PET/CT的臨床應用

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Outline

- Introduction
- Indication
- Case presentation

Introduction

Positron Emission Tomography (PET)

- Radiopharmaceuticals: radioisotops + labeled agents
- Emission (vs. transmission)
- Functional/Molecular imaging (vs. Anatomic/Morphologic)

Radioisotops

Table 8-1 Common Positron-Emitting Nuclides Update

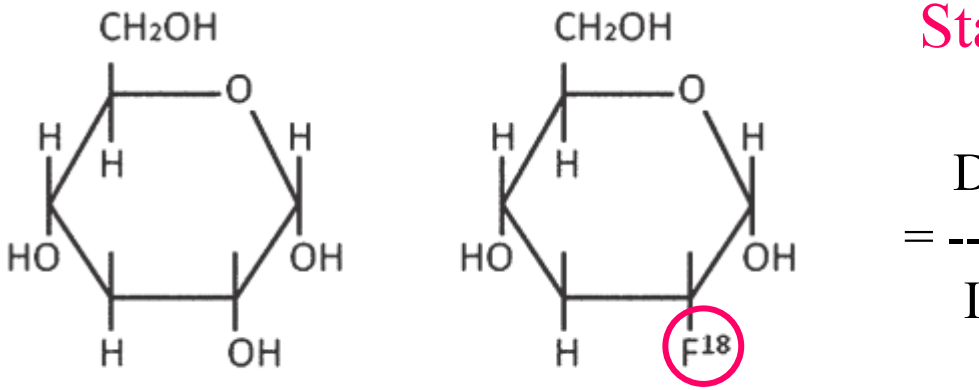
Nuclide	Half-Life (min)	Positron Yield (%)	Maximum Energy (MeV)	Method of Production
^{11}C	20.4	99.0	0.960	Cyclotron
^{13}N	9.96	100.0	1.190	Cyclotron
^{18}F	110.00	97.0	0.635	Cyclotron
^{15}O	2.04	99.9	1.720	Cyclotron
^{82}Rb	1.27	96.0	3.350	Generator
^{62}Cu	09.8	98.0	2.930	Generator
^{68}Ga	68.1	90.0	1.900	Generator

Radiopharmaceuticals

Table 8-2 Some of the Available PET Radiopharmaceuticals Update

Radiopharmaceutical	Physiologic Imaging Application
$[^{15}O]_2$	Cerebral oxygen metabolism and extraction
$H_2[^{15}O]$	Cerebral and myocardial blood flow
$C[^{15}O]$	Cerebral and myocardial blood volume
$[^{11}C]$-N-methylspiperone	Cerebral dopamine receptor binding
$[^{11}C]$-methionine	Tumor localization
$[^{11}C]$-choline	Tumor localization
$[^{18}F]$-fluorodeoxyglucose FDG	Cerebral and myocardial glucose metabolism and tumor localization
$[^{13}N]H_3$	Myocardial blood flow
$[^{11}C]$-acetate	Myocardial metabolism
$[^{82}Rb]^+$	Myocardial blood flow

F-18 FDG



Standard uptake value (SUV)

$$= \frac{\text{Decay-corrected dose / cm}^3\text{ tumor}}{\text{Injected dose / Patient Wt (gm)}}$$

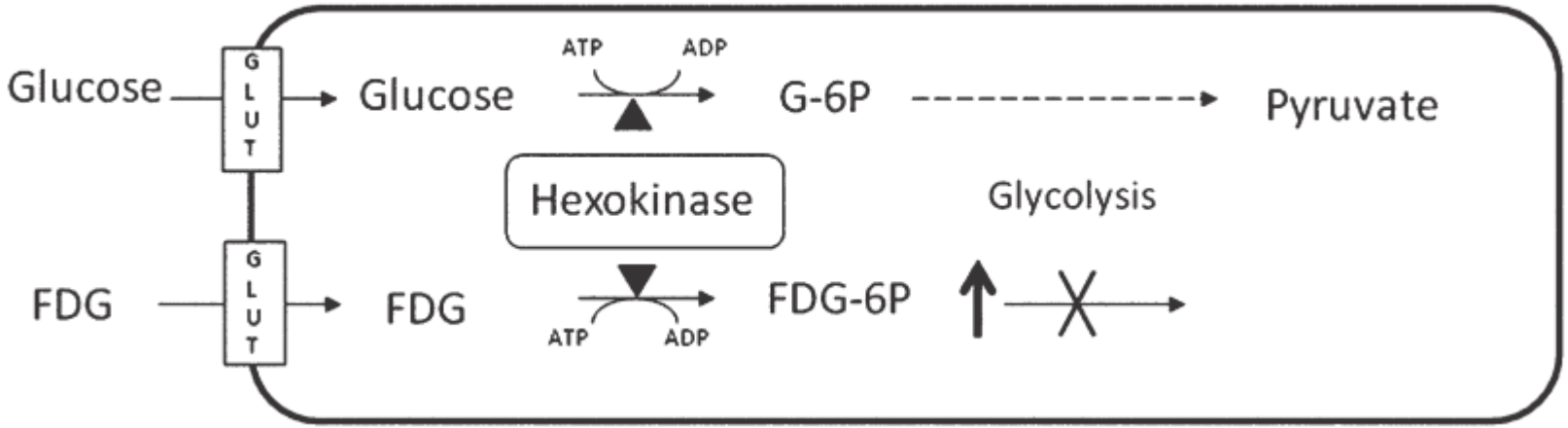


Image-guided Biopsy: What the interventional Radiologist Needs to Know about PET/CT
RadioGraphics 2012;32:1483-1501

Indication

行政院衛生署中央健康保險局
健保醫字第0990072701號

2004年納入健保給付

- **心臟學 - 存活心肌偵測**

  限LVEF≦40%以下且以(或認定)傳統心肌斷層灌注掃描無法做確切心肌存活者適用

- **神經學 - 癲癇病灶術前評估**

  持續且規則性服用三種(含)以上抗癲癇藥物治療≧一年，且近一年內平均每月有一次以上發作合併意識喪失者之術前評估

腫瘤學

1. 乳癌*
2. 淋巴癌*
3. 大腸癌
4. 直腸癌
5. 食道癌
6. 頭頸部癌(不含腦瘤)
7. 甲狀腺癌
8. 原發性肺癌
9. 黑色素癌
10. 子宮頸癌(2010)

適應症

- 分期：評估腫瘤之期別

  (乳癌&淋巴癌)

- 治療：評估腫瘤對治療之反應，擬改變治療方式時

- 懷疑復發或再分期：使用於患者已接受一階段之正統治療後，偵測疑似有復發或轉移及評估復發之程度(不得用於例行之追蹤)

✓ 經電腦斷層、核磁共振、核子醫學掃瞄等檢查仍無法分期者，或認定電腦斷層、核磁共振等檢查不足以提供足夠資訊以供治療所需者，且須於病歷中說明施行正子造影之必要性理由

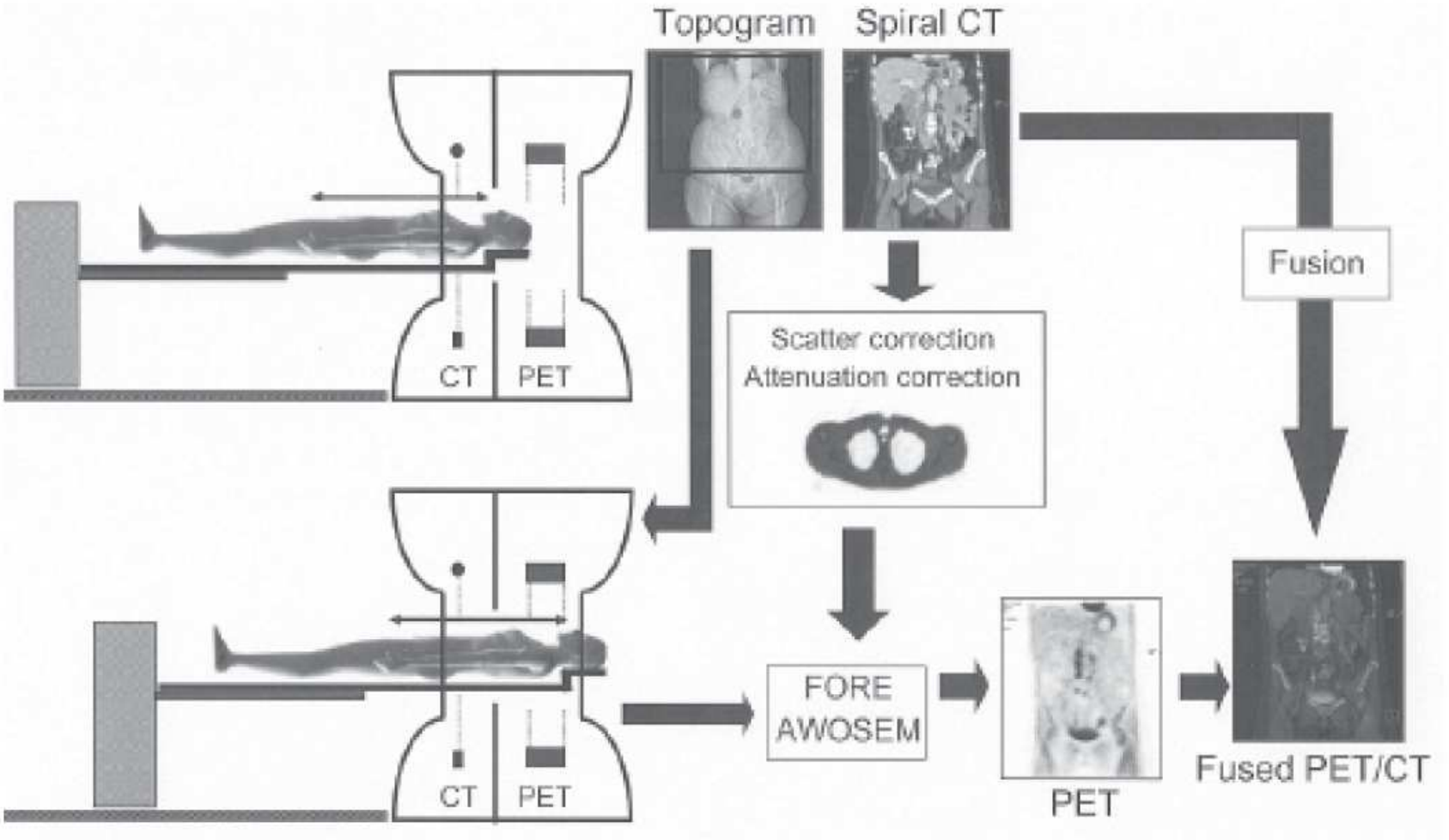
✓ 配合腫瘤治療計畫者方得以正子造影作為療效評估項目，未有後續積極處置之計畫者，不得施行

Protocol

- 報到　　至正子造影中心報到(檢查前至少禁食4小時)
- ↓
- 基本測量　　測量身高、體重、血糖值
- ↓
- 問診　　至問診室由醫師問診以了解個人及家族病史
- ↓
- 注射藥物　　至注射室注射藥物 (^{18}F-FDG)
- ↓
- 休息　　注射後靜躺放鬆休息，時間約40-60分鐘
- ↓
- 排空尿液　　掃描前先行上洗手間排空尿液
- ↓
- 檢查掃描　　至掃描室進行掃描，時間約半小時

PET/CT scanner

PET/CT scanner



Physical Principles and Technology of Clinical PET Imaging.
Ann Acad Med Singapore 2004;33:133-145

Case presentation

1. Breast cancer

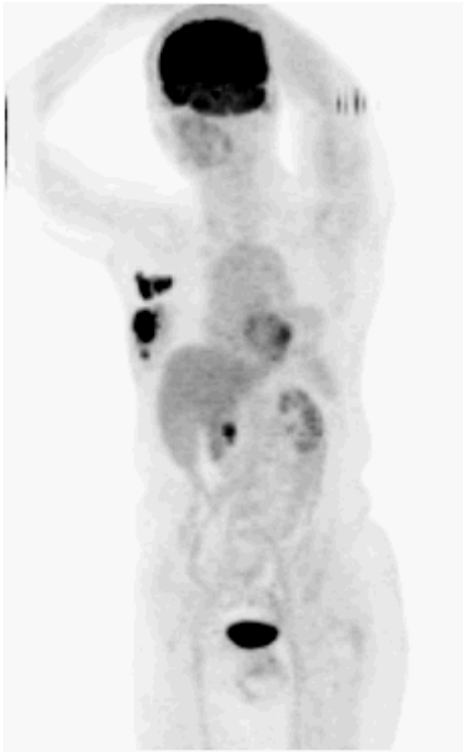
- 51 y/o woman
- Invasive ductal carcinoma of right breast

- Manopause for about 2 years
- No hormone replacement therapy

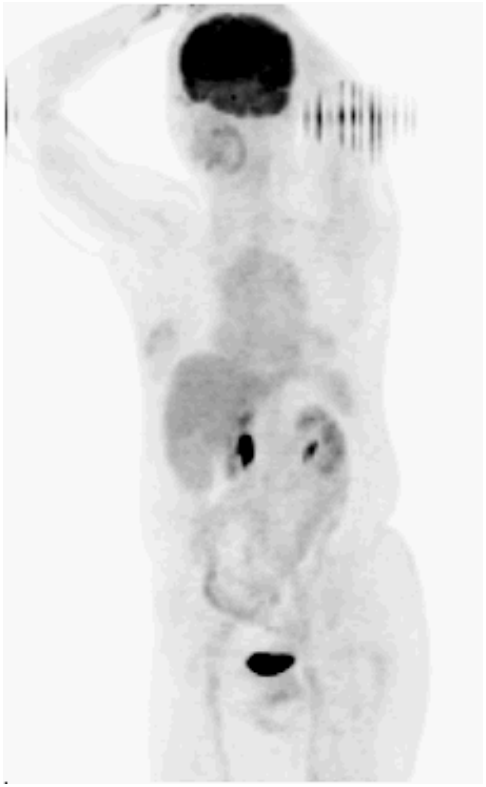
- Right breast lump noted for >2 years
- Getting enlargement, foreign body sensation over it
- PE: large mass about 7 cm, right axillary LAP (+)

1. Breast cancer

- Pre-C/T: cT3N1M0, stage IIIA
- Multifocal, 3.7 cm (SUVmax: 13.9)
- LAPs (SUVmax: 15.1)

