INTRODUCTION

Breast cancer is the commontest cancer in women world wide with an estimated 1.4 million cases in 2008.The rates have been increasing steadily and there is every indication that they will continue to do so over the next few decades **(Jack, 2010).**

The majority of the lesions that occur in the breast are benign, It is important to recognize benign lesions and distinguish them from breast cancer **(Guray and Sahin, 2006).**

Mammography is an effective means of detecting and diagnosing breast cancer, it decreases breast cancer mortality by 1/3 when used as screening tool, however reported false negative rate ranges from 4-34% (**Lee, 2004).**

Mammography has been proven to detect breast cancer at an early stage, other screening technologies also may contribute to the earlier detection of breast cancer, particularly in women under the age of 40 years for whom mammography is less sensitive such as breast ultrasound or magnetic resonance imaging **(Saslow et al., 2007).**

Breast ultrasound examination has been used for years as an adjunct to mammography for evaluating palpable or mammographically detected breast masses to determine if a lesion represents a cyst or a solid mass **(Scott et al., 2006).**

Breast MRI has become an important tool for breast cancer detection and characterization. Dynamic contrast-enhanced MRI is highly sensitive for breast cancer, allowing detection of malignancy that is occult on physical examination, mammography, and sonography **(Wang et al., 2009).**

Contrast enhanced MR imaging has high sensitivity for detection of breast cancer and this has led to growing interest in the use of this modality for the evaluation of breast diseases. It is an important method of diagnosis suspicious breast lesions **(Lee, 2004).**

Several investigators have evaluated MR imaging in the characterization of mammographically and clinically detected suspicious lesions and have reported improved specificity with MR imaging using difference in enhancement kinetics and morphologic features between malignant and benign lesions **(Liberman et al., 2002).**

MR imaging allows assessment of both morphologic and kinetic features of the lesion, first based on its morphology. If the lesion has suspicious morphologic features, regardless of its enhancement kinetics, further evaluation including tissue diagnosis should be considered. If the lesion has benign or indeterminate morphologic features, assessment of the kinetics can help to separate those lesions that are most likely benign from those require further evaluation or possible biopsy **(Lee, 2004).**

MR imaging can provide clinically important information that can not be obtained with conventional imaging methods. So in the future MRI will be an adjunctive breast imaging tool just as breast US is today **(Orel, 2000).**

AIM OF THE WORK

To investigate the role of digital mammography, ultrasound, and MRI**.** imaging as a complementary tools in evalution of beingn and malignant of breast masses and planning patient mangement in the future.

ANATOMY OF THE BREAST

Development:

During the 5th week of human fetal life, the ectodermal primitive milk streak or “galactic band” develops from axilla to groin on the embryonic trunk. In the region of the thorax, the band develops to form a mammary ridge, whereas the remaining galactic band regresses. Incomplete regression or dispersion of the primitive galactic band leads to accessory mammary tissues, found in 2% to 6% of women **. Fig. [1].**

At 7 to 8 weeks of gestation, a thickening occurs in the mammary ridge (milk hill stage), followed by invagination in to the chest wall mesenchyme (disc stage) and tridimensional growth (globular stage). Further invasion of chest wall mesenchyme results in a flattening of the ridge (cone stage) at 10-14 weeks of gestation. Between 12-14 weeks, mesenchymal cells differentiate into the smooth muscle of the nipple and areola. Epithelial buds develop (budding stage) and then branch to form15-25 strips of epithelium (branching stage) at 16 weeks; these strips represent the future secretory alveoli. The secondary mammary ridge then develops, with differentiation of hair follicle, sebaceous gland and sweat gland elements, but only the sweat gland develops fully at this time. Genetically, the breast parenchyma is believed to develop from sweat gland tissue. In addition, special apocrine glands develop to form the Montgomery glands around the nipple. The developments described thus far are independent of hormonal influences.

