

ASSISTANCE  
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*Hôpital Saint-Louis*  
*Centre Hospitalo-Universitaire et de Recherche*

# **$^{18}\text{F}$ -FDG PET/CT in the Diagnosis and Staging of Breast Cancer**

David Groheux, Elif Hindié, Marc Espié

**Diagnosis of Breast cancer:**

**Is PET(/CT) useful?**

# Breast lesions screening

References	Nb patientes	sensitivity	Specificity	Accuracy
Adler 1993	28	96%	100%	~~
Dehdashti 1995	32	88%	100%	91%
Avril 1996	72	83%	84%	83%
Palmedo 1997	20	92%	86%	90%
Hubner 2000	35	96%	91%	94%
Yutani 2000	40	79%	~~	80%
Schirrmeister 2001	117	93%	75%	89%
Samson 2002 [1]	606	88%	79%	~~
Heinisch 2003	36	68%	~~	~~
<b>Kumar 2006 [2]</b>	111	48%	97%	61%

[1] Should FDG PET be used to decide whether a patient with an abnormal mammogram or breast finding at physical examination should undergo biopsy? Samson DJ Acad Radiol 2002;9:773-83.

[2] Clinicopathologic factors associated with false negative FDG-PET in primary breast cancer. Kumar R, et al. Breast Cancer Res Treat. 2006;98:267-74.

# Correlation of high $^{18}\text{F}$ -FDG uptake to clinical, pathological and biological prognostic factors in breast cancer

David Groheux • Sylvie Giacchetti • Jean-Luc Moretti • Raphael Porcher •  
Marc Espié • Jacqueline Lehmann-Che • Anne de Roquancourt • Anne-Sophie Hamy •  
Caroline Cuvier • Laetitia Vercellino • Elif Hindié

Eur J Nucl Med Mol Imaging 2011;38:426-35.

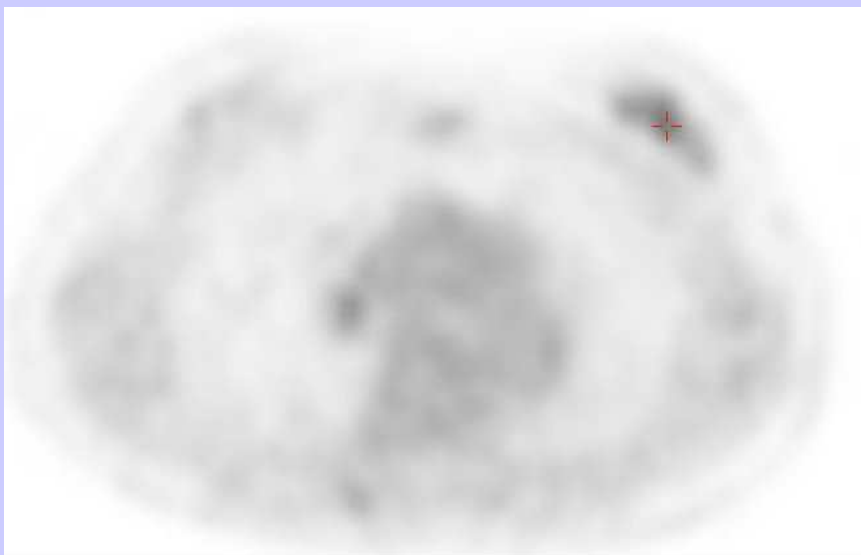
- Prospective study
- 132 consecutive patients with a large (>2cm) and/or locally advanced breast cancer.
- $^{18}\text{F}$ -FDG PET-CT examination was performed before starting neoadjuvant chemotherapy.