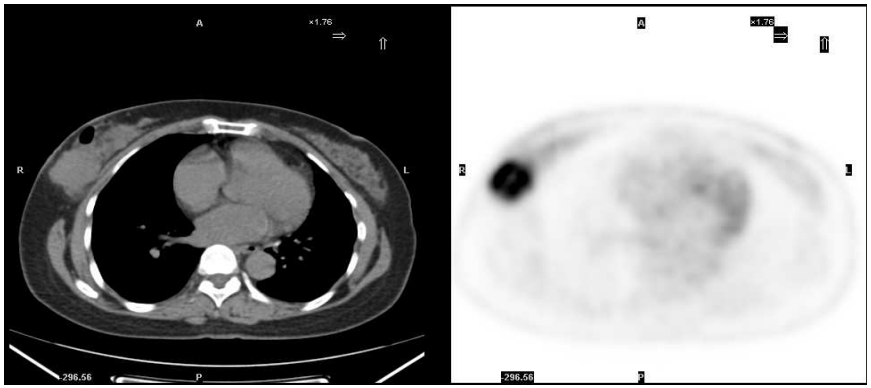


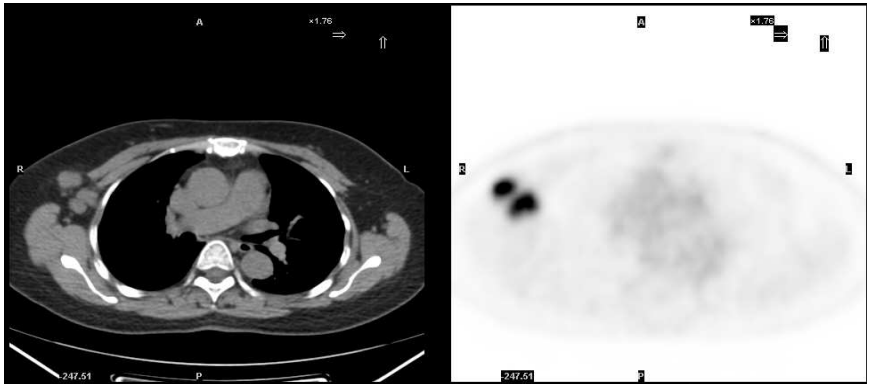
- Post-C/T:
- Shrinkage (SUVmax: 2.6)
- Almost complete remission of LAPs

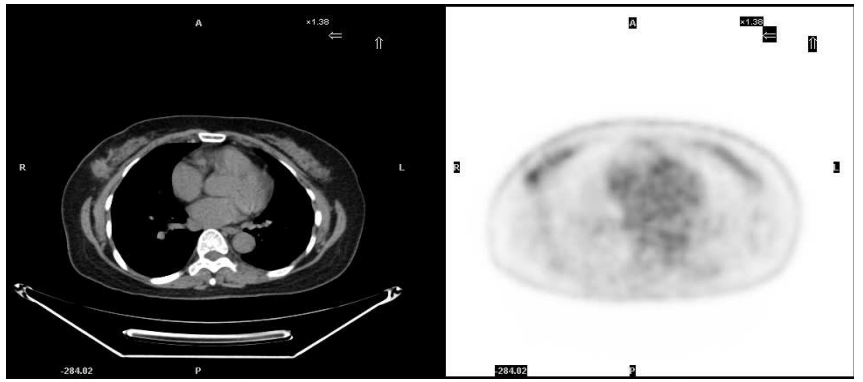


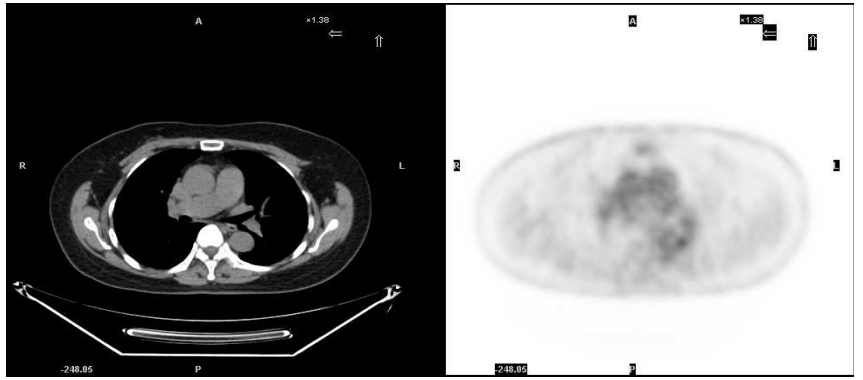
1. Breast cancer

- Pre-C/T
- Post-C/T









PLOS ONE

RESEARCH ARTICLE

Role of 2-[^{18}F] Fluoro-2-Deoxy-D-Glucose-Positron Emission Tomography/Computed Tomography in the Post-Therapy Surveillance of Breast Cancer

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Abstract

Purpose: To evaluate the usefulness of 2-[^{18}F] fluoro-2-deoxy-D-glucose-positron emission tomography/computed tomography (FDG-PET/CT) in the early detection of breast cancer tumor recurrences and its role in post-therapy surveillance.

Methods: FDG-PET/CT was performed on patients with increased serum CA 15-3 levels and/or clinical/radiologic suspicion of recurrence. A group of asymptomatic patients who underwent FDG-PET/CT in the post-therapy surveillance of breast cancer served as the controls. The results were analyzed based on the patients' histological data, other imaging modalities and/or clinical follow-up. Recurrence was defined as evidence of recurrent lesions within 12 months of the FDG-PET/CT scan.

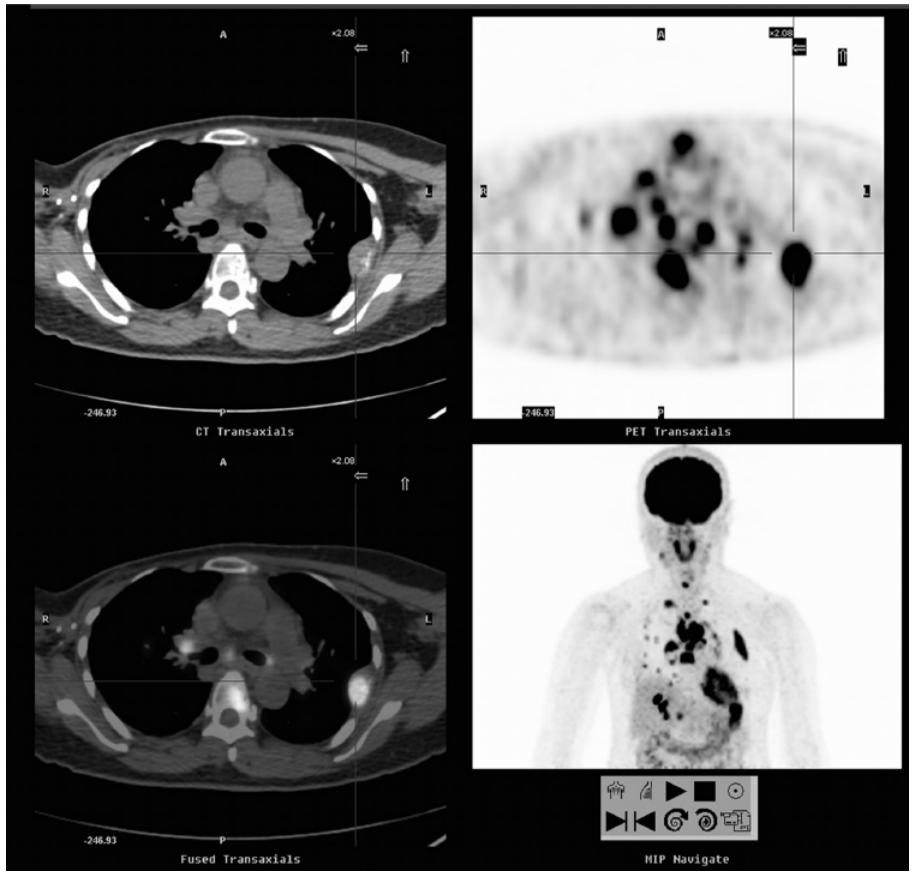
Results: Based on elevated serum CA15-3 levels (n=31) and clinical/radiologic suspicion (n=40), 71 scans were performed due to suspected recurrence, whereas 69 scans were performed for asymptomatic follow-up. The sensitivity and specificity of FDG-PET/CT were 87.5% and 87.1% in the patients with suspected recurrence and 77.8% and 91.7% in the asymptomatic patients. The positive predictive value in the patients with suspected recurrence (mainly due to elevated serum CA 15-3 levels) was higher than that in asymptomatic patients (P=0.013). Recurrences

Table 4. Effectiveness of CA 15-3 and FDG-PET/CT in detecting recurrent breast cancer in patients with suspected recurrence and in asymptomatic patients.

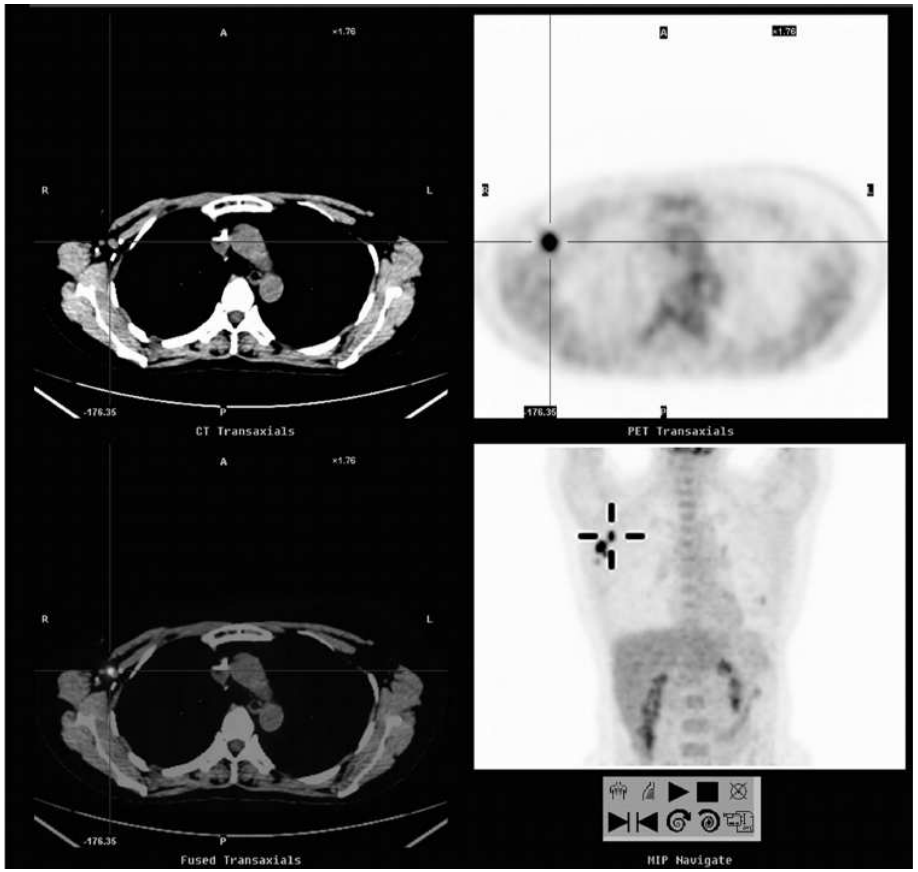
	TP	FP	TN	FN	Sensitivity	Specificity	PPV	NPV	Accuracy
Serum CA 15-3									
Suspected recurrence (n=71)	19	12	19	21	47.5%*	61.3%†	61.3%*	47.5%*	53.5%*
Group 1 (n=31)	19	12	0	0					
Group 2 (n=40)	0	0	19	21					
Asymptomatic (n=69)	0	0	60	9					
Total (n=140)	19	12	79	30	38.8%	86.8%	61.3%	72.5%	70%
FDG-PET/CT									
Suspected recurrence (n=71)	35	4	27	5	87.5%*	87.1%†	89.7%*§	84.4%*	87.3%*
Group 1 (n=31)	18	1	11	1	94.7%	91.7%	94.7%‖	91.7%	93.5%
Group 2 (n=40)	17	3	16	4	80.9%	84.2%	85%	80%	82.5%
Asymptomatic (n=69)	7	5	55	2	77.8%	91.7%	58.3%§‖	96.5%	89.9%
Total (n=140)	42	9	82	7	85.7%	90.1%	82.4%	92.1%	88.6%

FN, false negative; FP, false positive; PPV, positive predictive value, NPV, negative predictive value, TN, true negative; TP, true positive; Group 1, patients with elevated serum CA 15-3 levels>31.3 U/ml; Group 2, patients with clinical/radiologic suspicions of recurrences without serum CA 15-3 level increases;
*, $P<0.01$ FDG-PET/CT vs. serum CA 15-3;
†, $P=0.04$ FDG-PET/CT vs. serum CA 15-3;
§, $P=0.013$ suspected recurrence vs. asymptomatic;
‖, $P=0.012$ Group 1 vs. asymptomatic.

IDC of right breast, stage I
CA-153: 44.7 U/ml



IDC of right breast, stage IIIA
Asymptomatic follow-up



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MEDICAL IMAGING—ORIGINAL ARTICLE

FDG-PET/CT detection of very early breast cancer in women with breast microcalcification lesions found in mammography screening

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Abstract

Introduction: To assess the efficacy of positron emission tomography/computed tomography with the glucose analogue 2-[^{18}F]fluoro-2-deoxy-D-glucose (FDG-PET/CT) in Taiwanese women with early breast cancer detected by mammography screening.
Methods: Dual-time-point imaging of whole-body supine and breast prone scans using FDG-PET/CT were performed sequentially in the pre-operative stage.
Results: A total of 11,849 patients underwent screening mammography, of whom 1,209 (10.2%) displayed positive results. After further investigation, 54 patients underwent FDG-PET/CT. Post-operative pathology examinations

