ROLE OF PET-CT IN BREAST CANCER, GUIDELINES AND BEYOND

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CANCER Key facts

- Estimated 15.2 million new cases per year in 2015 worldwide (GLOBOCAN project 2012) and expected to increase to 21.6 million by 2030.

- Cancer is a leading cause of death worldwide and estimated to account for 8.9 million deaths in 2015 (around 14% of all deaths), and projected to rise to over 13 million in 2030.

- About 70% of all cancer deaths occurred in low- and middle-income countries.
The Most Commonly Diagnosed Cancers Worldwide

International Agency for Research on Cancer

World: Both sexes, all ages

Breast cancer is the most common cancer among women worldwide.
### Estimated Cancer Death in the US 2016

<table>
<thead>
<tr>
<th>Tumor Site</th>
<th>Males 314,290</th>
<th>Females 281,400</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>27%</td>
<td>26%</td>
</tr>
<tr>
<td>Prostate</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Esophagus</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Brain &amp; other nervous system</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>All other sites</td>
<td>24%</td>
<td>24%</td>
</tr>
</tbody>
</table>

- **Lung & bronchus**
- **Breast**
- **Colon & rectum**
- **Pancreas**
- **Uterine corpus**
- **Leukemia**
- **Esophagus**
- **Liver & intrahepatic bile duct**
- **Non-Hodgkin lymphoma**
- **Brain & other nervous system**
- **All other sites**

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CANCER COSTS

COUNTING THE COST OF CANCER
The burden of cancer, calculated as the cost of years lost from ill-health, disability or early death, outweighs all other health concerns.

Road accidents $204.4 bn
Lower respiratory infections (including pneumonia) $125.8 bn
Malaria $24.8 bn
Cirrhosis of the liver $92.8 bn
HIV/AIDS $193.3 bn
Cerebrovascular disease $298.2 bn
Heart diseases $753.2 bn
Cancer $895.2 bn

SOURCE: THE GLOBAL ECONOMIC COST OF CANCER (ACS, 2010).
GE Discovery LS
Inside a PET/CT

Full ring of PET detectors seen in a dedicated PET scanner

PET/CT scanner with a CT gantry in front of PET detectors
Role of $^{18}$F-FDG PET/CT in Breast Cancer

Established Role
(Guideline based & cost-effective)

New Tracers with Potential

Changing Technology
GUIDELINES

• National Comprehensive Cancer Network (NCCN)

• Evidence-based indications for the use of PET-CT in the United Kingdom 2016

• SNMMI: A summary of the recommendations and practice guidelines of professional groups 2013

• Revised RECIST v1.1 2009 (CT/MRI)

• From RECIST to PERCIST (Wahl et al. 2009)

• EANM procedure Guidelines version 2.0, 2015

• NICE Guidelines & Individual National Guidelines
National Comprehensive Cancer Network (NCCN) guidelines:

FDG PET/CT for

- Locoregional staging, for locally-advanced BC.
- Early response indicator for systemic, neoadjuvant therapy for metastatic disease.
- Assessment of treatment response in metastatic disease, particularly bony disease.
National Comprehensive Cancer Network (NCCN) guidelines:

$^{18}$F-FDG PET/CT Not indicated for

1. Detecting or screening of primary BC.
2. Staging of primary, axilla, or metastatic early-stage disease.
3. Screening.
43 years old lady newly diagnosed right breast cancer with two low density liver lesions on CT, FDG PET to rule out metastasis.
FDG PET/CT showed right BC with axillary nodal (Level 1 and 2) involvement. No distant metastasis.
RCR/RCP: Evidence-based indications for the use of PET-CT in BC in the United Kingdom 2016:

1. Assessment of multi-focal disease or suspected recurrence in patients with dense breasts.
2. Differentiation of treatment-induced brachial plexopathy from tumour infiltration in symptomatic patients with an equivocal or normal MR.
3. Assessment of extent of disease in selected patients with disseminated BC before therapy.
4. Assessment of response to chemotherapy in patients whose disease is not well demonstrated using other techniques; for example, bone metastases.
38 years old lady, with known right breast cancer with right axillary nodal involvement.

FDG PET showed IM nodes

30/10/2017
Invasive carcinoma of left breast classified as T3N2M0 (stage IIIA) before PET imaging in 62-y-old woman. David Groheux et al. J Nucl Med 2016;57:17S-26S
SNMMI: A summary of the recommendations and practice guidelines of professional groups 2013:

BREAST CANCER:

1. Initial staging of patients with locally advanced or metastatic BC when conventional scans are equivocal or suspicious.

2. Follow-up of patients with BC.
Bifocal invasive ductal carcinoma of left breast initially classified T3N0M0 (stage IIB) in 63-y-old woman.


