بسم الله الرحمن الرحيم

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شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار

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INTRODUCTION

B reast cancer (BC) incidence rates have increased by 20% with a possible increase of breast cancer diagnosed before the age of 50 *(Siegel et al., 2013).* The pursuit of accurate and cost-effective ways to diagnose BC early remains of interest. Mammography is the only breast imaging examination with a demonstrated ability to reduce BC mortality, but it has a population-based sensitivity of 80% *(Tagliafico et al., 2016)*.

Cancer care has become more individualized for our patients, and thus, better characterization for treatment planning is required. Imaging examination is an important tool to help diagnose cancer and determine therapeutic response based on microstructure *(Jae-Hun et al., 2017)*.

Angiogenesis has been a common prognostic indicator for breast carcinoma in the last decade. Indeed, previous studies have shown that higher intratumoral micro vessel density is statistically correlated with a greater incidence of metastases, and that intratumoral micro vessel density is an independent prognostic indicator for overall and relapse-free survival in early-stage invasive breast carcinoma *(Dromain et al., 2006).*

Mammography (MG) is the standard of care in the detection of breast cancer in screening programmes and in symptomatic women. Nevertheless, mammography suffers from several limitations, primarily due to reduced contrast

between tumours and surrounding tissue. Especially in dense breasts, this can lead to a decrease in sensitivity and additional imaging methods are necessary *(Emaus et al., 2015)*.

Over the last few years, new methods have been developed and tested using contrast media to detect BC and to extend the capability of mammography. These methods are based on the biological principle of rapid formation of tumoral micro-vessels that render malignancy associated vessels more permeable to contrast agent than normal tissue, resulting in tumour enhancement *(Kuhl, 2007)*.

Contrast-enhanced spectral mammography (CESM) is a relatively new tool in breast imaging, which combines the benefits of full field digital mammography (FFDM) with intravenous contrast utilization. FFDM alone is a two-dimensional modality in which summation of overlapping tissues accounts for false-negative and false-positive findings, resulting in increased recall rates and limited sensitivity of the examination, especially in the setting of heterogeneously dense or extremely dense breast tissue. CESM advantageously uses the concept of angiogenesis in tumors by allowing contrast agents to highlight the areas of blood vessel proliferation relative to the surrounding normal breast tissue *(Bhimani et al., 2017).*

CESM is a technique based on dual-energy acquisitions, where two images are acquired using conventional low-energy

MMG and high-energy MMG after intravenous injection of an iodinated contrast medium. The differences between X-ray attenuation of iodine and breast tissues at these two energy levels are exploited to suppress the background breast tissue then highlight hyper vascular lesions for evaluation. This technology holds the potential for better detection of malignant lesions within dense breast tissue *(Mori et al., 2016).*

CESM imaging technique based on this principle uses mammography in combination with iodine-based contrast agents to increase diagnostic capability through detection of areas of increased vascularization in the breast *(Tagliafico et al., 2016)*.

CESM received FDA clearance in 2011. CESM serves as a valuable tool in high-risk screening, further evaluation of extremely dense breast tissue, and diagnostic assessment of suspicious lesions, breast cancer staging, surgical planning, and assessment of treatment response. CESM can help characterize and guide management particularly when there are multiple suspicious findings on initial screening mammogram *(Daniaux et al., 2015).*

AIM OF THE WORK

- To assess the diagnostic performance of CESM in detection and diagnosis of breast lesions, in comparison to the standard sonomammographic examination.

- To predict the most reliable enhancement characteristics and morphology descriptors to discriminate benign and malignant lesions.

- To assess the role of contrast-enhanced (CEM) mammography for detecting malignant lesions compared to histopathological results.

Chapter 1
ANATOMY OF THE BREAST

The female breast is located on the chest wall between the 2nd and 6th or 7th ribs, lateral to the sternum and medial to the anterior axillary line. The fatty and glandular tissue is suspended by the fascial-ligamentous system and the skin envelope. The quantity, quality and relationship of these four factors determine the shape of the breast *(Palhazi, 2018)*.