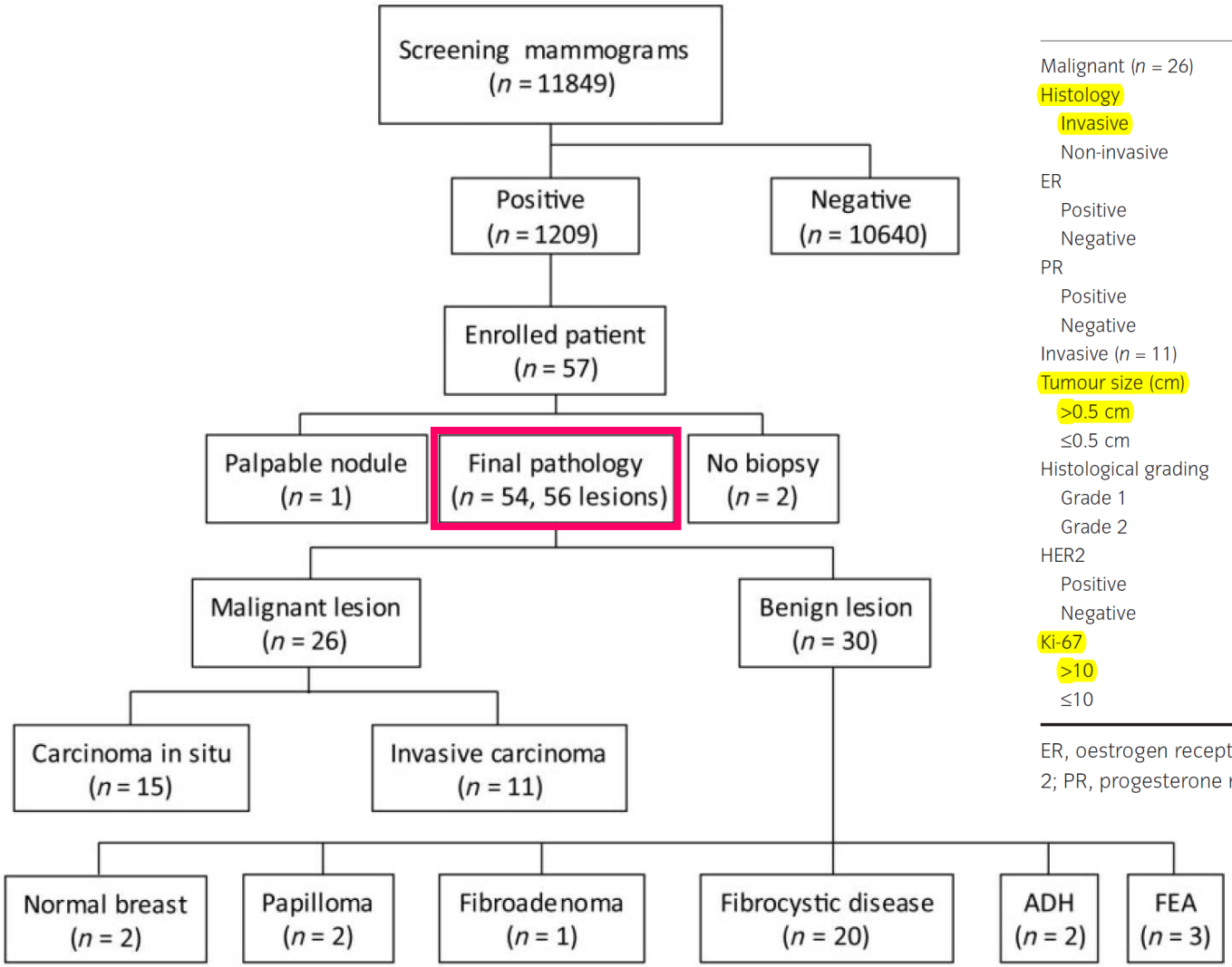


Table 3. Comparison of PET findings and breast-tumour characteristics

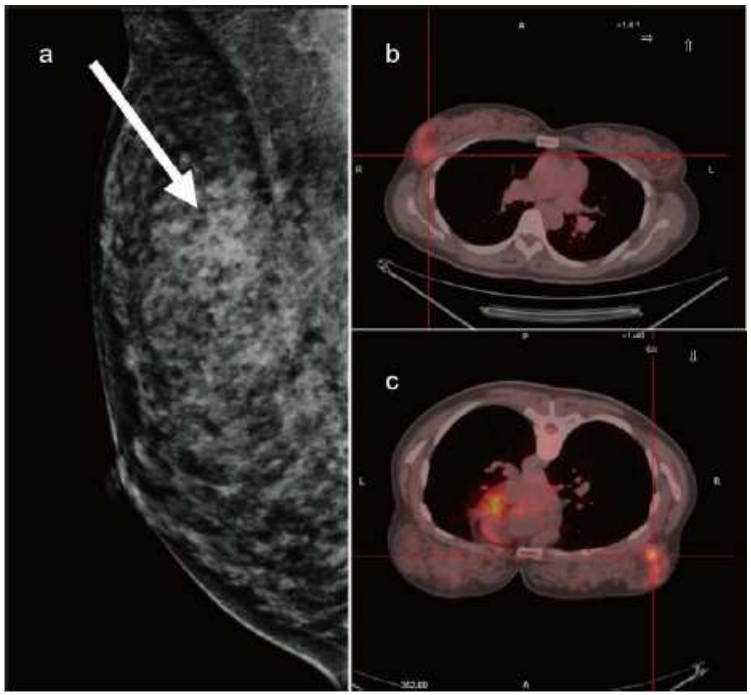
Variables	No. (%)	PET-positive, no. (%)	*P*-value
Malignant (*n* = 26)			
Histology			**0.006**
Invasive	11 (42)	9 (82)	
Non-invasive	15 (58)	4 (27)	
ER			0.619
Positive	21 (81)	10 (48)	
Negative	5 (19)	3 (60)	
PR			0.658
Positive	19 (73)	10 (53)	
Negative	7 (27)	3 (42)	
Invasive (*n* = 11)			
Tumour size (cm)			**0.039**
>0.5 cm	7 (64)	7 (100)	
≤0.5 cm	4 (36)	2 (50)	
Histological grading			0.087
Grade 1	5 (45)	3 (60)	
Grade 2	6 (55)	6 (100)	
HER2			0.425
Positive	3 (27)	2 (74)	
Negative	8 (73)	7 (86)	
Ki-67			**0.011**
>10	8 (73)	8 (100)	
≤10	3 (27)	1 (33)	

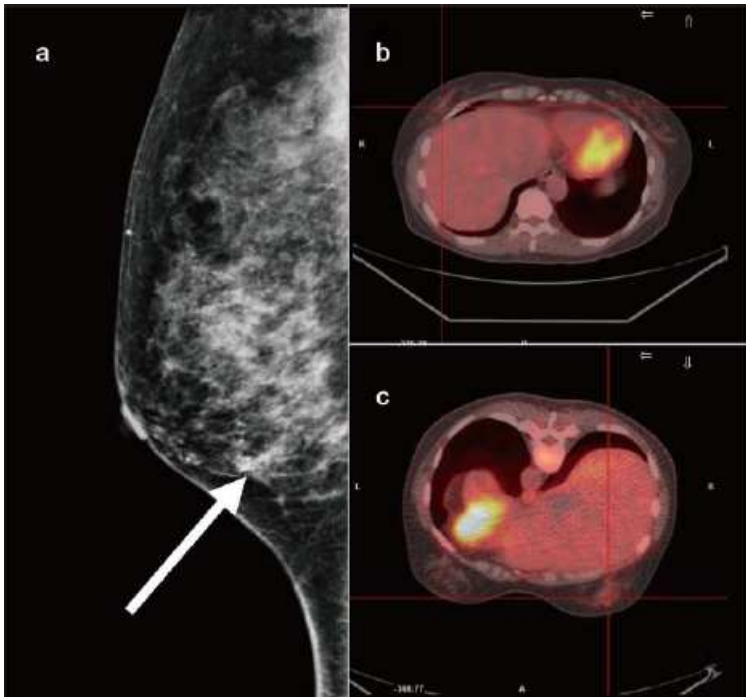
ER, oestrogen receptor; HER2, human epidermal growth factor receptor 2; PR, progesterone receptor.

Table 2. Performance of whole-body supine and breast prone FDG-PET/CT imaging for the detection of primary breast cancer

FDG-PET/CT (*n* = 56 lesions)	TP (n)	FP (n)	TN (n)	FN (n)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
Whole-body supine	12	0	30	14	46.2	100	100	68.2	75.0
Invasive	9			2	81.8*				
Non-invasive	3			12	20.0*				
Breast prone	13	0	30	13	50.0	100	100	69.8	76.8
Invasive	9			2	81.8†				
Non-invasive	4			11	26.7†				

*P = 0.002 invasive vs. non-invasive; †P = 0.006 invasive vs. non-invasive. FN, false negative; FP, false positive; NPV, negative predictive value; PPV, positive predictive value; TN, true negative; TP, true positive.



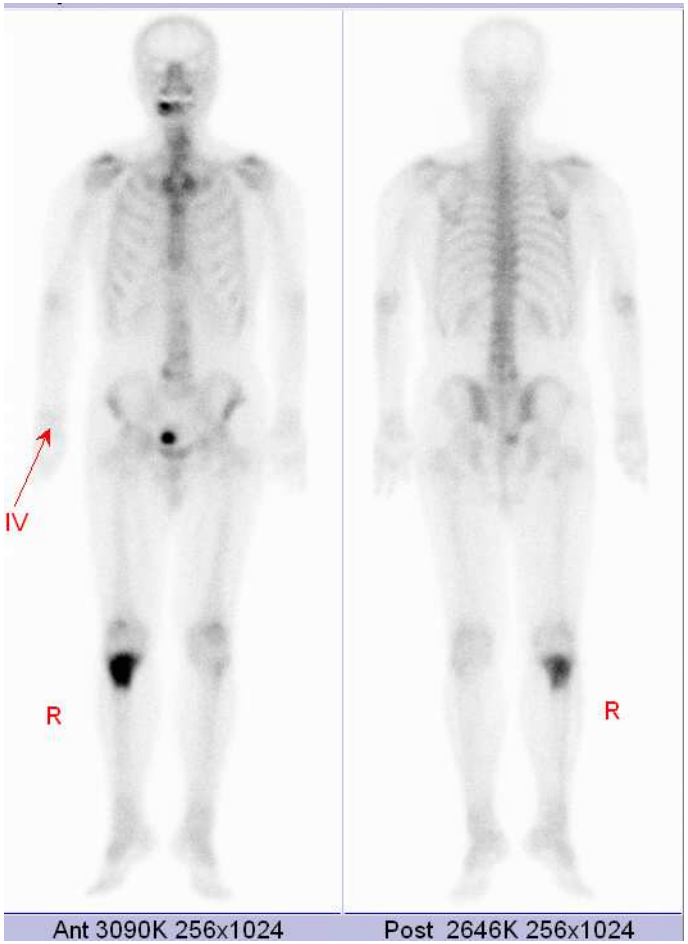


2. Lymphoma

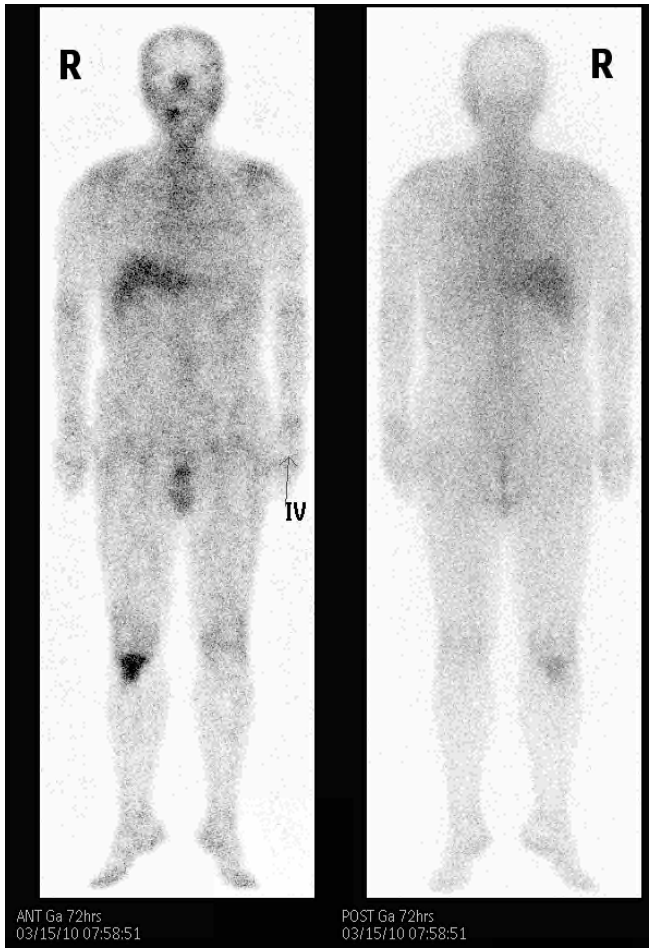
- 76 y/o man
- Peripheral cutaneous T-cell lymphoma over right temporal area, left flank and buttock skin s/p R/T
- A palpable small nodule over left upper arm
- Swelling and painful disability of right knee, traumatic insult months ago
- Bone scan and gallium scan (+) over right upper tibia