## Results: Univariate analysis

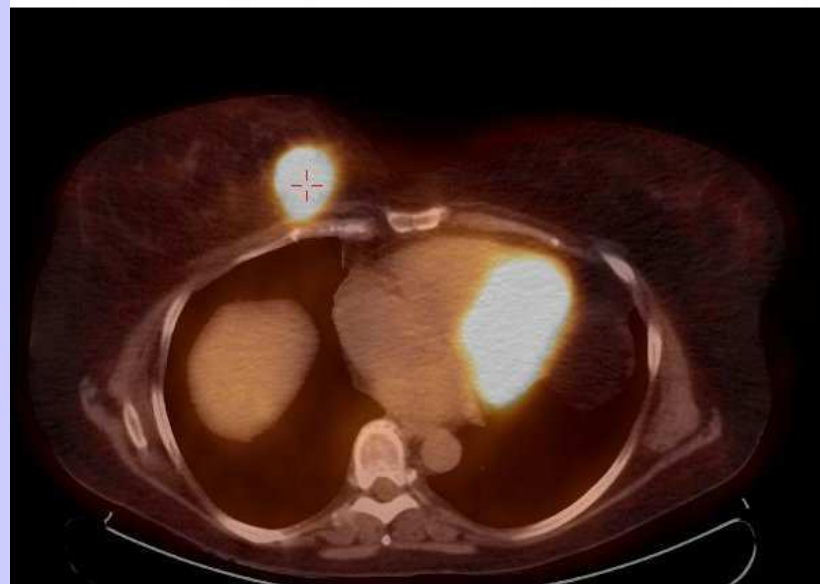
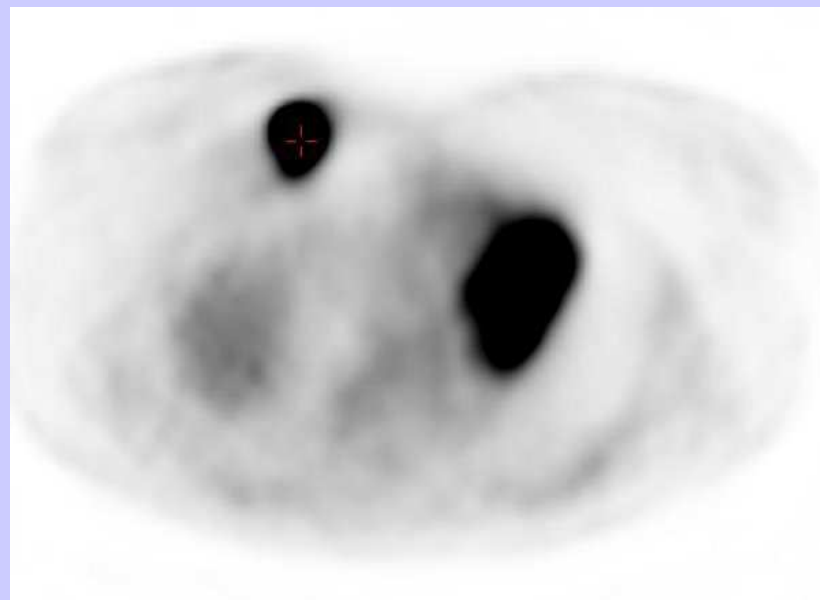
<b>Variables</b>		<b>%</b>	<b>Median SUVmax</b>	<b>P-value</b>
<b>Menopausal</b>	<b>No</b>	<b>54</b>	<b>6.7</b>	<b>0.008</b>
	<b>Yes</b>	<b>46</b>	<b>5.5</b>	
<b>T-Stage</b>	<b>T2</b>	<b>44</b>	<b>6.3</b>	<b>0.073</b>
	<b>T3</b>	<b>28</b>	<b>5.3</b>	
	<b>T4</b>	<b>28</b>	<b>7.6</b>	
<b>Node status</b>	<b>N0</b>	<b>31</b>	<b>5.7</b>	<b>0.43</b>
	<b>N1, N2, N3</b>	<b>69</b>	<b>6.6</b>	
<b>Histology</b>	<b>IDC</b>	<b>82</b>	<b>6.6</b>	<b>&lt;0.0001</b>
	<b>ILC</b>	<b>11</b>	<b>3.4</b>	
	<b>metaplastic</b>	<b>5</b>	<b>12.9</b>	

