INTRODUCTION

In vivo proton magnetic resonance spectroscopy (H-MRS) is a functional imaging modality. When magnetic resonance imaging is coupled with H-MRS, it results in accurate metabolic characterization of various lesions. Proton magnetic resonance spectroscopy has an established role in evaluating malignant breast lesions, and the increasing number of published literature supports the role of H-MRS in patients with breast cancer. However, H-MRS can be of help in evaluating benign breast disease ***(Das et al., 2008)***

Magnetic resonance imaging (MRI) of the breast has emerged as a highly sensitive modality. In addition to morphologic and kinetic analysis obtained from contrast-enhanced breast MRI, functional information has been needed for diagnosis of breast disease. In vivo proton hydrogen 1 [(1)H] MR spectroscopy of the breast has demonstrated that choline (Cho) can be detected in breast cancer, whereas Cho is generally undetectable in normal breast tissue. Thus, breast MR spectroscopy has shown great promise as a way to differentiate between benign and malignant lesions and to gauge the effect of chemotherapeutic agents in patients with locally advanced breast cancer. Prior studies performed on 1.5-TMR imagers have reported sensitivities of 70-100 % (average 89%, 149/168) and specificity of 67-100% (average 87%, 97/112) for breast MR spectroscopy. Moreover, the presence of a (Cho) peak in breast cancer may reflect the increased cell proliferation, with a decrease in this peak after treatment reflecting decreased viability of the tumor. With further development and the assessment of (Cho) quantity in the tumor ***(Tozaki, 2008)***.

In vivo proton magnetic resonance (MR) spectroscopy (hydrogen 1 spectroscopy) provides useful information about the pathology of breast lesions by the measurement of diagnostic chemicals visible on the MR timescale. Spectroscopic measurements may be obtained following contrast-enhanced MR imaging by applying a point-resolved spatially localized spectroscopy sequence.

The observation of resonances at discrete spectral frequencies allows an accurate diagnosis. In spectra obtained in vivo in malignant breast cancers, an observed resonance at 3.23ppm is consistent with phosphocholine. In spectra from benign breast lesions and some normal breast tissue in lactating mothers and in some nonlactating healthy women, a recorded resonance at 3.28ppm is thought to originate from glycerophosphocholine, taurine, or myoinositol. The success of in vivo spectroscopy depends on the appropriate pre-acquisition setup, acquisition protocol, and post processing techniques for achieving high spectral resolution and a signal-to-noise ratio sufficient to separate the resonances of the important biomarkers. When implemented correctly, the method is diagnostically accurate ***(Stanwell et al., 2007)***.

Proton (hydrogen) (1H) magnetic resonance (MR) spectroscopy provides biochemical information about the tissue under investigation. Its diagnostic value in cancer is typically based on the detection of elevated levels of choline compounds, choline being a marker of active tumor.

The two main potential clinical applications of 1H MR spectroscopy are (a) as an adjeunct to breast MR imaging to improve specificity in differentiating benign from malignant lesions, and (b) for monitoring or even predicting response to treatment in patients undergoing neoadjuvant chemotherapy. Preliminary data are promising; with study results suggesting that 1H MR spectroscopy may decrease the number of benign biopsies recommended on the basis of MR imaging findings and may help predict response as early as 24 hours after the first dose of neoadjuvant chemotherapy. Although several limitations currently exist that make the technique premature for clinical use, further evaluation with larger, preferably multicenter trials is certainly warranted ***(Bartella et al., 2007)***.

AIM OF THE WORK

Is to emphysis the role of proton MR spectroscopy in diagnosis of malignant breast lesions.