2. Lymphoma

- Bone scan

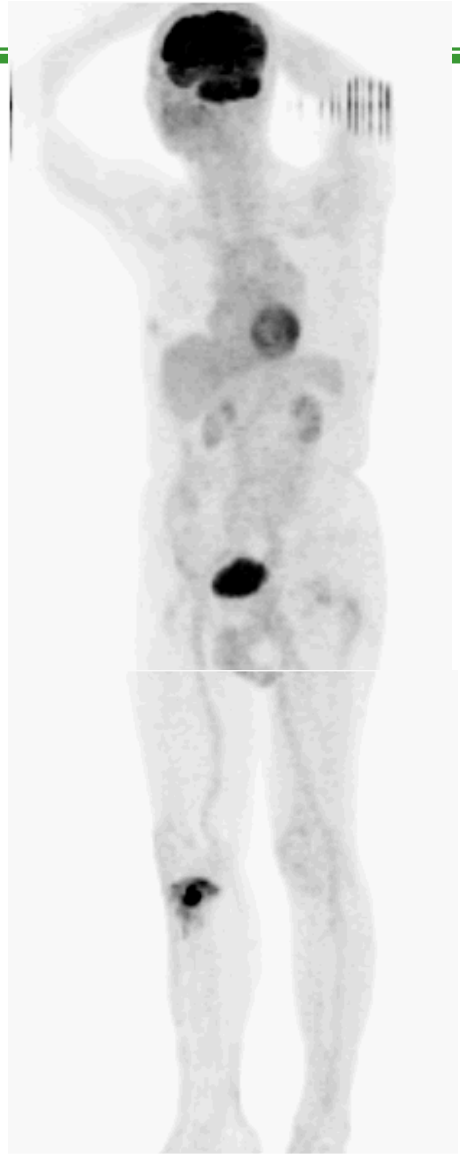


- Gallium scan

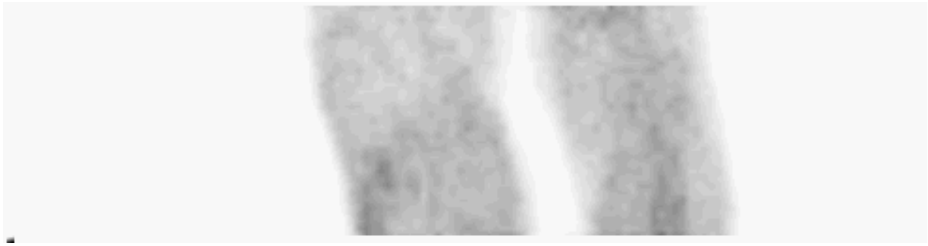


2. Lymphoma

- Pre-R/T:
- SUVmax
- 14.7-19.8

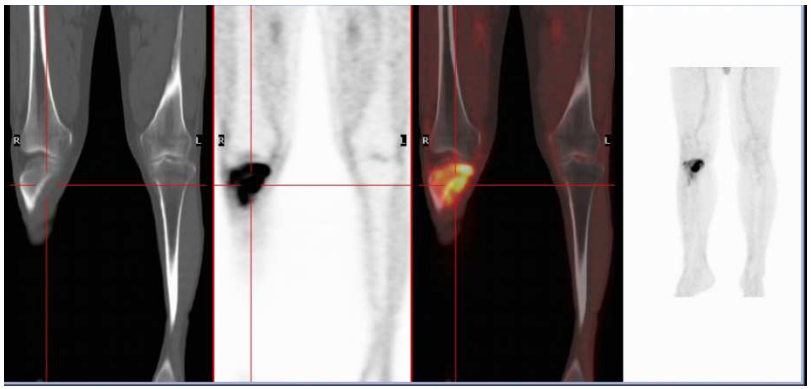


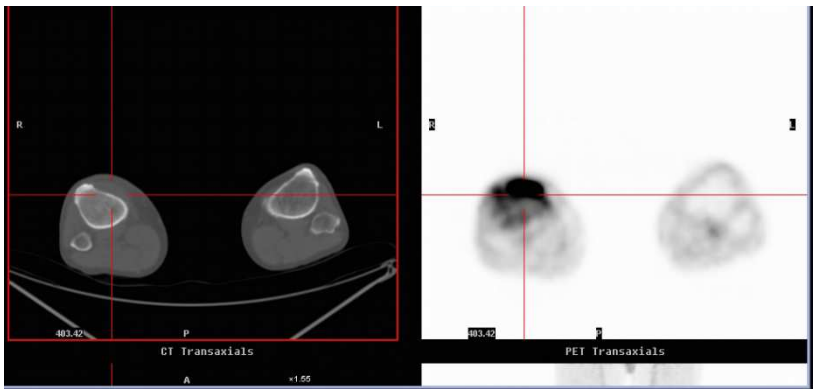
- Post-R/T:
- SUVmax
- 1.5



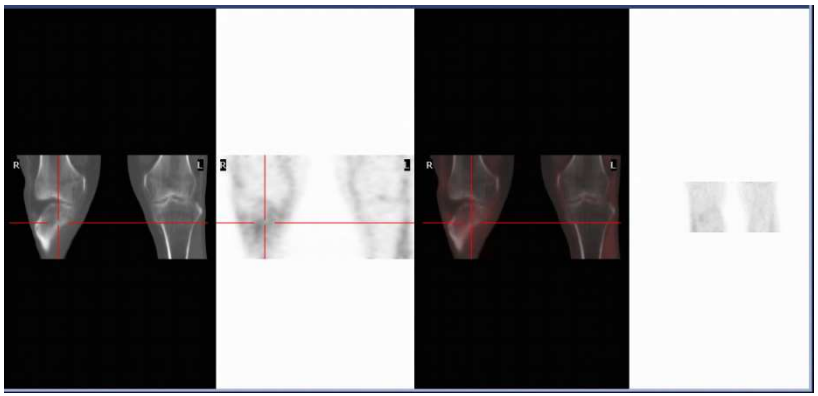
2. Lymphoma

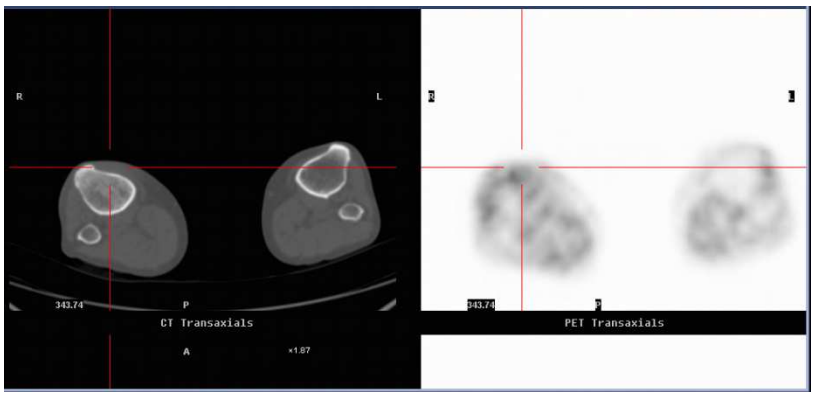
- Pre-R/T





- Post-R/T





2. Lymphoma

- Staging
- Treatment response evaluation
  - PET after completion of C/T (DDx: active tumor, fibrosis, necrosis)
  - PET after 1-3 cycles of C/T
  - PET before autologous stem cell transplantation
  - PET during or after R/T (6 months, recurrence) or radioimmunotherapy
- Restaging and surveillance

PET 5-POINT SCALE (DEAUVILLE CRITERIA)

Score	PET/CT scan result
1	No uptake
2	Uptake ≤ mediastinum
3	Uptake > mediastinum but ≤ liver
4	Uptake moderately higher than liver
5	Uptake markedly higher than liver and/or new lesions
X	New areas of uptake unlikely to be related to lymphoma

FDG PET in the Evaluation of Treatment for Lymphoma: Clinical Usefulness and Pitfalls
RadioGraphics 2005;25:191-207

3. Colon/rectal cancer

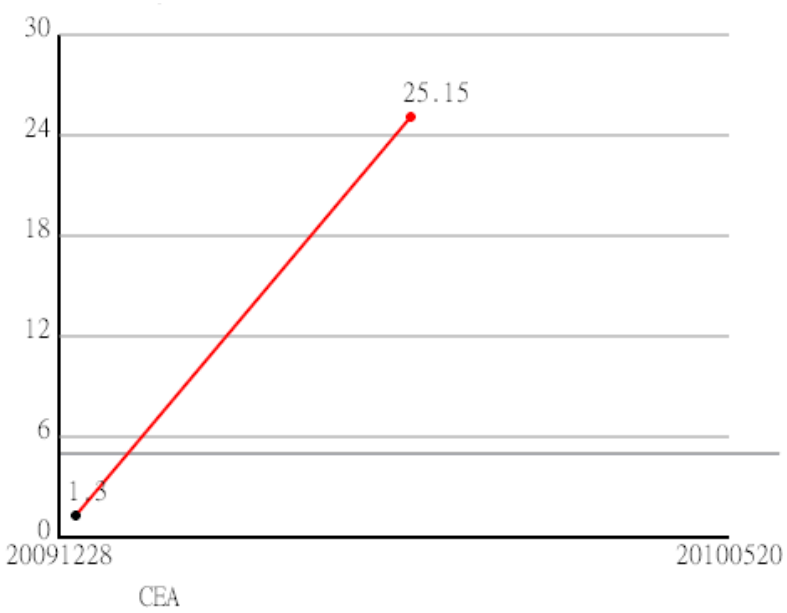
- 70 y/o man
- Adenocarcinoma of rectum

- Bloody stool off and on for weeks, bowel habit change (+), tenesmus (+)
- APR (T3N2M0, stage IIIB, Duke's) and CCRT

- Elevation of CEA level (25.15 ng/ml)
- Abdominal CT (-)

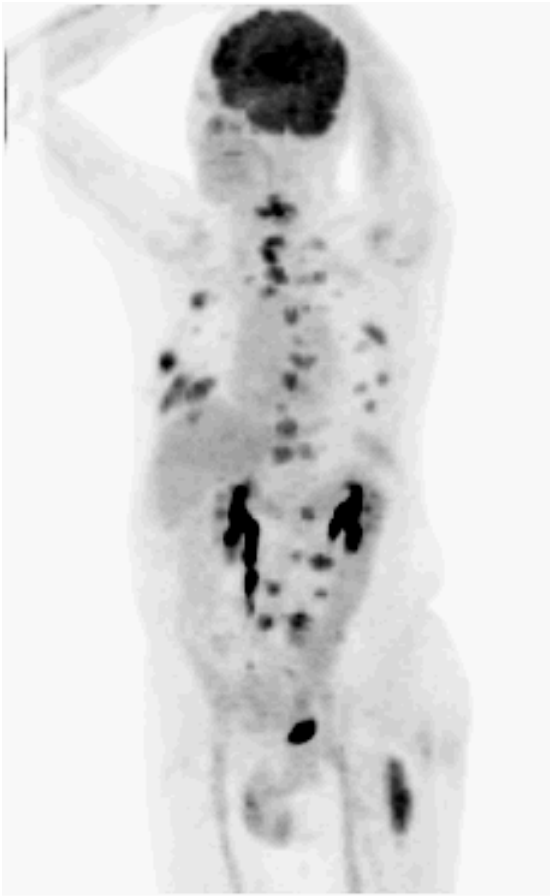
3-4. Colon/rectal cancer

- CEA ↑ , Abdominal CT (-)



- Multiple osteolytic bony metastases

→ C/T with FOLFIRI



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Detection of Resectable Recurrences in Colorectal Cancer Patients with 2-[^{18}F]Fluoro-2-Deoxy-D-Glucose-Positron Emission Tomography/Computed Tomography

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Abstract

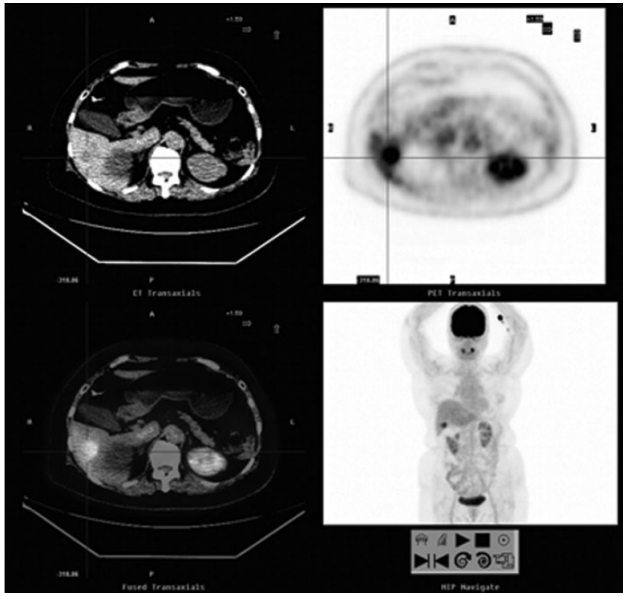
Purpose: To evaluate the usefulness of 2-[^{18}F]fluoro-2-deoxy-D-glucose-positron emission tomography/computed tomography (FDG-PET/CT) in the early detection of resectable recurrences of colorectal cancer (CRC) and the impacts on the clinical disease management.
Methods: FDG-PET/CT was performed on patients with elevated serum carcinoembryonic antigen (CEA) levels >5 ng/mL (Group 1) or suspicious recurrences without rise in serum CEA levels (Group 2). The results were analyzed on the basis of histological data, disease progression, and/or clinical follow-up. Recurrence was defined as evidence of recurrent lesions within 6 months of the FDG-PET/CT scan. Resectable recurrences and changes in management were calculated based on medical records.
Results: In our study, 128 consecutive FDG-PET/CT analyses ($n=49$ in Group 1 and $n=79$ in Group 2) were performed on 96 recruited patients. Recurrences were proven in 63. The overall sensitivity, specificity, and accuracy of FDG-PET/CT were 98.4%, 89.2%, and 93.8%, respectively, and were 100%, 88.9%, and 95.9% in Group 1 and 96.9% and 89.4% and 92.4% in Group 2, respectively. Surgical resections were performed in 38.7%

Table 4. Performance of Serum Carcinoembryonic Antigen Levels and FDG-PET/CT in the Detection of Recurrent Cancer

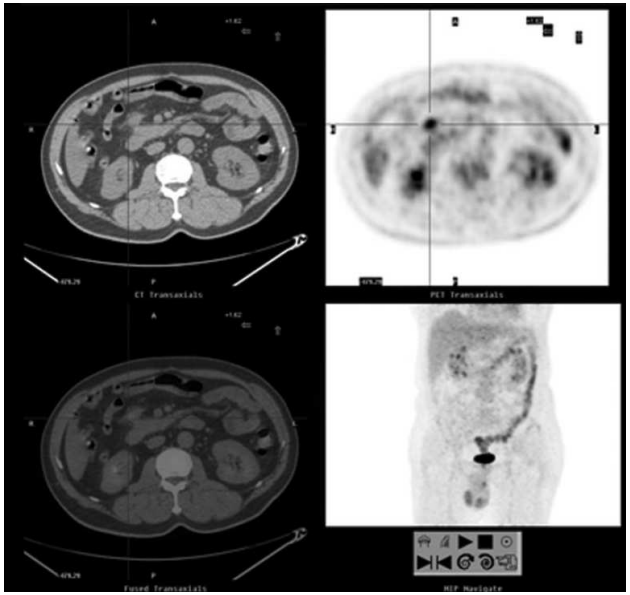
	TP	*FP*	*TN*	*FN*	*Sensitivity*	*Specificity*	*Accuracy*
Serum CEA ($n=128$)	30	18	47	32	48.4%[a]	72.3%[b]	60.2%[a]
FDG-PET/CT ($n=128$)	62	7	58	1	98.4%[a]	89.2%[b]	93.8%[a]
Group 1 FDG-PET/CT ($n=49$)	31	2	16	0	100%	88.9%	95.9%
Group 2 FDG-PET/CT ($n=79$)	31	5	42	1	96.9%	89.4%	92.4%

[a] $p<0.001$ FDG-PET/CT versus serum CEA.
[b] $p=0.025$ FDG-PET/CT versus serum CEA.
FN, false negative; FP, false positive; TN, true negative; TP, true positive.

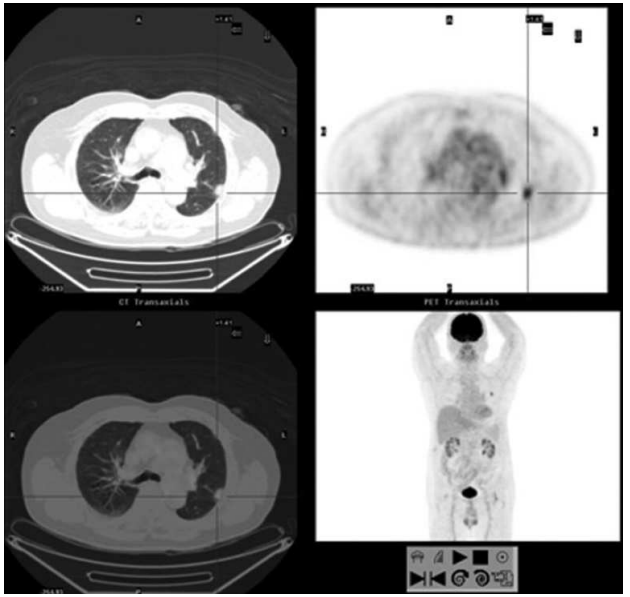
Group 1: CEA >5 ng/mL
Group 2: normal CEA



D-S colon, stage IIIB
Normal CEA



T-colon, stage IIIB
Elevated CEA: 7.7 ng/mL



Rectal cancer, stage IIA
Normal CEA: 2.9 ng/mL

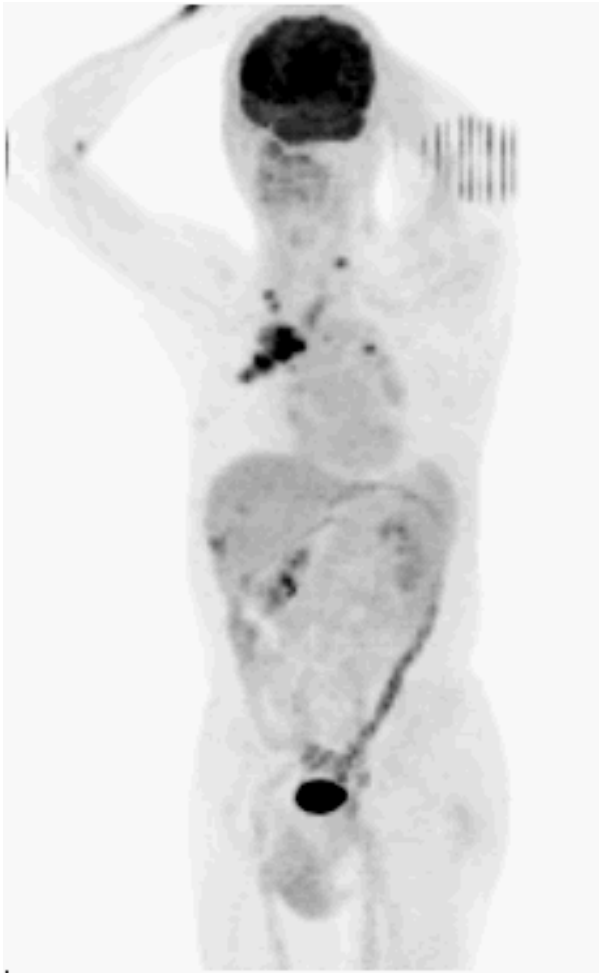
5. Esophageal cancer

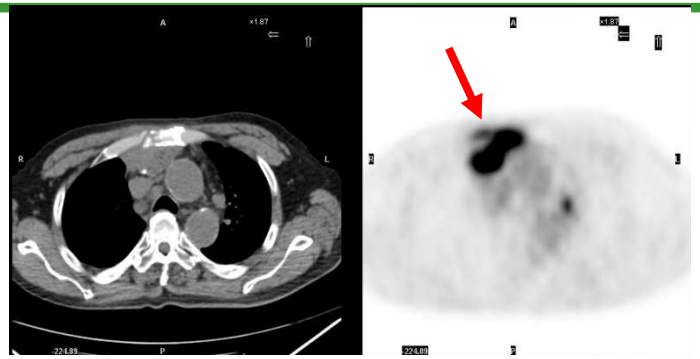
- 71 y/o man
- Squamous cell carcinoma of lower-third esophagus

