INTRODUCTION

Breast cancer is the most common invasive cancer in females worldwide. It accounts for 16% of all female cancers and 22.9% of invasive cancers in women. 18.2% of all cancer deaths worldwide, including both males and females, are from breast cancer. According to the National Cancer Institute (NCI), 232,340 female breast cancers and 2,240 male breast cancers are reported in the USA each year, as well as about 39,620 deaths caused by the disease ***(Christian, 2012).***

Although scientists have identified many risk factors that increase a woman's chance of developing breast cancer, they do not yet know how these risk factors work together to cause normal cells to become cancerous. Most experts agree that breast cancer is caused by a combination of genetic, hormonal, and environmental factors (**National Institutes of Health, 2012).**

Most women who have one or more breast cancer risk factors never develop breast cancer, while many women with

breast cancer have no known risk factors (other than being a woman and growing older). Even when a woman with risk factors develops breast cancer, it's hard to know just how much these factors might have contributed (***American Cancer Socity, 2015*****).**

Breast cancer patients have most often been treated with a combination of surgical resection, radiation therapy, and possibly chemotherapy. There are several surgical options offered to breast cancer patients which depend on the stage of the cancer, age of the patient when the cancer is diagnosed, tumor histology, racial or ethnic differences, and patient preference **(Neal,et al.,2014).**

Multiple treatment options are available for breast cancer including chemotherapy, endocrine therapy, radiation therapy, and / or surgery, however, selecting an appropriate treatment plan is a difficult task **(Matsen and Neumayer, 2013).**

Current recommendations for the follow-up of patients after mastectomy for breast cancer include a physical examination of the surgical site every 3–6 months during the first 3 years, every 6–12 months during the fourth and fifth years, and yearly thereafter **(Lee, et al., 2013)**.

However, post-treatment surveillance programs for patients with breast cancer have not been firmly established. In this review, we focus on the imaging modalities that have been used in post-treatment surveillance for patients with breast cancer, such as mammography, ultrasonography, magnetic resonance imaging, and positron emission tomography, the effectiveness of each modality for detecting recurrence, and how they can be applied to manage patients **(Yoon, et al.,2015)**.

AIM OF THE WORK

The aim of this study is to review the role of different imaging modalities in detection and diagnosis of recurrent breast cancer and usefulness in follow up of patients with breast cancer.

Anatomy of the Breast

Gross Anatomy of the Breast

The breast overlies the pectoralis major and serratus anterior muscles. It is usually hemispherical, overlaps the 2nd to the 6th ribs and their costal cartilages, and extends from the lateral margin of the sternum to the mid axillary line. The greater part of the breast lies in the superficial fascia and can be moved freely in all directions. Its upper lateral edge (axillary tail) extends around the lower border of the pectoralis major and enters the axilla, where it comes into close relationship with the axillary vessels. In middle-aged multiparous women the breast may be large and pendulous, and in older women the breast may be smaller (Figure 1) **(Snell, 2012).**

This fascia is connected with the deep fascia of the breast through fibrous fascia called Cooper's ligaments, which support the breast. On the posterior face of the gland there is a layer of thin adipose tissue that connects with the superficial fascia. This is separated from the pectoralis major muscle fascia by a layer of

dense connective tissue called the posterior suspensory ligament of the breast ***(Urban, et al. 2013) .***