(Rosai, 2004)

During the 3rd trimester of pregnancy, placental sex hormones enter the fetal circulation and induce canalization of the branched epithelial tissue (canalization stage). This process continues from the 20th to the 32nd week of gestation. At about term, 15-25 mammary ducts are formed, with coalescence of duct and sebaceous glands near the epidermis**.**

Parenchyma differentiation occurs at 32 to 40 weeks with the development of lobular**-** alveolar structures that contain colostrum (end-vesicle stage). A four fold increase in mammary gland mass occurs at this time, and the nipple alveolar complex develops and becomes pigmented. In the neonate the stimulated mammary tissue secretes colostral milk (witch's milk). During early child hood, the end vesicles become further canalized and develop in to ductal structures by additional growth and branching **.**

(Harris et al., 2000)

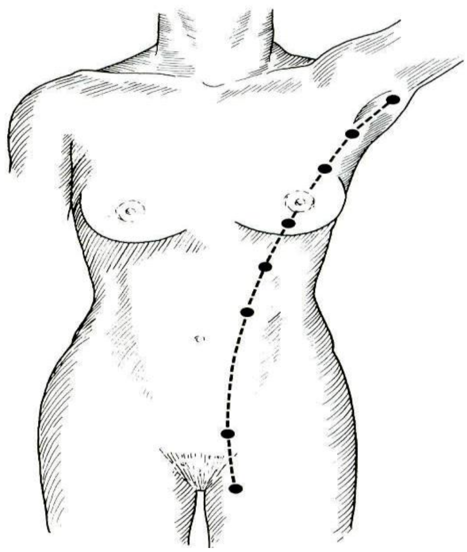


Figure [1]: The extent of the mammary ridge**.** Accessory nipples or breasts are usually found along this line **(Harris et al., 2000).**

Gross anatomy of the breast:

Breast parenchyma and support structure: In the female they are two large hemispherical eminences lying within the superficial fascia and situated on the front and sides of the chest, each extends from the second rib above to the sixth rib below and from the side of the sternum to near the mid axillary line **(Hansen et al., 2005).**

The breast lies on the deep pectoral fascia, the superficial pectoral fascia envelops the breast, suspensory ligaments called Cooper's ligaments connect the two layers providing a degree of support to the breast and giving the breast its shape **(Jonathan et al., 2008). Fig. [2].**

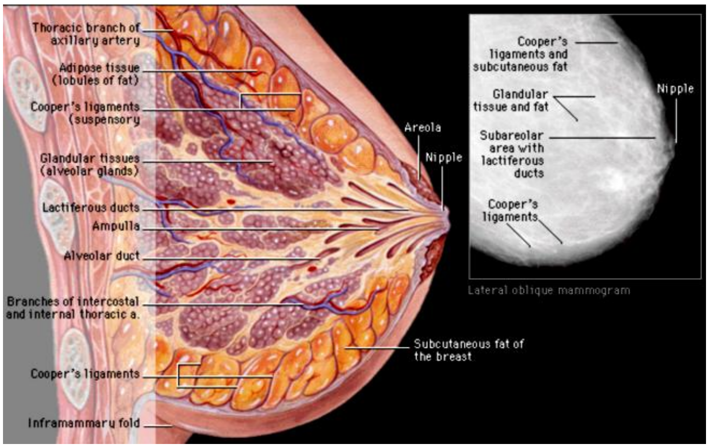


Figure [2]: Anatomy of the Breast **(Hussain et al., 2003).**

<u>The mature female breast is composed of essentially four structures</u>: Figure [2].

- Lobules or glands.
- Milk ducts.
- Fat.
- Connective tissue.

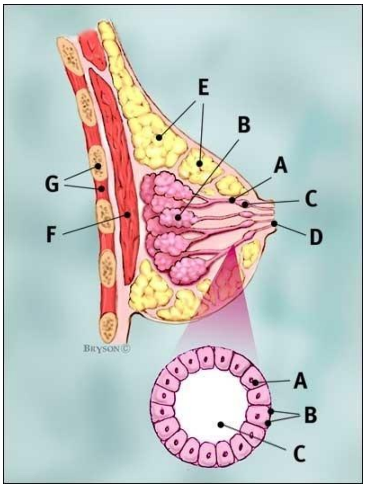


Figure [3]: Represents Breast profile**.**
A ducts**.**
B lobules**.**
C dilated section of duct to hold milk**.**
D nipple**.**
E fat**.**
F pectoralis major muscle**.**
G chest wall/rib cage**.**
Enlargement**:**
A normal duct cells**.**
B basement membrane**.**
C lumen (center of duct)**. (Ellis et al., 1993).**

