Rectal Cancer: the role of PET/CT

Eastern Piedmont University
Nuclear Medicine Department
Novara - Italy
Rectal Anatomy

<table>
<thead>
<tr>
<th>Portion of Rectum</th>
<th>cm from anal verge</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper 1/3</td>
<td>15</td>
</tr>
<tr>
<td>middle 1/3</td>
<td>10</td>
</tr>
<tr>
<td>lower 1/3</td>
<td>6</td>
</tr>
</tbody>
</table>

Left upper valve of Houston
Right middle valve of Houston
Peritoneum
Ampulla of Rectum
Left lower valve of Houston
Anal verge

Pelvic size/structures: M vs. F
Accurate disease staging is essential for optimal management of patients affected by rectal cancer due to the close correlation between staging, prognosis, and survival.
Multimodality Staging

Biopsy, CEA, Proctoscopy, Coloscopy, CXR, ceCT A/P, Liver US, Transrectal EUS: 82-93% accurate for depth of invasion, less for nodes

• T1 submucosa
• T2 muscularis propia
• T3 serosa and non-peritonealized peri-rectal tissue
• T4 other organs or visceral peritoneal surface
• N1 1-3 nodes
• N2 4+ nodes

Location, fixity, % circumferential, size, grade, LVI, PNI
Tumor spread: circumferential and lateral into the mesorectum

Stage I  T1-2 N0  Stage II: T3-4 N0  Stage III: Tx N+

Rodriguez 2003
Accepted and **evolving** indications for FDG-PET/CT in rectal carcinoma

- **Staging of rectal disease**
  - Nodal staging

- **Staging of non-liver metastases**
  - Patient selection for liver surgery

- **Staging recurrent disease**

- **Radiation treatment planning**

- **Response to chemotherapy**
# Accuracy of PET Staging in rectal carcinoma

<table>
<thead>
<tr>
<th>Findings at PET/CT</th>
<th>True-Positive at PET</th>
<th>True-Negative at PET</th>
<th>False-Positive at PET</th>
<th>False-Negative at PET</th>
<th>Equivocal Findings at PET</th>
</tr>
</thead>
<tbody>
<tr>
<td>True-positive</td>
<td>36</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>True-negative</td>
<td>0</td>
<td>24</td>
<td>6</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>False-positive</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>False-negative</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Equivocal</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Parameter</th>
<th>PET Analysis</th>
<th>Patient Based</th>
<th>PET/CT Analysis</th>
<th>Patient Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity (%)</td>
<td>82 (36/44)</td>
<td>88 (21/24)</td>
<td>98 (43/44)</td>
<td>96 (23/24)</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>65 (24/37)</td>
<td>74 (28/38)</td>
<td>86 (32/37)</td>
<td>89 (34/38)</td>
</tr>
<tr>
<td>Positive predictive value (%)</td>
<td>73 (36/49)</td>
<td>68 (21/31)</td>
<td>90 (43/48)</td>
<td>85 (23/27)</td>
</tr>
<tr>
<td>Negative predictive value (%)</td>
<td>75 (24/32)</td>
<td>90 (28/31)</td>
<td>97 (32/33)</td>
<td>97 (34/35)</td>
</tr>
<tr>
<td>Accuracy (%)</td>
<td>74 (60/81)</td>
<td>79 (49/62)</td>
<td>93 (75/81)</td>
<td>92 (57/62)</td>
</tr>
</tbody>
</table>

Even-Sapir E. *Radiology* 2004
Nodal Staging in Rectal Cancer

TC $\rightarrow$ T4N0M0

FDG-PET/ TC $\rightarrow$ T4N2M0
Hepatic Staging in Rectal Cancer

T3N0M0 ➔ T3N0M1

Multiple hepatic lesions

Treatment strategy change ➔ palliative

Ruers TJ. *J Clin Oncol* 2002
Bipat S. *Radiology* 2005
Comparison FDG PET/multiphase CT and intraoperative US for Detection of Hepatic Metastases

- 131 patients selected for hepatic resection of colorectal liver metastases: 363 liver metastases were identified
- Sensitivity for detection:
  - 63 lesions < 10 mm: CT PET 16%
  - 172 lesions 10-20 mm: CT 72% PET 75%
  - 128 lesions > 20 mm: CT 97% PET 95%
  - All CT 71% PET 72%

  Both CT and PET missed ~ 30% smaller lesions resulting in change in management in 7% (9/131) patients
Hepatic and T.B. Staging in Rectal Cancer
Impact of FDG PET in the Management of Colorectal Hepatic Metastases: Meta-analysis

- Pooled Sensitivity and Specificity of FDG PET and CT from studies in patients evaluated for hepatic resection:
  
  **Hepatic metastases:**
  Sensitivity: PET 88%  CT 82%
  Specificity: PET 96%  CT 84%

  **Extrahepatic metastases:**
  Sensitivity: PET 91%  CT 61%
  Specificity: PET 95%  CT 91%

- Change in management: 31% (range 20-58%)

Wiering Cancer 2005
Total Body PET/CT in Detecting Occult Disease

• One of the main contribution of FDG-PET imaging for preoperative restaging of patients with rectal cancer is in detecting occult disease, leading to reduction of futile surgeries.

