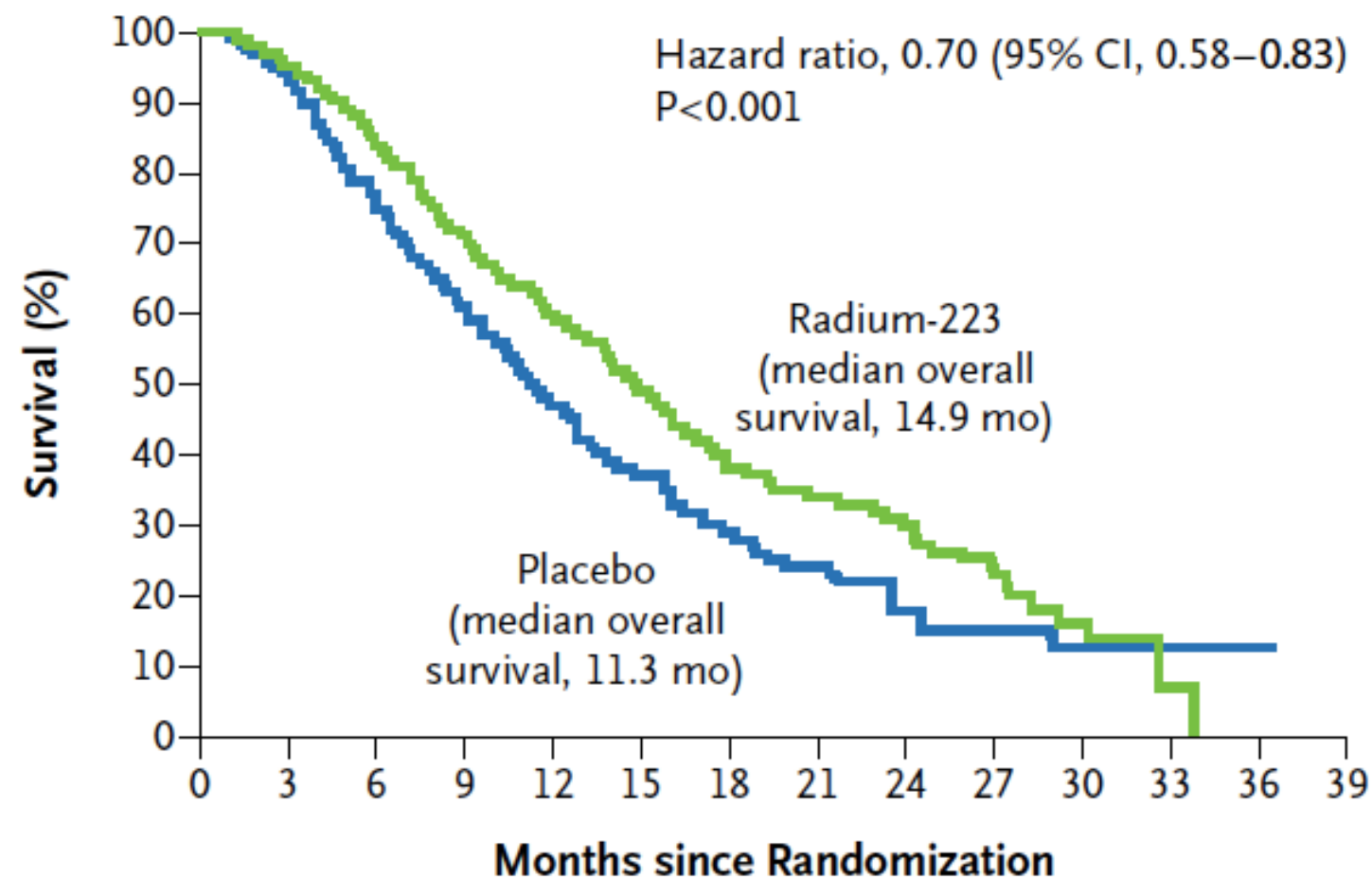


New isotopes: Alpha emitters



Alpha Emitter Radium-223 and Survival in Metastatic Prostate cancer ALSYMPCA Investigators, NEJM July 18, 2013

A Overall Survival



No. at Risk

Radium-223	614	578	504	369	274	178	105	60	41	18	7	1	0	0
Placebo	307	288	228	157	103	67	39	24	14	7	4	2	1	0

Radium-223 extended **OS + 3.6 mo**

Conclusions

- Nuclear medicine
 - Active & diverse
 - Imaging & therapy
 - New techniques - isotopes - radiopharmaceuticals
 - Increased regulatory burden
 - pharma - radioprotection
 - Trend towards centralization in larger centers - collaborations - associations