

Case 1: 79 yr-old woman with a lump in upper outer quadrant of left breast.

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Relevant history

79-yr old woman with a lump in upper outer quadrant of left breast.

Background

Veronesi: tumorectomy-quadrantectomy with axillary lymph node dissection.

Histopathology of all dissected lymph nodes (15-25 per axilla), for staging purposes.

Limited curative value of axillary node dissection *per-se* (5% gain in 5-yr survival).

High incidence of morbidity and long-term post-operative complications.

Despite the growing body of additional prognostic information provided by other factors, tumor status of the axilla still represents the single most important prognostic factor in patients with breast cancer.

- November 2006: FNAC from lump in left breast had shown some atypical cell nuclei.
- April 2008: Core biopsy suggested infiltrating breast cancer (but not definite diagnosis).

Radionuclide study

- Lymphoscintigraphy for radioguided sentinel lymph node biopsy.
- [^{18}F]FDG-PET for staging.

Rationale for examination

- [^{18}F]FDG accumulation in tumors can be used as a guide to identify lesion margins, by using new intra-operative probes able to detect high-energy gamma rays or beta particles.

Lymphoscintigraphy with ^{99m}Tc -Albumin nanocolloid is performed to map sentinel lymph node(s).

The use of probes with variable energy windows capable of detecting gamma photons with different energies (e.g., both 140 KeV of ^{99m}Tc and 511 KeV from β^+/β^- annihilation), can play an important role in breast-conserving surgery.

Technical parameters of lymphoscintigraphy (I)

- Subdermal injection of 3.7 MBq (in a volume of 0.3 mL) of ^{99m}Tc -Nanocoll (upper outer quadrant of left breast on the cutaneous projection of lesion).
- Planar acquisitions: anterior, 45° anterior oblique and 90° lateral, performed within 15 min after the injection (if required, they can be performed at 2–3 h);

- Planar images are acquired for 3–5 min using a 128×128 matrix (zoom 1,33).
- SPECT/CT acquired with 360°step-&-shoot, 20 sec/step, 128×128 matrix, and zoom 1;
- The site of any suspected sentinel node can be localised on the 45° anterior oblique image using a ^{57}Co point-source, marking the skin marked with indelible ink; if a ^{57}Co source is not available, $^{99\text{m}}\text{Tc}$ sources using syringe needles can be employed.

Technical parameters of [^{18}F]FDG-PET:

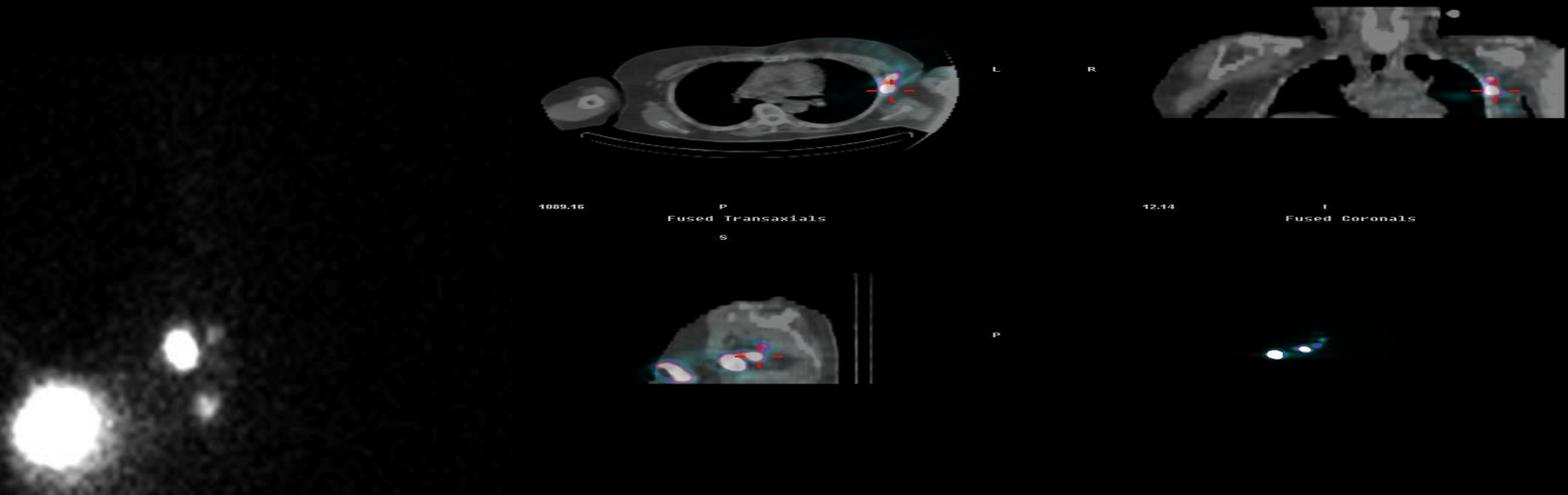
- I.v. injection of 200 MBq of [^{18}F]FDG-PET (patient fasting since at least 6 hours) three hours before surgery.
- Whole-body acquisition after 50 minutes.