Fernandez FG *Ann Surg* 2004
## Recurrent Rectal Cancer

A meta-analysis of FDG PET accuracy

### Meta-Analysis of Sensitivity and Specificity Data

<table>
<thead>
<tr>
<th>Type</th>
<th>Calculation method</th>
<th>Patients/lesions</th>
<th>n</th>
<th>TP</th>
<th>FP</th>
<th>TN</th>
<th>FN</th>
<th>Combined sensitivity (95% confidence interval)</th>
<th>Combined specificity (95% confidence interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole body</td>
<td>Pooled data</td>
<td>Patients</td>
<td>281</td>
<td>229</td>
<td>11</td>
<td>34</td>
<td>7</td>
<td>97.03% (94.87%–99.20%)</td>
<td>75.56% (63.00%–88.11%)</td>
</tr>
<tr>
<td></td>
<td>Weighted average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>97.13%</td>
<td>77.12%</td>
</tr>
<tr>
<td></td>
<td>sROC curve not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatic involvement</td>
<td>Pooled data</td>
<td>Patients</td>
<td>393</td>
<td>182</td>
<td>2</td>
<td>202</td>
<td>7</td>
<td>96.30% (93.6%–98.99%)</td>
<td>99.02% (97.67%–100%)</td>
</tr>
<tr>
<td></td>
<td>Weighted average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>96.04%</td>
<td>97.12%</td>
</tr>
<tr>
<td></td>
<td>sROC curve not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hepatic involvement</td>
<td>Pooled data</td>
<td>Lesions</td>
<td>182</td>
<td>130</td>
<td>1</td>
<td>38</td>
<td>13</td>
<td>90.91% (86.20%–95.62%)</td>
<td>97.44% (92.48%–100.00%)</td>
</tr>
<tr>
<td></td>
<td>Weighted average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>90.86%</td>
<td>96.97%</td>
</tr>
<tr>
<td></td>
<td>sROC curve not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local/pelvic</td>
<td>Pooled data</td>
<td>Patients</td>
<td>366</td>
<td>137</td>
<td>5</td>
<td>214</td>
<td>8</td>
<td>94.48% (90.77%–98.2%)</td>
<td>97.72% (95.74%–99.7%)</td>
</tr>
<tr>
<td></td>
<td>Weighted average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>94.71%</td>
<td>97.25%</td>
</tr>
<tr>
<td></td>
<td>sROC curve not applicable</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### Detailed Management Data

<table>
<thead>
<tr>
<th>Author (reference no.)</th>
<th>n</th>
<th>% Management changes</th>
<th>No. change in location</th>
<th>No. surgery*</th>
<th>Upstaged†</th>
<th>Downstaged‡</th>
<th>Surgery avoided§</th>
<th>Upstaged‖</th>
<th>Downstaged‖</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beets et al. (29)</td>
<td>35</td>
<td>40 (14/35)</td>
<td>0</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Vitola et al. (27)</td>
<td>24</td>
<td>25 (6/24)</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Lai et al. (26)</td>
<td>34</td>
<td>29 (10/34)</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>7</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Delbeke et al. (24)</td>
<td>52</td>
<td>33 (17/52)</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>1</td>
<td>11</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Ogumbi et al. (4)</td>
<td>23</td>
<td>44 (10/23)</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Vaik et al. (3)</td>
<td>78</td>
<td>31 (24/78)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Flamen (31)</td>
<td>103</td>
<td>20 (21/103)</td>
<td>8††</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>12</td>
<td>9</td>
<td>3</td>
</tr>
</tbody>
</table>

### Accuracy of PET in recurrence after surgical removal of rectal cancer

<table>
<thead>
<tr>
<th></th>
<th>Sens</th>
<th>Spec</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvic recurrence</td>
<td>98</td>
<td>96</td>
<td>90</td>
<td>97</td>
<td>93</td>
</tr>
<tr>
<td>Presacral recurrence</td>
<td>100</td>
<td>96</td>
<td>88</td>
<td>100</td>
<td>-</td>
</tr>
</tbody>
</table>