The lobules group together into larger units called lobes. On average there are 15-20 lobes in each breast arranged roughly in a circular fashion. The distribution of the lobes is not even. However, there is a preponderance of glandular tissue in the upper outer portion of the breast. This is responsible for the tenderness in this region that many women experience prior to their menstrual cycle. It is also the site of half of all breast cancers **.**

The lobes empty into the milk ducts which course through the breast towards the nipple/areolar area. There, they converge into 6-10 larger ducts called collecting ducts (lactiferous duct) Just beneath the nipple-areolar complex, each lactiferous duct opens into a lactiferous sinus, which then continues to drain into a separate opening on the apex of the nipple**.**

(Allen, 2009)

The major ducts of the breast are composed of two cell layers: an inner cuboidal (or columnar) layer and an outer myoepithelial layer. The portion of the duct at the location of the lactiferous sinus, as well as the portiduct within the nipple, is lined by stratified squamous epithelium **(Collins. 2004).**

The basic functional unit of the breast is called the terminal ductal-lobular unit (TDLU), which is composed of a small segment duct and a cluster of alveoli (acini) **(Rosen, 2001). Fig. [4].**

The TDLU is the most important structure in the breast.It is the glandular unit, and it is postulated that most cancers arise in the terminal duct either inside or just proximal to the lobule. In addition to cancer, most of benign lesions that develop in the breast develop in the TDLU **(Kopans, 2004).**

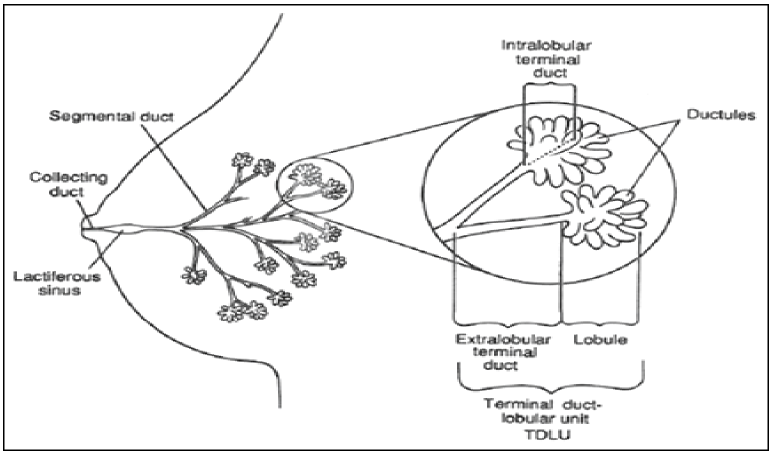


Figure [4]: Terminal ductal lobula unit**.**

The consistencies of breast lobes vary from woman to woman and may even vary in an individual from one side to the other. However, in general, the glandular portion of the breast has a firm, slightly nodular feel to it**.**

Surrounding the lobes there is lots of fat that covers the lobes and gives the breast its size and shape. Unlike the lobes, the fat is almost always soft. The discrepancy in textures between these two components allows one to outline the lobes by carefully palpating the breast. Interestingly, the difference in density between glandular breast tissue and breast fat is also the basis for mammographic imaging **.**

In general, the younger the woman, the denser her breasts. As a woman ages, her breasts become less dense and the space is filled with fatty tissue shown as dark areas on mammography x-rays. It is usually easier for radiologists to detect breast cancer in older women because abnormal areas are easier to spot**.**

(Allen, 2009)

The base of the breast overlies the pectoralis major muscle between the second and sixth ribs. It lies on the deep pectoral fascia, the superficial pectoral fascia envelops the breast **(Jay, 2009).**

The gland is anchored to the pectoralis major fascia by the suspensory ligaments(Cooper's Ligaments).These ligaments connect the two layers of the fascia providing a degree of support to the breast and giving the breast its shape ***(*Jonathan et al., 2008).**