- Qualitative and semiquantitative analysis (it is necessary to record specific information including patient's weight and height, administered [^{18}F]FDG activity, and time of injection).

Findings

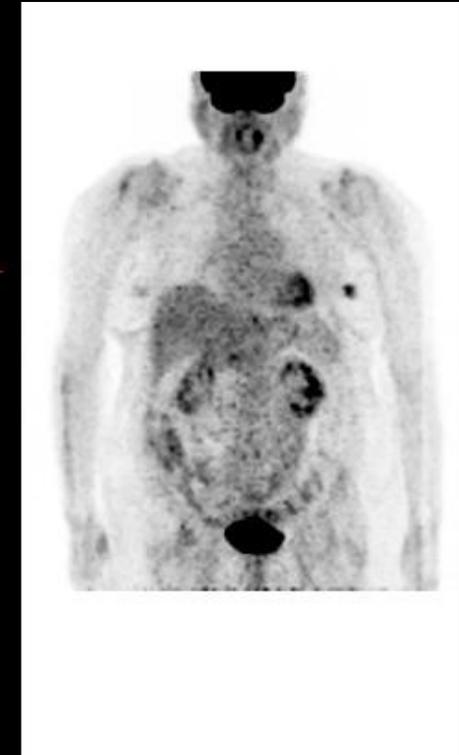
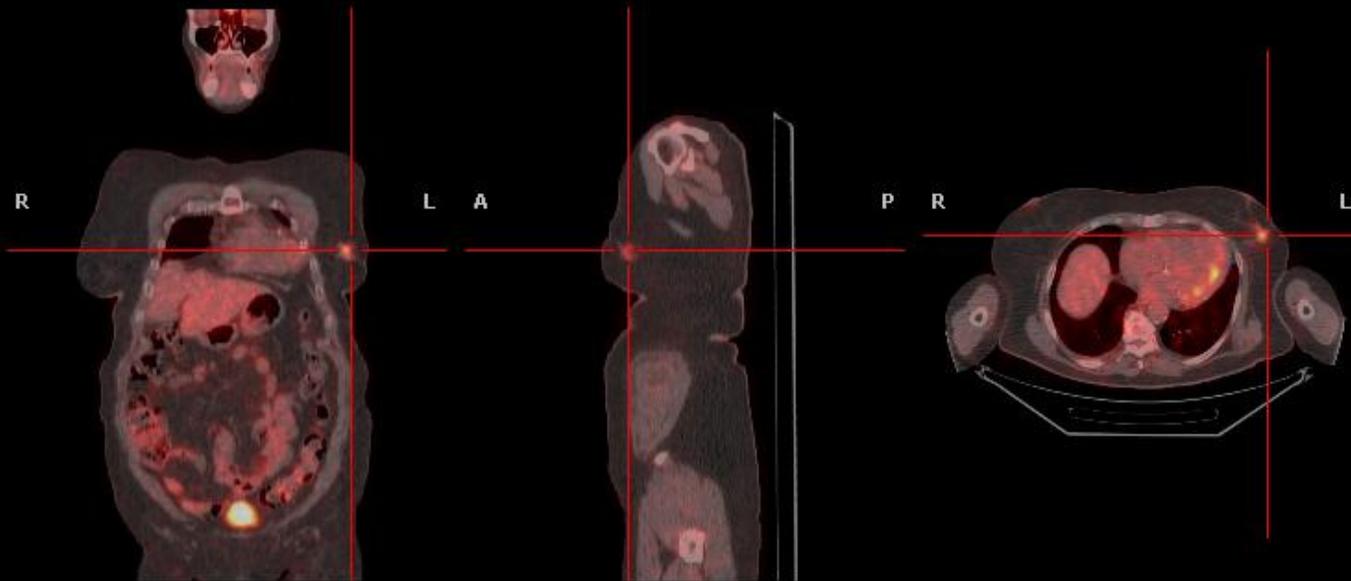
- **Structured approach to image review:**
 - **quality: satisfactory;**
 - **completeness: complete;**
 - **scintigraphic findings and interpretation: see next slides.**