Huener *J Nucl Med* 2000  
Gambhir *J Nucl Med* 2001  
Even-Sapir *Radiology* 2004
Clinical Case of Relapse

• **July 2003:** *Knight-Griffen intervention for rectal cancer G2, pT3 N0 M0*

• **Sept-Oct 2003:** *pelvis RT (45 Gy)*

• **May 2006:** *clinical suspect of recurrence*
  – *coloscopy: negative biopsy at the anastomotic site*
  – *tumor markers: negative*
  – *endoUS: anastomotic lesion suggestive of relapse*
  – *CT & NMR abdomen: thickening of rectum anterior wall with extension to the deep rectal-bladder space*
Clinical Case of Relapse
May 2006 PET/CT

Presacral focus of intense FDG uptake
Clinical Case of Relapse

• **January 2007:** *Exploratory laparatomy*
  – negative rectal biopsy
  – **non diagnostic pre-sacral needle citology**

• **June 2007:**
  – *Percutaneous TC guided biopsy:* fragments of rectal carcinoma
  – *PET/CT:* progression of the presacral focus of abnormal FDG uptake both in terms of intensity and extension
Clinical Case of Relapse
June 2007 PET/CT
Evidence of a tumor mass of 6.5 cm diameter, anterior to the sacrum and infiltrating the anal elevator muscle and the prostate
Guidelines for Rectal Cancer

- Optimal preoperative radiotherapy for localized rectal cancer provide a modest improvement in overall survival but is effective in improving local control. The addition of chemotherapy provides even better local control but did not increase the likelihood of cure or the ability to avoiding a permanent colostomy.

The “Cochrane Database of Systematic Reviews 2010 Issue 3”
Copyright © 2010 The Cochrane Collaboration
How Could PET/CT Help XRT?

• **Tumor localization**
  – Enlarge/reduce/confirm primary tumor target
  – Enlarge/reduce/confirm pelvis coverage

• **Treatment selection**
  – Locoregional and whole body staging
  – Biological characterization

• **Response assessment**
  – Need for more close follow-up
PET for Neoadjuvant CRT monitoring

18F-FDG SUV changes after neoadjuvant CT/RxT for rectal cancer

Martoni 2005
PET/CT to predict the response of radiochemotherapy in pts with locally advanced rectal cancer

- 33 patients submitted to 3 cycles of oxaliplatin, raltitrexed, 5-fluorouracil, and folinic acid during pelvic radiotherapy (45Gy) and total mesorectal excision

- $^{18}$F-FDG PET scans were performed at baseline and 12 days after RCT

- A significant correlation was found between Tumor Regression Grades and early SUV changes ($P < 0.0001$)

- Responders were identified correctly by an early decrease of the mean SUV of $\geq 52\%$.

## Rectal Cancer TNM Staging before and after PET/CT

25 pts with rectal cancer (T3-4 N0-1 M0-1) and candidates for preoperative radiotherapy, underwent PET/CT simulation.

### Staging changement: 6/25 cases (24%)

<table>
<thead>
<tr>
<th>Nº cases</th>
<th>CT/MRI</th>
<th>PET/CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/25 (8%)</td>
<td>cN1</td>
<td>N negative</td>
</tr>
<tr>
<td>3/25 (12%)</td>
<td>cN0</td>
<td>N positive</td>
</tr>
<tr>
<td>1/25 (4%)</td>
<td>cM0</td>
<td>M1 (liver)</td>
</tr>
</tbody>
</table>

*Fig. B*

### Treat. strategy changement: 1/25 cases (4%)

<table>
<thead>
<tr>
<th>CT/MRI</th>
<th>PET/CT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single liver MTS</td>
<td>Multiple liver MTS</td>
</tr>
<tr>
<td>Curative</td>
<td>Palliative</td>
</tr>
</tbody>
</table>

Bassi M. *IJROBP* 2008
RT alone or chemo-RT in preoperative setting of Rectal Cancer

- RT total dose of 45.0-50.4 Gy:
  - 1.8 Gy/fx (long-course RT)
  - or 25 Gy, 5 Gy/fx (short-course RT)
- Treatment volume segmentation made by 2 different radiation oncologists, firstly on CT images (CT-GTV, CT-CTV), then on PET/CT (PET-GTV, PET-CTV)
- Fixed threshold value of 40% of the maximum uptake to delineate PET-GTV margins (volume always > 4 cm³)

Bassi M. *IJROBP* 2008
Target Volume Delineation in preoperative 3D Conformal Radiotherapy of Rectal Cancer

- Image fusion system: Syntegra, Philips (mutual information system) **TPS**: Pinnacle3 Philips
- Accuracy of image fusion checked by bony landmarks (pubic symphysis, acetabula and sacrum)
- CTV included GTV and potentially involved lymph nodes (perirectal, presacral, obturator, internal iliac).
- PET-GTV and PET-CTV were compared to CT-GTV and CT-CTV respectively.

