INTRODUCTION

Breast lesions were classified as benign or malignant categories (***Catalano et al., 2009)***The majority of the lesions that occur in the breast are benign, benign lesions of the breast are more frequent than malignant ones. It is important to recognize benign lesions and distinguish them from breast cancer **(*Guray and sahin, 2006*)**.

Breast cancer is the most common female neoplasm (31 % of tumors in female), and the second leading cause of death among women ***(Catalano et al., 2009).***

Further, the increasing rate of breast cancer continues to be a major area of concern for both clinicians and researchers. Increased awareness in the affected population leads to more frequent physical examinations and diagnostic imaging procedures which results in earlier diagnosis and hence improved prognosis**. *(Guo et al, 2002***).

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 MRI. ***(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).***

Conventional mammography is known to have high false positive rates in the detection of breast malignancy (60-80%), resulting in unnecessary biopsies being performed. So, MR techniques have shown strong potential to improve the sensitivity and specificity in the diagnosis of breast cancer ***(Button et al., 2002).***

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).***

Typical breast MRI exams involve a contrast-enhanced scan to highlight tissue with increased vascularity, very sensitive for detecting malignancies but also producing many false-positives. ***(Partridge et al, 2007).***

DWI is a technique that involves the exchange of water molecules (diffusion) between breast tissue compartments. Diffusion rates vary between normal and pathologic tissue.The value of diffusion of water in tissues is called apparent diffusion coefficient (ADC) and it is calculated in the MRI machine by using (ADC) mapping.The studies showed that the (ADC) vary between malignant and benign breast masses. So application of DW sequence to the breast MRI will improve the specificity of the MRI ***(Woodhams et al., 2005).***

Using Diffusion-weighted imaging (DWI) combined to MRI is helpful to distinguish malignant versus benign breast lesions and it also may reduce the number of unnecessary breast biopsies. ***(Barker and Salkowski, 2009).***

AIM OF THE STUDY

Our purpose was to study the utility of diffusion-weighted MRI in increasing specifity of MRI in differentiating benign from malignant solid breast lesions.

BREAST ANATOMY

The breast is a modified skin gland enveloped in fibrous fascia. The superficial pectoral fascia is located just beneath the skin and in the retromammary space. The undersurface of the breast lies on the deep pectoral fascia. Although there are fascial layers between the breast proper and the pectoralis major muscle, the breast is not completely separate from the pectoralis major muscle, as there are penetrating lymphatics and blood vessels ***(Morris and Liberman, 2005).***

The breast overlies the second to sixth ribs on the anterior chest wall. It is hemispherical with an axillary tail and consists of fat and a variable amount of glandular tissue. It is entirely invested by the fascia of the chest wall, which splits into anterior and posterior layers to envelop it. The fascia forms septa called cooper's ligaments, which attach the breast to the skin anteriorly and the fascia of pectoralis posteriorly. They also run through the breast, providing a supportive framework between the two fascia layers. The pigmented nipple projects from the anterior surface of the breast. It is surrounded by the pigmented areola and its position is variable, but it usually lies over the fourth intercostal space in the non-pendulous breast ***(Ryan et al., 2011).***