Lymphoscintigraphy for radioguided sentinel lymph node biopsy



Lymph channels leading to sentinel nodes in left axilla

[¹⁸F]FDG-PET



Hypermetabolic lesion in upper outer quadrant of left breast (SUV_{max} 3.7), corresponding to known primary tumor.

Surgery 3 hr after injection of 200 MBq [^{18}F]FDG and 18 hr
after injection of 3.7 MBq $^{99\text{m}}\text{Tc}$ -Nanocoll

(γ -counting with electronically-collimated probe)

***In-vivo* $^{99\text{m}}\text{Tc}$**

Sentinel node: 5500 cps

Background: 655 cps

***In-vivo* ^{18}F**

Tumor: 10600 cps

Background: 400-500 cps

***Ex-vivo* $^{99\text{m}}\text{Tc}$**

Sentinel node 1: 3000 cps

Sentinel node 2: 1051 cps

Background: 400-500 cps

***Ex-vivo* ^{18}F**

Tumor: 9030 cps

Background: 400 cps

Surgical bed: 400 cps

Intra-Operative Frozen-Section Histology

- ✓ **Infiltrating cancer of the upper outer quadrant of left breast (tumor-free resection margins)**
- ✓ **Sentinel lymph node: micrometastasis.**



Axillary dissection

Definitive Histology

- ✓ **Poorly differentiated ductal breast cancer (1 cm, Grade 3) infiltrating the dermis and the subcutaneous tissue.**
- ✓ **Micrometastasis in 1/18 axillary lymph nodes (the sentinel lymph node).**

Teaching Points

- The use of PET-guided surgery is expanding.
- The most recent probes detect intra-operatively either the high-energy annihilation γ rays (with adequate shielding and collimation), or directly the β^+ particles (with a beta probe).
- Since β^+ particles have a very short range of penetration in tissues, beta-probe counting is only possible in direct contact with tissues (not affected by background γ radiation).

- The use of either a high-energy gamma probe or a beta probe in radioguided surgery for assessing post-resection [^{18}F]FDG-avid residual disease yields in principle similar results.
- Considering that the radiopharmaceutical used for mapping sentinel lymph nodes is $^{99\text{m}}\text{Tc}$ -Nanocoll, the intra-operative probe used must detect low-energy γ rays as well.

References

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- Crippa F, Bombardieri E. Nuclear medicine imaging in breast cancer: current strategies and future directions. Oncology. 2009; 23: 269-70.**
- Lavavssière R, Cabée AE, Filmont JE. Positron Emission Tomography (PET) and breast cancer in clinical practice. Eur J Radiol. 2009; 69: 50-8.**