The base of the breast extends from the sternal border medially to the mid axillary line laterally and is encompassed by the superficial and deep fascia of the chest wall. Two-thirds of the breast lies anterior to the pectoralis major; the remainder lies anterior to the serratus anterior. A prolongation of the upper outer quadrant of the breast, referred to as the tail of Spence, extends into the axilla *(Soran et al., 2016)*.
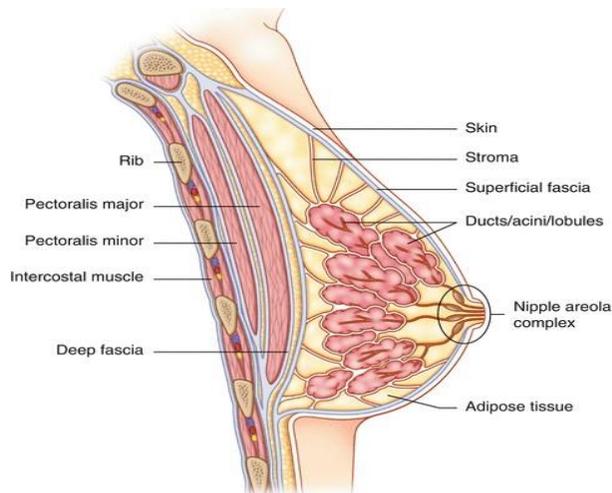
Fig. 1: Component of the breast *(Soran et al., 2016).*

I. **General Breast Anatomy**

Average breast size: Diameter 10-12 cm; thickness 5-7 cm and median 5 cm thick with mammographic compression. Its support and mobility relate to fascial attachments to skin and chest wall *(Kettler, 2006).*

The breast is made up of glandular and ductal elements embedded within fibro-fatty tissue with a ratio of glandular to fibro-fatty tissue that varies among individuals *(Untch et al., 2014).*

It is composed of the following structures:

1. *Glandular & ductal Elements:*

The breast ductal system consists of 15–20 branching ducts, which radiate from the nipple to continue to the functional units of the breast.

- Extra-lobular ducts.

- TDLUs (A terminal ductal-lobular unit (TDLU), is the basic functional and histopathological unit of the breast. The TDLU is composed of a small segment of terminal duct and a cluster of ductules, which are the effective secretory units **(Fig. 2).** A normal terminal ductal lobular unit ranges from 1 - 4 mm).

Extra-lobular ducts and TDLUs contain two cell layers: Outer myoepithelial cell layer and inner epithelial cell layer surrounded by the basement membrane.

2. *Stroma/Connective Tissue:*

- Fat.

- Connective tissue.

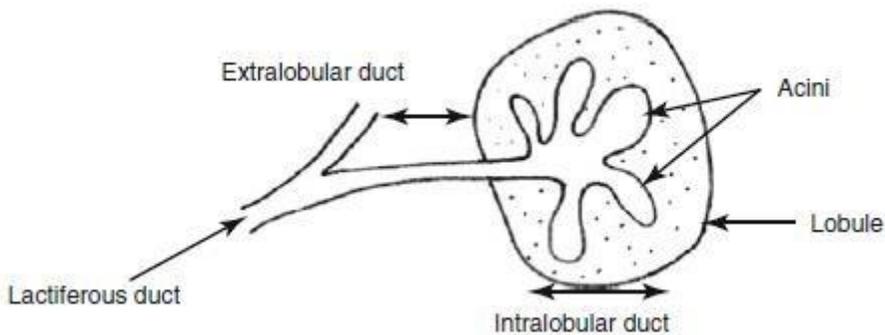- Coopers ligament.

- Nerves, blood vessels and lymphatics.

3. *Interlobular Tissue*

- High in collagen content.

- Relatively lower in cellular elements and hyaluronic acid.

4. *Intralobular Tissue*

- Relatively loose with lower collagen content.

- Higher in cellular elements and hyaluronic acid.

- Hormone sensitive and shows cyclic histologic changes.

(Holmes, 2015)

Fig. 2: Illustration of Terminal Ductal Lobular Unit (TDLU)
(Darlington, 2015).

Zonal Anatomy of the breast (Fig. 3):

### 1. *Pre- mammary (Subcutaneous) Zone:*

- Most superficial zone, its anterior margin is defined by skin, posterior margin is defined by AMF.