- Dysphagia for 1+ years, poor appetite, difficult swallowing and epigastric pain after oral intake
- PES: a cauliflower mass over 33~36 from incisior with central ulcer
- Subtotal esophagectomy + gastric tube reconstruction + feeding jejunostomy with pericardiac LN metastasis (pT2N1M0, stage II) and C/T Cisplatin + 5-FU *4 courses

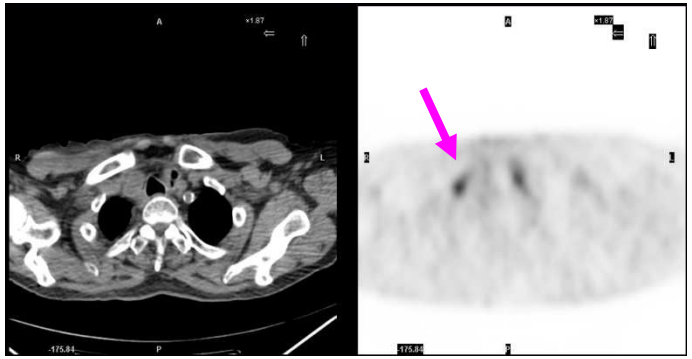
- Swallowing disturbance, body weight loss and hoarseness
- Chest CT: right paratracheal LN (+)
- R/T and C/T with Cisplatin + 5-FU *4 courses

5. Esophageal cancer

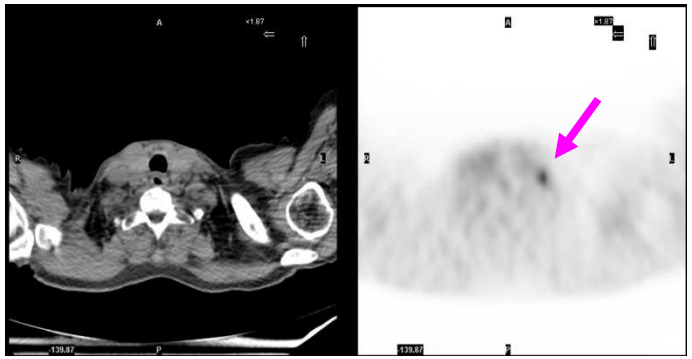




Chest wall
(SUVmax: 10.8)



Multiple LNs
(SUVmax: 5.8)



→C/T with
Carboplastin +
Etoposide

6. Head & neck cancer

- 45 y/o woman
- NPC

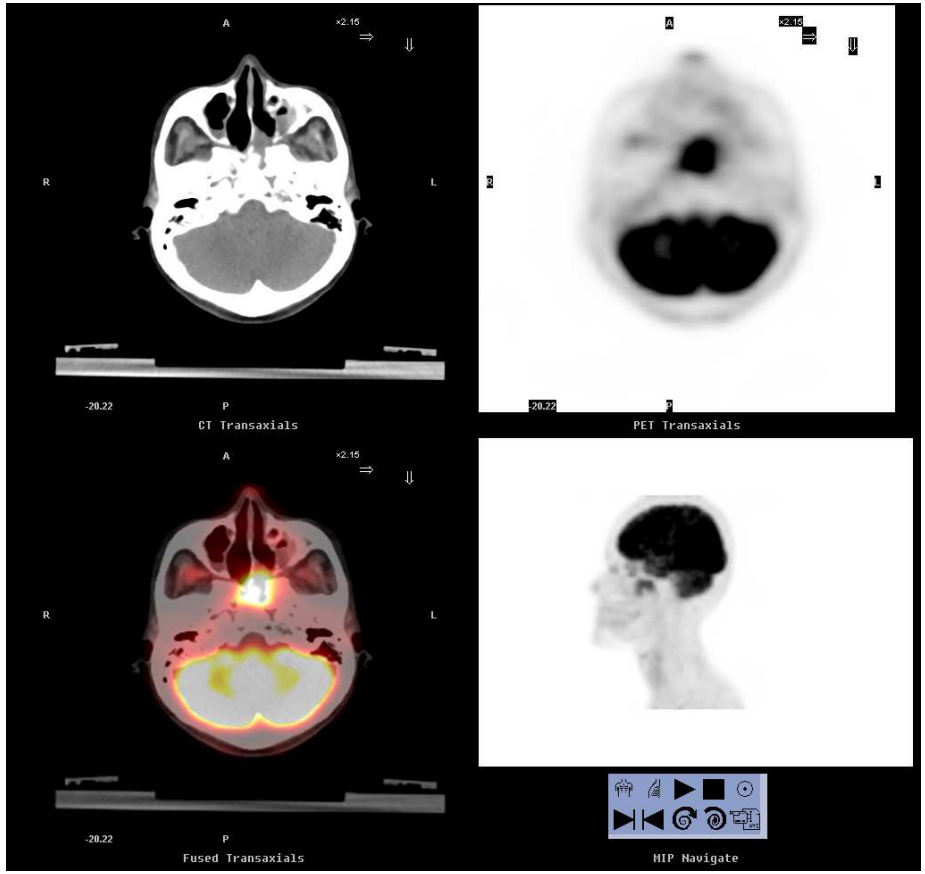
- Nasal obstruction, intermittent nasal bleeding, headache for months
- Nasopharyngoscopy: mass lesion over nasopharynx
- T4N2M0, stage IV (MRI), CCRT

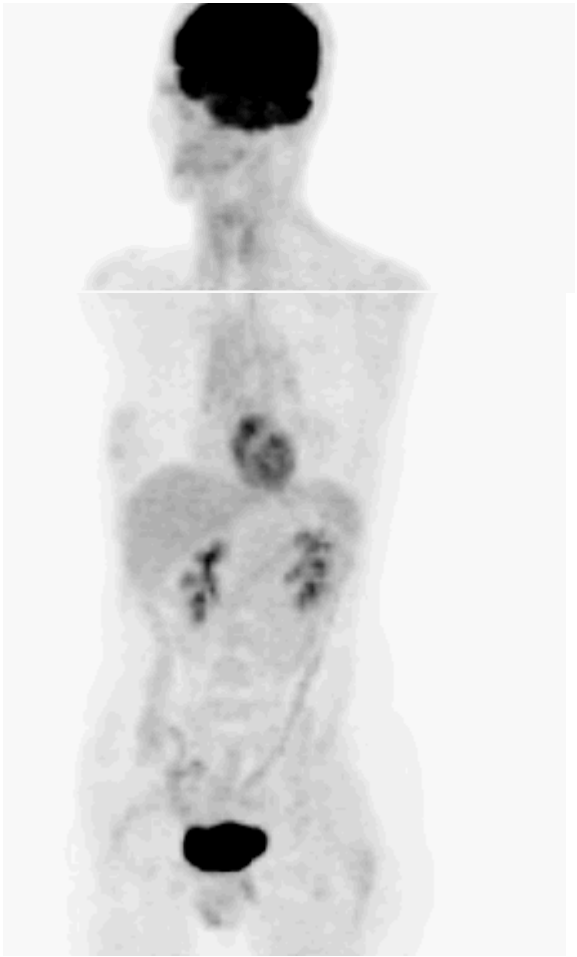
- MRI: increased soft tissue and enhancement over nasopharynx and posterior nasal cavity, DDx: tumor recurrence or post-treatment change

6. Head & neck cancer

- SUVmax: 7.6

→ Re-R/T





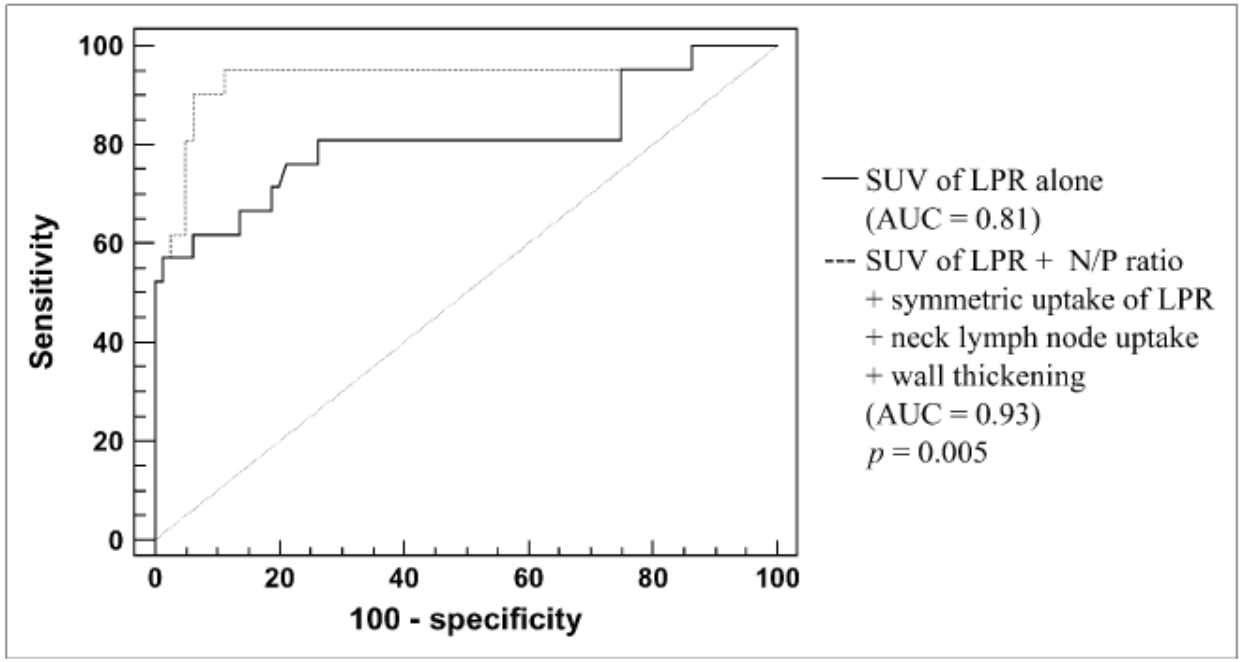


FIGURE 5. Receiver-operating-characteristic curve and AUC for differentiating benign from malignant lesions in LPR of nasopharynx. When combination of SUV, LPR of N/P ratio, symmetric uptake of LPR, cervical lymph node uptake, and wall thickening of LPR was considered, AUC improved to 0.932 ± 0.042 (95% CI, 0.86–0.98), with 90.4% sensitivity and 93.8% specificity.

- SUV of LPR less than 3.9 + N/P ratio less than 1.5
- Symmetric uptake in the LPR
- Detectable lymph node uptake
- Normal or symmetric wall thickening

Utility of F-18 FDG PET/CT Uptake Patterns in Waldeyer's Ring for Differentiating Benign from Malignant lesions in Lateral Pharyngeal Recess of Nasopharynx *J Nucl Med 2007;48:8-14*

Table 2 Results of PET/CT and conventional imaging in 111 NPC patients for distant malignancies

	FN	TP	TN	FP	Sensitivity (%)	Specificity (%)	Accuracy (%)	PPV (%)	NPV (%)
Patient basis									
Conventional	12	4	94	1	25.0 (7.3–52.4)	98.9 (94.3–100.0)	88.3 (80.8–93.6)	80.0 (28.4–99.5)	88.7 (81.1–94.0)
PET/CT	3	13	92	3	81.3 (54.4–96.0)	96.8 (91.0–99.3)	94.6 (88.6–98.0)	81.3 (54.4–96.0)	96.8 (91.0–99.3)
Location basis									
Lung									
Conventional	6	1	104	0	14.3 (0.4–57.9)	100	94.6 (88.6–98.0)	100	94.5 (88.5–98.0)
PET/CT	1	6	103	1	85.7 (42.1–99.6)	99.0 (94.8–100.0)	98.2 (93.6–99.8)	85.7 (42.1–99.6)	99.0 (94.8–100.0)
Mediastinal node									
Conventional	2	1	108	0	33.3 (0.8–90.6)	100	98.2 (93.6–99.8)	100	98.2 (93.6–99.8)
PET/CT	0	3	107	1	100	99.1 (94.9–100.0)	99.1 (95.1–100.0)	75.0 (19.4–99.4)	100
Liver									
Conventional	2	0	109	0	0	100	98.2 (93.6–99.8)	–	98.2 (93.6–99.8)
PET/CT	1	1	109	0	50.0 (1.3–98.7)	100	99.1 (95.1–100.0)	100	99.1 (95.0–100.0)
Bone									
Conventional	7	2	101	1	22.2 (2.8–60.0)	99.0 (94.7–100.0)	92.8 (86.3–96.8)	66.7 (9.4–99.2)	93.5 (87.1–97.4)
PET/CT	1	8	100	2	88.9 (51.8–99.7)	98.0 (93.1–99.8)	97.3 (92.3–99.4)	80.0 (44.4–97.5)	99.0 (94.6–100.0)

Ranges in parentheses indicate 95% confidence intervals
FN false-negative, *TP* true-positive, *TN* true-negative, *FP* false-positive, *PPV* positive predictive value, *NPV* negative predictive value

- MRI appears to be superior to PET/CT for the assessment of locoregional invasion and retropharyngeal nodal metastasis.
- PET/CT is more accurate than MRI for determining cervical nodal metastasis and should be the better reference for the neck status.

Staging of untreated nasopharyngeal carcinoma with PET/CT: comparison with conventional imaging work-up
Eur J Nucl Med Mol Imaging 2009;36:12-22

Table 2 Location of 56 confirmed second primaries

Location		Number of tumours	
Aerodigestive tract		46	**(82%)**
Upper		15	27%
Lower	Oesophagus	5	b9%
	Lung	26	46%
Non-aerodigestive tract		10	**(18%)**
Stomach		1	
Colorectal		5	
Thymus		1	
Breast		1	
Kidney		1	
Lymphoma		1	

- FDG-PET/CT detects a considerable number of synchronous primaries (8.0% prevalence) at initial staging of patients with HNSCC.