Anatomy

General anatomy

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 coopers 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 intercostals space in the non-pendulous breast **(Fig. 1)** ***(Ryan et al., 2004).***

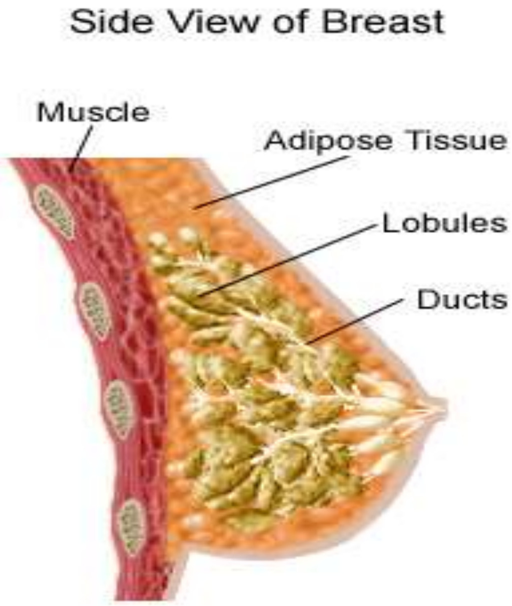

Figure (1): Normal breast anatomy quoted from ***(Ryan et al., 2004)***

Lobular Structure

The internal architecture of the breast is arranged into 15-20 lobes, each of which is drained by a single major lactiferous duct that opens on to the nipple. Each lobe is made up of several lobules, each of which drains several acini. The lobules drain via a branching arrangement of ducts to the single lobar duct. Each lobule drains several acini-these are blind saccules into which milk is secreted during lactation. The glandular tissue of the acini and the ductal tissue draining them comprise the breast parenchyma. The fat surrounding the Parenchymal structure and the fibrotic framework of the breast constitute the stroma. The relative abundance of parenchyma and stroma varies according to age and other factors **(Fig. 2)** ***(Bergman et al., 1999)***.

