Sudan University of Sciences and Technology
College of Graduate Studies

Evaluation of Breast Masses using Ultrasonography

تقويم أورام الثدي بإستخدام الموجات فوق الصوتية

A Thesis Submitted for A Partial Fulfillment of Award of Master degree in Medical Diagnostic Ultrasound

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بسم الله الرحمن الرحيم

(إنما يخشى الله من عباده العلماء إن الله

عزيز غفور)

صدق الله العظيم ،،،

فاطر 28

DEDICATION

I dedicate this research to my big family: parents who were the biggest supporter to me all the way, sisters and brothers who were encouraged me to finish this study.

To my small family: my dearest husband who believed in me, stood beside me and helped me all over the way, to my children who were very patient with me during this whole program.

To my friends and colleagues for their encouragement and emotional support during my study.

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ABSTRACT

Increased breast density is a risk factor for breast cancer and the sensitivity of detecting cancers in screening mammography in dense breasts is low. The use of ultrasonography in dense breast remains a controversial topic. The purpose of this study was to assess the usefulness of ultrasonography in evaluating of breast masses of women with or without family history of breast cancer, to evaluate the breast masses Echogenicity and texture, measure the size range, shape, and alignment of the breast masses, to evaluate the efficiency of ultrasound in diagnosing breast masses in order to reduce the mortality rate of the breast cancer. Mammogram was performed for 60 individuals with or without family history of breast cancer. Also all participants undergo ultrasonography for assessing breast masses. The breast ultrasound (US) examinations were performed by an expert radiologist in radial and anti-radial planes in a cross-sectional study. The data in this study were analyzed using **SPSS** version 21. From 60 subjects, there were 27 (45%) subjects diagnosed by ultrasound as Normal / benign, 19 (31.66%) subjects as probably benign this benignancy were approved by histology tests and none of them were malignant, 8 (13.33%) subjects as indeterminate on ultrasound and on histology only 2 (1.2%) were approved to be malignant, 2 (3.33%) subjects as probably malignant on ultrasound and approved by histology as malignant, and 4 (6.66%) subjects as malignant by ultrasound were approved by histology test as malignant . The results showed that ultrasonography is 100% sensitive in assessing breast masses than mammography**.** The sensitivity of mammography in the diagnosis of breast cancer is variable and influenced by age, breast density, family history, and other factors. Our data indicate that for the detection of breast cancer, sensitivity of US was greater than mammography in patients with dense breast.

ملخص البحث

تعتبر تكتلات الثدي الكثيفة عامل من عوامل الخطر التي تنذر بسرطان الثدي ،وذلك لأن زيادة هذه التكتلات تقلل فرص اكتشاف المرض عن طريق صورة الثدي . كما انه لايزال استخدام الموجات فوق الصوتية لفحص هذه التكتلات مثارا للجدل. الهدف من هذه الدراسة هو تقويم الفائدة من استخدام الموجات فوق الصوتية في اكتشاف اورام الثدي سواء كان للسيدة تاريخ عائلي او ليس لها تاريخ عائلي بمرض سرطان الثدي. تم عمل صورة الثدي على 60 سيدة ممن لديهن تاريخ عائلي او ليس لديهن تاريخ عائلي بمرض سرطان الثدي.كما ان جميع السيدات خضعن بعد ذلك لفحص بالموجات فوق الصوتية وقد تم عمل هذا الفحص على يد استشاري أشعة متخصص في هذا الفحص. تم تحليل نتائج هذا البحث بإستخدام برنامج الحزم الإحصائية للعلوم الإنسانية، النسخة 21. دلت النتائج على أنه من بين 60 سيدة كان هناك 27(45 %) حالة تم تقويمها بالموجات فوق الصوتية على أنها حميدة أو طبيعية، و 19 (31.66 %) من الحالات تميل الى انها حميدة بالموجات فوق الصوتية وقد أثبت انها حميدة بعد فحص الأنسجة ولم تكن بينهم اي حالة خبيثة او مشكوك فيها، و 8(13.33%) حالة مشكوك بها عن طريق الموجات فوق الصوتية وقد اكد فحص الأنسجة وجود 2(1.2%) منها خبيثة، وشخصت 2 (3.33 %) على انها أورام خبيثة وذلك بالموجات فوق الصوتية وقد اثبت انها خبيثة بعد عمل فحص الانسجة، و4 (6.66 %) حالة خبيثة بالموجات فوق الصوتية أثنت انها خبيثة بعد فحص الانسجة.كل النتائج أكدت على أن حساسية الموجات فوق الصوتية في تقويم أورام الثدي هي 100% مقارنة بأشعة الثدي.وذلك لأن أشعة الثدي تعتمد على عوامل منها عامل العمر،تكتلات الثدي الكثيفة ،التاريخ العائلي وعوامل اخرى قد تؤثر على نتائج الفحص النهائية.كما أشارت البيانات والنتائج الى ان الموجات فوق الصوتية أكثر حساسية في اكتشاف اورام الثدي من أشعة الثدي عامة،وفي النساء ذوات تكتلات الثدي الكثيفة **خاصة.**

