Results of the ClearPEM scanners in clinical environment

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The ClearPEM scanners

- Spatial resolution: 1.3 mm
  Obtained with Derenzo phantom (Na22 rods)

- Sensitivity: 2 to 5%, depending on the configuration
Main Activities @ ICNAS
Instituto de Ciências Nucleares Aplicadas à Saúde. Coimbra.

1. Several studies with phantoms
2. Small Animal Imaging
3. Clinical Exams and Training (positioning)
Clinical Trials

ClearPEM Exam Conditions:

• The patient does PET/CT 40 min after FDG injection
• The PET/CT is 25 to 30 minutes long
• The ClearPEM exams are performed 1 hour and 10 minutes after de FDG administration
• No extra dose is required for the ClearPEM exam
• Patients perform a complete ClearPEM exam: breast (left and right) and axilla (left and right), starting with the side where the lesion was detected (in the clinical report file).
• Acquisition times:
  – 20 min for each breast (4 angles);
  – 12 min for each axilla (3 angles)
Clinical exams performed @ ICNAS:

<table>
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<tr>
<th>#</th>
<th>Date</th>
<th>Age (yr)</th>
<th>Weight (kg)</th>
<th>FDG [mCi]</th>
<th>Detector Heads Distance (mm)</th>
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<td>77</td>
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**Eligibility:**
Patients with indication for biopsy
Patients for a PET scan (staging)
Clinical case: bilateral breast cancer

Cancer cells are concentrated in the periphery of the tumor

Small lesion in the left breast seen in PEM, but not in the whole body PET

Click for 3D animation
Small Animal: Colon tumour detection

- FDG scan
- $A = 1.2 \text{ mCi}$
- Weight = 180g
- Colon tumor
Small Animal: Melanoma detection

- FDG scan
- A = 170 µCi
- Weight = 18g
- Melanoma
$^{11}$C-Raclopride PET on the ClearPEM scanner

- **Morning**: 2 time frames: 4x5 min, 4x5min
  (4 angles x 5 min per angle on each frame)
- **Afternoon**: 3 time frames: 4x5min, 4x5min, 4x2.5min

N. Ferreira, ICNAS
Expanded view of the brain slices (in time)
Medical Study with ClearPEM @Marseille

- **Clinical Study in Marseille:**
  - Patients with breast cancer confirmed
  - FDG injection for whole-body PET

- **Goals:**
  - Prove feasibility and safety
  - Patient tolerance
  - Compare with other modalities (US, X-ray, MRI, WB-PET)
  - Optimize clinical protocol

*Patient exam on the Marseille ClearPEM*
Case Study 1

Right Breast: Tumour visible, Left breast: possible lesion only on MRI

**PET/CT**

**whole-body PET**

**MRI**
Case Study 1

ClearPEM sees both the big tumour and the small tumour!

MRI

ClearPEM right breast

ClearPEM left breast
Case Study 2

PET/CT shows two lesions in the left breast
MRI shows both lesions, but the one in the breast could be multifocal!

*Whole-body PET/CT*

*MRI*
Case Study 2

ClearPEM confirms multifocality!

MRI sagittal

ClearPEM coronal

ClearPEM sagittal
The invisibility of posterior lesions

Whole-body PET/CT

ClearPEM coronal

ClearPEM sagittal
ClearPEM-II transferred to Monza

Photo credits: J.C. Silva
State of the Activities

• **ClearPEM @ ICNAS**
  – **Clinical trials with $^{18}$F-FES**
    • $^{18}$F-FES - 16α-(18)F-fluoro-17β-estradiol ((18)F-FES) offers the possibility to study the presence of estrogen receptors in both primary and tumour metastasis, and may be a useful tool in the therapeutic management and prognostic evaluation of breast cancer.
    • Contacts with hospital (HUC) and IPO-Coimbra already established
    • Clinical protocols are being defined for ethical committee approval
  – **Small animal platform**
    • As part of a multimodal facility for small animal imaging

• **ClearPEM-II @ Monza**
  – **Clinical trials with FLT**
    • 3’-deoxy-3’-$^{18}$F[fluorothymidine ($^{18}$FLT) biomarker for in vivo imaging of cell proliferation, it may play an important role in the staging, monitoring, and prediction of response to therapy agents
    • Clinical protocol was approved by the ethical committee
Back up slides
PET is the medical imaging modality of reference in cancer detection.

The commercial equipments allow images of the entire body (whole body systems) but have low resolution (> 5mm) and low sensitivity (~1%), requiring long scans (~30 min) and expose the patient to significant radiation doses (~5-7 mSv).

The research in new PET detectors is intended to improve these two parameters (sensitivity and resolution).
Technology

• 2 parallel rotating detector plates
• Detector Plate:
  • 8 modules
• Modules:
  • 12 submodules
  • 4 192-channel ASICs
• Submodule:
  • 32 crystals: LYSO, 2x2x20 mm³
  • 2 APD arrays for individual double-sided readout

In total: 6144 crystals, 12288 APD channels, 32 ASICs