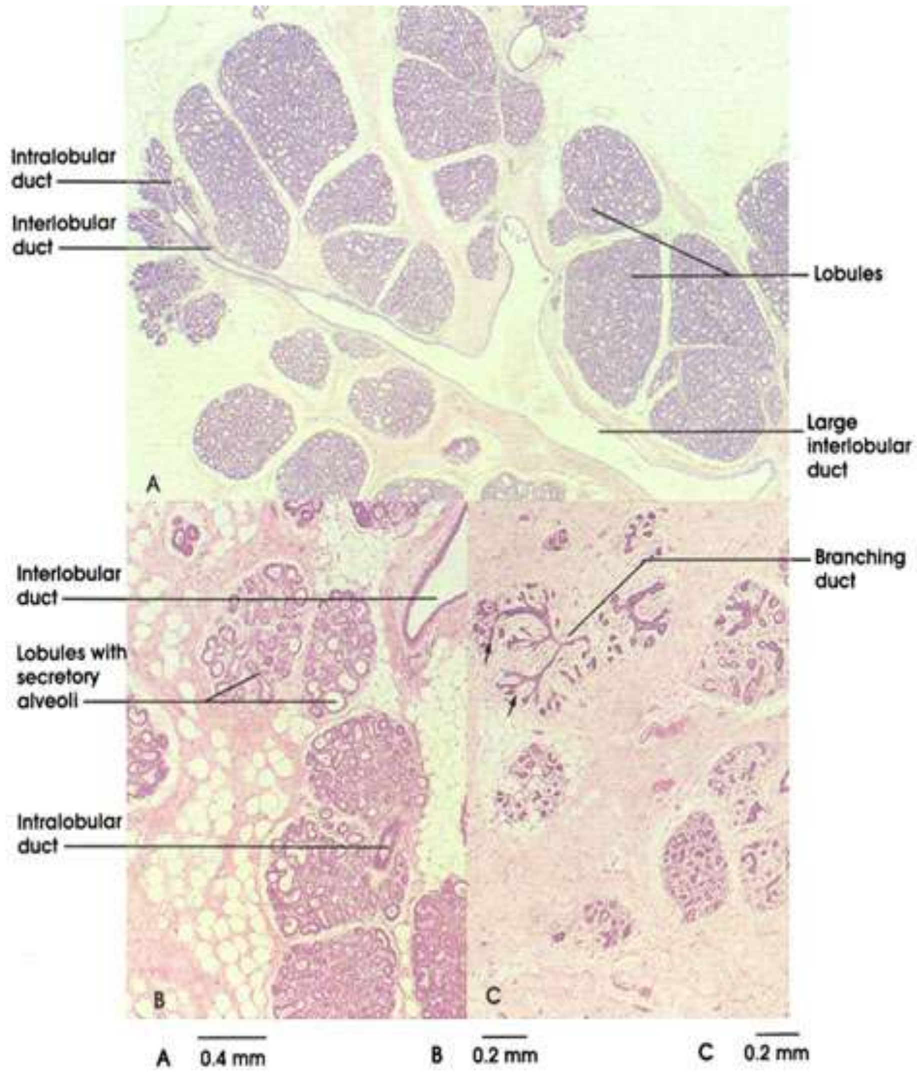

Figure (2): Mammary gland A. in pregnancy, B. late pregnancy, C. resting, quoted from ***(Bergman et al., 1999)***.

Blood Supply

The blood supply to the breast is composed of the following

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 **(Fig. 3).**

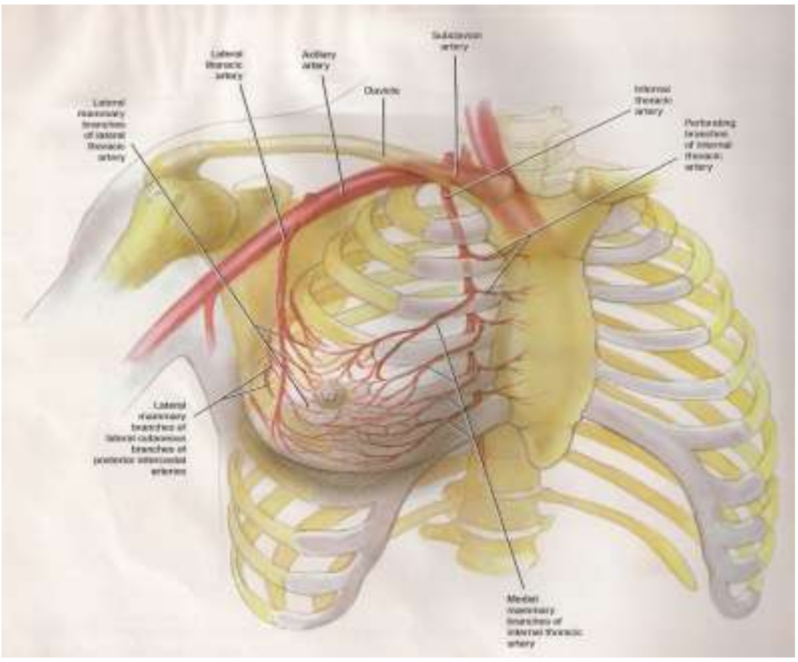

Figure (3): Blood supply to the Breast quoted from ***(Agur and Lee, 1999)***.

Venous drainage of the breast

There is a circumareolar venous plexus, and from the glandular tissue, blood drains in veins which accompany the corresponding arteries that supply the breast, which is finally drained to the axillary, internal thoracic and intercostals veins ***(Agur and Lee, 1999)***.

Metastatic emboli traveling through any of these venous routes will pass through the venous return to the heart and then be stopped as they reach the capillary bed of the lungs, providing a venous route for metastasis of breast carcinoma to the lungs **(Fig. 4)** ***(Krontiras et al., 2000)***.