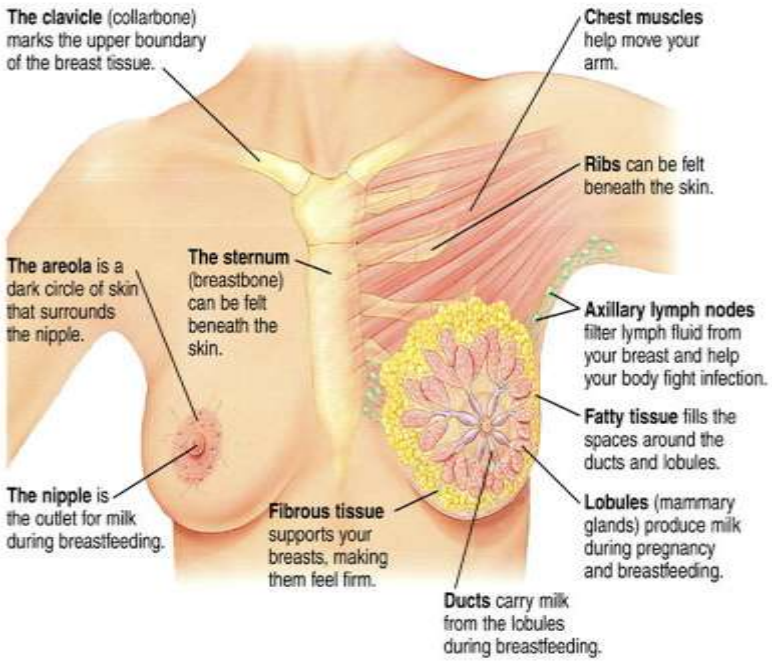

Fig.(1): Breast anatomy ***(Quoted from Maxwell and Gabriel, 2009)***

There is a predominance 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 (intra lobular duct then to the extralobular) which course through the breast towards the nipple/areolar area. There, they converge into 6-10 larger ducts called main duct (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 (Figure 2) **(Shiffman, 2009).**

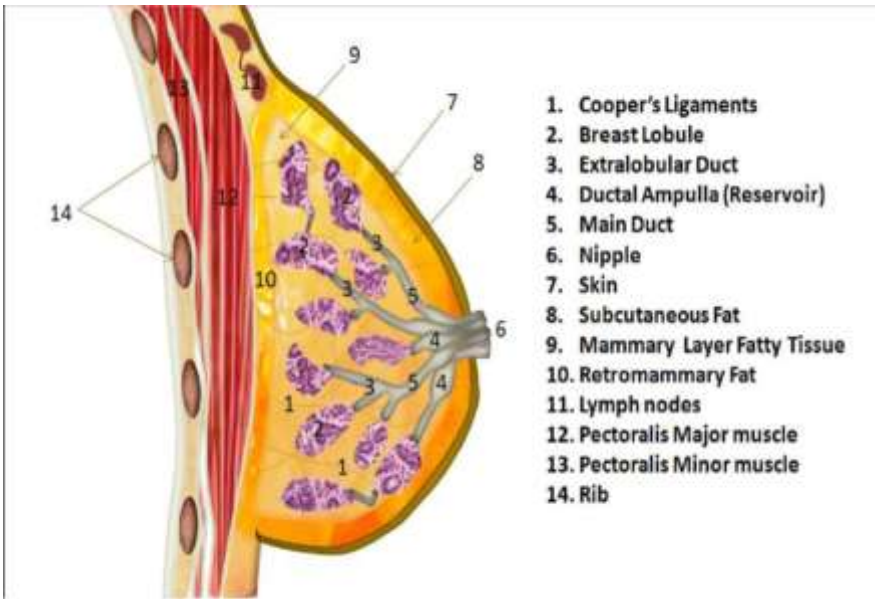

Fig.(2): Anatomical structures of the breast and underlying chest wall ***(Quoted from Gabriel and Long, 2013).***

In addition the collecting duct has several branches, which end in a terminal ductal-lobular unit (TDLU), 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 (Figure 3). A normal terminal ductal lobular unit ranges from 1 - 4 mm **(Canon, 2009).**

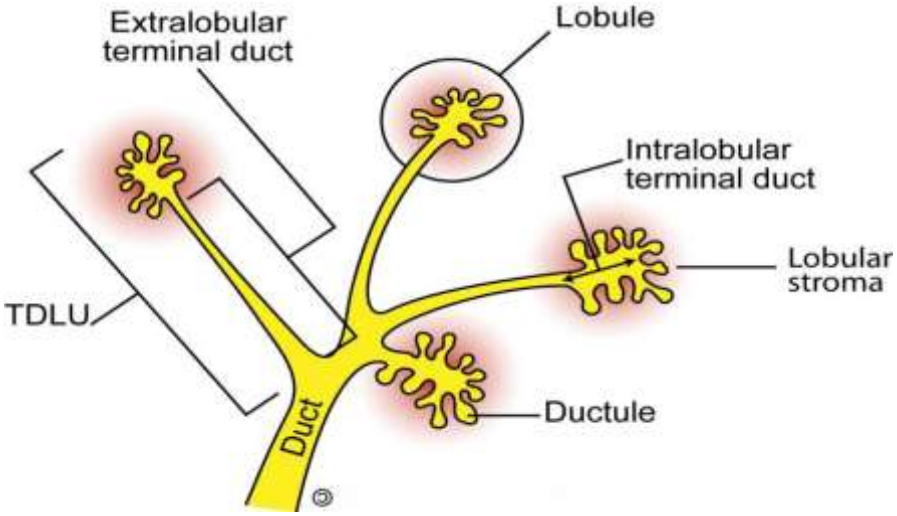

Fig.(3): Classification of the microstructure of the breast
(Quoted from Ellen Shaw, 2007)

