Introduction

Breast cancer is the commonest cancer in women worldwide 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 ***(Cuzick, 2010).***

When patients present for diagnostic evaluations, our goal is to establish the correct diagnosis, accurately and efficiently. For some women this may include mammographic images only or additional ultrasound; for other patients additional mammographic views, an ultrasound, MRI and a core biopsy are performed ***(Gilda, 2007).***

Mammography is the main investigation for imaging of the breast cancer. Full field digital mammography is superior to standard mammography especially in the women with dense breasts but mammographic images are usually not enough to determine the existence of benign or malignant disease and the radiologist in some circumstances recommend further diagnostic studies ***(Qaseem et al., 2007).***

Mammography is known to have high accuracy in detect breast cancer (sensitivity) but show high false positive rates (specificity) in the detection of breast malignancy (60-80%), resulting in unnecessary biopsies being performed ***(Daniel, 2007).***

Magnetic resonance imaging (MRI) can discriminate benign from malignant lesions. Contrast enhanced MRI study of the breast is based on the enhancement pattern of the lesions and morphologic changes, with these two criteria breast MRI has a sensitivity of about 75-89 % in detecting malignant breast lesions, however there is an overlap of these criteria with benign lesions which leads to a reported specificity of about 50 to 90% ***(Marini et al., 2007).***

Nowadays, there is increasing number of published studies which mentioned that the specificity of the breast MRI could be increased by using diffusion –weighted imaging (DWI) ***(Wenkel et al., 2007).***

Diffusion-weighted magnetic resonance imaging (DW-MRI) depends on the microscopic mobility of water. This mobility, classically called Brownian motion, is due to thermal agitation and is highly influenced by the cellular environment of water. Thus, findings on DW-MRI could be an early harbinger of biologic abnormality ***(Padhani et al., 2009).***

By using the DWI sequence, one can calculate the apparent diffusion coefficient (ADC), a quantitative measure that is directly proportional to the water diffusion. High cell proliferation in malignant tumors increases cellular density, creating more barriers to the extracellular water diffusion, reducing the ADC, and resulting in signal loss. This sequence appears to be a useful tool for tumor detection and characterization, as well as for monitoring and predicting treatment response ***(Pereiera et al., 2009).***

Aim of the Work

To highlight the role of diffusion weighted MRI in increasing the specificity of the MRI of the breast for detection of cancer breast in women with primary cancer or recurrent breast cancer.

Anatomy

In young women, it is usually hemispherical and slightly pendulous, overlaps the 2^{nd} 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, 2) ***(Snell, 2012).***