## Univariate analysis (continue)

Variables		%	Median SUVmax	P-value
<b>Histological grade</b>	<b>1-2</b>	<b>59</b>	<b>4.8</b>	<b>&lt;0.0001</b>
	<b>3</b>	<b>41</b>	<b>9.7</b>	
<b>ER</b>	<b>-</b>	<b>38</b>	<b>7.6</b>	<b>0.003</b>
	<b>+</b>	<b>62</b>	<b>5.5</b>	
<b>PR</b>	<b>-</b>	<b>64</b>	<b>7.0</b>	<b>0.003</b>
	<b>+</b>	<b>36</b>	<b>5.2</b>	
<b>c-erbB2</b>	<b>-</b>	<b>82</b>	<b>6.2</b>	<b>0.76</b>
	<b>+</b>	<b>18</b>	<b>6.7</b>	
<b>Triple negativity</b>	<b>TN</b>	<b>27</b>	<b>9.2</b>	<b>0.0005</b>
	<b>non-TN</b>	<b>73</b>	<b>5.8</b>	
<b>p53</b>	<b>Wild type</b>	<b>54</b>	<b>5.0</b>	<b>&lt;0.0001</b>
	<b>Mutated</b>	<b>46</b>	<b>7.8</b>	



**Patient 21. 53 years old, IDC, 52mm,  
SBR1, ER +++, PR +++, c-erbB2-, p53 wild type,  
SUV max: 2.5**



**Patient 10. 64 years old, IDC, 52mm,  
SBR 3, triple negative, mutated p53,  
SUV max: 12.9**

# PET and Diagnosis: Conclusions

- Low FDG uptake :
  - 1- « small » lesion (<1-2cm)
  - 2- DCIS, ILC
  - 3- Biochemical and biological tumor characteristics (low grade, low proliferation, well-differentiated oestrogene-positive tumors...)
- ⇒ **Whole body PET/CT is not indicated for breast cancer diagnosis.**
- In the future : PEM ?



**Initial Work-up**

**Stage I Breast Cancer**

# Axillary Staging

**Table 1.** Tabulated Summary of Studies Assessing Axillary Staging

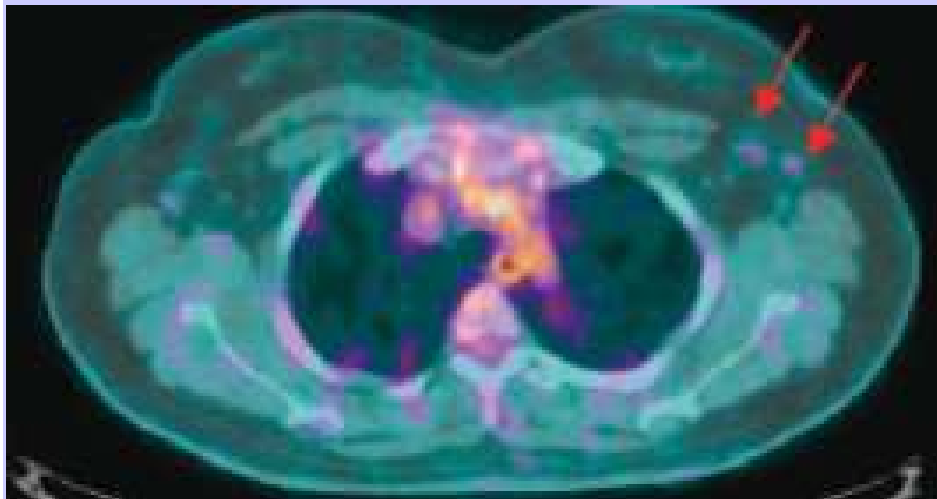
Study	Year	No. of Patients	Sensitivity (%)	Specificity (%)	Positive Predictive Value (%)	Negative Predictive Value (%)
Veronesi et al <sup>15*</sup>	2006	236	37	96	88	66
Gil-Rendo et al <sup>16*</sup>	2006	245	84.5	98.5	98.4	85.6
Chung et al <sup>18*</sup>	2006	51	60	100	—	—
Kumar et al <sup>19*</sup>	2005	80	44	95	—	—
Zornoza et al <sup>20*</sup>	2004	200	84	98	62	79
Lovrics et al <sup>21*</sup>	2004	80	40	97	90	78
Febr et al <sup>22</sup>	2004	24	20	93	67	62
Wahl et al <sup>23</sup>	2004	360	61	80	62	99
Barranger et al <sup>24*</sup>	2003	32	20	100	—	—
van der Hoeven et al <sup>25*</sup>	2002	70	25	97	63	95
Guller et al <sup>26*</sup>	2002	31	43	94	86	67
Kelemen et al <sup>27*</sup>	2002	15	20	90	50	69
Yang et al <sup>28</sup>	2001	18	50	100	—	—
Schirmeister et al <sup>17</sup>	2001	117	79	93	82	79
Greco et al <sup>14</sup>	2001	167	94	86	84	95
Yutani et al <sup>29</sup>	2000	38	50	100	100	100
Crippa et al <sup>30</sup>	1998	72	85	91	—	—
Noh et al <sup>31</sup>	1998	27	93	100	—	—
Smith et al <sup>13</sup>	1998	50	90	97	95	95
Crippa et al <sup>12</sup>	1997	82	84	85	—	—