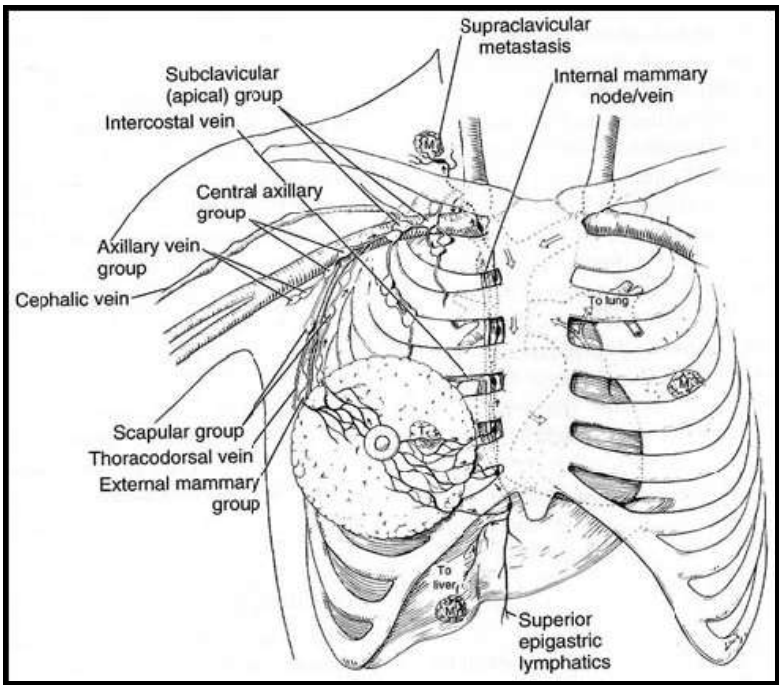

Figure (4): *Metastasis of breast carcinoma to the lungs* ***(Krontiras et al., 2000).***

Direct continuity with vertebral plexus of veins (Baston's plexus) that surrounds the vertebrae and extends from the base of the skull to the sacrum this plexus may provide an important pathway for hematogenous dissemination of cancer breast that explains metastases to skull, vertebrae, pelvic bones, and central nervous system in the absence of pulmonary metastases ***(Anson and McVac, 2005).***

Lymphatic Drainage

There are superficial lymphatics under the skin of the breast and a particular concentration in the subareolar plexus, beneath the nipple. Lymph flows unidirectionally from superficial to deep in the breast to the peri lobular and deep subcutaneous plexus. Lymph in deep plexus then drains centrifugally from the nipple to the axillary and internal mammary chains. However, the majority of drainage is to the axillary chain, with less than 5% draining to the internal mammary chain.

The axillary lymph nodes are arranged in groups referred to as levels. Level I nodes lie lateral to the lateral border of pectoralis minor. Level II nodes lie behind pectoralis minor. Level III nodes lie medial to medial border of pectoralis minor .Nodes may also lie in the breast tissue. The most common location is in the upper outer quadrant and axillary tail .The significance of identifying the nodal groups is that breast cancer is thought to spread in a sequential fashion, initially to the level I nodes. If the level I nodes is not involved, then it is unlikely that other (higher levels) nodes will be involved .Thus finding negative level I nodes may save the patient further axillary surgery in the case of breast cancer.

The internal mammary nodes lie in the intercostal spaces in the parasternal location, adjacent to the internal mammary vessels in the extra pleural fat **(Fig. 5)** *(McMinn, 1990)*.