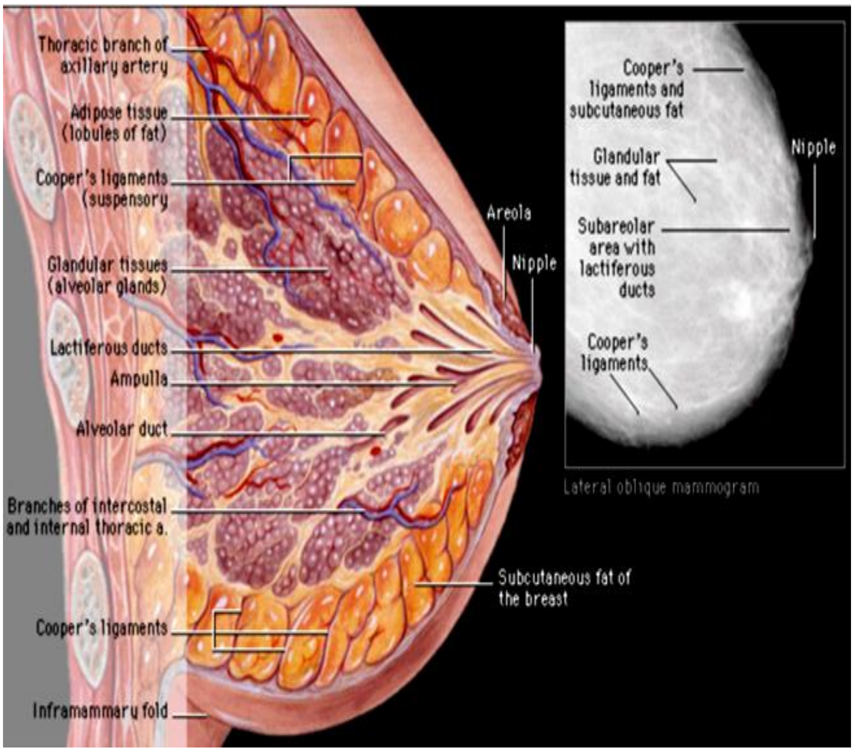

Fig. (1): Anatomy of the Breast ***(Hussain et al., 2003).***

Breasts originate from the fourth pair of lactiferous points. The development starts during the fourth week of gestation with the growth of a basic milk streak. Milk lines, or "ventral epidermal ridges, " are seen by the sixth week of the embryo's life. Glands and their ducts develop separately. The development progresses in women, while in men, the progress stops. Some people have several pairs of breast germs within milk lines, although not all of them develop completely after birth ***(Sencha et al., 2013).***

The breast is composed of three major structures: skin, subcutaneous tissue, and breast tissue (parenchyma and stroma). The parenchyma is divided into 15 to 20 lobes or segments that converge at the nipple in a radial arrangement.

The ducts from the lobes converge into 6 to 10 major collecting ducts that have openings at the nipple and connect to the outside. Each of these major ducts arborizes back from the nipple and forms a lobe or segment of glandular tissue that is supported by surrounding connective or stromal tissue [Figure 1)] ***(Morris and Liberman, 2005).***

The distribution of lobes is not even as there is a preponderance of glandular tissue in the upper outer quadrant of the breast. Each duct drains a lobe made up of 20 to 40 lobules. Each lobule contains 10 to 100 alveoli or acini. Each lobule also consists of branching ducts that divide into subsegmental structures and terminate in the terminal duct lobular unit. The terminal duct lobular unit consists of the terminal duct and the acinus ***(Morris and Liberman, 2005).***

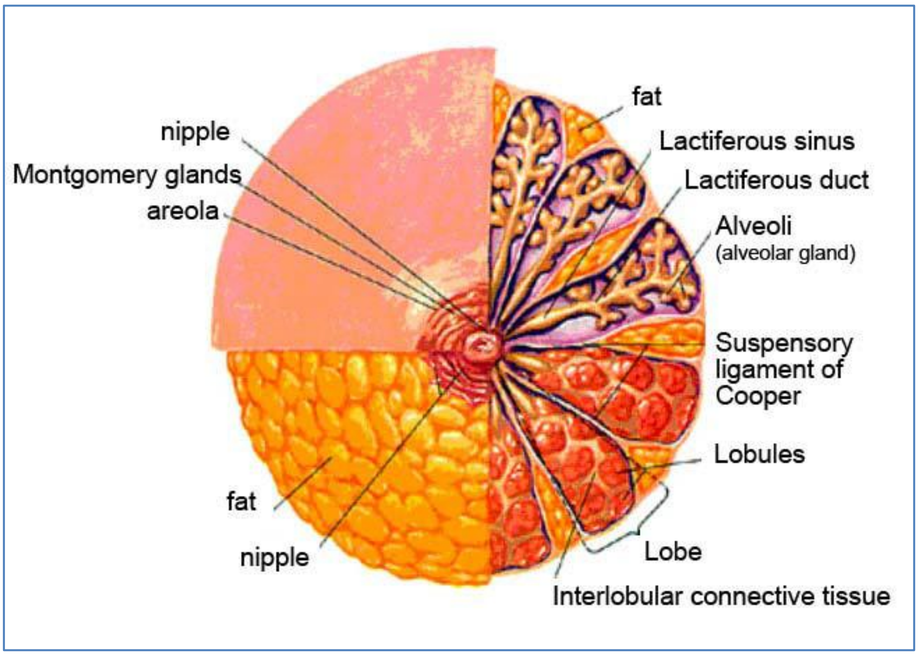

Fig. (2): Breast architecture ***(Patasi, 2010).***

Glandular tissue of the breast is covered with a superficial layer of subcutaneous fat. Its thickness depends on the age and constitution of the woman. Adipose tissue can be also observed as fatty lobes, which are incorporated into glandular tissue and surrounded with connective tissue fibers. ***(Sencha et al., 2013).***