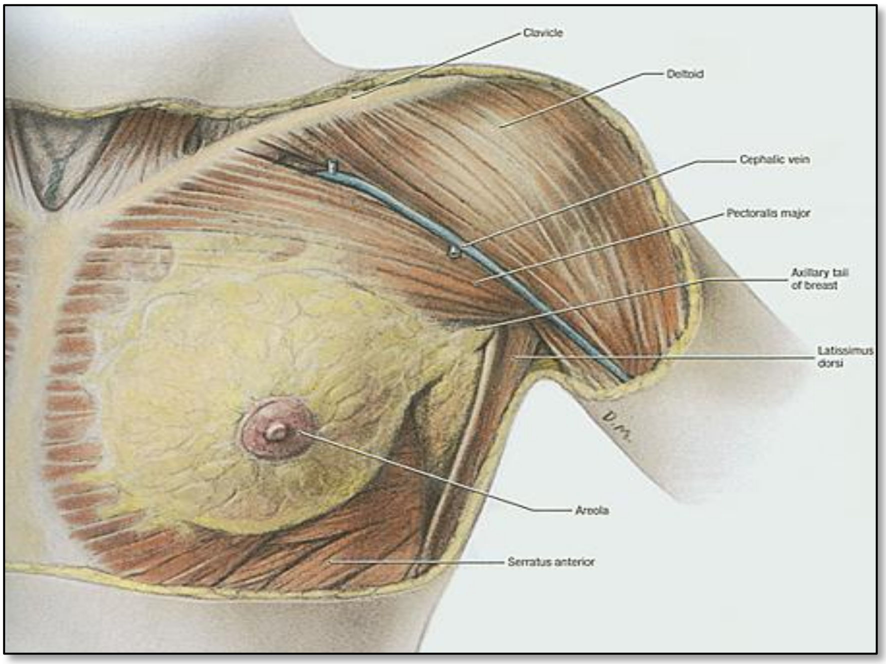

Fig. (1): Axillary tail of breast ***(Quoted from Dashner, 2010).***

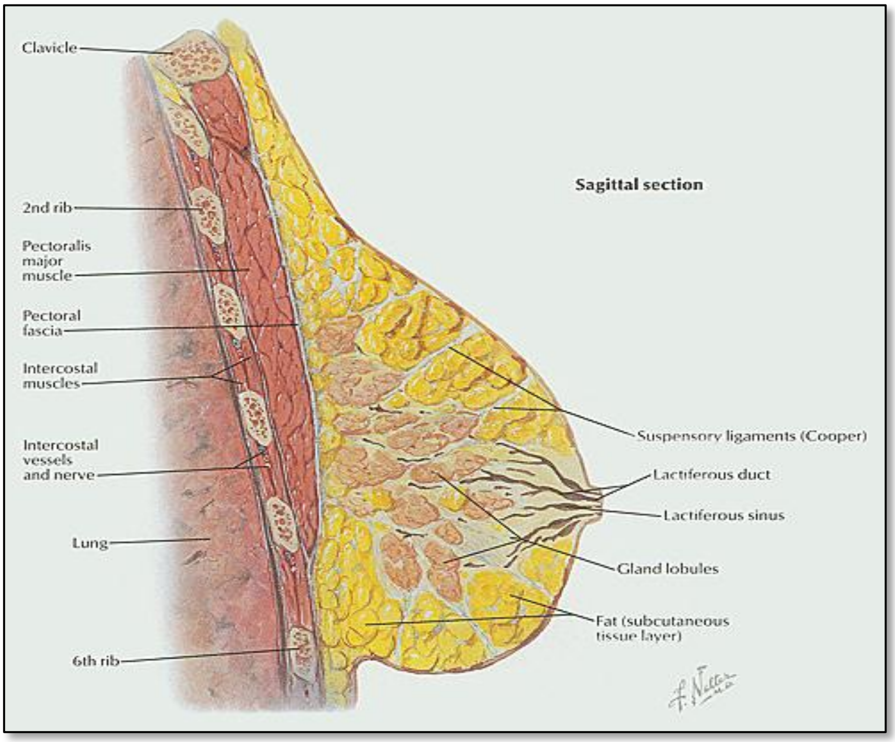

Fig. (2): Anatomical structures of the breast and underlying chest wall ***(Quoted from Agur, 2009).***

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 (Figure 3) ***(Shiffman, 2009).***

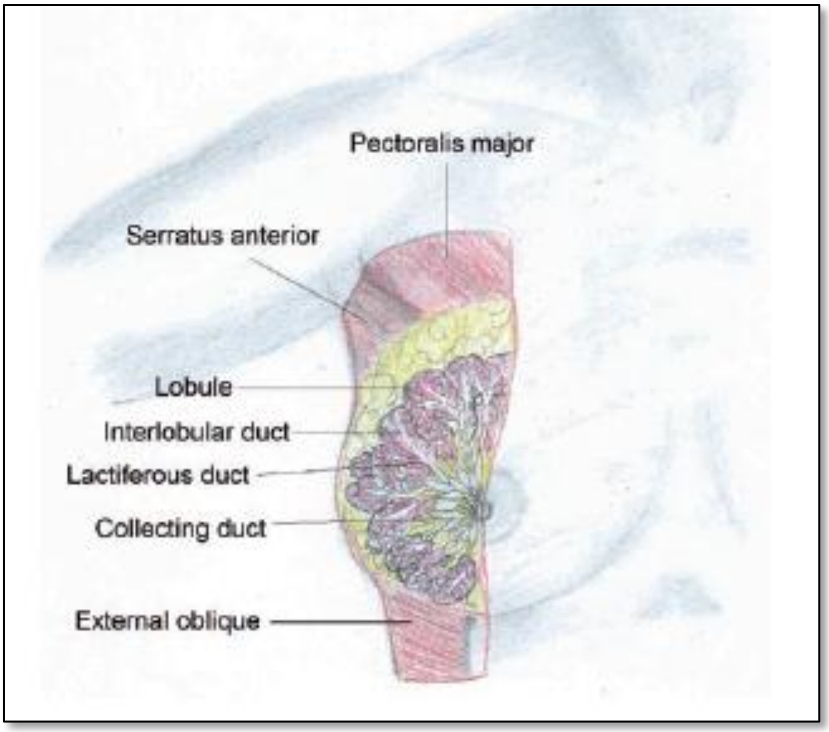

Fig. (3): Glandular breast tissue ***(Quoted from Davis, 2010).***

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. A normal terminal ductal lobular unit ranges from 1 - 4 mm ***(Canon, 2009).***