TABLE OF CONTENTS

List of Tables

List of Diagrams

List of Figures

List of Figures

List of Abbreviations

Abbreviation	Terminology
ACR	American College of Radiology
Aka	Also Known As
Anechoic	No signal Comparing to the Surrounding Tissue
BIRADS	Breast Imaging Reporting and data system
BSE	Breast self examination
CBE	Clinical Breast Examination
DNA	Deoxyribonucleic acid.
Hyper	Signal more than surrounding tissue
Hypo	Signal less than surrounding tissue
Iso	Signal equal to the surrounding tissue
M	Mammography
MHz	Megahertz
MRI	Magnetic Resonance Imaging
SPSS	Statistical Package for Social Sciences
TDLU	Terminal Ductal Lobular Unit
US	Ultrasound
USG	Ultrasonography

CHAPTER ONE

1.1 Introduction

Breast cancer is among the most common causes of cancer deaths today, coming fifth after lung, stomach, liver and colon cancers. It is the most common cause of cancer death in women. In 2005 alone, 519 000 deaths were recorded due to breast cancer. This means that one in every 100 deaths worldwide and almost one in every 15 cancer deaths were due to breast cancer. (Gokhale, S. 2009).

The most recent estimate indicated that more than 1.6 million new cases of breast cancer occurred among women worldwide in 2010. Control of modifiable breast cancer risk factors such as maintaining a healthy weight, regular exercise and reducing alcohol intake could eventually have an impact in reducing the incidence of breast cancer. However, these strategies cannot eliminate the majority of breast cancers. Therefore, early detection in order to improve breast cancer outcome and survival remains the cornerstone of breast cancer control. Breast cancer screening is one way of reducing morbidity and mortality and improving the survival rate. In the United Arab Emirates (UAE), the Federal Ministry of Health initiated a breast cancer screening program in 1995. The program follows international guidelines using a combination of monthly Breast Self-Exam (BSE), regular Clinical Breast Exam (CBE), and a mammography every two years after the age of 40.

UAE society has experienced major shifts in lifestyle mainly because of acquired oil wealth since the formation of the country in 1971. Screening services are widely available and free of charge for UAE national women over the age of forty. (Elobaid, Y. E., Aw, T. C., Grivna, M., & Nagelkerke, N. 2014).

1.2 Problem of the study

Breast masses are common disease in women and it could be benign and it could be malignant and to know which is which, it should be proved by biopsy .The aim of this study is to reduce these biopsies by using ultrasonography which has the ability to specify masses criteria to determine masses are benign or malignant in order to reach the correct diagnosis, avoid unnecessary biopsies and to reduce the rate of false negative results.

1.3 Objectives of the study

1.3.1 General objective:

- The aim of this study is to prove that using ultrasonography has high sensitivity in detecting breast masses in order to reach the correct diagnosis and to reduce the rate of the false negative results.

1.3.2Specific objectives:

- To evaluate the breast masses Echogenicity and texture.
- To measure the size range, shape, and alignment of the breast masses.
- To evaluate the efficiency of ultrasound in diagnosing breast masses in order to reduce the mortality rate of the breast cancer.
- To evaluate the application of BIRADS categories for suspicious masses of the breast detected by primary performed breast ultrasound.

CHAPTER TWO

2.1 LITERATURE REVIEWS

Cancer of the breast is the most prevalent cancer in women worldwide and also in Iranian women. In spite of many progresses in identifying genetic markers and risk factors for breast cancer, approximately 70-80% of cases will occur in women without any known major predictor. When there is no effectual primary prevention measures, screening, and early detection could be an important way for reducing the mortality rate of breast cancer and to prolong patients' life; it emphasizes on detecting cancer at an early stage when tumor size is preferably smaller than 1 cm, lymph nodes are negative and there is no evidence of distant spread. As a primary method for screening, mammography has been established and shown to reduce mortality from breast cancer about 30-50%. But still, in screening with mammography the sensitivity to nonpalpable cancer in women with dense breasts is as low as 30-48%. This is more important in Iranian breast cancer women whom are diagnosed at the younger age (10 years younger than western countries), and so the density of mammary tissue is higher. In addition, dense breast tissue is an independent marker that strongly associated with breast cancer risk especially in subjects with higher risk of interval cancer that is, cancer detected between screening tests. The performance of this method is reduced to detection of cancer in women with dense breast because mammograms are summation images,

and all of breast tissues overlap in each view; so because of overlying dense breast tissue, cancers may not be seen. American Cancer Society has recommended magnetic resonance imaging to screen women who are very high risk for breast cancer, but it carry risks of the contrast media and is costly. Screening with a supplemental ultrasound (US) has the potential to identify early, nodenegative cancers that not seen on mammography. It has been greatly reported that in diagnosis of breast cancer US is more sensitive than mammography and had been shown to identify mammographically occult breast cancers in dense breasts. It is easily available and is largely inexpensive. (Adibi, et al, March 2015).

Ultrasonography is often suggested for supplemental screening of women with dense breasts because it is widely available and has relatively low direct medical costs. Shortly after Connecticut became the first state to enact a law about breast density notification, as many as 30% of women with dense breasts at some practices within the state were having supplemental ultrasonography screening. Limited data from clinical trials and observational studies suggest that the addition of handheld ultrasonography screening to mammography for women with dense breasts increases cancer detection rates at the expense of increased biopsies for women without cancer. (Sprague BL, Stout NK, Schechter C, Van Ravesteyn NT, Cevik M, Alagoz O, et al. 2015).

Supplemental screening ultrasound (US) has the potential to depict early, node-negative breast cancers not seen on mammography (M) and its performance is improved, if anything, in dense parenchyma. Methods that improve detection of small, node-negative cancers should further reduce mortality when performed in addition to screening mammography. (Berg et al, 2008).