Connective tissue is also included into the structure of fibrillar tissue between glandular elements and in the walls of lactiferous ducts. With years, along with the beginning of involution, Cooper's ligaments become denser and surround areas of fatty tissue, thus forming fatty lobes ***(Sencha et al., 2013).***

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. ***(Peart and Hill, 2005)*** as shown in fig. (3).

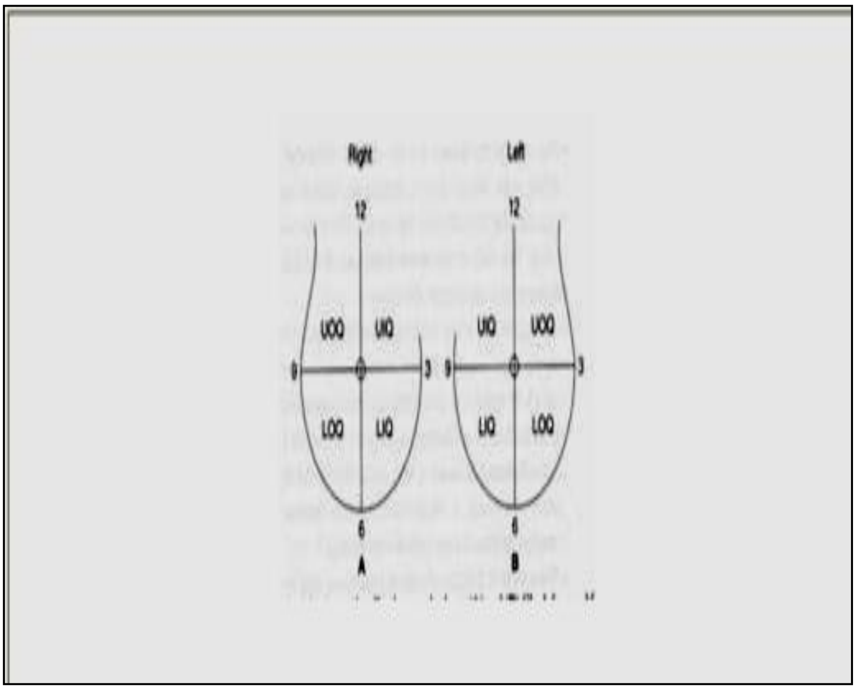

Fig. (3): Quadrant and Clock Divisions of the breast
(Peart and Hill, 2005).

BLOOD SUPPLY

Arteries

The main arteries supplying the breast are branches of the lateral thoracic artery (also termed the external mammary artery Or mammarii lateralis) and perforting branches of the internal mammary artery (also termed the internal thoracic artery or mammarii medialis).The lateral thoracic artery arises from the axillary artery distal to the thoracoacromial artery, it passes inferiorly along the lateral border of the pectoralis major muscle and gives lateral mammary branches, which turn around the lateral border of the pectoralis major muscle to supply the breast ***(Macéa and Fregnani, 2006).***

The internal mammary artery arises from the first part of subclavian artery and descends behind the cartilages of the upper ribs, where it lies slightly lateral to the sternum. Branches arise in the First to fourth intercostal spaces and penetrate the pectoralis major muscle reach the deep surface of the gland along its medial edge. A small supply also comes from the pectoral branch of the thoracoacromial artery and from the intercostal arteries ***(Macéa and Fregnani, 2006)*** as shown fig. (4).