The breast is anchored to the pectoralis major fascia by the suspensory ligaments (Cooper's Ligaments) (Figure 4). These ligaments connect the two layers of the fascia providing a degree of support to the breast and giving the breast its shape ***(Jonathan, 2008).***

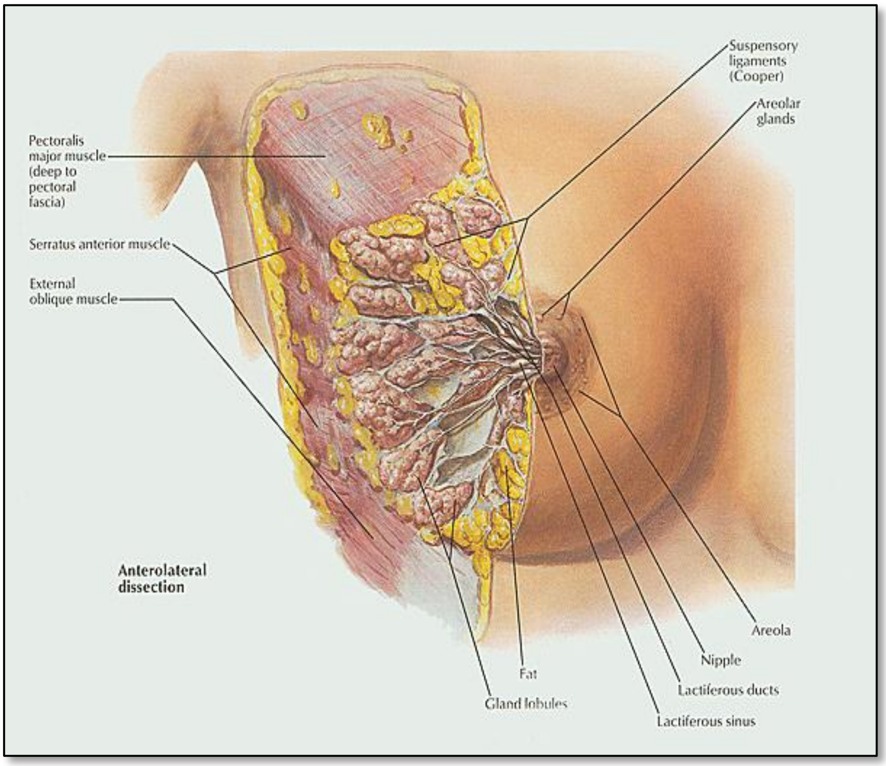

Fig. (4): Pectoralis major fascia and suspensory ligament ***(Quoted from Agur, 2009).***

Blood Supply

Arteries

The blood supply of the breast is mostly from superficial vessels. The principal blood supply is derived from the internal thoracic (mammary) and lateral thoracic artery. Enlarged lateral branches of the anterior perforating arteries originating from the internal thoracic artery run to the breast as medial mammary arteries. The lateral mammary arteries are often multiple in origins and are derived from the lateral thoracic artery (Figure 5) ***(Borgenand, 2000).***