2.2 Anatomy of the Breast

The breast is the tissue overlying the chest (pectoral) muscles. Women's breasts are made of specialized tissue that produces milk (glandular tissue) as well as fatty tissue. The amount of fat determines the size of the breast. The milk-producing part of the breast is organized into 15 to 20 sections, called lobes. Within each lobe are smaller structures, called lobules, where milk is produced. The milk travels through a network of tiny tubes called ducts. The ducts connect and come together into larger ducts, which eventually exit the skin in the nipple. The dark area of skin surrounding the nipple is called the areola. Connective tissue and ligaments provide support to the breast and give it its shape. Nerves provide sensation to the breast. The breast also contains blood vessels, lymph vessels, and lymph nodes. (www.webmd.com/women/picture-of-the-breasts). (Figure2.1)

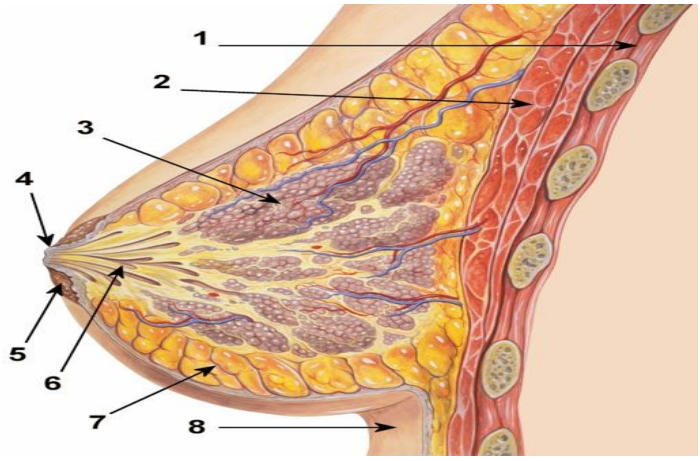

Figure 2.1 Breast Anatomy

1. **Chest wall. 2. Pectoral muscles. 3. Lobules (glands that make milk). 4. Nipple surface. 5.Areola. 6. Lactiferous duct tube that carries milk to the nipple 7. Fatty tissue. 8. Skin.**

2.3 Breast verses Age

Normal breast parenchymal pattern in the young non-lactating breast, the parenchyma is primarily composed of fibroglandular tissue, with little or no subcutaneous fat. With increasing age and parity, more and more fat gets deposited in both the subcutaneous and retromammary layers (figure 2.2).

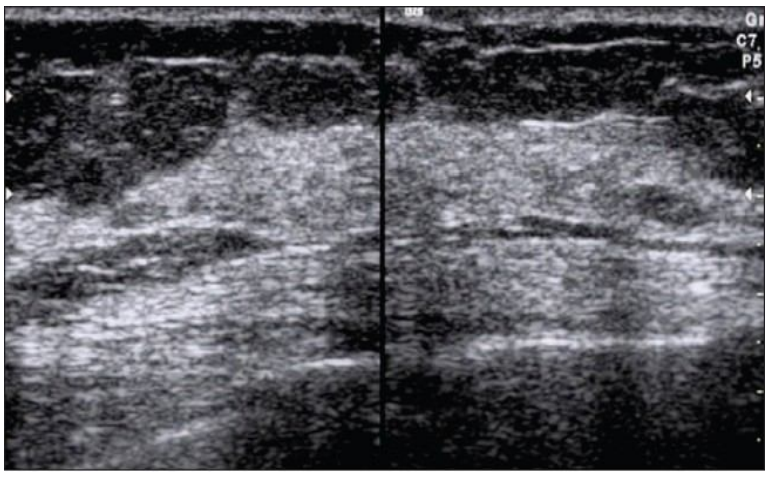

Figure 2.2 **Normal breast. Mid transverse scan of a normal breast. The fibroglandular parenchyma is echogenic (arrowheads) and is surrounded by hypoechoic fat**

Ultrasound evaluation criteria between benign and malignant masses includes: shape, alignment, margins, echotexture, homogeneity of internal echoes, lateral shadowing, posterior effect, and other signs. The significances of this study is to determine the effectiveness of US screening in decreasing breast cancer mortality among women aged 30 to 80 years.

2.4 Breast Cancer Pathophysiology

Breast cancer is a malignant tumor that starts in the cells of the breast. Like other cancers, there are several factors that can raise the risk of getting breast cancer. Damage to the DNA and genetic mutations can lead to breast cancer have been experimentally linked to estrogen exposure. Some individuals inherit defects in the DNA and genes like the BRCA1, BRCA2 and P53 among others. Those with a family history of prostate, ovarian or breast cancer thus are at an increased risk of breast cancer.

The immune system normally seeks out cancer cells and cells with damaged DNA and destroys them. Breast cancer may be a result of failure of such an effective immune defense and surveillance.

These are several signalling systems of growth factors and other mediators that interact between stromal cells and epithelial cells.

Disrupting these may lead to breast cancer as well. (www.news-medical.net/health/Breast-Cancer-Pathophysiology.aspx).

The normal breast is composed of both dense fibroglandular tissue and fatty tissue. Fatty tissue appears dark on mammograms, whereas fibroglandular tissue appears white, much like a tumor. Many factors (eg, age, genetics, and hormones) can cause the breast to be denser, making diagnosis of breast cancer difficult. In an attempt to overcome this challenge, doctors might suggest that additional diagnostic imaging be performed using ultrasonography, magnetic resonance imaging (MRI), breast tomosynthesis, or a combination of these technologies. In addition, patients with dense breasts should be aware of their breast anatomy. It is well known that dense breast anatomy can hinder the accuracy of screening mammography. To help remedy this problem, breast density notification laws serve to inform patients of their unique breast anatomy and introduce them to additional imaging options.