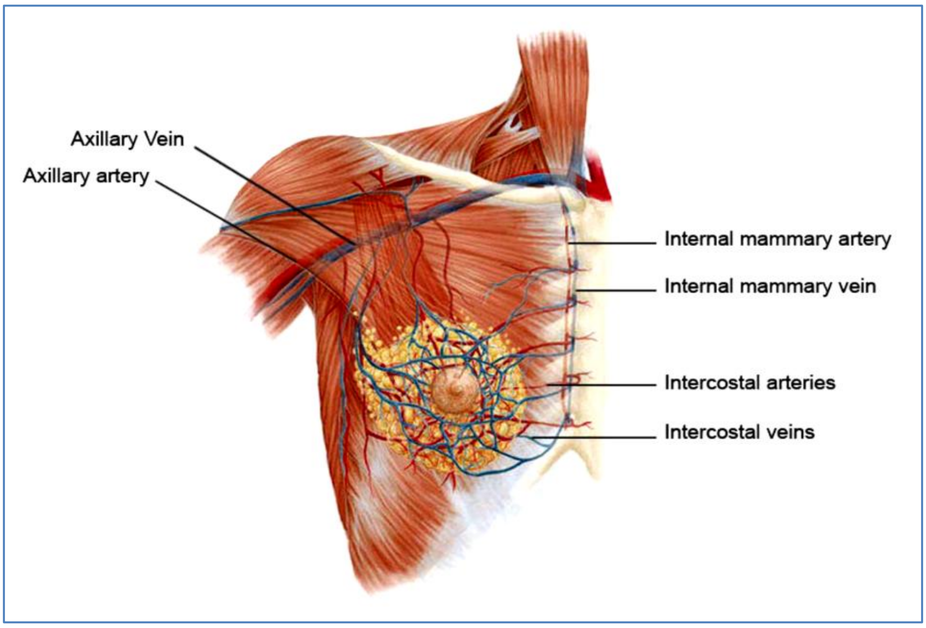

Fig. (4): Arterial & venous networks of the breast architecture ***(Patasi, 2010).***

Veins

The venous drainage of the breast is important not only because veins are the route of hematogenous metastases from carcinomas but also because the lymphatic vessels generally follow the same course. The veins are divided into two systems: superficial and deep ***(Macéa and Fregnani, 2006).***

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 ***(Macéa and Fregnani, 2006).***

The deep veins usually ran along side 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 ***(Macéa and Fregnani, 2006).***

The intercostal veins anastomose with the vertebral veins and this route is considered to be responsible for bone metastases that by pass the pulmonary bed. The superficia1 and deep veins anastomose with each other through the mammary gland ***(Macéa and Fregnani, 2006).***

Lymphatics

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	: 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

(Macéa and Fregnani, 2006)

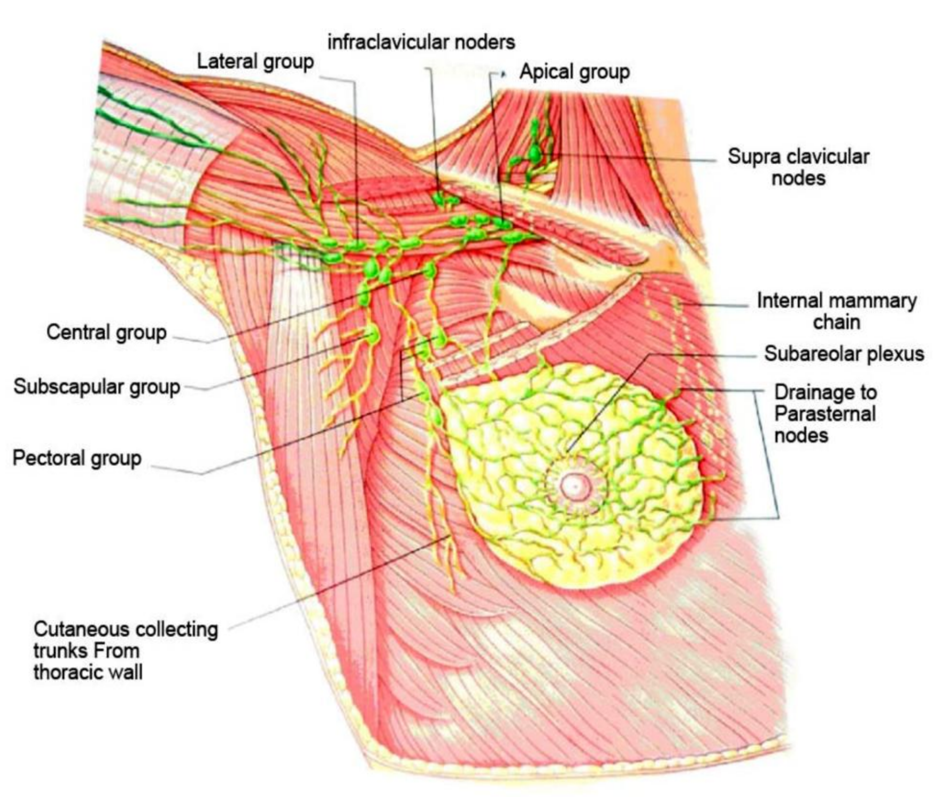

Fig. (5): Lymph drainage of the breast ***(Johnson & Shah, 2005).***

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

(Macéa and Fregnani, 2006)