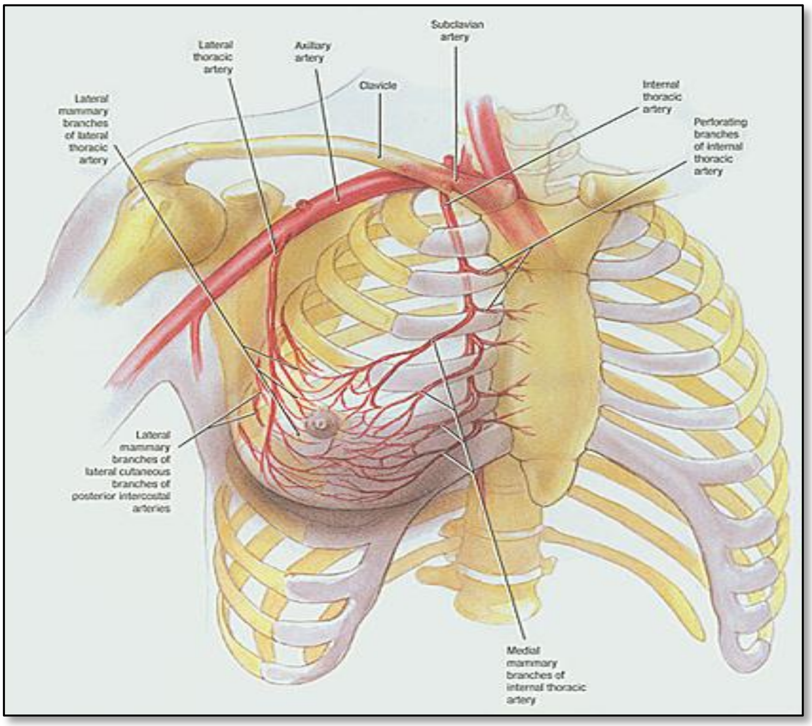

Fig. (5): Internal and lateral thoracic arteries
(Quoted from Dashner, 2010).

Intercostal vessels represent an additional important blood supply to the breast. The lateral breast receives anterior Intercostal arteries from the third through the sixth interspaces. These perforate the serratus anterior just lateral to the pectoral border. Lateral Intercostal vessels enter the breast at the anterior margin of the latisssimus dorsi to supply the lateral breast and the overlying skin (Figure 6) ***(Davis, 2007).***

Also, Thoracoacromial artery represents another source of blood supply. It is a Branch of second part of axillary artery (under pectoralis minor), located in the anterior shoulder region and Sends off 4 subsequent branches, but it is not generally a major source of blood supply to breast (Figure 7) ***(Dashner, 2010).***

Superior thoracic artery is a small artery arising from the first part of axillary artery sometimes from the Thoracoacromial artery. It supplies Pectoralis minor muscle and Serratus anterior muscle (upper part). Superior thoracic artery descends medial 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 (Figure 8) ***(Kopan, 2007).***