Ultrasound (US) is becoming a popular clinical diagnosis modality in the past decades with the major advances in transducer, electrical circuit, digital signal processing, and system control, and has already been applied to large varieties of diseases because of its uniqueness of low cost, flexibility, non-invasion, and non-ionization. US has the ability to image and evaluate patient's internal anatomy structure and physiology in real-time with astounding clarity. Therefore, it makes significant contributions to healthcare.

The breast examination by US started from 1951 with an optimistic opinion that US would replace mammography eventually in detecting breast cancer. However, with more comprehensive studies, it illustrates that US is only valid for the discrimination between cysts and solid masses. The performance of US depends on the size, number, location, and properties of the lesions, the operation skills, and the system specifications i.e., resolution and frequency. (Yufeng, Z. 2013).

Refinement of high-frequency technology, particularly with 7.5–13 MHz probes, has brought out a totally new facet in ultrasonography (USG) breast imaging. For example:

• High-density probes provide better lateral resolution.

• Harmonic imaging leads to improved resolution and reduced reverberation and near-field artifacts.

• Real-time compound scanning results in increased tissue contrast resolution.

• Extended or panoramic views provide a better perspective of the lesion in relation to the rest of the breast.

The reason why any lesion is visible on mammography or USG is the relative difference in the density and acoustic impedance of the lesion, respectively, as compared to the surrounding breast tissue. This is exemplified in women with dense breast tissue, where USG is useful in detecting small breast cancers that are not detected on mammography. (Gokhale, S. 2009).

Advancements in ultrasound technology have expanded the uses for ultrasonography in the evaluation of the breast. Breast masses can be delineated by specific ultrasonographic characteristics that allow them to be categorized according to their relative risk of being malignant. When combined with physical examination and mammography, breast ultrasonography can decrease additional radiation exposure associated with repeat mammograms. It also can lower the cost of evaluation of the breast, and it often reduces the number of open biopsies. In addition, ultrasound can be used for definitive pathologic diagnosis by guiding fine-needle aspiration and core biopsy, as well as facilitating preoperative needle localization for excisional biopsy.(Sabel MS, Staren ED. 1999).

Ultrasound shows certain discrete structures that can be recognized. It should be understood that the reference tissue in the breast screened by ultrasonography is the fat, and structures are labeled as hypo, iso, or hyper-echoic with reference to fat. The structures are seen from superficial to deep these are as follows:

- Skin: This is recognized as a thin hyperechoic to isoechoic zone between 2 thinner hyperechoic lines. Usually this is less than or equal to 2 mm in thickness but is slightly thicker over the areolae.
- Subcutaneous fat (premammary fat): This is the reference tissue. Premammary fat is more hypoechoic than fat elsewhere and has a lobular structure with the fat lobules surrounded by a very thin echogenic layer.

- Parenchyma: This layer appears as an echogenic plate; this can be homogenous in some women but can be heterogeneous, almost tigroid in appearance in others, especially in young women. This can also vary in echogenicity from echogenic in usual cases to almost isoechoic in lactating breasts. Within the parenchyma ducts, the terminal ductal lobular unit (TDLU) can be seen occasionally. An image depicting the breast structures visible on ultrasound can be seen below (Figure2.4).(http://emedicine.medscape.com/article/1948269-overview)

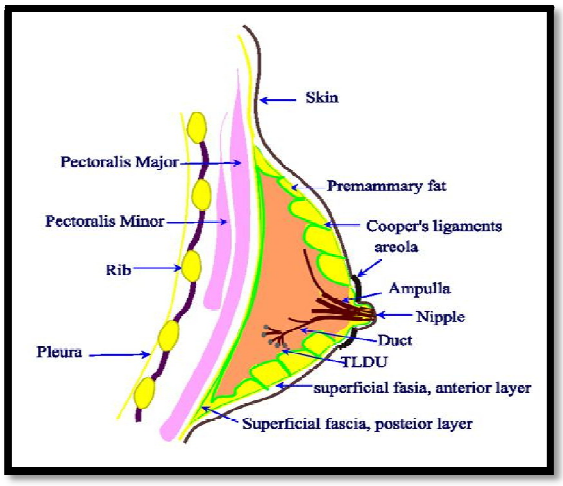

Figure 2.3 Breast Structure

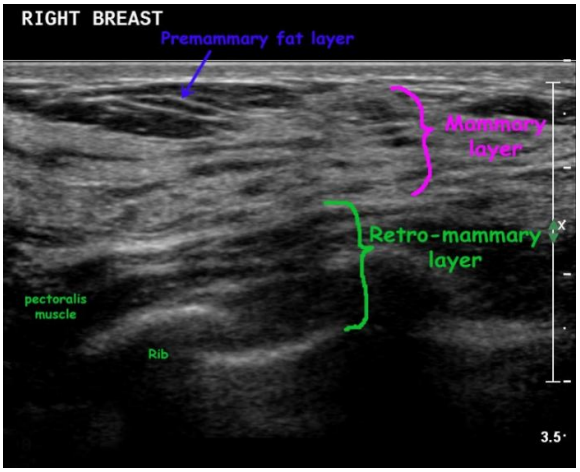

Figure 2.4 Breast Structure via US

Diagrammatic and sonographic representation of breast structures visible on ultrasound.