Involvement of the supraclavicular lymph nodes is considered as a distant metastasis because it occurs in a retrograde fashion ***(Macéa and Fregnani, 2006).***

The internal mammary lymph nodes accompany the internal mammary vessels and lie in the fat and areolar tissue behind the intercostal spaces ***(Macéa and Fregnani, 2006).***

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).***

According to ***(Moore et al., 2006),*** the lymphatic drainage of the breast is important because of its role in the metastasis of cancer cells. Lymph passes from the nipple, areola, and lobules of the gland to the subareolar lymphatic plexus, as follows:

Most lymph (> 75%), especially from the lateral breast quadrants, drains to the axillary lymph nodes, initially to the anterior or pectoral nodes for the most part. However, some lymph may drain directly to other axillary nodes including subscapular, humeral, central, and apical or even to interpectoral, deltopectoral, supraclavicular, or inferior deep cervical nodes ***(Moore et al., 2006).***

Most of the remaining lymph, particularly from the medial breast quadrants, drains to the parasternal lymph nodes or to the opposite breast, whereas lymph from the inferior quadrants may pass deeply to abdominal lymph nodes (subdiaphragmatic inferior phrenic lymph nodes) ***(Moore et al., 2006).***

Lymph from the skin of the breast, except the nipple and areola, drains into the ipsilateral axillary, inferior deep cervical, and infraclavicular lymph nodes and also into the parasternal lymph nodes of both sides ***(Moore et al., 2006).***

Nerve Supply of the Breast

The nerves of the breast derive from anterior and lateral cutaneous branches of the 4^{th} to 6^{th} intercostal nerves. The branches of the intercostal nerves pass through the deep fascia covering the pectoralis major to reach the skin, including the breast in the subcutaneous tissue overlying this muscle. The branches of the intercostal nerves thus convey sensory fibers to the skin of the breast and sympathetic fibers to the blood vessels in the breasts and smooth muscle in the overlying skin and nipple ***(Moore et al., 2006)*** as shown in fig. (6).

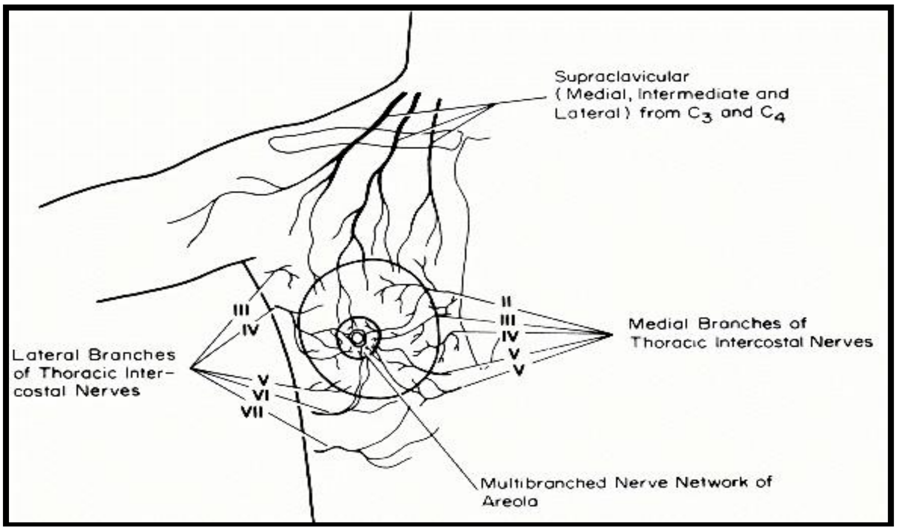

Fig. (6): Innervation of the breast ***(Powell, 1990).***