- It contains subcutaneous fat, blood vessels, anterior suspensory (Coopers) ligaments which provides support for breast and usually visible on mammograms and sonograms.

2. *Mammary Zone:*

- Defined anteriorly by ant.mamary fascia (AMF) and posteriorly by post.mamary fascia (PMF).

- Contains majority of ducts/TDLUs, stromal fat and stromal connective tissue.

- Subdivided haphazardly by interspersed ant.suspensory ligaments (ASLs).

3. *Retro-mammary Zone:*

- Most posterior of three zones.

- Defined anteriorly by PMF and posteriorly by chest wall Contains fat and PSLs which attach PMF to chest wall (***Kettler, 2006).***
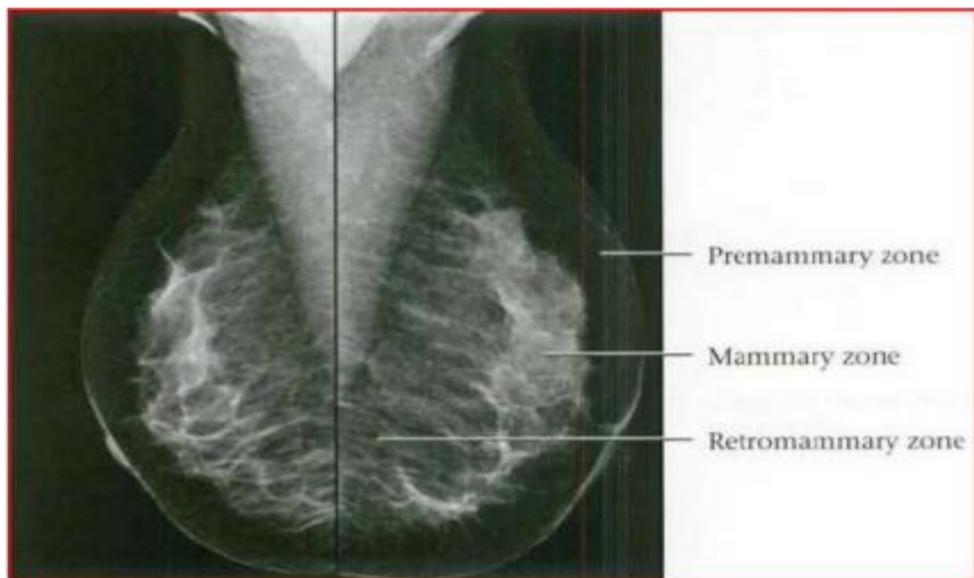
Fig. 3: Retro-mammary Zone *(**Quoted from Tweet board, 2015).***

II. Nipple areolar complex & skin

The Skin:

The skin overlying the breast is typically 0.5–2.0 mm in thickness. Beneath the skin is a superficial layer of fascia that divides into the superficial and deep layers as it reaches the breast. Between these layers the breast proper develops. The deep layer of fascia lies directly on the fascia of the pectoralis major muscle. This allows slight movement of the breast on the

chest wall. The breast is supported by the Cooper's ligaments, and also by the skin, deep and superficial layers of the fascia and pectoralis major muscle.

The superficial fascia is covered by a layer of adipose tissue 2–2.5 cm thick and is attached to the skin by the Cooper's Ligaments which pierce the fat. The retro mammary space lies between the deep fascia of the breast and the fascia of the pectoralis major muscle and is filled by loose connective tissue.

The main suspensory ligaments of the breast course from the pectoral fascia through the glandular tissue to the skin. These are the so-called Cooper's ligaments. These ligaments have three distinct segments (deep, middle, superficial) created by the anterior and posterior lamella of the superficial fascia of the breast. The deep segment is between the pectoral fascia and the posterior lamella, the middle segment is between the posterior and anterior lamella, and the superficial segment is between the anterior lamella and the skin.

Cooper's ligaments have significant oncologic importance. Their deep segment anchors the breast to the pectoral fascia, so total removal of the gland is facilitated by removal of the pectoral fascia. A tumor may also infiltrate these ligaments causing skin retraction, which is an important diagnostic sign of breast cancer. By contraction of the pectoralis major muscle, this skin sign can be provoked, which