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Monitoring Response to Therapy
# Difference between RECIST and PERCIST

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>RECIST 1.1 (CT)</th>
<th>PERCIST (PET/CT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete Response (CR)</td>
<td>Disappearance of all lesions. No new lesions</td>
<td>Disappearance of all metabolically active disease</td>
</tr>
<tr>
<td>Partial Response (PR)</td>
<td>30% decrease in the sum of diameters of the target lesion</td>
<td>30% and a 0.8 unit decline in SUV peak between the most intense lesion before treatment and the most intense lesion after treatment, although not necessarily the same lesion</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>Progression of Disease (PD)</td>
<td>. 20% increase in the sum of diameters of the target lesions. One or more new lesion</td>
<td>30% and a 0.8 unit increase in SUV peak, or new lesions or 75% increase in total lesion metabolic activity</td>
</tr>
<tr>
<td>Stable Disease (SD)</td>
<td>Neither PR or PD</td>
<td>Neither PR or PD</td>
</tr>
</tbody>
</table>
KEY MESSAGE

Change in glucose metabolism precedes anatomical change
66 years old lady with left breast cancer, post mastectomy developed metastasis to lung, liver and bones.
67 yr F, with right BC, post lumpectomy developed widespread pulmonary, liver and bone metastasis.

06/05/2016

05/08/2016
Example of Complete Metabolic Response (CR)
Patient with recurrence in right breast, palpable right lymph nodes, and general feeling of tiredness.

PET scan showed
TNBC in left breast initially classified as T3N1M0 and treated with neoadjuvant chemotherapy, conservative surgery, and locoregional radiotherapy in 50-y-old woman.

SHARED MESSAGE

- SUSPECTED DIAGNOSIS  X
- INITIAL WORKUP/STAGING
- RESTAGING/RECURRENTCE
- SURVEILLANCE/FOLLOW-UP  X
- SUSPECTED RECURRENTCE
BREAST CANCER
1,790,861 cases in 2015

SUSPECTED DIAGNOSIS: No Indication

INITIAL WORKUP/STAGING

Locally Advanced BC:

FDG PET-CT for the detection and evaluation of metastatic disease is generally encouraged especially when other imaging studies are suspicious or equivocal.

Recommended
BREAST CANCER

SUSPECTED DIAGNOSIS: No Indication

INITIAL WORKUP/STAGING

Recommended:
• Assessment of multi-focal disease
• Prior to neoadjuvant chemo for locally advanced or limited metastatic disease
  • inflammatory breast ca
  • skin and/or pectoral muscle involvement
  • breast ca >5cm
  • ≥4 axillary nodes
  • Axillary lymph nodes fixed to one another or to other structures
  • Lymph node sites other than the axilla
RE-STAGING/RECURRANCE:
- For re-staging if all known disease has been surgically removed. **Not indicated**
- Repeated use of PET in Stage IV disease is of **unproven benefit**.
- Assessment of response to chemotherapy in patients whose disease is not well demonstrated using other techniques; e.g., bone metastases. **Recommended**
- Differentiation of treatment-induced brachial plexopathy from tumour infiltration in symptomatic patients with an equivocal or normal MR. **Recommended**

SURVEILLANCE/FOLLOW-UP: **not indicated unless high risk pt**
BREAST CANCER

SUSPECTED RECURRENCE: Recommended

[18F]Fluorodeoxyglucose (FDG)-Positron Emission Tomography (PET)/Computed Tomography (CT) in Suspected Recurrent Breast Cancer: A Prospective Comparative Study of Dual-Time-Point FDG-PET/CT, Contrast-Enhanced CT, and Bone Scintigraphy

Malene Grubbe Hildebrandt, Oke Gerke, Christina Baun, Kirsten Falch, Jeannette Ansholm Hansen, Ziba Ahangarani Farahani, Henrik Petersen, Lisbet Børnsø Larsen, Sandra Davnijak, Inguna Buskevica, Selma Bekas, Katrine Sæve, Anne Marie Bak Jylling, Marianne Ewertz, Abbas Alavi, and Poul Flemming Høiland-Carlson

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The latest version is at http://jco.ascopubs.org/cgi/doi/10.1200/JCO.2015.63.5185

JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT
• There is need for health economics driven evidence to address the cost-effectiveness of $^{18}\text{F}-\text{FDG}$ PET/CT.
So What is BEYOND Guidelines??

New PET tracers (the Queen Maker)
Change in Hardware (better resolution)
Change in software (AI)

RESULT
Detection of disease in very small lesions
e.g. 4-5mm lymph nodes
Tracers with Potential

**F-18-FES**

Pt with progressive disease after multiple lines of antihormonal/chemotherapy.

FES uptake also appears predominant in bone marrow of this patient, in whom laboratory signs of bone marrow infiltration were present.

Van Kruchten JNM Feb 2012

**F-18-Annexin V**

**Cu-64 and I-124** humanised MoAb (HER-2/neu)
Mrs YC Lt Breast Ca
F-18-FLT PET scan
To

the Organising Committee, &

Colleagues

UCLH Cancer Collaborative

London Cancer North and East