Bassi M.  *IJROBP*  2008
Results of PET/CT for XRT Planning in Rectal Cancer at our Institution

- Stage variation was observed in 12% of cases and a change of treatment intent in 4%.
- The PET/CT-GTV and PET/CT-CTV were significantly smaller than the CT-GTV and CT-CTV respectively.
- The mean difference between PET/CT-GTV and CT-GTV was 25.4% and between PET/CT-CTV and CT-CTV was 4.1%.
- Imaging with PET/CT for preoperative radiotherapy of rectal cancer may lead to a change in staging and target volume delineation.

Bassi M.  

*IJROBP* 2008
FDG-PET in Radiation Therapy

• Higher overall accuracy vs stand alone CT
• Useful in staging and monitoring response
• Delineating tumor volume requires further investigation
  – Poor spatial resolution, blurred boundary
  – FDG uptake is a non-specific biological process
  – Inaccurate PET-CT registration
  – Typically large observer variation

Frank SJ Nat Clin Pract Oncol 2005
Open questions

- Observers variability in delineation of target volume

- Thresholding of PET/CT in defining the tumor’s borders for delineation of target volume:
  - SUV or 40% threshold of max uptake?
Target Volume for Preoperative RadioTherapy of Rectal Cancer: Influence of PET/CT on Observers Variability

Piedmont Multicenter Trial and Involved Centres

- 1 Radiotherapy, University Hospital Maggiore della Carità, Novara, Italy
- 2 Medical Physics, University Hospital Maggiore della Carità, Novara, Italy
- 3 Radiotherapy, Hospital degli Infermi, Biella, Italy
- 4 Radiotherapy, Hospital SS Antonio e Biagio, Alessandria, Italy
- 5 Radiotherapy, Institute for Cancer Research and Treatment, Candiolo, Italy
- 6 Radiotherapy, Hospital Cardinal Massaia, Asti, Italy
- 7 Radiotherapy, Hospital Sant’Anna, Torino, Italy
- 8 Radiotherapy, Hospital Santa Croce e Carle, Cuneo, Italy
- 9 Radiotherapy, University Hospital San Giovanni Battista, Torino, Italy
- 10 Radiotherapy, Hospital ASL 9, Ivrea, Italy
- 11 Radiotherapy, Hospital San Giovanni Antica Sede, Torino, Italy
- 12 Nuclear Medicine, University Hospital Maggiore della Carità, Novara, Italy
Two cases selected: Case A (T4 N0 M0) of the lower rectum and Case B (T3 N1 M0) of the mid rectum. 20 contour sets were obtained on case A and case B: 10 drawn on CT (GTV and CTV) by five observers and 10 on PET/CT (GTV and CTV) by the other five.
Results of Piedmont Multicenter Trial on Observer Variability in Target Volume Delineation

Case A: T4 N0 M0 of the lower rectum

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CT-GTV</th>
<th>PET/CT-GTV</th>
<th>CT-CTV</th>
<th>PET/CT-CTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (cc)</td>
<td>115.6</td>
<td>123.6</td>
<td>690.1</td>
<td>756.2</td>
</tr>
<tr>
<td>Median (cc)</td>
<td>125.9</td>
<td>117.7</td>
<td>719.7</td>
<td>697.2</td>
</tr>
<tr>
<td>Minimum (cc)</td>
<td>74.3</td>
<td>108.6</td>
<td>449.6</td>
<td>587.1</td>
</tr>
<tr>
<td>Maximum (cc)</td>
<td>138.7</td>
<td>142.3</td>
<td>820.4</td>
<td>1003.3</td>
</tr>
<tr>
<td>SD</td>
<td>24.8</td>
<td>16.8</td>
<td>141.1</td>
<td>162.2</td>
</tr>
<tr>
<td>CV</td>
<td>0.21</td>
<td>0.14</td>
<td>0.20</td>
<td>0.21</td>
</tr>
<tr>
<td>CI</td>
<td>0.3</td>
<td>0.32</td>
<td>0.29</td>
<td>0.41</td>
</tr>
</tbody>
</table>

