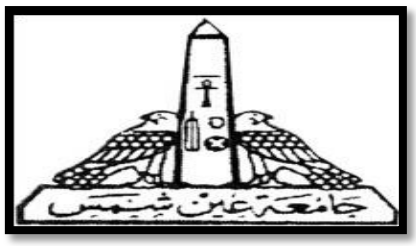

The Role of Positron Emission Mammography in Breast Cancer

Protocol of an essay

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List of abbreviations

ADH	Atypical ductal hyperplasia
APD	Avalanche photodiodes
ASIC	Application specific integrated circuit
BIRADS	Breast imaging reporting and data system
BRCA 1	Breast cancer gene 1
BRCA 2	Breast cancer gene 2
CC	craniocaudal
DAQS	Data acquisition boards-slaves
DCIS	Intraductal carcinoma insitu
DOI	Depth of interaction
FDG	Fluoro-deoxyglucose
FES	Fluoro-estradiol
FLT	Fluoro-L-thymidine
FMAU	C-11-2'-Fluoro-5 methyl-1-beta-d-arabinofuranosyl uracil
HRT	Hormone replacement therapy
keV	Kilo electron volt
LCIS	Lobular carcinoma insitu
MBq	Megabequerel
mCi	millicuries
MeV	Mega electron volt
MLO	Mediolateral oblique
MRI	Magnetic resonance imaging
mSv	milliSieverts
NOS	Not otherwise specified
PEM	Positron emission mammography
PET	Positron emission tomography
PUV	PEM uptake value
SUV	Standardized uptake value
TGR-DCC	Trigger and data concentrator board-master
WBPET	Whole body positron emission tomography

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Introduction

Breast cancer is the most common cancer and the leading cause of cancer death in females, accounting for 23% of the total new cancer cases and 14% of the total cancer deaths in 2008. Like other cancers, early detection, accurate staging, and appropriate treatment can improve survival from breast cancer ***(Eo et al., 2012).***

Three key factors in improving the efficacy of breast cancer therapies include; appropriate patient selection for therapies, early evaluation of therapeutic efficacy, and early identification of both primary and recurrent disease ***(Franc and Hawkins, 2007).***

For diagnosis and characterization of primary breast lesions, anatomical imaging such as mammography, ultrasonography, and magnetic resonance imaging (MRI) are commonly used. However, the diagnostic accuracy of mammography is limited even when combined with ultrasonography. MRI is not perfect, because many benign lesions are detected as false-positives, and some tumors are missed due to increased background signal, particularly under estrogen-modulation conditions. Additionally, some technical limitations

exist such as claustrophobia and implanted metal materials ***(Eo et al., 2012).***

New technologies for diagnosis and treatment of breast cancer aim for higher specificity to genetic and biological processes occurring at the tumor site. Positron emission tomography (PET) is a functional "in vivo" imaging technique relying on the uptake of positron-emitting radio-labeled molecules. It has been extensively used to probe for cancer loci in oncological pathologies ***(Oliveira et al., 2009).***

However, PET is not currently indicated for breast cancer detection. Studies show severe limitations, mainly due to a poor spatial resolution. The sensitivity of PET to detect breast lesion under 1 cm remains low around 57% ***(lavaysiere et al., 2009).***

Therefore comes the need to develop Positron Emission Mammography (PEM), which has been reported to have higher sensitivity than whole-body positron emission tomography (PET) due to higher spatial resolution **(*Eo et al., 2012).***

PEM uses a dedicated instrument for breast cancer detection that is equipped with two parallel photon detectors in a configuration similar to mammography compressors. As an organ-specific instrument, it can provide high spatial resolution compressed-breast images. In initial studies, the sensitivity of PEM was reported to be about 91% (***Eo et al., 2012).***

Aim of the work

This essay is designed to highlight the role of Positron Emission Mammography in characterization, diagnosis and guiding treatment of breast cancer.

Anatomy of the breast

The adult (female) breast lies on the anterior thoracic wall. Its base extends from the 2nd to the 6th rib. It lies from the edge of the sternum to almost the mid-axillary line. Part of the superior lateral quadrant is sometimes extended towards the axilla. This is the axillary tail of the breast ***(Lagopoulos, 2007).***

The two mammary glands (mammo=breast) are modified sudoriferous (sweat) glands that produce milk. The superficial fascia splits to contain the breast. The deep layer of the superficial fascia overlies the chest muscles, separated from them by the retro-mammary space. The superficial (or subcutaneous) layer lies deep to the dermis. Cords of connective tissue connect the dermis to the ducts of the gland and to the deep layer of the superficial fascia (the suspensory ligaments of Astley Cooper) (Fig. 1). Contraction of these cords leads to indentation of the skin associated with some tumors ***(Lagopoulos, 2007).***

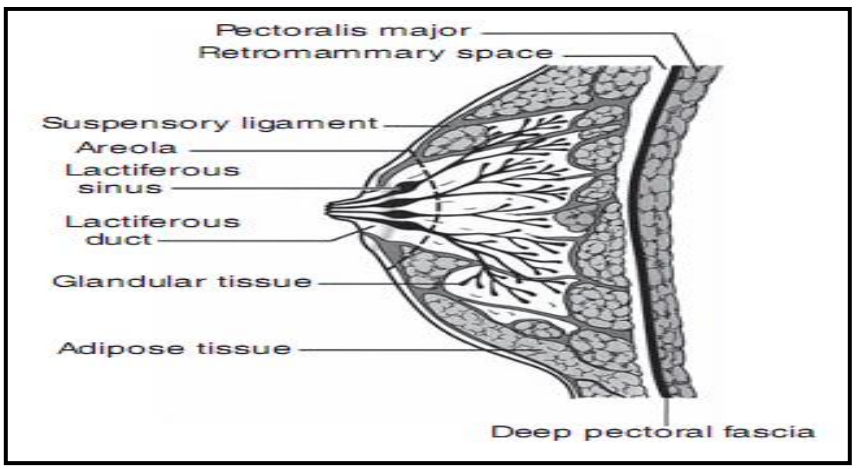

Fig. (1): *The suspensory ligaments* ***(Quoted from: Dudek, 2002).***

The breast lies over the muscles of the anterior thoracic wall. Also, there are muscles associated with the axillary region. Knowledge of these muscles and their blood and nerve supply is important to the surgeon in reconstructive breast surgery. The serratus anterior receives its nerve supply from the long thoracic nerve. The nerve can be damaged during dissection of the axillary lymph nodes (***Lagopoulos, 2007).***

Centrally located on the surface of the breast is the areola – a circular pigmented area of skin 2-6 cm in size. Pigmentation of the areola is partially dependent upon estrogen levels. Elevations around the perimeter of areola are called the Morgani's Tubercles. These tubercles are formed by the openings from the ducts of the Montgomery's glands. The Montgomery's glands secrete a fatty lubricant, which protects the nipple during lactation (nursing). In the center of the areola is the nipple protuberance, which contains 5-10 opening for the ducts that lead from the milk-producing lobes of the breast (Fig. 2). Sudden inversion or flattening of the nipple may indicate underlying malignancy ***(Hussain et al., 2003).***