\*These studies included a comparison with sentinel lymph node biopsy.

Hodgson et al. J Clin Oncol. 2008 Feb 10;26(5):712-20.

## **A comparative study on the value of FDG-PET and sentinel node biopsy to identify occult axillary metastases**

U. Veronesi<sup>1,3\*</sup>, C. De Cicco<sup>2</sup>, V. E. Galimberti<sup>3</sup>, J. R. Fernandez<sup>3</sup>, N. Rotmensz<sup>4</sup>, G. Viale<sup>5,6</sup>, G. Spano<sup>7</sup>, A. Luini<sup>3,6</sup>, M. Intra<sup>3</sup>, P. Veronesi<sup>3,6</sup>, A. Berrettini<sup>3</sup> & G. Paganelli<sup>2</sup>



236 patients with clinically  
negative axilla  
=> Axillary Clearance when  
Sentinel lymph nodes or PET  
were positive

=> 103 N+ (44%)

Se PET : 37%    SNB : 96%

Sp PET : 96%    SNB : 100%

## Initial Work-up: Stage I Breast Cancer

- FDG PET/CT has no indication:
  - Performances of PET/CT  $\ll$  SNB
  - Group with low risk of distant metastases and potential risk of false-positive PET-findings

**Initial Work-up**

**Locally Advanced and  
inflammatory Breast Cancer**

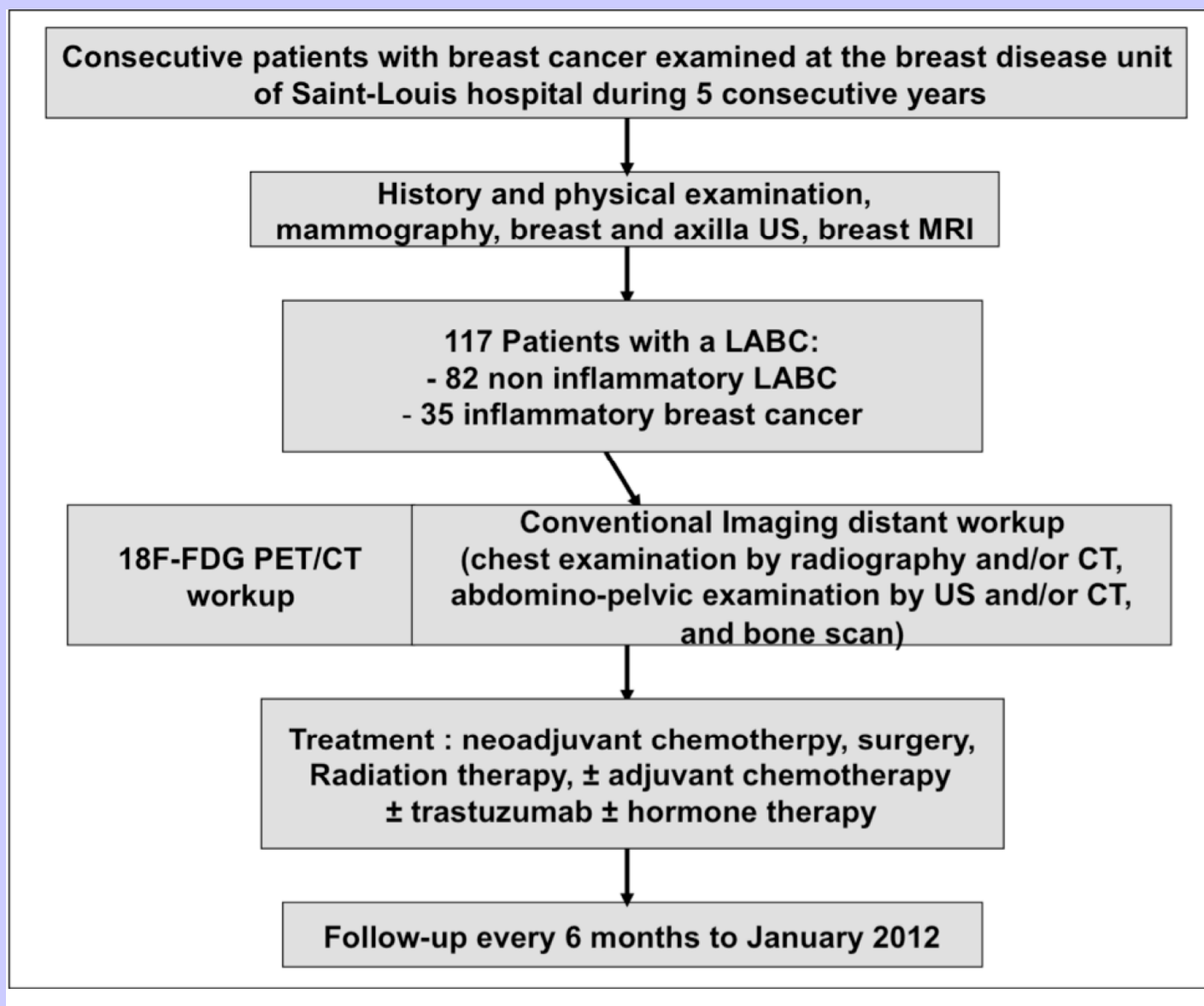
# 18F-Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography (FDG-PET/CT) Imaging in the Staging and Prognosis of Inflammatory Breast Cancer

Jean-Louis Alberini, MD<sup>1,6</sup>; Florence Lerebours, MD, PhD<sup>2</sup>; Myriam Wartski, MD<sup>1</sup>; Emmanuelle Fourme, MD<sup>3</sup>; Elise Le Stanc, MD<sup>4</sup>; E. Gontier, MD<sup>1</sup>; O. Madar, PD<sup>1</sup>; P. Cherel, MD<sup>5</sup>; and A. P. Pecking, MD<sup>1</sup>

Cancer November 1, 2009

- 62 patients with inflammatory cancer
- Primary Tumor: Se PET/CT=100%
- Extra-axillary lymph nodes evidenced in 33 patients with PET/CT vs 5 with clinical examination.
- Distant metastases detected in 18 patients (vs 6 with conventional imaging)