The nipple should lie above the inframammary crease and is usually level with the fourth rib and just lateral to the midclavicular line **(Jay, 2009).**

Musculature related to the breast:

The breast lies over the musculature that encases the chest wall. The muscles involved include the pectoralis major, serratus anterior, external oblique, and rectus abdominus fascia. The blood supply that provides circulation to these muscles then perforates through to the breast parenchyma, thus also supplying blood to the breast **(Allen, 2009).**

Breast Quadrants and clock position:

The breasts can either be divided into quadrants or in relationship to the face of a clock for purposes of location of abnormalities. The Four Quadrants are the**:**

- UIQ: Upper Inner Quadrant**.**
- LIQ: Lower Inner Quadrant**.**
- UOQ: Upper Outer Quadrant**.**
- LOQ: Lower Outer Quadrant**.**

The exact locations within the quadrants can be represented by viewing each breast separately as a clock face**. Fig.[5] (Peart and Hill, 2005).**

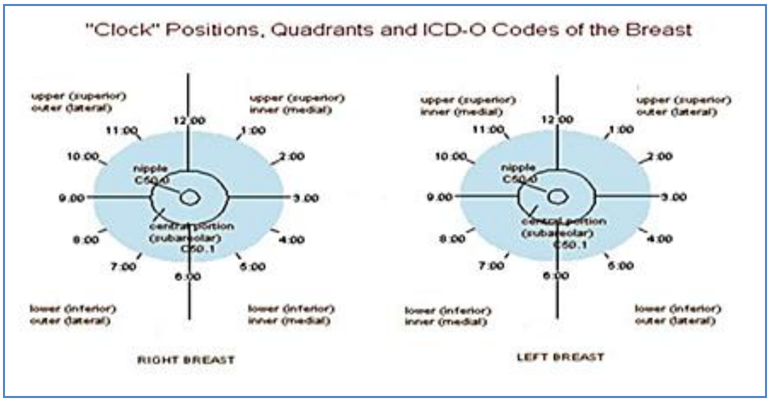
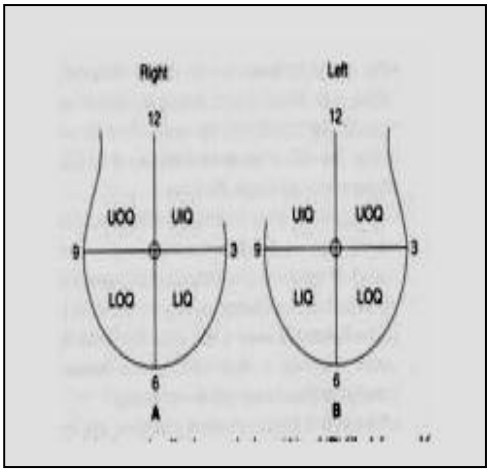


Figure [5a]: Breast Quadrants and clock position -Quadrant and Clock Divisions of the Breast (**Peart and Hill, 2005).**

Fig. [5-b]: Quadrant and Clock Divisions of the Breast (**Peart and Hill, 2005).**



The axilla:

Boundaries:

The axilla is a pyramidal space located between the upper part of the thoracic wall and the arm. The axilla forms a passageway for the vessels and nerves from the neck to reach the upper limb. Anatomically, the axilla is taken to have an apex, a base and four walls, three of which formed by muscles **. Fig.[6].**

- **Apex (or cervicoaxillary margin):** limited medially by the first rib, posteriorly by the upper margin of the scapula and medial face of the coracoid process of the scapula, and anteriorly by the clavicle**.**
- **Base:** This is an imaginary downward-turned surface that is wide at the thorax and narrow at the arm and correlates with the skin and thick layer of the fascia between, anteriorly, the inferior margins of the pectoralis major muscle (anterior axillary fold) and, posteriorly, the latissimus dorsi (posterior axillary fold)**.**
- **Anterior wall:** This is formed by the pectoralis major and minor muscles**.**
- **Posterior wall:** This is formed by the subscapularis muscle in its upper part and the teres major and latissimus dorsi muscles, in its lower part**.**
- **Medial wall:** This is formed by the first four ribs with their intercostales muscles, and also the upper part of the serratus anterior muscle**.**
- **Lateral wall:** The anterior and posterior walls converge laterally towards the humerus, and the lateral wall is formed by the tendon of the long head of the biceps brachii muscle and, more medially, the coracobrachialis muscle**.**