BLOOD SUPPLY

Arterial supply:

The blood supply to the breast skin depends on the subdermal plexus, which is in communication with deeper underlying vessels supplying the breast parenchyma. The blood supply is derived from the following (Figure 4):

1- The internal thoracic (mammary) perforators (branch of firs part subclavian), enlarged lateral anterior perforators (most not ably second to fifth perforators) run to the breast as medial mammary arteries and accounts for about 60% of the total breast blood supply.

2- The lateral thoracic artery (branch of second part of axillary) giving the lateral mammary arteries.

3- Intercostal perforators terminal branches (from 3rd to the 8th) represent an additional important blood supply to the lateral aspect of the breast. They perforate the serratus anterior just lateral to the pectoral border and enter the breast at the anterior margin of the latisssimus dorsi **(Davis, 2010).**

4- The thoracoacromial artery (branch of second part axillary), but it is not generally a major source of blood supply to breast **(Dashner, 2010).**

5- Superior thoracic artery, arising from the first part of axillary artery. It supplies pectoralis minor muscle and upper part of serratus anterior muscle. It descends medially along the upper border of the pectoralis minor muscle on the anterior wall of the thorax. It extends to the second intercostal space, and anastomoses with the internal thoracic artery and intercostal arteries **(Dashner, 2010).**

Venous drainage:

The veins are divided into two systems: superficial and deep venous system. The superficial veins lie just deep to the superficial fascia (occasionally observed when blood flow is

increased) the superficial veins on the two sides communicate with each other. The deep veins usually run alongside the arteries but are more variable in position. They drain into the internal mammary, axillary, subclavian veins and the azygos system via the intercostal veins. The intercostal veins anastomose with the vertebral veins. The superficia1 and deep veins anastomose with each other through the mammary gland (Figure 4)**(Macéa and Fregnani, 2006).**

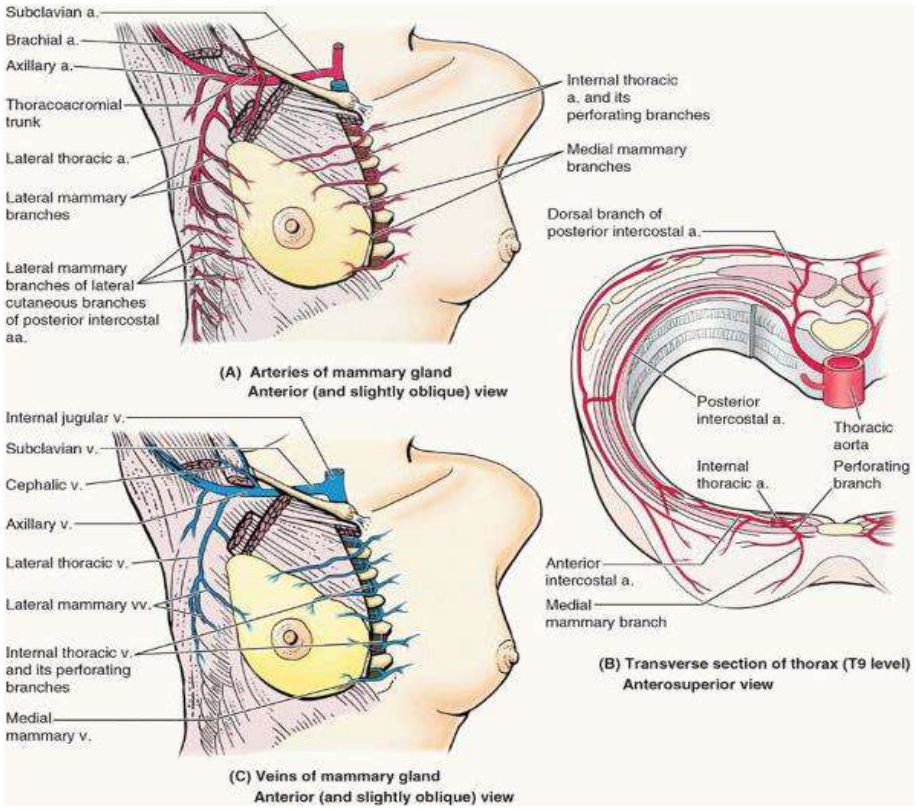

Fig.(4): Blood supply of mammary gland ***(Quoted from Agur and Dalley, 2009)***.