2.5 Evaluating breast lumps using ultrasound

Ultrasound considers one of the evaluating procedures. During an ultrasound, sound waves are used to create images of the breast on a monitor. If the breast lump isn't painful and the ultrasound appears normal, further testing or treatment might not be

needed. If the breast lump hurts, the doctor might uses ultrasound to guide fine needle aspiration a procedure in which any fluid is removed from the lump with a special needle. This can help relieve pain. If ultrasound reveals that the lump is solid, the doctor will likely use a needle to collect a small amount of breast tissue (biopsy) for lab analysis. Evaluation of a breast lump typically begins with the Self Breast Examination followed by the Clinical Breast Examination. (www.meded.edu/clinicalmed/breast.htm)

2.6 Breast Self-Examination (BSE):

BSE is a procedure a woman can do to physically and visually examine her breasts and underarm areas for changes. It has not been shown that BSEs alone can accurately determine the presence of breast cancer. The U.S. Preventive Services Task Force has found evidence that suggests BSEs do not lower the risk for death from breast cancer. Therefore, if you choose to do BSE, it should not be used in place of, but in addition to, clinical breast examination (performed by a health care provider every three years for women in their 20s and 30s, and every year for women ages 40 and older) and mammography. By doing BSEs regularly, women get to know how their breasts normally feel and look so that she will be able to detect any changes more easily. Women can begin practicing BSE at about age 20 and continue the practice throughout their lives—even during pregnancy and after menopause.

- If the woman is still menstruate, the best time to do BSE is when breasts are least likely to be tender or swollen, such as a few days after period ends.
- If the woman is no longer menstruate, pick a certain day—such as the first day of each month—to remind your-self to do BSE.

If the woman is taking hormones, she should talk to her health care provider about when to do BSE. (www.meded.edu/clinicalmed/breast.htm)

If the woman finds any changes in her breast(s) that causes her concern she should check with her health care provider. Changes in breasts may include:

- Development of a lump
- A discharge other than breast milk
- Swelling of the breast
- Skin irritation or dimpling
- Nipple abnormalities (such as pain, redness, scaliness, or turning inward).(www.meded.ucsd.edu/clinicalmed/breast.htm)

2.7 Clinical Breast Examination (CBE)

A clinical breast exam is performed by a healthcare professional who is trained to recognize many different types of abnormalities and warning signs.

This in-office exam will most likely be completed by your family physician or gynecologist at your annual exam, During this exam, the patient will be asked about any symptoms and risk factors for breast cancer or benign breast conditions, examine the breasts, noting their shape and size, observe the condition of the skin on breasts, check for nipple problems, such as inversion or discharge, examine the deeper tissue in the breasts and armpits for lumps or areas of thickening. (www.nationalbreastcancer.org/clinical-breast-exam).

If health care professional confirms that the patient have a breast lump or other area of concern, patient likely need testing to determine what's causing the problem using different evaluating procedures. Whereas your breast self-exam is something every woman should do at once a month at home. The goal of the examination in the setting of symptoms is to better characterize the abnormality, identify underlying etiology, and direct additional evaluation and treatment. Breast related symptoms may include any of the following:

- Discrete masses detected by the patient, often concerning for malignancy
- Pain, which can be associated with a number of processes including: cyclical in a menstruating women (reflecting transient hormone induced changes in the breast tissue), occasionally malignancies.

- Unusual nipple discharge, which may include:
    - Blood, concerning for malignancy
    - Milk when not pregnant. Suggestive inappropriate Prolactin secretion from the pituitary - may also be induced by certain medications
    - Other
- Discoloration or change in the quality of the skin:
    - Redness suggests infection or inflammation - in the post partum patient; this is often due to mastitis, a diffuse inflammatory condition caused by congestion from inadequately expressed milk.
    - "Peau d'orange" quality - an "Orange Peel" like texture that's caused by an uncommon, aggressive inflammatory malignancy

If a mass or other abnormality is identified, its location can be described as being in one of 4 quadrants (left upper, left lower, right upper, right lower) of the breast. Alternatively, it can be described relative to its position, imagining a clock face was superimposed on the breast. If a mass or other abnormality is identified, its location can be described as being in one of 4 quadrants (left upper, left lower, right upper, right lower) of the breast. Alternatively, it can be described relative to its position, imagining a clock face was superimposed on the breast. (Figure 2.5) (https://meded.ucsd.edu/clinicalmed/breast.htm)

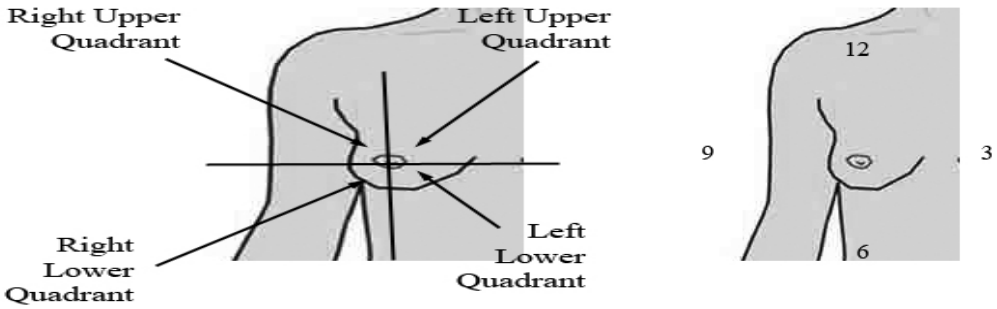

Figure 2.5 Mass location

2.8 Examination

2.8.1 Getting Started:

1. Health care provider should carefully explain what she is going to do - and why.
2. Room should be a comfortable temperature.
3. Patient should be in a gown - all undergarments (bras, shirts, etc) should be removed.
4. The patient remove their arms from the sleeves of the gown - though keep both breasts covered by laying the garment on top of their chest. Alternatively, the patient may put on the gown so that it opens in the front, which may make exposing one breast at a time a bit easier.