Contents of the axilla:

The contents of the axilla consist of the axillary artery and its branches, the axillary vein and its tributaries, nerves coming mostly from the brachial plexus, and finally lymph vessels and axillary lymph nodes. In this proximal portion, these elements are surrounded by the axillary sheath, which is a prolongation of the pre-vertebral portion of the fascia cervicalis. Between these elements, there is adipose tissue and mammary tissue that is cranially projected from the anterior face of the thorax into the axilla**.Fig.[6].**

(Macéa and Fregnani, 2006)

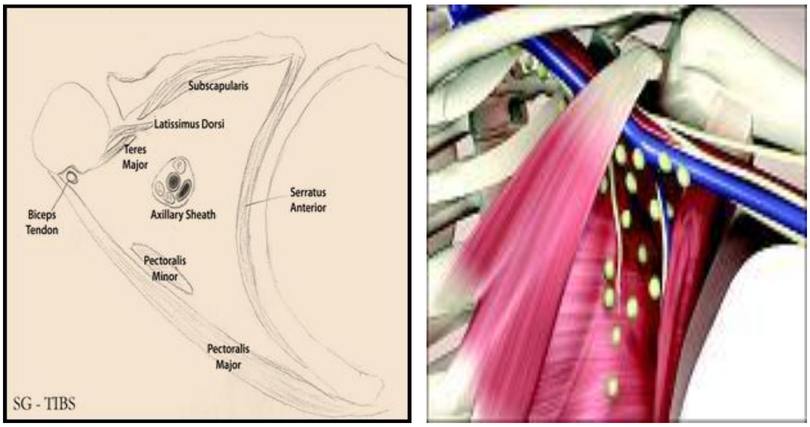


Figure [6]: Anatomy of the axilla **(Hugo, 2000).**

Microscopic anatomy of the breast:

The lobes of the breast are composed of smaller lobules – the structural unit of the breast. Each lobule is composed of an intralobular terminal duct and multiple saclike ductules lined with a single layer of epithelial cells and a peripheral layer of myoepithelial cells (smooth muscle). Cellular layers are separated from other breast tissues by a boundary layer known as the basement or basal membrane. The lobule and duct form a histopathologic unit called the terminal Ductal Lobular Unit or abbreviated as TDLU **(Andolina and Lippincot, 2001). Fig. [7].**

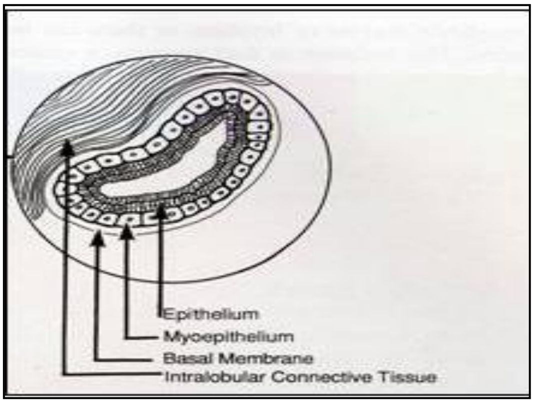


Figure [7]: Diagram of the lining of a breast lobule **(Andolina and Lippincot, 2001).**

Blood Supply:

Arterial supply:

The blood supply to the breast is composed of the following**: Fig.[8].**

1- Branches of the internal mammary (thoracic) artery pierce the intercostals spaces and traverse pectoralis muscle to supply approximately 60%of the breast mainly medial and central**.**

2- The lateral thoracic branch of the axillary artery supplies 30%, mainly upper outer quadrant**.**

3- Perforating branches of the anterior intercostal arteries**.**

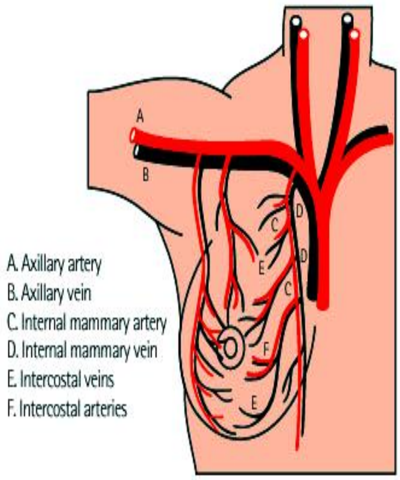


Figure [8]: Blood supply of the breast **(Agur & Lee.1999).**

Venous drainage:

Venous drainage accompanies the arteries to the axillary and subclavian veins and the azygos system.