Case B: T3 N1 M0 of the mid rectum

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CT-GTV</th>
<th>PET/CT-GTV</th>
<th>CT-CTV</th>
<th>PET/CT-CTV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (cc)</td>
<td>113.2</td>
<td>114.5</td>
<td>752.7</td>
<td>743.7</td>
</tr>
<tr>
<td>Median (cc)</td>
<td>117.0</td>
<td>114.0</td>
<td>775.0</td>
<td>695.4</td>
</tr>
<tr>
<td>Minimum (cc)</td>
<td>67.4</td>
<td>85.0</td>
<td>460.3</td>
<td>579.3</td>
</tr>
<tr>
<td>Maximum (cc)</td>
<td>179.1</td>
<td>163.8</td>
<td>1062.0</td>
<td>114.9</td>
</tr>
<tr>
<td>SD</td>
<td>47.2</td>
<td>30.4</td>
<td>225.4</td>
<td>166.6</td>
</tr>
<tr>
<td>CV</td>
<td>0.42</td>
<td>0.26</td>
<td>0.30</td>
<td>0.22</td>
</tr>
<tr>
<td>CI</td>
<td>0.32</td>
<td>0.26</td>
<td>0.30</td>
<td>0.35</td>
</tr>
</tbody>
</table>

GTV variations analyzed by CV were greater across the observers contouring on CT than across those contouring on PET/CT either for case A (0.21 versus 0.14) or for case B (0.42 versus 0.26). The reduction of inter-observer variability can be of relevant interest especially in case of boost on macroscopic disease.

accepted for publication in TCRT
Altering Threshold level can drastically influence the “tumor” volume CT (A) and $^{18}$F-FDG PET (B) transverse slices for patient with base-of-tongue cancer, and profile plot of $^{18}$F-FDG signal along horizontal line (C).

Example $^{18}$F-FDG signal threshold levels (red lines, C) demonstrate that cutoff levels of 40% and 70% of maximum would result in very different tumor volumes.

Ford EC  *J Nucl Med*  2009
Threshold of Maximum Intensity
Is a Single Threshold Appropriate?

TABLE 1 Comparison of $\text{PET}_{\text{GTV}}$ and $\text{CT}_{\text{GTV}}$

<table>
<thead>
<tr>
<th>Tumors (n)</th>
<th>$\text{SUV}_{\text{max}}$</th>
<th>$\text{CT}_{\text{GTV}}$ (cm³)</th>
<th>$\text{PET}_{\text{GTV}}$ at 40% threshold (cm³)*</th>
<th>Optimal threshold (%)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (20)</td>
<td>12 ± 8</td>
<td>198 ± 277</td>
<td>44 ± 30</td>
<td>24 ± 13</td>
</tr>
<tr>
<td>&lt;3 cm (4)</td>
<td>3.0 ± 0.4</td>
<td>13 ± 7</td>
<td>14 ± 14</td>
<td>42 ± 2</td>
</tr>
<tr>
<td>3–5 cm (10)</td>
<td>13 ± 9</td>
<td>90 ± 69</td>
<td>38 ± 22</td>
<td>24 ± 9</td>
</tr>
<tr>
<td>&gt;5 cm (6)</td>
<td>16 ± 5</td>
<td>502 ± 348</td>
<td>69 ± 28</td>
<td>15 ± 6</td>
</tr>
</tbody>
</table>

* GTV determined by PET with 40% $\text{SUV}_{\text{max}}$ threshold.

† Optimal threshold is percentage threshold that yields 1:1 volumetric match between PET- and CT-delineated tumors.

Is A Single Threshold Appropriate?

Narrow: 40% max
Wide: 2.5 SUV
Red: 40% max
Green: 0.15 x mean + bkg
Yellow: CT

Nestle U  *J Nucl Med* 2005
Issues With Fixed Thresholding

- A wide range of threshold value are used
- Tumor volume are sensitive to the threshold value
- Large differences between different threshold selection methods
- Fixed thresholding methods have inherent limitations for tumor delineation in PET
- New Methods: adaptive thresholding, iterative thresholding, gradient-based, ….
Iterative Threshold Selection as a Function of Mean SUV

- Background SUV or tumor volume is not an independent factor when mean SUV is applied
- 1% error in phantoms

Black QC 2004 Grills IS 2007 *IJROBP*
Conclusions

The role of FDG-PET in rectal cancer:

- provides incremental information in the staging workup of pts with local advanced rectal cancer, frequently leading to changes of management
- is very sensitive to local and distant recurrences
- provides the opportunity to identify patients in whom a major response to neo-adjuvant CRT is expected and who may therefore benefit from alternative surgical approaches
- in at least 15% of patients selected for conformal radiotherapy, the metabolic informations about tumor volume margins and/or involved nodes are determinant for a more accurate delineation of CTV
Tanks for attention !