5. Patient should be lying flat on the table - It may help to have them place hand on side to be examined behind their head, allowing easier access to breast and axilla.
6. Uncover only the breast that is going to be examined.
7. The health care provider should observe the breast, looking for evidence of skin or nipple dimpling/retraction, discoloration, obvious masses or asymmetry.
8. The health care provider should keep observing the breasts while the patient sits up which may increase the ability to detect asymmetry or other surface abnormalities, particularly if the person has large breasts. (www.meded.ucsd.edu/clinicalmed/breast.htm)

2.8.2 Palpation of the Breast and Axilla:

The goal of this exam is to examine the breast in a systematic fashion, such that all of the tissue is palpated. The accuracy of the exam is increased by allowing adequate time. This will vary with breast size. Specifically, it will take more time to carefully evaluate larger breasts. Regardless of the method used to assure that the breast is examined in its entirety, palpation technique should be as follows:

2.8.3 Palpation Technique

a. Use the pads of the middle 3 fingers of one hand (Figure 2.6).
b. Press downward using a circular motion.

c. Apply steady pressure, pushing down to the level of the chest wall. Apply enough pressure to palpate to 3 levels of depth: first superficial, then medium, and then deep/to the level of the chest wall.

d. Make sure to palpate the nipple and areolar regions. (www.meded.ucsd.edu/clinicalmed/breast.htm)

What precisely should be identified? Normal breasts have a lumpy consistency, created by the mix of lobular, ductal and supporting tissue. The CBE (as mentioned above) is largely performed to identify masses consistent with malignancy. Most lumps are benign (e.g. fibroadenomas, cysts).

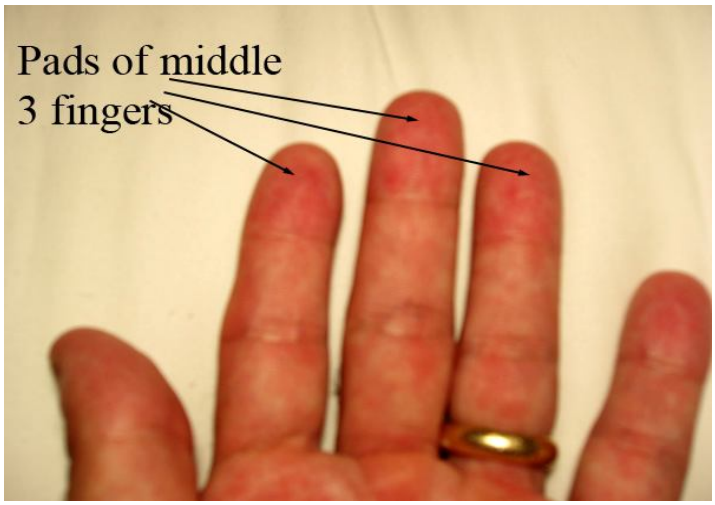

Figure 2.6 Pads of middle 3 fingers

Masses of concern tend to have the following characteristics: Feel different from the rest of the breast tissue (aka "dominant mass"), firmness, irregular/hard to

define borders, fixed/stuck to adjacent tissue - and increase in size over time. As breast density decreases with age (lobular tissue replaced by fat), it is easier to identify masses in older patients. If doctor confirms that the patient have a breast lump the patient should undergo through further investigations using different evaluating procedures.(www.meded.ucsd.edu/clinicalmed/breast.htm).

2.9 Criteria of Radiographic assessment

The first line for radiographic assessment is mammogram. A mammogram is basically an x-ray exam that produces images of the internal structures of the breasts. Mammography is the gold standard in breast imaging, since it is the most accurate method in evaluating the entire breast. Through mammography, cancer or other problems before a lump becomes large enough to be felt can be detected, as well as diagnosis of other breast problems can also be done.It is recommended that all women should have a screening mammogram every two years starting at age 40 and earlier if there is a family history of breast cancer. If the mammogram is abnormal the client will be advised to do further mammogram views such as magnify a specific area to get a more detailed picture or repeat the same views from the screening mammogram because those images weren't clear enough. And based on diagnose the client will be referred to do ultrasound. (www.emirateshospital.ae/services/medical-tests/mammograms/)

2.10 Role of Ultrasound

Ultrasound is a valuable diagnostic tool in assessing the following indications:

•Investigating a palpable lump

•Mammography abnormality

•Follow up of known lesion

•Mastalgia

•Nipple discharge

•Infection or mastitis

•Guidance for biopsy or hookwire localisation

Ultrasound increasingly enlisted as part of a comprehensive screening program alongside mammography. (Griffiths, T.2000).

2.11 Limitations

- Extremely large, mobile breasts will be difficult to scan thoroughly.
- Post injury, surgery or biopsy, the resultant hematoma will reduce detail and may obscure pathology. (Griffiths, T.2000).

