

IAEA Regional Training Course on Hybrid Imaging

**Hybrid Imaging is not only PET/CT:
the Emerging Role of SPECT/CT**

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Planar and SPECT imaging in the era of PET and PET-CT: can it survive the test of time?

Alavi A, Basu S. Eur J Nucl Med Mol Imaging. 2008.

Key point:

Soon-to-come wide availability of a complete armamentarium of PET radiopharmaceuticals capable of substituting virtually all of the single photon agents currently employed.

A “dream come true” for nuclear medicine:

Functional imaging combined with the highest possible anatomic definition.

Eur J Nucl Med Mol Imaging (2008) 35:1560–1565

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CONTROVERSIES

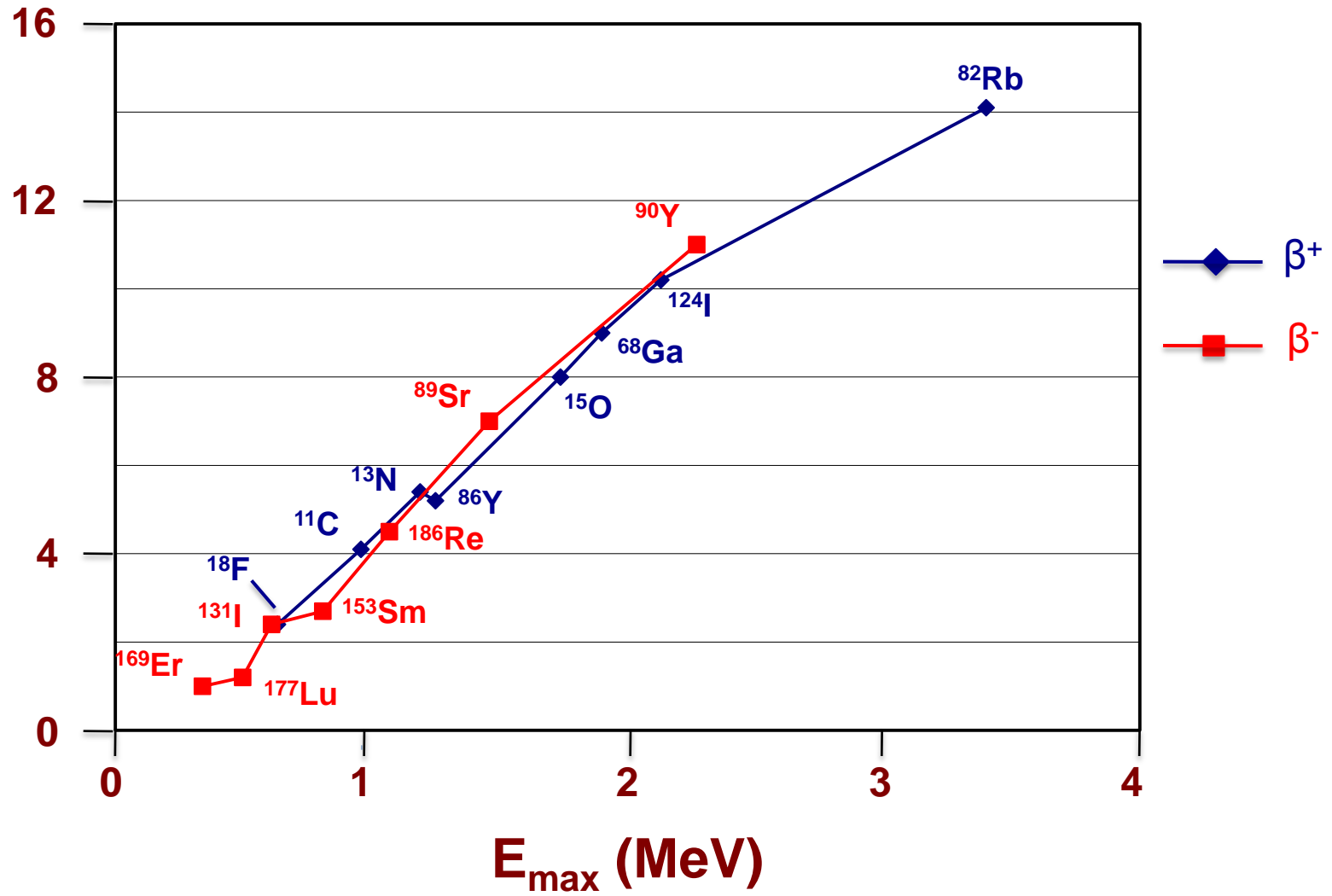
Is PET always an advantage versus planar and SPECT imaging?

Giuliano Mariani • Laura Bruselli • Adriano Duatti

Factors Limiting Translation of Any Single-Photon Emitting Radiopharmaceutical into its Positron-Emitting Counterpart

Emission physics	Availability	Regulatory issues	Local economy
^{94m}Tc	^{11}C	Cost for new approvals	Developing countries
^{124}I	^{13}N		
^{86}Y	^{15}O		

Maximum Range in Water (mm)



Single-Photon Emitting Radiopharmaceuticals with Commercial License or Included in a Pharmacopeia