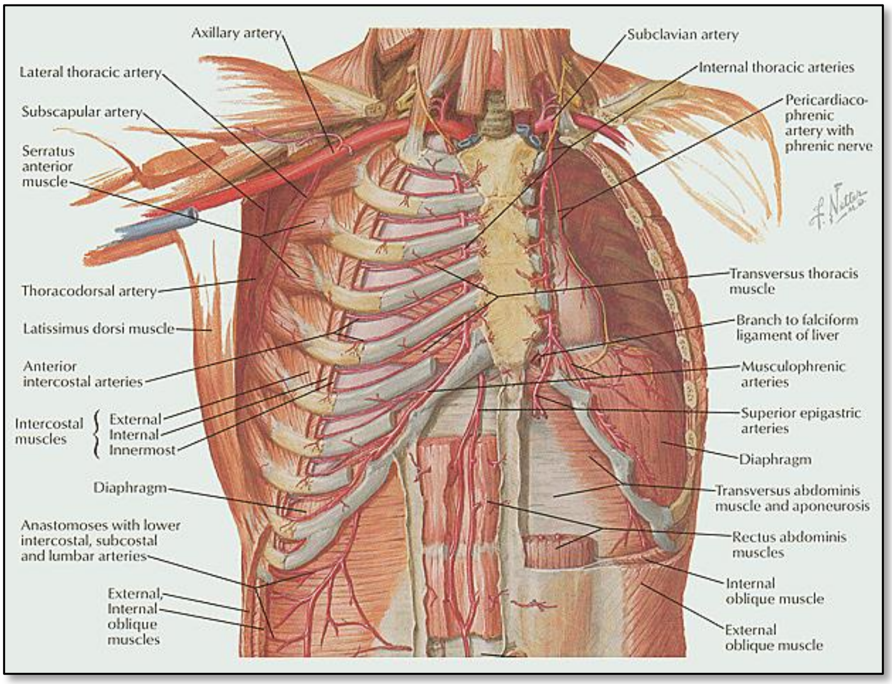

Fig. (6): Intercostal arteries ***(Quoted from Dashner, 2010).***

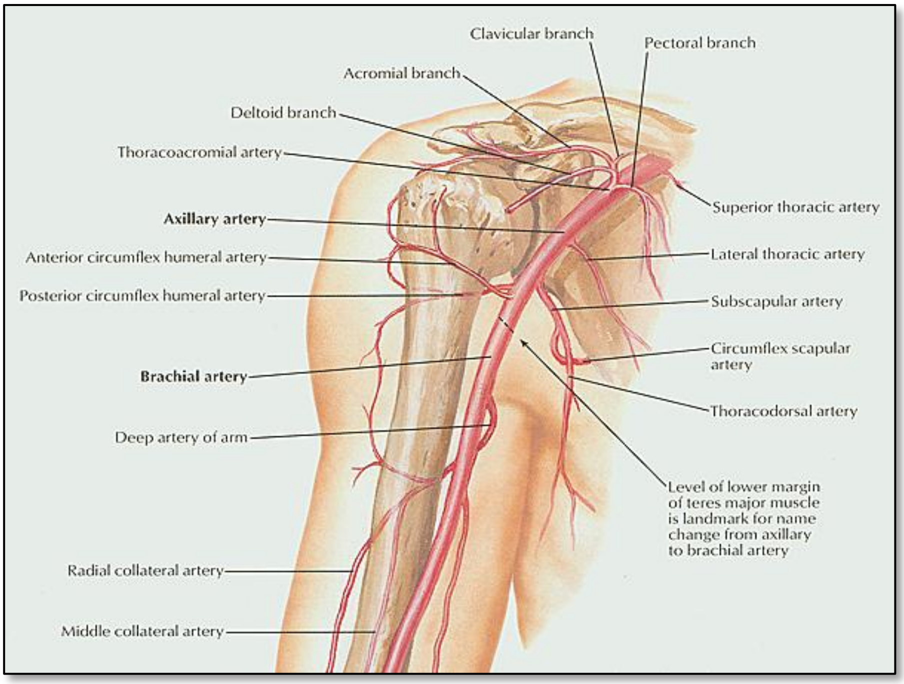

Fig. (7): Thoracoacromial artery ***(Quoted from Dashner, 2010).***

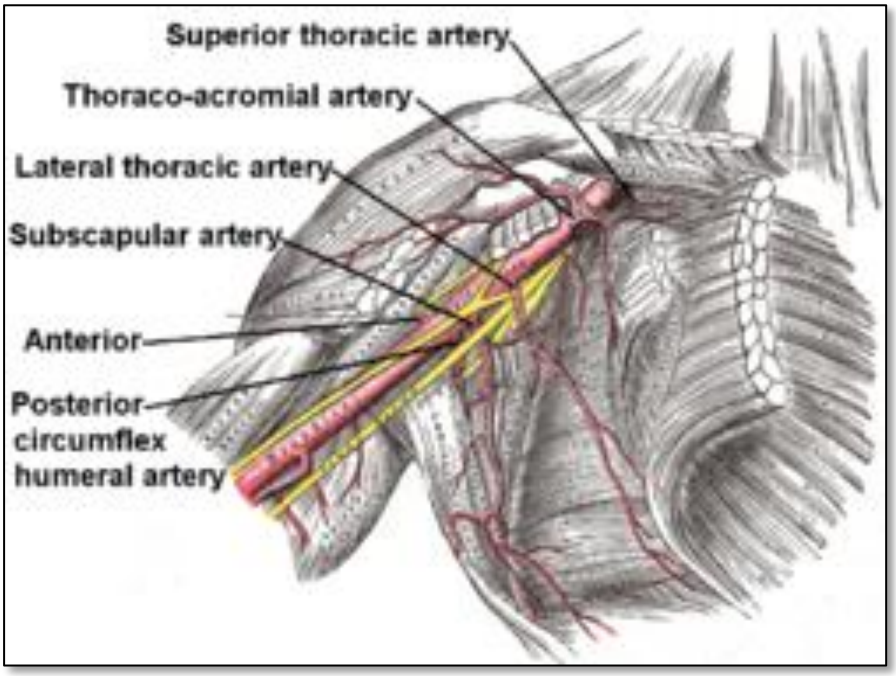

Fig. (8): Superior thoracic artery ***(Quoted from Davis, 2010).***

Veins

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 ran 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 (Figure 9).

The intercostal veins anastomose with the vertebral veins. The superficia1 and deep veins anastomose with each other through the mammary gland ***(Macéa and Fregnani, 2006).***