Head and neck squamous cell carcinoma (HNSCC) – detection of synchronous primaries with F-18 FDG PET/CT
Eur J Nucl Med Mol Imaging 2009;36:919-927

7. Thyroid cancer

- 44 y/o woman
- Papillary carcinoma of left thyroid lobe

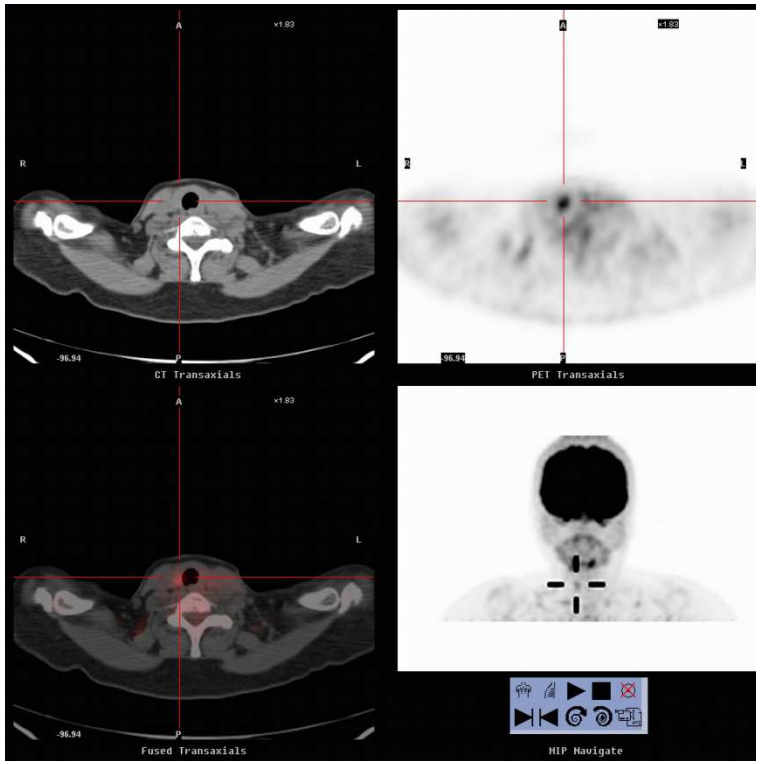
- Neck mass for > 6 months
- Total thyroidectomy and left functional neck dissection (pT1N1M0), 150 mCi I-131 ablation

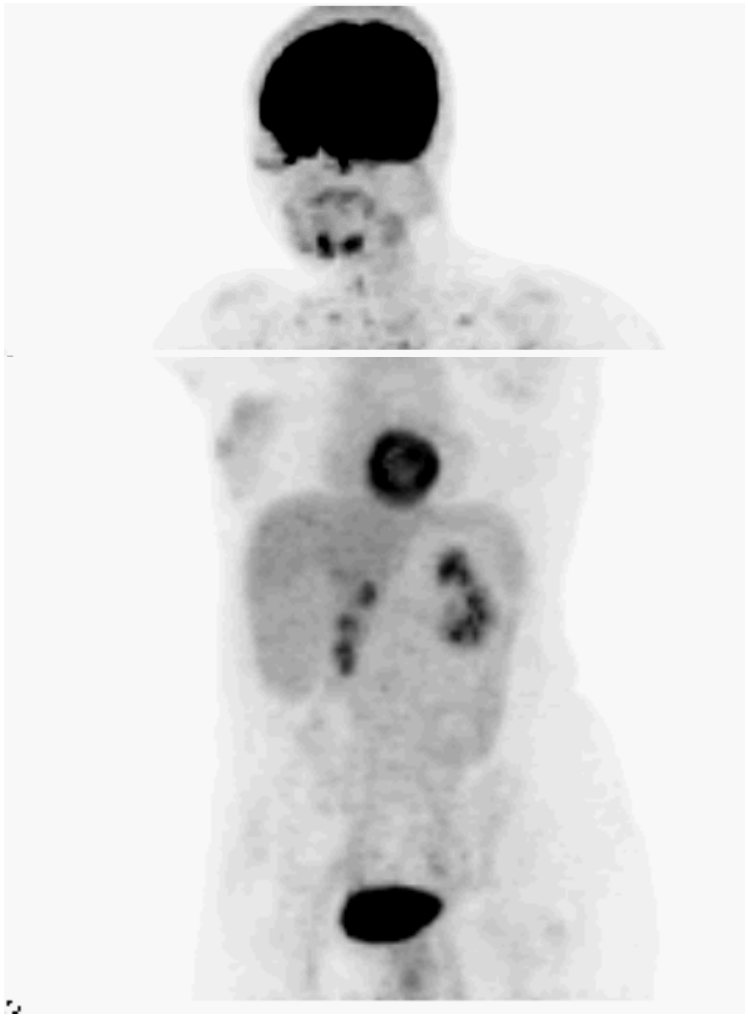
- Elevation of thyroglobulin (Tg/TSH: 143 ng/ml/84.06 uIU/ml)
- Negative I-131 Whole body scan

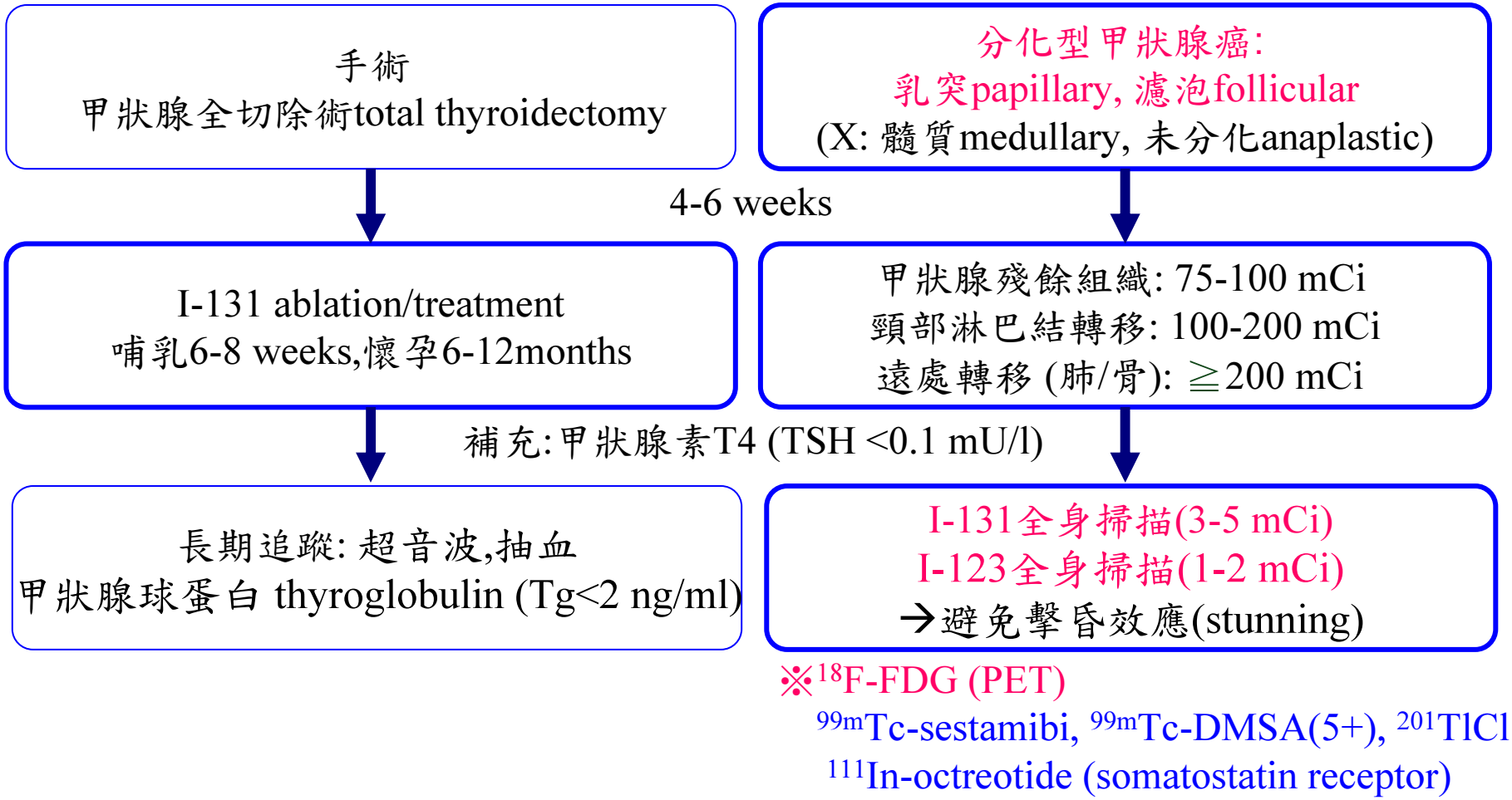
7. Thyroid cancer

- Right thyroid bed (SUVmax: 3.0-4.1)

→150 mCi I-131 treatment






手術
甲狀腺全切除術total thyroidectomy
分化型甲狀腺癌:
乳突papillary, 濾泡follicular
(X: 髓質medullary, 未分化anaplastic)
4-6 weeks
I-131 ablation/treatment
哺乳6-8 weeks,懷孕6-12months
甲狀腺殘餘組織: 75-100 mCi
頸部淋巴結轉移: 100-200 mCi
遠處轉移 (肺/骨): ≧200 mCi
補充:甲狀腺素T4 (TSH <0.1 mU/l)
長期追蹤: 超音波,抽血
甲狀腺球蛋白 thyroglobulin (Tg<2 ng/ml)
I-131全身掃描(3-5 mCi)
I-123全身掃描(1-2 mCi)
→避免擊昏效應(stunning)
※18F-FDG (PET)
99mTc-sestamibi, 99mTc-DMSA(5+), 201TlCl
111In-octreotide (somatostatin receptor)

8. Lung cancer

- 40 y/o man
- Small cell carcinoma of LUL

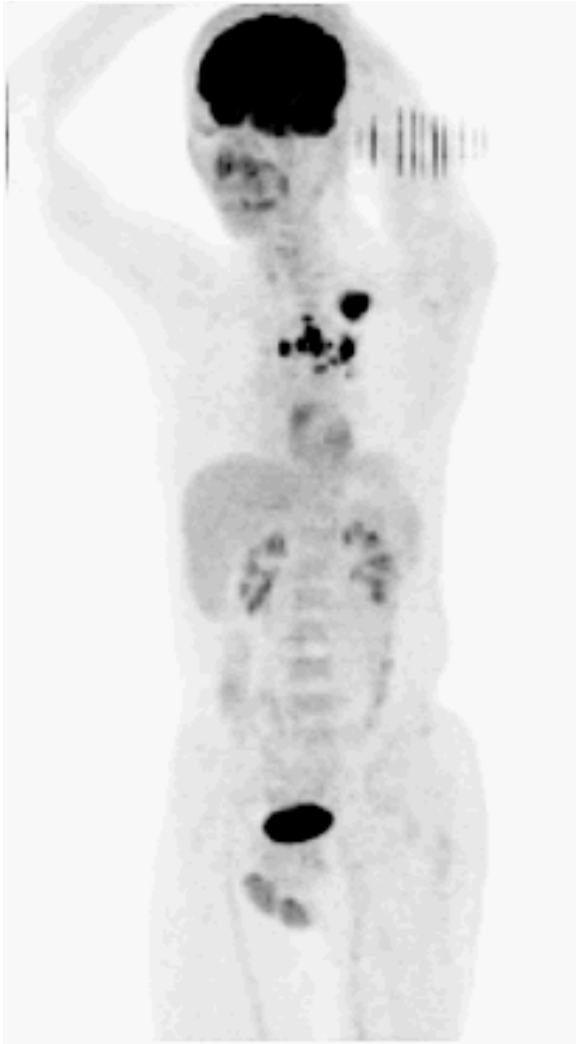
- Smoking for 16 years
- Pulmonary TB s/p Tx 2 years ago
- Family history of colon cancer (parents)

- Elevation of CEA level (48.5 to 189 ng/ml within 1 month)
- Colonoscopy: polyp

8. Lung cancer

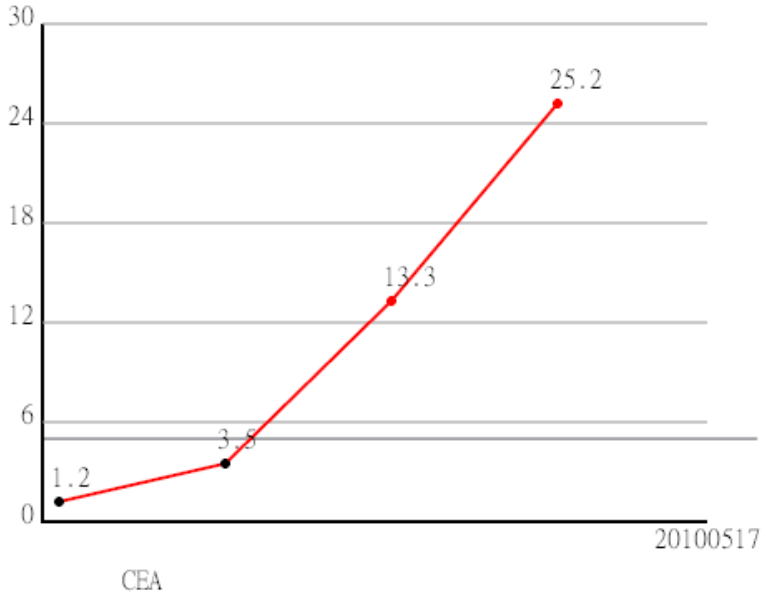
- Tumor survey: T2N3M0
- LUL, 3.4 cm, SUVmax: 15.8-18.1
- Mediastinal & left hilar LNs, SUVmax: 20.1-21.8

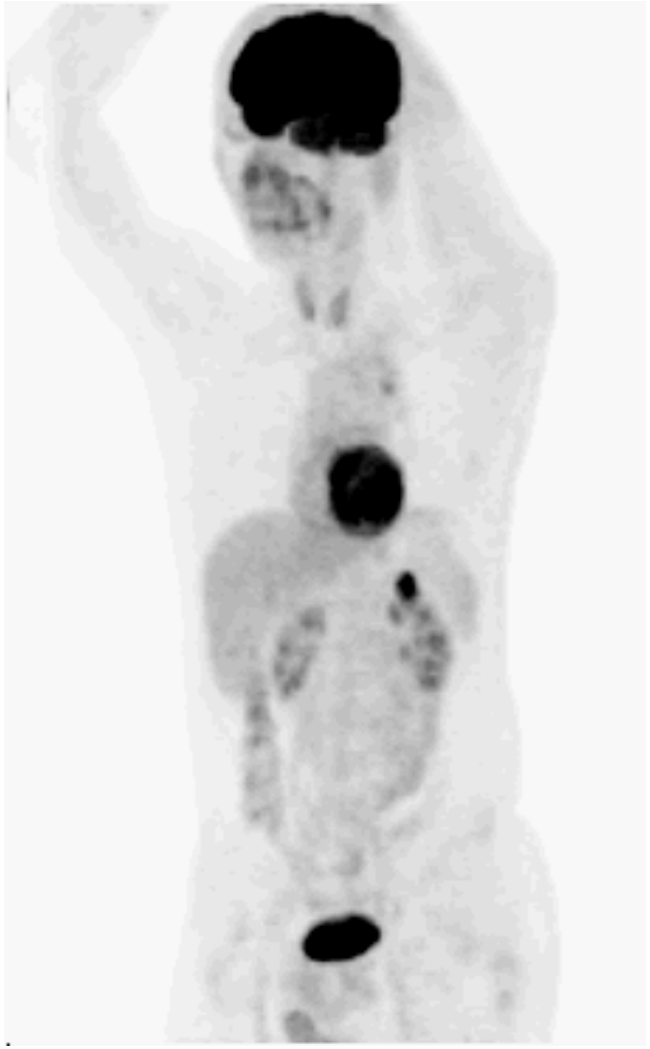
→ R/T and C/T with Cisplatin + Etoposide *6 courses



8. Lung cancer

- Progressive elevation of CEA
- Chest CT (-), Upper abdomen SONO (-), Brain MRI (-)