^{67}Ga-Citrate	$^{99\text{m}}\text{TcO}_4^-$	$^{99\text{m}}\text{Tc}$-Tin colloid
^{111}In-Chloride	$^{99\text{m}}\text{Tc}$-Rhenium Sulfide	$^{99\text{m}}\text{Tc}$-Etifenin
^{111}In-Oxine	$^{99\text{m}}\text{Tc}$-Sulfur Colloid	$^{99\text{m}}\text{Tc}$-HMPAO
^{111}In-DTPA	$^{99\text{m}}\text{Tc}$-HSA-Nanocolloid	$^{99\text{m}}\text{Tc}$-ECD
^{111}In-Octreotide	$^{99\text{m}}\text{Tc}$-Gluconate	$^{99\text{m}}\text{Tc}$-Sestamibi
^{111}In-Prostascint	$^{99\text{m}}\text{Tc}$-PYP	$^{99\text{m}}\text{Tc}$-Tetrofosmin
^{125}I-HSA	$^{99\text{m}}\text{Tc}$-HSA	$^{99\text{m}}\text{Tc}$-Depreotide
^{123}I-MIBG	$^{99\text{m}}\text{Tc}$-MDP	$^{99\text{m}}\text{Tc}$-HYNIC-TOC
^{131}I-MIBG	$^{99\text{m}}\text{Tc}$-HDP	$^{81\text{m}}\text{Kr}$
^{131}I-Nor-cholesterol	$^{99\text{m}}\text{Tc}$-MAA	^{133}Xe
^{123}I-Iodide	$^{99\text{m}}\text{Tc}$-HSA-Microspheres	^{201}Tl-Chloride
^{131}I-Iodide	$^{99\text{m}}\text{Tc}$-DTPA	
^{123}I-Hippurate	$^{99\text{m}}\text{Tc}$-DMSA	
^{131}I-Hippurate	$^{99\text{m}}\text{Tc}$-Mebrofenin	
^{123}I-Ioflupane		
^{123}I-BMIPP		

Positron Emitting Radiopharmaceuticals with Commercial License or Included in a Pharmacopeia (except those labeled with ^{11}C , ^{13}N , ^{15}O)

[^{18}F]FDG

^{18}F -Fluoride

^{18}F -DOPA

^{18}F -Florbetapir

^{18}F -Flutemetamol

^{18}F -Florbetapen

^{18}F -MISO

^{18}F -Choline

^{18}F -FLT

^{82}Rb -Chloride

^{68}Ga -DOTA-TOC (soon to be published)

(^{18}F -BMS747158)

Cost-Related Issues

- **Currently performed ^{99m}Tc -MDP bone scans in Europe: about 2.5 million/year.**
- **Replacing those procedures with ^{18}F -fluoride PET/CT would result in a sudden 25-40% increase in the current cost for health-care.**
- **Additional health-care costs would result from installing the PET/CT tomographs required to accommodate such large number of new PET procedures (by a factor of >10).**

Patterns of Changes in the Number of PET Procedures Performed

- In the period 2005-2008, the number of PET procedures has increased by 35% in the USA and by 82% in Western Europe.**
- Nevertheless, the computed annual growth rate over the same period has been declining both in the USA and in Western Europe.**
- Has this increase in PET procedures translated into a parallel decline in the number of single-photon procedures?**

Patterns of Changes in the Number of Single-Photon Procedures Performed

- **In the period 2005-2008, the only procedure that has consistently declined (by 7-8%) is ventilation-perfusion scintigraphy for acute pulmonary embolism (not because of competition from PET!).**
- **All other procedures have remained stable or have actually increased.**
- **More pronounced rates of increase:**
 - **brain and myocardial perfusion (+2%)**
 - **infection/inflammation (+17.4%)**
 - **sentinel lymph node scintigraphy (+17.5%)**
 - **brain receptor imaging (+42.1%)**

What about Manufacturers?

- **Starting from the third quarter of 2010, sales of SPECT installations are exceeding those from PET installations (for the first time in years).**
- **A large proportion of the newly installed gamma cameras are hybrid SPECT/CT.**
- **Trend to move from low-definition CT to full-diagnostic CT also for gamma cameras.**
- **Investment in new technologies for single-photon imaging (solid state detectors).**

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REVIEW ARTICLE

A review on the clinical uses of SPECT/CT

**Giuliano Mariani • Laura Bruselli • Torsten Kuwert •
Edmund E. Kim • Albert Flotats • Ora Israel •
Maurizio Dondi • Naoyuki Watanabe**

SPECT/CT Applications Covered by the Review

- Follicular thyroid cancer
- Medullary thyroid cancer
- GEP tumors
- Chromaffin tumors
- Adrenocortical tumors
- Parathyroid tumor
- Skeletal metastasis
- Lung cancer
- Breast cancer
- Sentinel node scintigraphy
- Lymphoma
- Cerebral masses
- Liver tumors
- Prostate cancer
- Benign bone diseases
- Infection
- Inflammation
- GI bleeding/Meckel's
- Pulmonary embolism
- Coronary artery disease
- Splenosis
- CNS diseases

Positron emission and single-photon emission imaging: synergy rather than competition

Giuliano Mariani • H. William Strauss

Cross-Fertilization between PET/CT and SPECT/CT

- **Transfer of PET/CT cross-sectional imaging expertise has clearly revitalized SPECT/CT for both preclinical and clinical applications.**
- **Not only improved topographic localization, but also more accurate attenuation correction, for improved quantitation.**
- **Transfer of SPECT studies to PET/CT can be explored in the opposite direction with questions such as: "How might we image infection and/or inflammation with PET/CT?" and "What would a high resolution ventilation/perfusion PET/CT lung scan look like?"**.
- **PET and SPECT are synergistic also for introducing new radiopharmaceuticals and new agents are now developed in parallel for positron and for single-photon emitters.**

The Future of Nuclear Medicine?

- The real issue is not which radionuclide imaging procedure will prevail (PET/CT or SPECT/CT), but rather how to make the best possible use of what is available now and for the foreseeable mid-term future.
- Multimodality imaging is just one of the facets of the clinical problems encountered in the daily routine.
- Would multiagent rather than multimodality imaging be optimal for improved patient's characterization?