2.12 Characteristics for benign lesions

Several studies have described the sonographic characteristics commonly seen in benign lesions of the breast:

1. Smooth and well circumscribed.
2. Hyperechoic, isoechoic or mildly hypoechoic.
3. Thin echogenic capsule.
4. Ellipsoid shape, with the maximum diameter being in the transverse plane.
5. Three or fewer gentle lobulations.
6. Absence of any malignant findings. (Gokhale, S. 2009).

2.13 Characteristics of malignant lesions:

Malignant lesions are commonly hypoechoic lesions with ill-defined borders. Typically, a malignant lesion presents as a hypoechoic nodular lesion, which is ‘taller than broader’ and has speculated margins, posterior acoustic shadowing and micro-calcification (Figure 2.7). Three-dimensional scanners with the capability of reproducing high-resolution images in the coronal plane provide additional important information. The spiky extensions along the tissue planes can be well seen in coronal images (Figure 2.8). It was initially believed that color Doppler scanning would add to the specificity of USG examination, but this has not proven to be very efficacious; however, in certain situations it does help resolve the issue, particularly

when there is significant vascularity present within highly cellular types of malignancies. (Figure 2.9). (Gokhale, S. 2009).

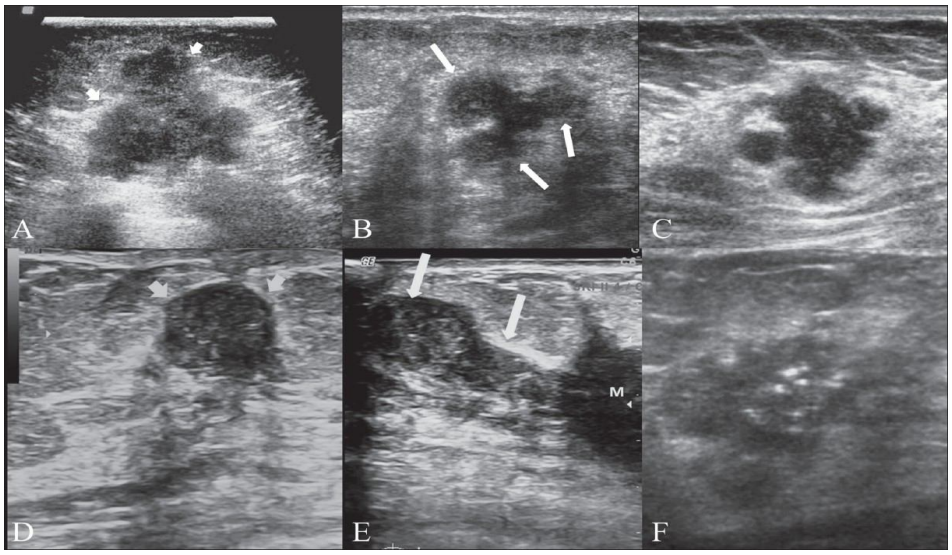

Figure 2.7 ***Transverse scan (A) shows a typical malignant nodule that is taller than wide, with hypoechoic echotexture. Arrowheads indicate irregular spiculated margins. Some of the nodules may reveal a branching pattern (arrows in B). Sagittal view (C) shows a nodule with multilobulated margins; the presence of more than 3–4 lobulations is suspicious for malignancy. Sagittal (D) and transverse (E) scans show duct extension (arrows). 'M' indicates the primary site. Duct extension appears smooth in outline in cross-section (arrowheads in E). Transverse scan (F) shows a typical malignant lesion with irregular spiky margins, microcalcifications and a branching pattern. This lesion is classifiable as US-BIRADS category 4.***

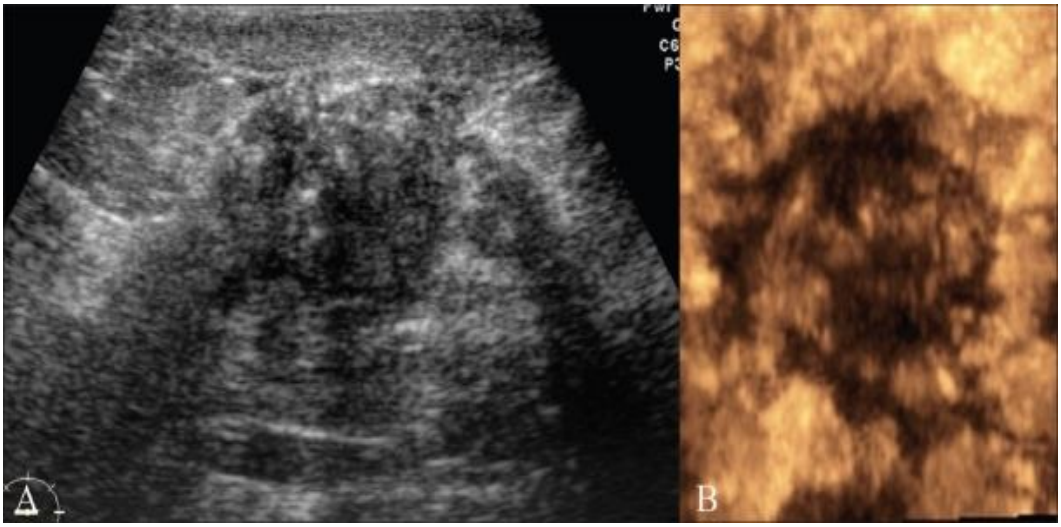

Figure 2.8 Transverse scan (A) shows smooth margins, suggesting a category 3 lesion. A 3Dimage in the coronal plane (B) however reveals spiky margins with a sunray appearance, suggestive of a category 4 lesion