8. Lung cancer

- Upper pole of left kidney
- <3 cm, SUVmax: 13.6-17.2

→Biopsy: small cell carcinoma

→Radiofrequency ablation

→C/T with Cisplatin + Etoposide

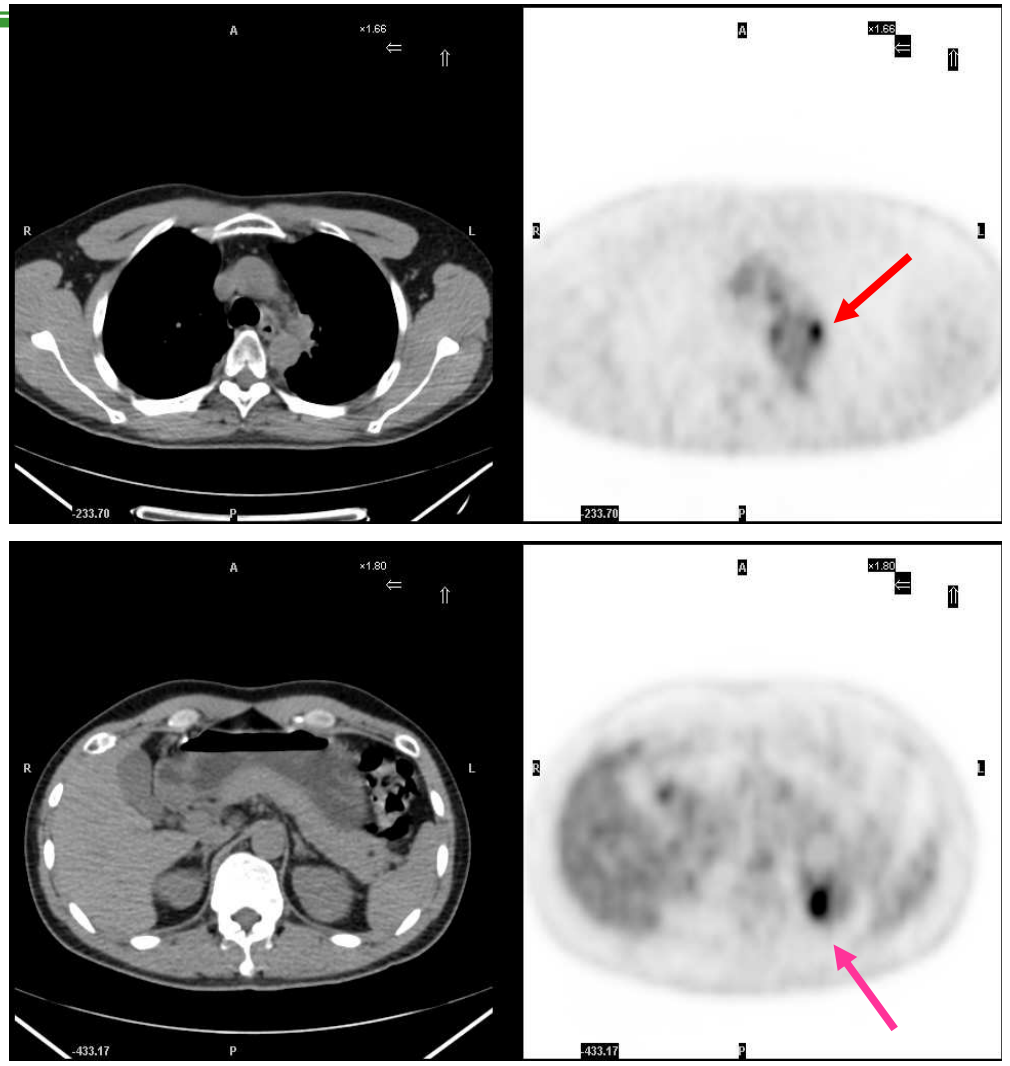


Table 3—*Role of PET for Diagnosis, Excluding Lesions That Are Suspicious for BAC or Carcinoid*

Likelihood Category	Lesion Size, cm	Recommended Imaging Study
Very low		CXR or CT in 6, 12, or 24 mo
Low	< 1	CT in 3, 6, 12, or 24 mo
Low	≥ 1	PET
Intermediate	< 1	CT in 3, 6, 12, or 24 mo
Intermediate	≥ 1	PET
High		Staging as dictated by presentation*

Table 2—*Role of PET Imaging in Patients With Suspected Lung Cancer*

Clinical Scenario	Confirmation of Extrathoracic Stage	Confirmation of Intrathoracic Stage	Confirmation of Diagnosis
SCLC	Multiple scans vs PET*	Not applicable	Easiest site†
NSCLC			
cIV, multiple typical metastases	PET vs multiple scans*	Not applicable	Easiest site†
cIV, solitary potential metastasis	PET vs biopsy of suspected site	Not applicable	Easiest site† vs biopsy of suspected site
cIII, diffuse mediastinal infiltration	PET vs multiple scans	Radiographic	Easiest site†
cIII, discrete node enlargement	PET vs multiple scans	Mediastinal node biopsy	Mediastinal node biopsy
cII	PET vs clinical	Mediastinoscopy vs PET	Surgical resection
cI, peripheral	Clinical	Intraoperative node biopsy	Surgical resection

*Unless the symptoms are highly suggestive and a simple radiographic test (*eg*, plain bone radiographs) are compelling.
†*eg*, sputum, bronchoscopy, fine-needle aspiration of supraclavicular node, TTNA.

Seeking a Home for a PET, Part 1: Defining the Appropriate Place for Positron Emission Tomography Imaging in the Diagnosis of Pulmonary Nodules or Masses. *Chest 2004;125:2294-2299*

Seeking a Home for a PET, Part 2: Defining the Appropriate Place for Positron Emission Tomography Imaging in the Staging of Patients with Suspected Lung Cancer. *Chest 2004;125:2300-2308*

Table 1—*Influence of FDG PET Intensity of the Primary Tumor on Survival of Patients With NSCLC

Source	Patients, No.	Stage	SUV Threshold Value	Overall Survival: MST, mo ≤	MST, mo >	2 yr (%) ≤	2 yr (%) >	p Value†	Significance by MVA
Dhital et al[12]	77	I–IIIa	15	33	9‡§	60‡	40‡§	0.04	
Ahuja et al[11]	155	I–IV	10	25	11	52‡	23‡	< 0.005	Yes
Vansteenkiste et al[9]	125	I–III	7	NR	22	83‡	45‡	0.001	Yes
Jeong et al[10]	73	I–IV	7	NR	NR§	98‡	58‡§	0.0011	Yes
Sasaki et al[8]	90	I–IIIa	5			(100)‖	(62)‖	0.015	
Higashi et al[7]	57	I–III	5	NR‡	37‡	91‡	70‡	< 0.0001	Yes

*MVA = multivariate analysis; MST = median survival time; NR = not reached; ≤ = cohort of patients with SUV less than or equal to threshold value; > = cohort of patients with SUV greater than threshold value.
†Log-rank test of Kaplan-Meier survival curves.
‡Estimated from survival graph in the article.
§Greater than or equal to.
‖One-year disease-free survival.

- PET intensity
  - a marker of biological behavior
  - independent predictor of survival

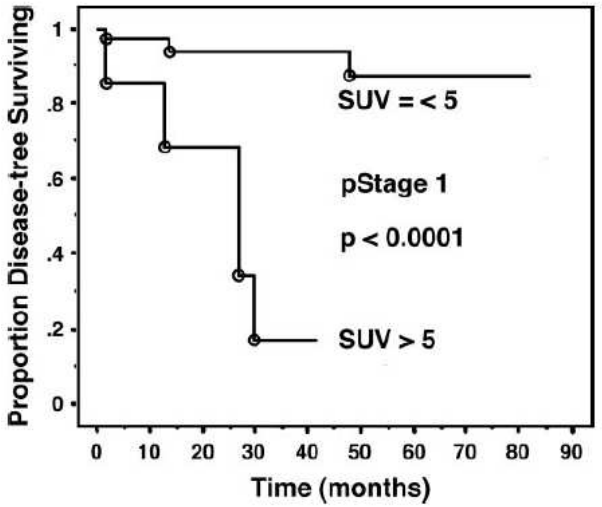


FIGURE 1. Disease-free survival of 46 resected patients with pathologic stage I NSCLC. Reprinted with permission.[7]

Seeking a Home for a PET, Part 3: Defining the Appropriate Place for Positron Emission Tomography Imaging in the Management of Patients with Lung Cancer. *Chest 2004;126:1656-1666*

9. Melanoma

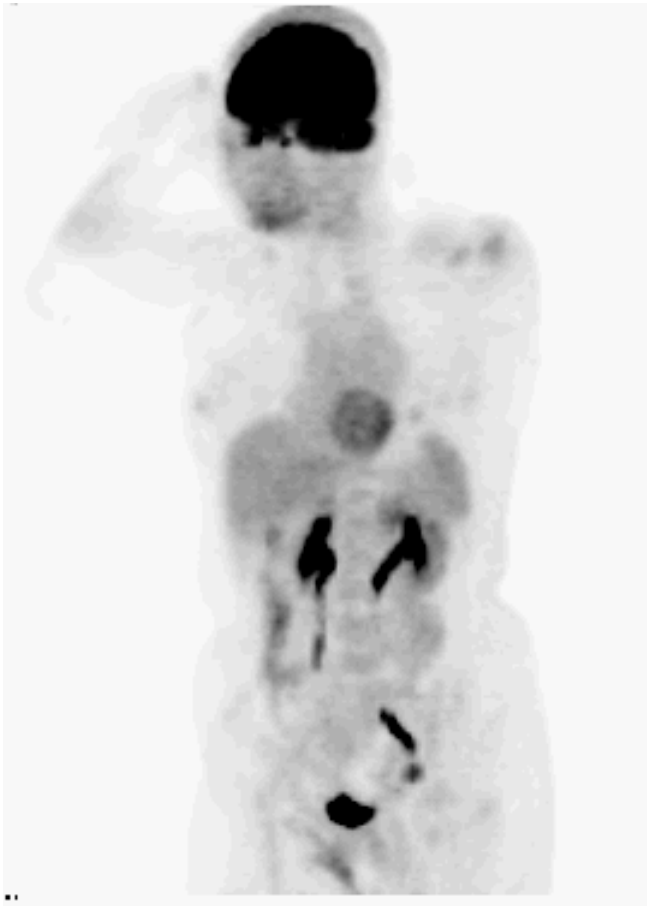
- 55 y/o woman
- Vaginal melanoma

- Uterine tumor s/p OP >10 years ago
- Vaginal spotting and hematuria for 1-2 months
- Radical vulvectomy + LSO + BPLND + total vaginectomy + BILND + rotation flap and Interferon alpha IIa (Interon A) induction

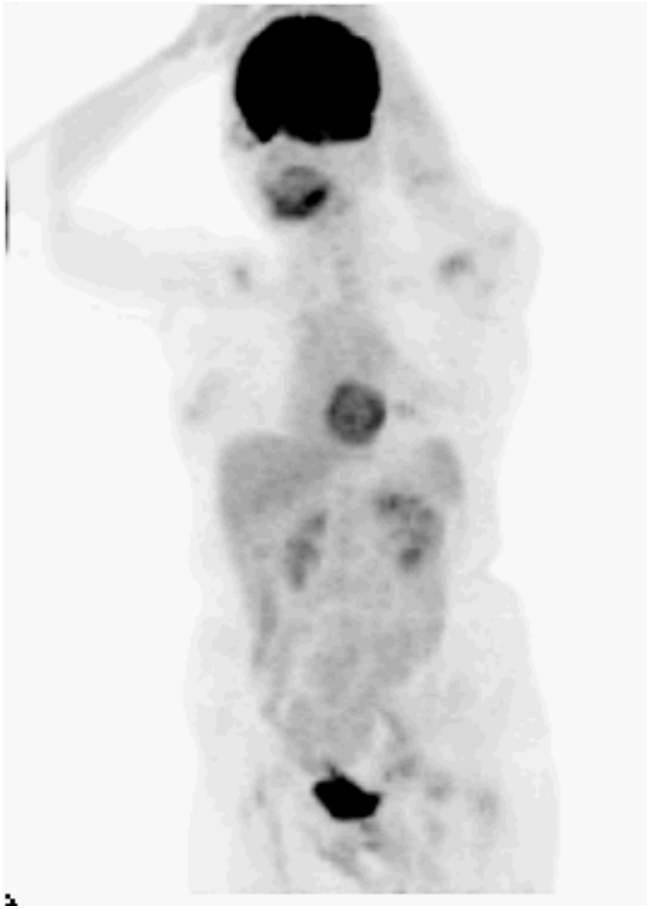
- Local recurrence s/p wide excision of right vulvar tumor

9. Melanoma

- Pre-C/T

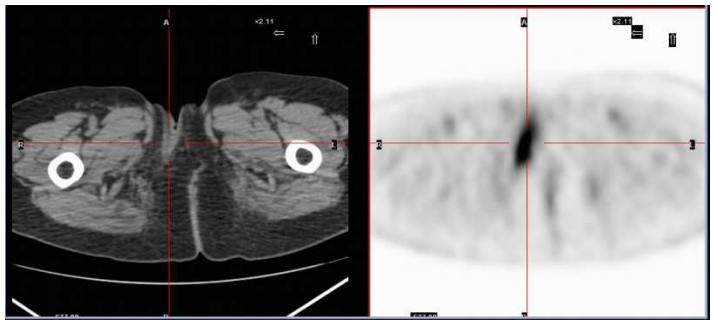


- Post-C/T

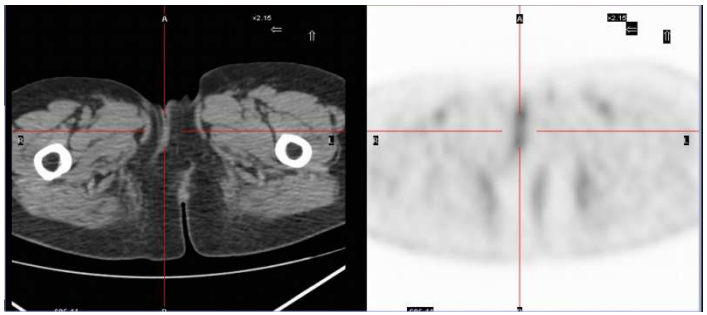


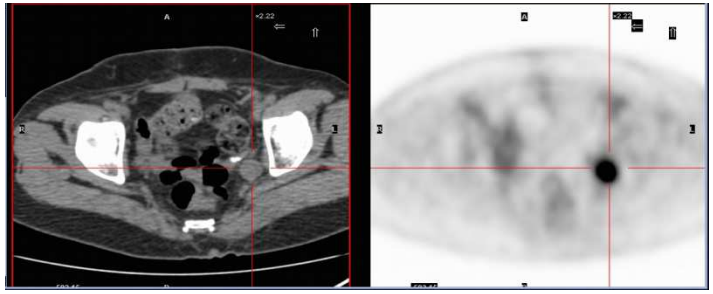
9. Melanoma

- Pre-C/T
- Post-C/T

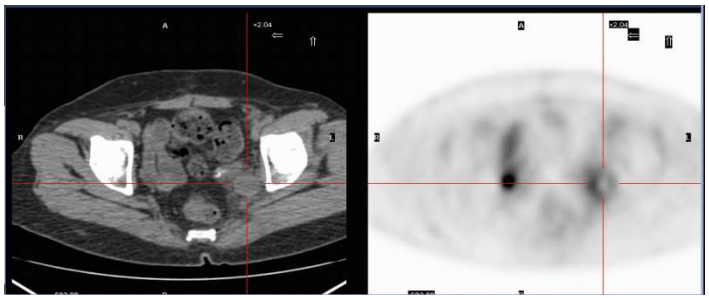


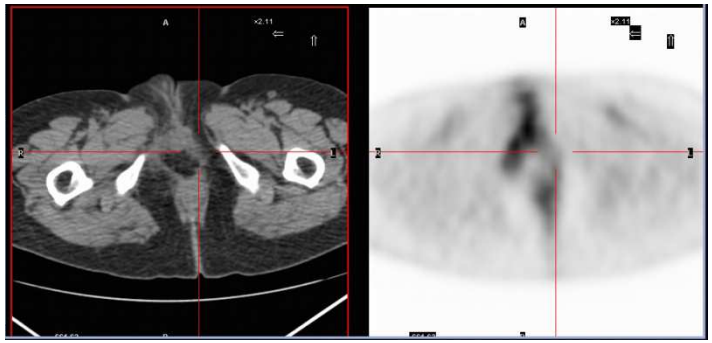
Right perineum
5.2-6.4 → 3.0-3.2





Left obturator LN
Larger size
7.3-10.9 → 3.7-5.2





Left perineum
2.5-2.5 → 4.1-6.2
→wide excision

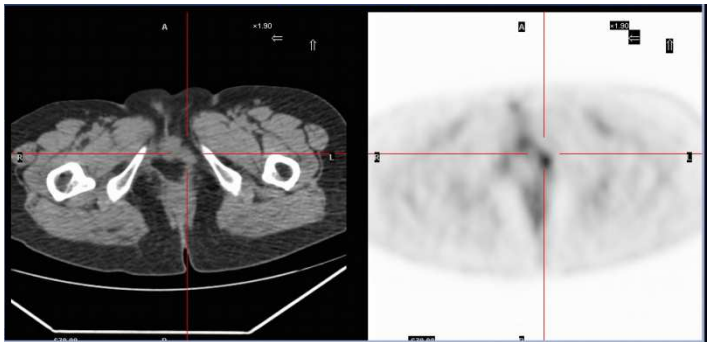


TABLE 6
Nuclear Medicine Platform for Management of Malignant Melanoma

Clinical indications	First-line imaging procedures	Comments
Initial staging		
AJCC stage I or II	LM/SL	SPECT/CT is recommended in head and neck melanomas and in posterior trunk melanomas ^{18}F-FDG PET (or PET/CT) may be indicated eventually in high-risk melanomas*
AJCC stage III or IV	Whole-body PET or, better, whole-body PET/CT†	^{18}F-FDG PET alone should be complemented by thoracic CT ^{18}F-FDG PET (or PET/CT) should be complemented by brain MRI
Restaging	Whole-body PET or, better, PET/CT†	^{18}F-FDG PET alone should be complemented by thoracic CT ^{18}F-FDG PET (or PET/CT) should be complemented by brain MRI

*Breslow thickness of ≥4 mm, ulceration, high mitotic rate, and melanomas of trunk and upper arms.
†Inclusion of images of both upper and lower extremities is recommended for patients with malignant melanomas that involve extremities, and inclusion of images of head is recommended for patients with known or suspected scalp involvement (*96*).