(Agur & Lee, 1999)

Lymphatic drainage:

The breast is drained by lymph nodes to multiple areas that include the skin surrounding the breast, the chest wall, and the axilla. The majority of the lymphatic drainage is via the axilla region. This is why general surgeons use the lymph nodes in the axillary region to assess the spread of breast cancer when considering the appropriate therapy **(Ellis et al., 1993).**

Fig. [9]: Represents lymph node areas adjacent to the breast.

A pectoralis major muscle.

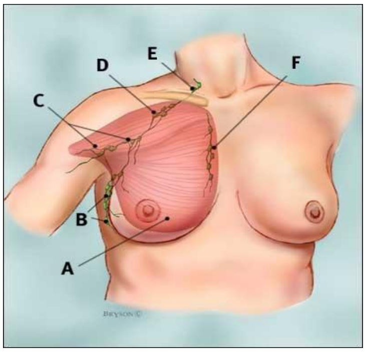
B axillary lymph nodes: level I.

C axillary lymph nodes: level II.

D axillary lymph nodes: level III.

E supraclavicular lymph nodes.

F internal mammary lymph nodes.



(Ellis et al., 1993)

Involvement of the supraclavicular lymph nodes is considered as a distant metastasis because it occurs in a retrograde fashion .

The internal mammary lymph nodes accompany the internal mammary vessels and lie in the fat and areolar tissue behind the intercostal spaces.

A small amount of the lymphatic flow from the breast crosses to the opposite side and some passes to the upper abdominal lymph nodes via diaphragmatic lymphatics **.**

(Macéa and Fregnani, 2006)

Innervation of the breast:

Innervation of the breast is provided by somatic sensory nerves and autonomic (sympathetic) motor nerves. Parasympathetic fibers do not exist in the breast. The supraclavicular nerves (somatic) supply sensory fibers for the innervation of the upper cutaneous part of the breast, while the lateral (IV–VI) and medial (II–IV) branches of the intercostal nerves supply the lower cutaneous parts and the mammary gland. Sympathetic motor fibers destined for the smooth muscles of the areola, nipple, and wall of the vessels travel along with all the above-mentioned nerves and then follow the arteries of the breast. The postganglionic sympathetic fibers stem from the ganglia of the paravertebral upper thoracic sympathetic chain **(Santen and Mansel, 2005). Fig. [10].**

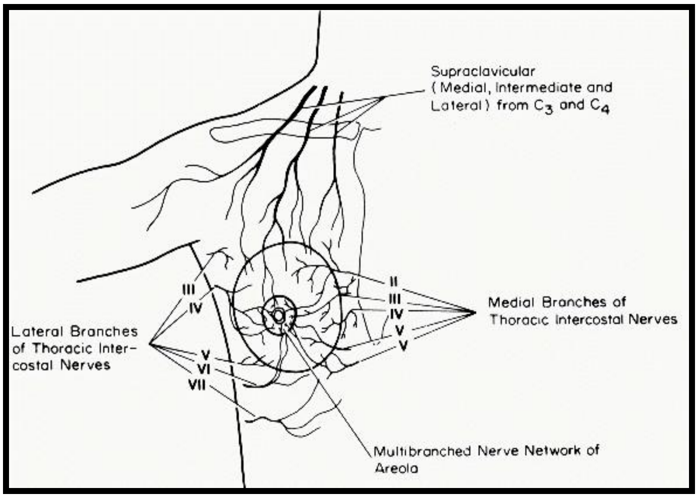


Figure [10]: Innervation of the breast **(Powell, 1990).**