THE ROLE OF POSITRON EMISSION TOMOGRAPHY/COMPUTED TOMOGRAPHY (PET/CT) IN CANCER BREAST

Essay

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Summary and Conclusion

Breast cancer is the most commonly diagnosed form of cancer and leading cause of death in women. The incidence rate is increasing and woman with 1 in 8 chances of women developing breast cancer in their lifetime.

Mortality for patients with breast cancer decreased significantly, largely because of early detection or screening for breast cancer and advances in medical care and treatments.

Conventional imaging modalities such as mammography and ultrasound rely primarily on changes in anatomic structure for disease detection. FDG PET can help detect accelerated metabolic activity that occurs before anatomic structural changes occur. However, the expense of the examination and radiation exposure involved is not generally suitable for routine screening purposes.

A major advantage of FDG PET imaging as compared to conventional imaging is the ability to screen the entire patient for local recurrence, lymph node metastases and distant metastases during a single whole body examination.

The main drawback of PET in tumor imaging is the complete absence of anatomic landmarks, which impedes precise localization of lesions. Furthermore, there are issues

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List Of Abbreviations

18FDG	18F- FluoroDeoxyGlucose
18-F-FES	Fluorine-18 estradiol
ALND	Axillary lymph node dissection
CIS	Carcinoma in situ
CT	Computed Tomography
DCIS	Ductal Carcinoma In Situ
ER	Esrtrogen Receptors
FDG	FluoroDeoxyGlucose
GLUT	Glucose Transporters
H+	Hydrogen ion
IDC	Invasive ductal carcinomas
ILC	Invasive lobular carcinoma
IV	Intravenous
KeV	Kilo electron Volt
KV	Kilo Volt
LABC	Locally Advanced Breast Cancer
LCIS	Lobular Carcinoma In Situ
LSO	Lutetium Oxyorthosilicate
MCi	Micro Curies
MeV	Mega electron Volt
MRI	Magnetic Resonance Imaging
PET	Positron Emission Tomography

List Of Abbreviations (Cont.)

PET/CT	Positron Emission Tomography/Computed Tomography
PHA	Pulse Height Analyzer
PMTs	Photomultiplier Tubes
PR	Progesterone Receptors
SLN	The sentinel lymph node
SUV	Standardized uptake value
SUVs	Standard Uptake Values
TDLU	Terminal ductal lobular units
WHO	World Health Organization

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Introduction

Breast cancer is the leading cause of death and the most common cancer in women, yet we still don't know how to prevent it. Early and accurate diagnosis remains a challenge. The current standards rely on physical examination, mammography and/or ultrasound, and fine needle aspiration. If the breast cancer is found early, prompt treatment could save lives ***(Rohren et al., 2004).***

Imaging modalities like computed tomography (CT) and magnetic resonance (MR) imaging rely on detecting anatomic changes for the diagnosis, staging and follow-up of cancer patients. However, positron emission tomography (PET) has the ability to demonstrate abnormal metabolic activity, and 18F-2-deoxy-D-glucose (FDG) PET provides important tumor-related qualitative and quantitative metabolic information that may be critical for the diagnosis and follow-up ***(Wahl et al., 1991).***

Moreover, the combination of PET and computed tomography (PET/CT) allows the functional PET and anatomical CT images to be acquired under identical conditions and then they are rapidly co-registered. This combined system has advantages over CT alone as functional information is added to morphological data. This combined

system has advantages over PET alone because pathological areas of tracer uptake are better localized and the image acquisition time is reduced ***(Tatsumi et al., 2006).***

PET/CT has a role to play in a selected group of patients, such as those with dense breasts or with implants, for determining tumor multiplicity, for localizing the primary tumor in those patients with metastases of a breast origin when the mammography is indeterminate, and for those patients whom biopsy is not a desirable option . PET/CT has a potential advantage over PET for evaluating small lesions in which the uptake may be artifactually lowered due to the partial volume effect of PET because areas of mild hyperglycolytic activity can be reliably assigned to normal or abnormal anatomical structures ***(Schirrmeister, Kühn et al., 2001).***

Axillary lymph node metastasis is an important factor when determining the prognosis of patients. Breast cancer patients with four or more involved axillary lymph nodes have a significantly higher risk of recurrence. The sensitivity and specificity of axillary PET imaging in breast cancer patient have been reported as 79-94% and 86-92%, respectively. PET/CT can accurately localize and differentiate the metastatic and reactive lymph nodes when CT shows multiple enlarged lymph nodes in the axilla ***(Bar-Shalom et al., 2003)***.

Distant metastases from breast cancer are frequently found in the lungs, liver and bones. One advantage of whole-body PET imaging over conventional imaging modalities such as chest films, bone scanning, and abdominal ultrasound is its ability to detect metastasis at different sites and organs during a single examination ***(Cook et al., 1998).***

Therapy induced changes in tumor metabolism may be helpful in making decisions about continuation, modification or cessation therapy. Therefore, [(18) F] FDG PET-CT appears to be a promising tool for the personalization of breast cancer treatment by its early identification of non responders. The introduction of new PET tracers and the development of new instruments will offer opportunities to improve the role of PET-CT in decision making of therapy in these patients ***(Pons et al., 2009)***.

Detecting early recurrence has an important survival benefit because it prompts clinical consideration for administering different therapies. However, it is difficult to differentiate true recurrence from postsurgical sequelae and radiation sequelae with using just the conventional imaging modalities ***(Eubank et al., 2002).***

PET is considered to be highly effective for evaluating patients with suspected recurrent breast cancer, and it surpasses the other conventional imaging modalities in terms of whole-body evaluation ***(Grahek et al., 2004).***

Aim of The Work

The aim of this work is to highlight the role of PET/CT in diagnosis, staging, follow up and assessment of therapy in patients with breast cancer.

Anatomy of The Breast

Gross anatomy of the breast:

The adult mammary gland is normally situated between superficial and deep layers of the superficial pectoral fascia of the anterior chest wall, extending roughly from the second intercostal space to the inframammary fold, overlying the sixth or seventh anterior intercostal space (Fig. 1). The ductal tissue can extend to the clavicle, to the anterior midline, into the axilla, and as far laterally as the border of latismus dorsi muscle. In 15% of cases ducts extend beyond the inframammary fold. The ducts don't communicate across the midline of the chest ***(Siegel et al., 1990).***

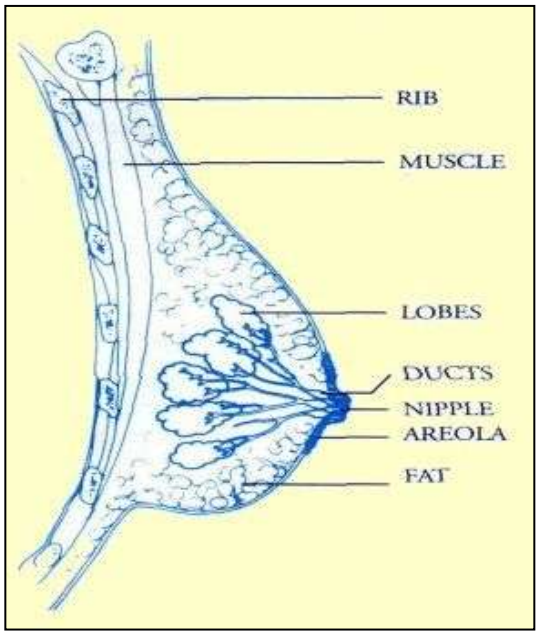

Figure (1): Cross sectional anatomy of the female breast ***(Rayan, 2000)***