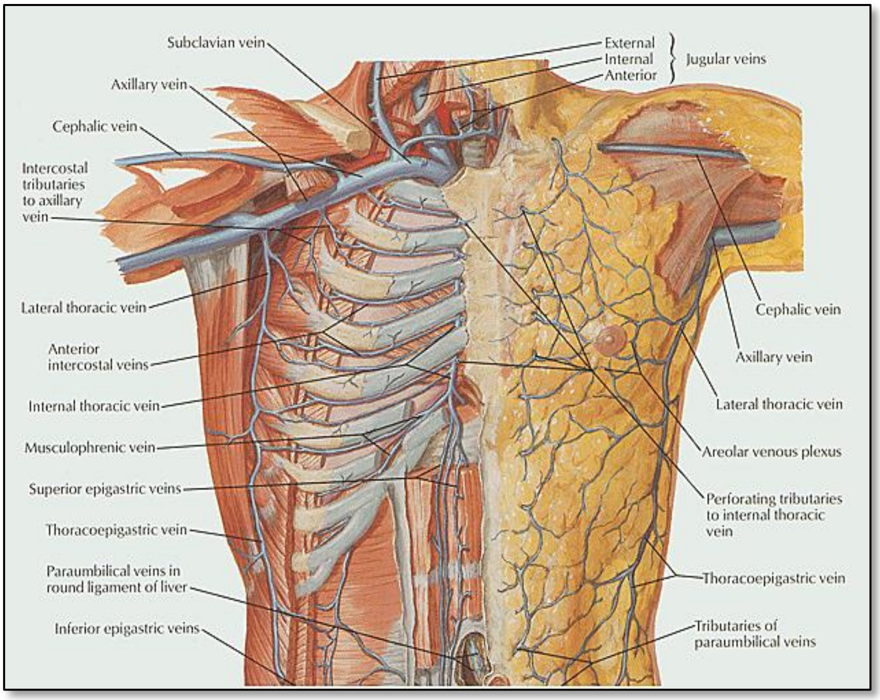

Fig. (9): Venous supply of the breast
(Quoted from Dashner, 2010).

Lymphatic

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).***

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

1. External mammary: Along the lateral thoracic vein.
2. Scapular: Along the subscapular vein.
3. Axillary: Along the lateral portion of the axillary artery.
4. Central (apical): Embedded in fat in the center of the axilla.
5. Sub (infra) clavicular: Along the subclavian vein.
6. Interpectoral (Rotter): Between major and minor pectoral muscles.

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

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 lymphatic (Figure 10) ***(Macéa and Fregnani, 2006).***

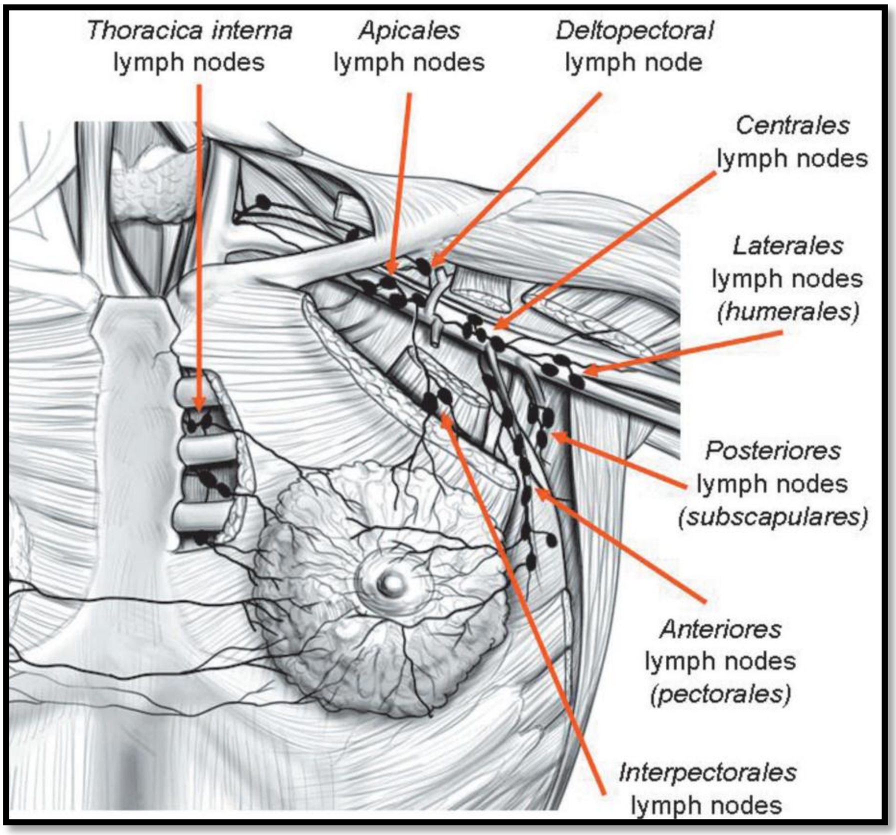

Fig. (10): Lymphatic drainage of the breast
(Quoted from Macéa and Fregnani, 2006).

Innervations of the breast:

Innervations of the breast are 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