Lymphatic drainage of the breast:

The lymphatic drainage of the breast has diagnostic and therapeutic implications. Investigators have suggested that the lymphatic drainage comes from the deeper tissues of the breast flowing toward the surface through lymphatic channels to the skin **(Kopans, 2007).**

- ***Lymph nodes groups are*** **(Figure 5):**

A-The axillary chain forms the main drainage; the associated nodes are subdivided into the following group:

1- Anterior (external mammary): Along the lateral thoracic vein.

2- Posterior Scapular: Along the subscapular vein.

3- Lateral Axillary: Along the lateral portion of the axillary artery, it drains the upper limb.

4- Pectoral (Rotter): Between major and minor pectoral muscles; drains most of the breast.

5- Central (apical): Embedded in fat in the center of the axilla.

6- Sub (infra) clavicular: Along the subclavian vein. Receive lymph from the other axillary groups.

The axillary lymph nodes are divided into three levels according to their relationship with the pectoralis minor muscle:

Level I Lateral to the muscle.

Level II Deep to the muscle.

Level III Medial to muscle.

B- The internal mammary lymph nodes.

Accompany the internal mammary vessels and lie in the fat and areolar tissue behind the intercostal spaces.

C- Small amount of the lymphatic flow from the breast crosses to the opposite side.

D- Some passes to the upper abdominal lymph nodes via diaphragmatic lymphatics.

E- The subareolar plexus drains by collecting trunks into the axillary nodes **(Macéa and Fregnani, 2006).**

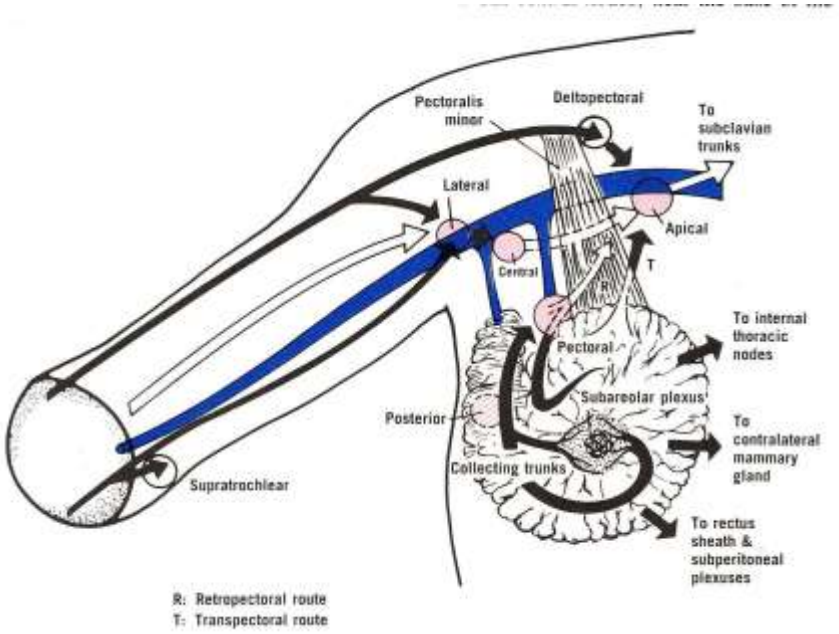

Fig.(5): Lymphatic drainage of the upper limb and breast.
(Quoted from Catlin, et al., 2009)

INNERVATION OF THE BREAST:

Innervations of the breast are provided by Figure (6):

1-Somatic sensory nerves, Sensory innervation of the breast is dermatomal in nature, the supraclavicular nerves (somatic) supply sensory fibers for the innervations 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.