# Saint Louis Hospital Experience between 2006-2011



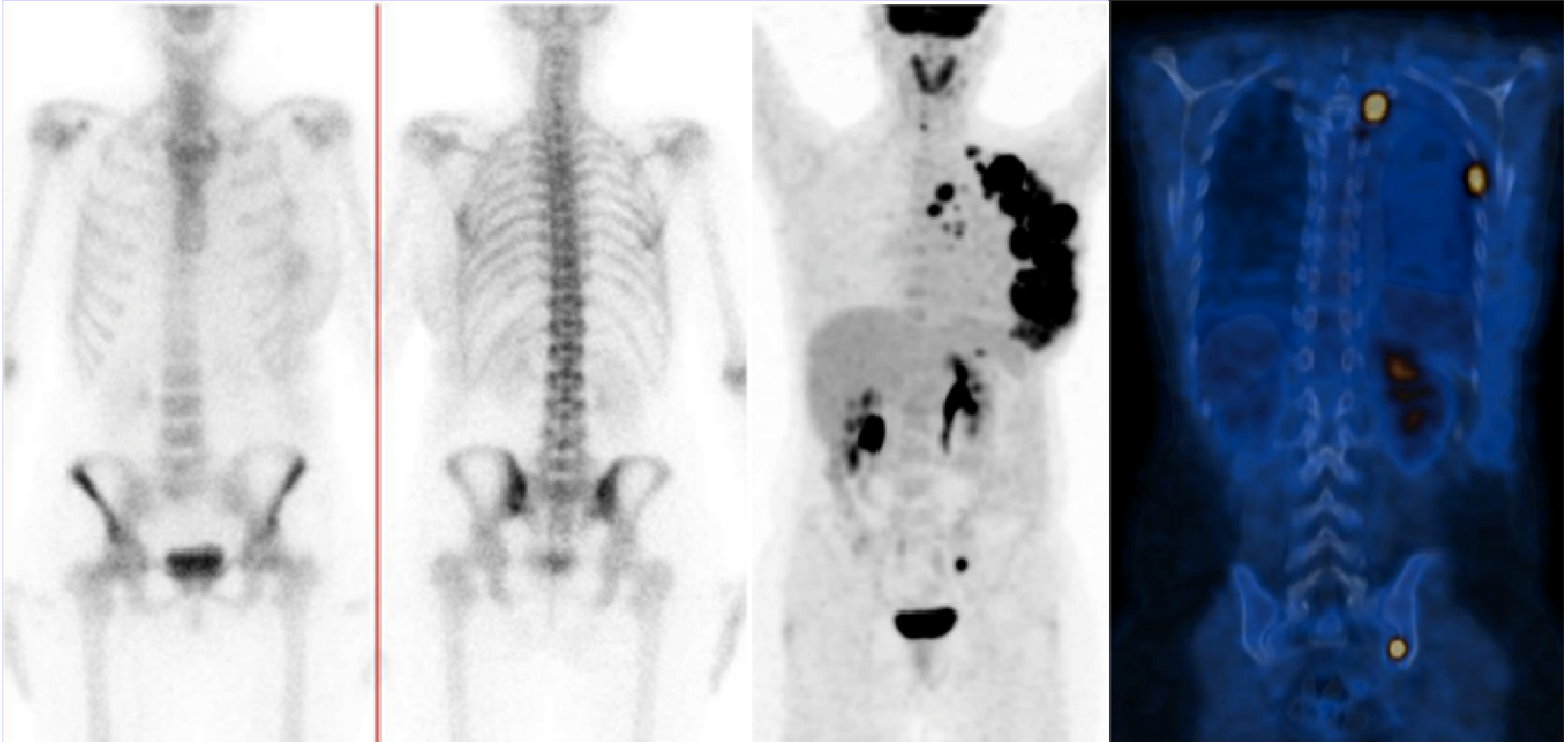
LABC was defined as a T4 primary tumor and/or a N2 or N3 lymph node disease according to the AJCC V7 classification

	Non inflammatory LABC	Inflammatory Breast Cancer	Whole population
n Patients (%)	82 (70)	35 (30)	117 (100)
Overall stage modifications* (%)	39 (48)	22 (63)	61 (52)
Lymph nodes** outside Level-I and Level-II axilla	27 (33)	22 (63)	49 (42)
- IM involvement	12 (15)	10 (28)	22 (19)
- Infra-clavicular	19 (23)	15 (43)	34 (29)
- Supra-clavicular	13 (16)	13 (37)	26 (22)
Distant metastases***	27 (33)	16 (46)	43 (37)
- Bone metastases	20 (24)	10 (29)	30 (26)
- Lung metastases	3 (4)	3 (9)	6 (5)
- Pleura	2 (2)	0	2 (2)
- Distant lymph nodes <sup>†</sup>	11 (13)	8 (23)	19 (7)
- Liver metastases	6 (7)	4 (11)	10 (8)
2 <sup>nd</sup> cancer	0	2	2