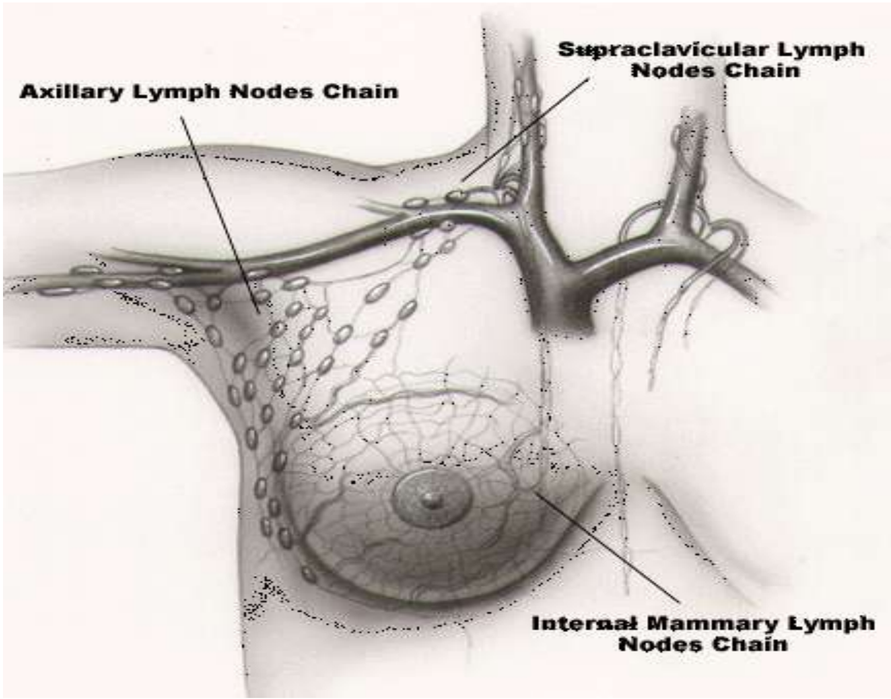

Figure (5): Breast lymphatic drainage ,quoted from *(Agur and Lee, 1999)*.

Changes in Breast Anatomy

1- Age Changes in the Breast

During puberty each menstrual cycle stimulates proliferation and active growth of breast tissue. The breast development is concerned with growth of the ductile system and the formation of ductile buds. The surrounding fat pads also develop, giving the breast size and shape ***(Brown, 2005)***.

Apart from the situation during pregnancy and lactation, Parenchymal atrophy starts in early adulthood and is accelerated at the menopause, with diminishing amounts of glandular tissue and an increasing amount of fat ***(Ryan et al., 2004)***.

2- Hormonal changes of the Breast

Breast tissue is very sensitive to hormonal changes, especially the hormonal changes of early pregnancy. For many women this is the first sign of pregnancy. The breasts are capable of full lactation from 16 weeks of pregnancy onwards, but women experience differing rates of growth and breast development during pregnancy. In the first trimester the mammary epithelial cells proliferate and further ductile branching starts. The ducts proliferate into the fatty pads of the breast where the ductile end buds develop into alveoli. In the third trimester the alveoli epithelium differentiates, developing a secretary function, and the alveoli become distended with colostrums ***(Brown, 2005).***

MRI anatomy of the breast

This technique is performed with the patient prone and the breast suspended in a surface coil.With MRI the breast and chest wall may be demonstrated; skin, subcutaneous fat, connective tissue, parenchyma and vessels are also shown. Connective tissue is of low signal intensity and fat is of high signal intensity. Parenchymal tissue varies in appearance, as with mammography, according to the age and hormonal status. Fat can be suppressed and contrast can be given to highlight abnormal areas (**Fig. 6**) ***(Ryan et al., 2004).***

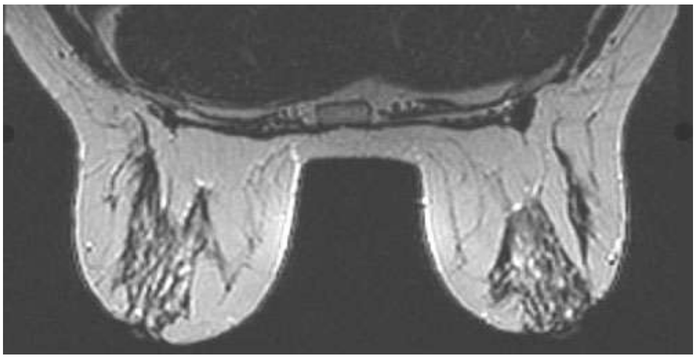

Figure (6): Breast MRI: T2-weighted image .Fat is bright, fibro glandular tissue dark, quoted from ***(Ryan et al., 2004).***

MRS of normal breast

MRS is potentially powerful method for studying the metabolism of human tissues, however before it is possible to interpret the metabolic compounds in MRS spectra it is important to establish the appearances of MRS spectra from normal patients, this is specially important when studying the breast which is sensitive to estrogen and progesterone and undergoes profound morphological and physiological changes in healthy women and this I to avoid misinterpretation of MRS spectra ***(Tozaki, 2008).***

A typical 1H spectrum of breast tissue consists of large lipid and water signals. Historically the choline peak seen at 3.2ppm was originally attributed to malignant tumors in studies performed at 1.5T However, small Cho signals have been detected in benign lesions and in normal breast tissues at higher field strength. Cho has also been seen in lactating breast spectra along with the characteristic lactose signal **(Fig. 7, 8)** ***(Bartell and Huang, 2007).***