2-Autonomic (sympathetic) motor nerves. 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. Parasympathetic fibers do not exist in the breast **(Santen and Mansel,2005).**

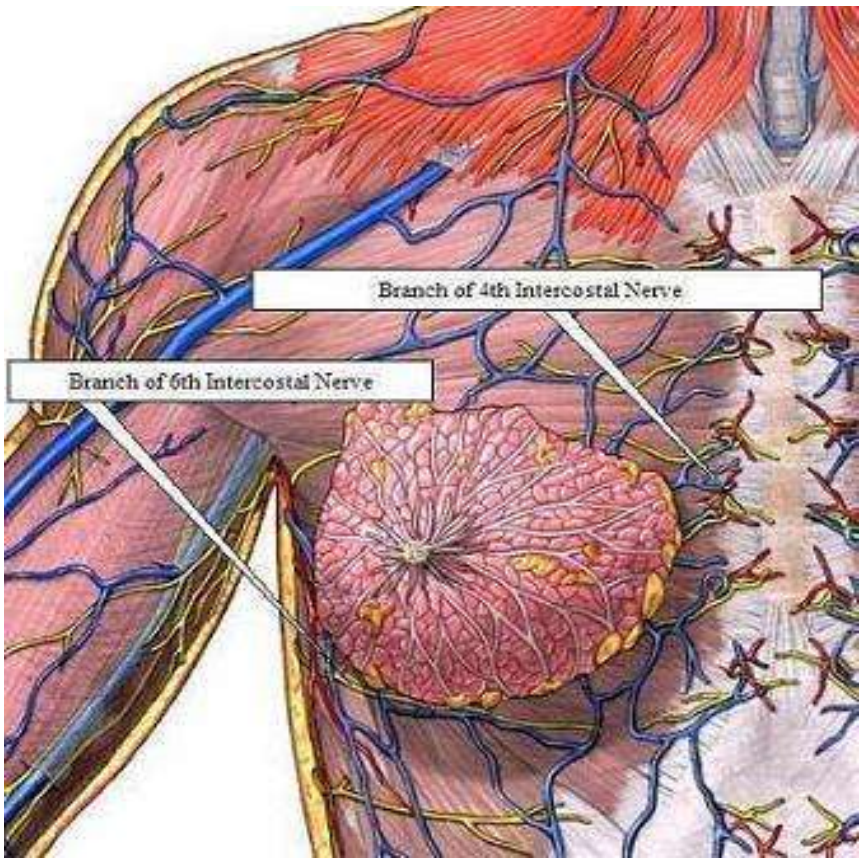

Fig. (6): Innervation of the breast **(Quoted from Urban, et al.,2013).**

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 following:

- 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 faces (Figure7) **(Blumgart, 2011).**

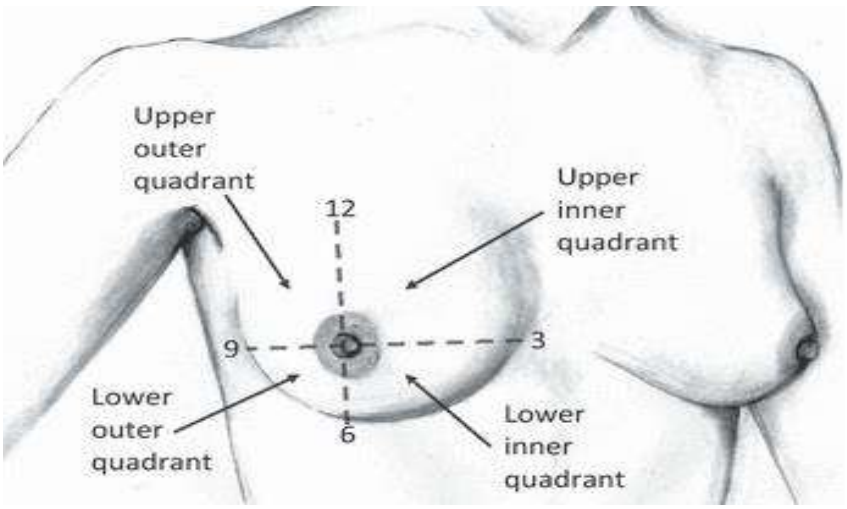

Fig. (7): Breast quadrants ***(Quoted from Blumgart, et al., 2011).***