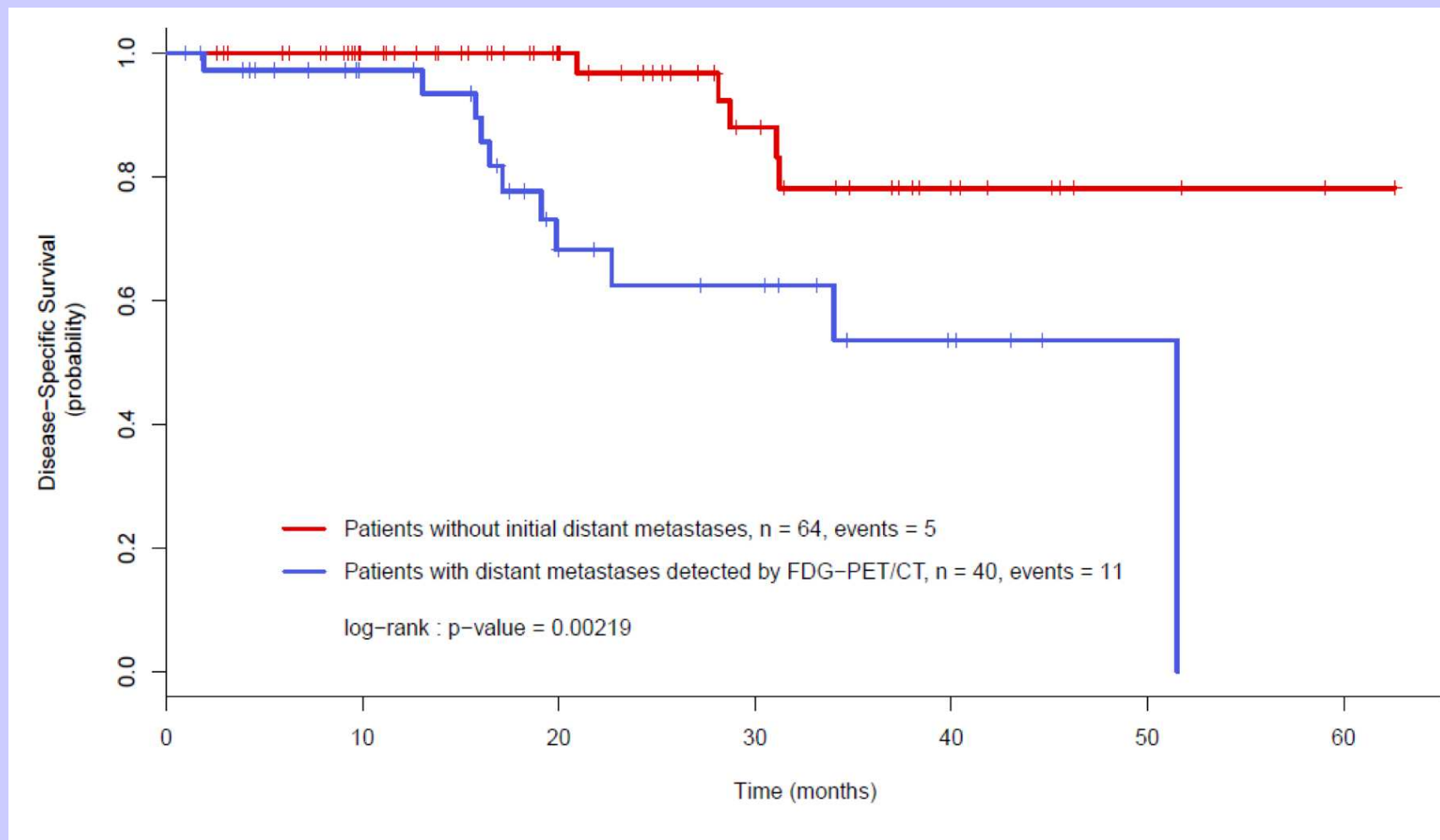
**Findings with <sup>18</sup>F<sup>18</sup>FDG-PET/CT in three different groups: non inflammatory LABC, inflammatory carcinoma, and the whole population. Results expressed per patient basis**