10. Cervical cancer

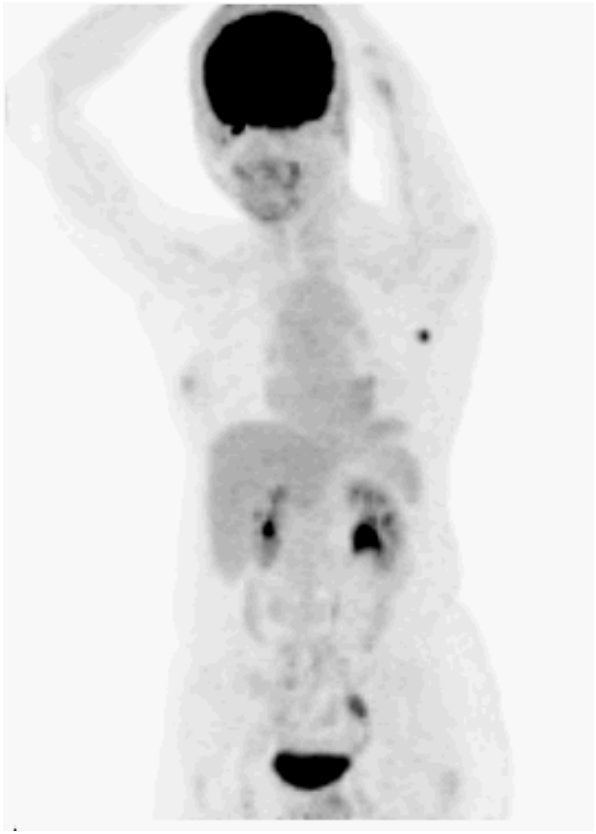
- 50 y/o woman
- Cervical cancer

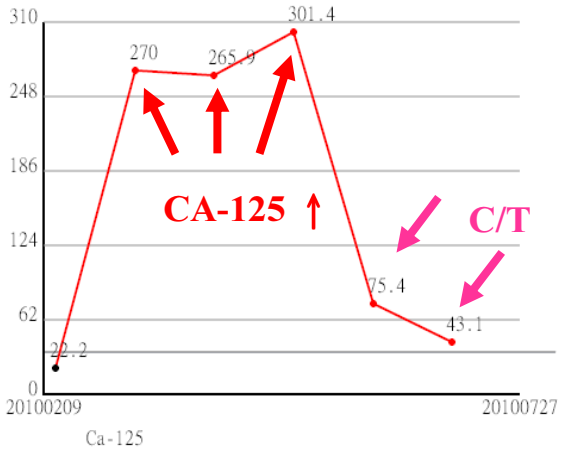
- PAP smear (+)
- LAVTH (stage IA1)

- Elevation of tumor markers:
  CA-125, CA 19-9, CEA
  401.8 U/mL, 267.7 U/mL, 33.3 U/mL

10. Cervical cancer

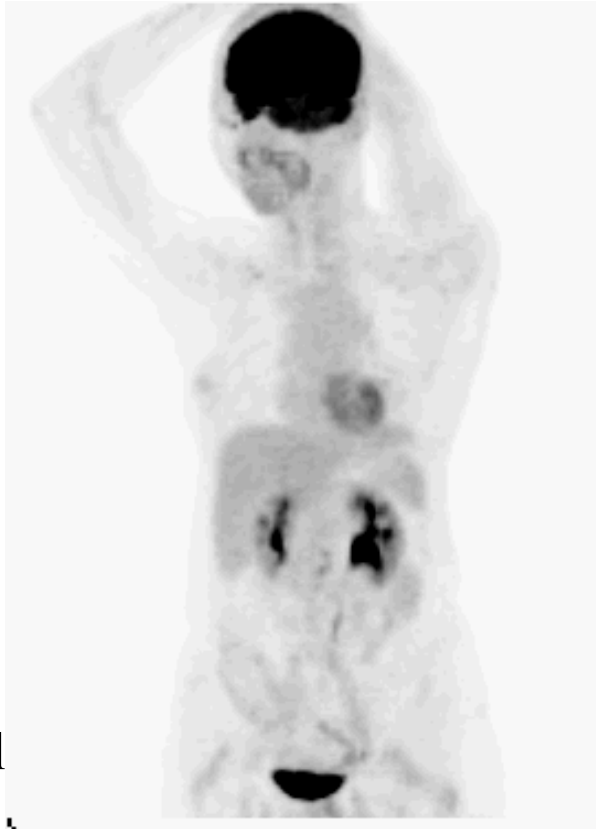
- Pre-CCRT with Cisplatin





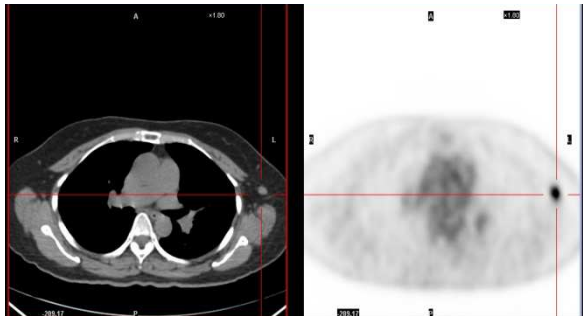
Abdominal CT: some left para-aortic retroperitoneal LNs, advising tumor marker correlation and short interval Follow-up

- Pre-C/T with Cisplatin + Topotecan

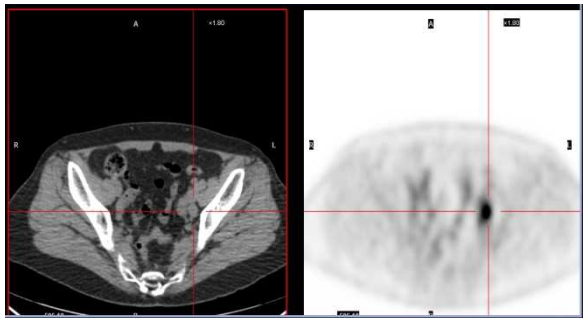


10. Cervical cancer

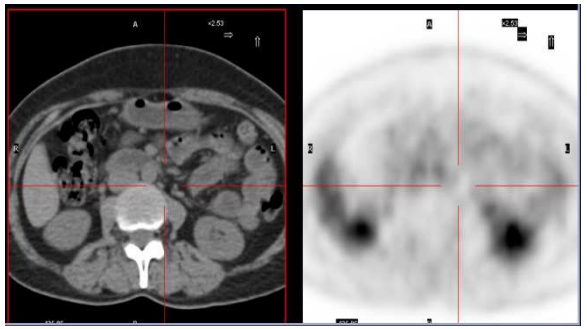
- Pre-CCRT with Cisplatin



Left axillary LN
7.4-10.1
→Necrotizing granulomatous inflammation

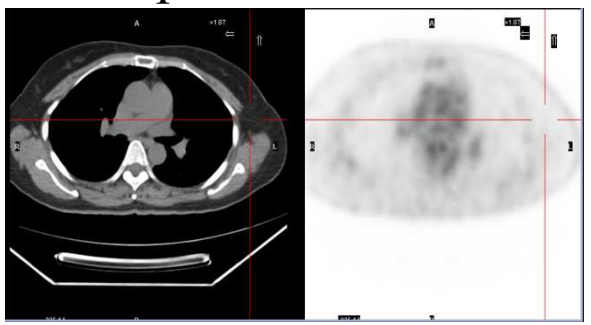


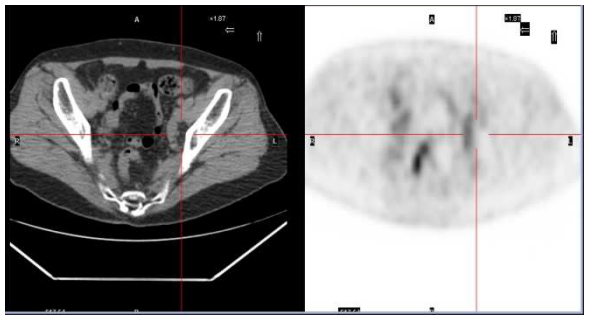
Pelvic LN
6.2-9.2
→CCRT with Cisplatin

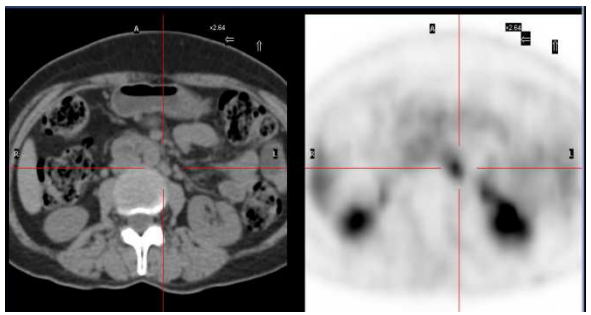


Left paraaortic LN
3.4-5.2

- Pre-C/T with Cisplatin + Topotecan







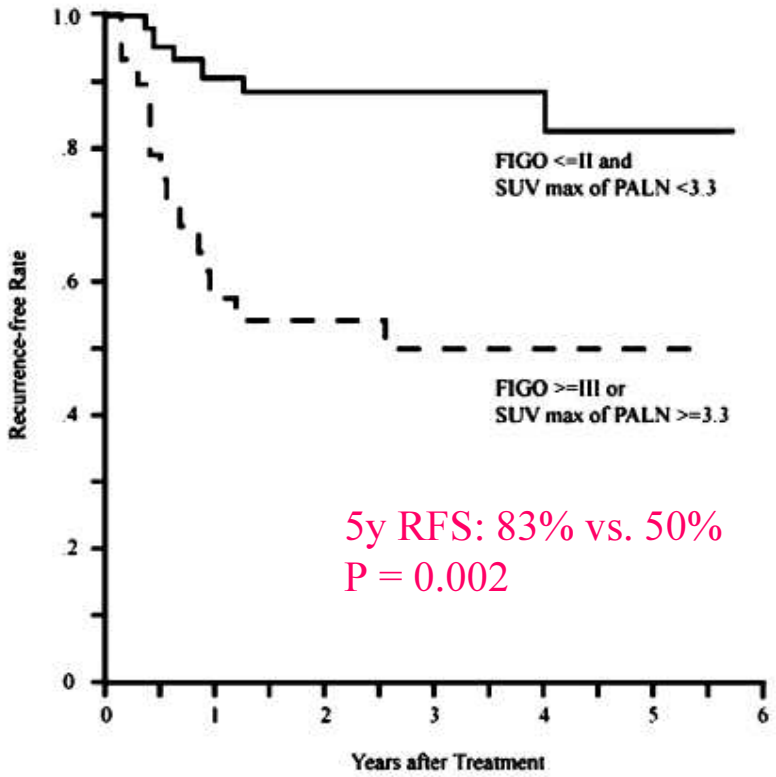


Fig. 3 Cumulative RFS in primary cervical cancer patients with FIGO stage ≥III or SUV_{max} at PALN ≥3.3, and FIGO stage ≤II and SUV_{max} of PALN <3.3 (p=0.002)

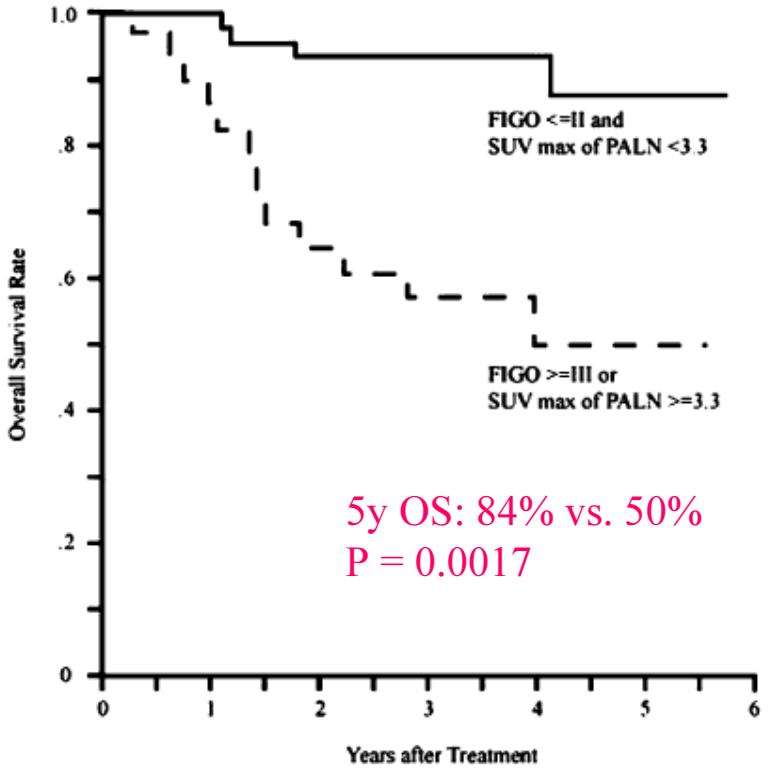


Fig. 4 Cumulative OS in primary cervical cancer patients with FIGO stage ≥III or SUV_{max} at PALN ≥3.3, and FIGO stage ≤II and SUV_{max} of PALN <3.3 (p=0.0017)

Standardized uptake value in para-aortic lymph nodes is a significant prognostic factor in patients with primary advanced squamous cervical cancer
Eur J Nucl Med Mol Imaging 2007;35:493-501 (Taiwan)

Thank you for your attention

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