# Saint Louis Hospital Experience between 2006-2011



# Saint Louis Hospital Experience between 2006-2011



Kaplan-Meier Disease-specific Survival for 104 patients with recent follow-up.

**Initial Work-up**

**Is there a role for PET/CT  
between Stage I and  
Inflammatory Breast Cancer ?**

Preoperative Staging of Large Primary Breast Cancer With [<sup>18</sup>F]Fluorodeoxyglucose Positron Emission Tomography/Computed Tomography Compared With Conventional Imaging Procedures

*David Fuster, Joan Duch, Pilar Paredes, Martín Velasco, Montserrat Muñoz, Gorane Santamaria, Montserrat Fontanillas, and Francesca Pons*

- **60 Patients (T >3cm)**
- **Staging Modification for 42 % of patients**
- **Extra-axillary lymph nodes: 3 patients**
- **Distant metastases: Se PET = 100% (60% for CI)  
Sp PET = 98% (83% for CI)**

**CI: Conventional Imaging**

# The Yield of $^{18}\text{F}$ FDG-PET/CT in Patients with Clinical Stage IIA, IIB, or IIIA Breast Cancer: A Prospective Study

David Groheux<sup>1,2</sup>, Sylvie Giacchetti<sup>3</sup>, Marc Espié<sup>3</sup>, Laetitia Vercellino<sup>1</sup>, Anne-Sophie Hamy<sup>3</sup>, Marc Delord<sup>4</sup>, Nathalie Berenger<sup>1</sup>, Marie-Elisabeth Toubert<sup>1</sup>, Jean-Louis Misset<sup>3</sup>, and Elif Hindié<sup>1,2</sup>

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⇒ Study assessing the yield of PET/CT for initial work-up of 131 breast cancer patients clinically stage IIA, IIB or IIIA

Consecutive patients with breast cancer examined at the breast disease unit of Saint-Louis hospital from Mai 2006 to December 2010

History and physical examination,  
mammography,  
breast and axilla US,  
breast MRI

131 Patients classified Stages IIA-IIB-IIIA:  
- 36 Stage IIA (2 T1 N1, 34 T2 N0)  
- 48 Stage IIB (28 T2 N1, 20 T3 N0)  
- 47 Stage IIIA (9 T2 N2, 29 T3 N1 and 9 T3 N2)

<sup>18</sup>F-FDG PET/CT  
workup

Conventional Imaging workup  
(chest examination by radiography and/or CT,  
abdomino-pelvic examination by US and/or CT,  
and bone scan)

## **The Yield of 18FDG-PET/CT in Patients with Clinical Stage IIA, IIB, or IIIA Breast Cancer: A Prospective Study.**

⇒ No difference in the yield between stage IIB (T3 N0, T2 N1) and T3 N1 of stage IIIA (7/48 vs 3/29 ;  $p=0.739$ ).

⇒ Staging modifications for 5.5% (2/36) in the stage IIA group, 13% (10/77) in the stage IIB + T3 N1 group and 56% (10/18) in the stage IIIA group with N2 disease ( $P < 0.0001$ ).

⇒ Accuracy: PET-CT > Bone scan ( $P = 0.036$ ).

# Conclusions

- **Diagnosis of malignancy:** PET/CT is not indicated
- **Stage I Breast Cancer Staging:** No role for PET/CT; SNB >> FDG-PET/CT
- **Stage III locally advanced and inflammatory breast cancer:** Recognized role for PET/CT
- **Stage IIB (T2N1, T3N0) and T3 N1 breast cancer:** A new emerging role for PET/CT



- ***Thank you for your attention***