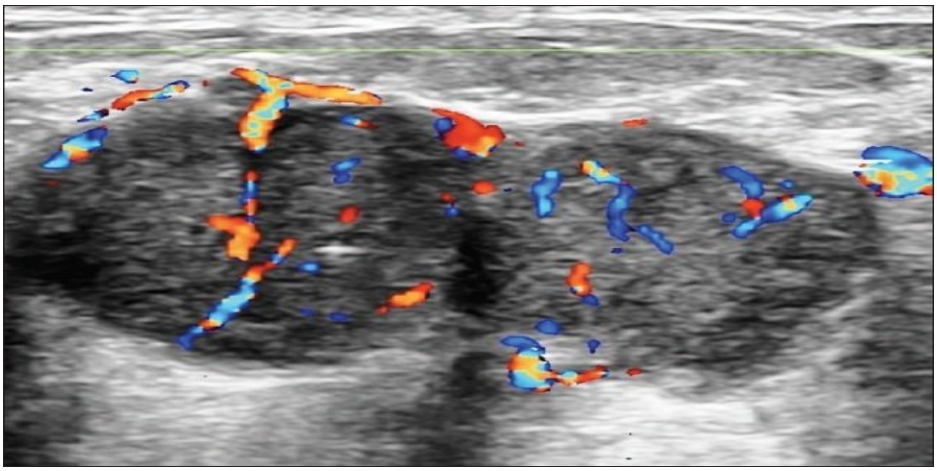

Figure 3 A smooth margin and homogenous echotexture suggest a category 3 lesion. Color Doppler reveals irregularly branching neovascularity

2.14 Abnormal Appearances

2.14.1 Breast cysts

Breast cysts are the commonest cause of breast lumps in women between 35 and 50 years of age. A cyst occurs when fluid accumulates due to obstruction of the extralobular terminal ducts, either due to fibrosis or because of intraductal epithelial proliferation. A cyst is seen on USG as a well-defined, round or oval, anechoic structure with a thin wall. They may be solitary or multiple Cysts. Cysts usually reveal thin walls and through transmission (A). An inflamed cyst (B) reveals a thick edematous wall (arrow) with internal layering of thick/thin fluid (arrowhead). A galactocele (C) reveals diffuse low-level echoes in the cyst. Chronic *Complex cyst*: When internal echoes or debris are seen, the cyst is called a complex cyst.

These internal echoes may be caused by floating cholesterol crystals, pus, blood or milk of calcium crystals (Figure 2.10). (Gokhale,S.2009).

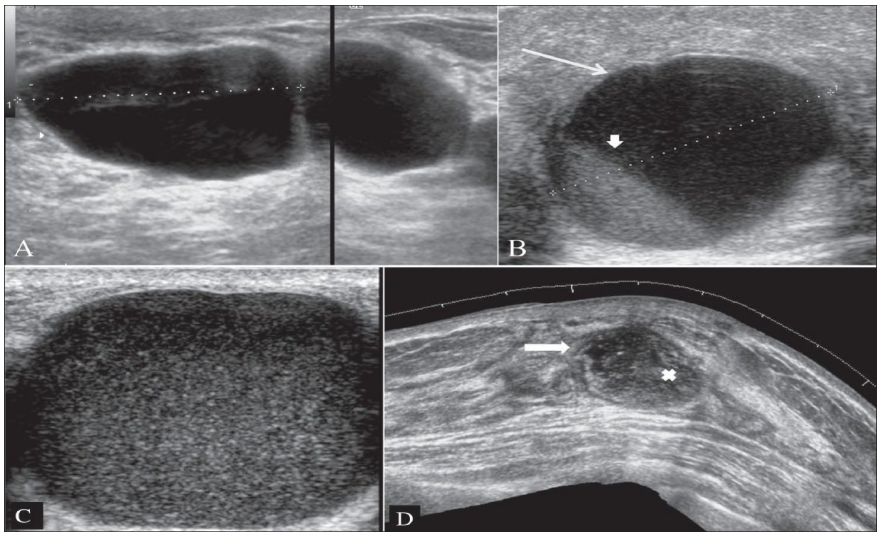

Figure2.10 breast cyst

2.14.2 Chronic abscess of the breast

Patients may present with fever, pain, tenderness to touch and increased white cell count. Abscesses are most commonly located in the central or subareolar area. An abscess may show an ill-defined or a well-defined outline. It may be anechoic or may reveal low-level internal echoes and posterior enhancement. (Gokhale, S. 2009).

2.14.3 Fibrocystic breast condition

This condition is referred to by many different names: fibrocystic disease, fibrocystic change, cystic disease, chronic cystic mastitis or mammary dysphasia.

The USG appearance of the breast in this condition is extremely variable since it depends on the stage and extent of morphological changes. In the early stages, the USG appearance may be normal, even though lumps may be palpable on clinical examination. There may be focal areas of thickening of the parenchyma, with or without patchy increase in echogenicity. Discrete single cysts or clusters of small cysts may be seen in some. Focal fibrocystic changes may appear as solid masses or thin-walled cysts. About half of these solid masses are usually classified as indeterminate and will eventually require a biopsy. Fibrocystic change. Extended view images (A, B) show a focal area of thickening of the breast parenchyma (A) with patchy increase in echogenicity (arrows) and scattered, discrete, thin-walled cysts (arrowheads in B). (Figure 2.11). (Gokhale, S. 2009).

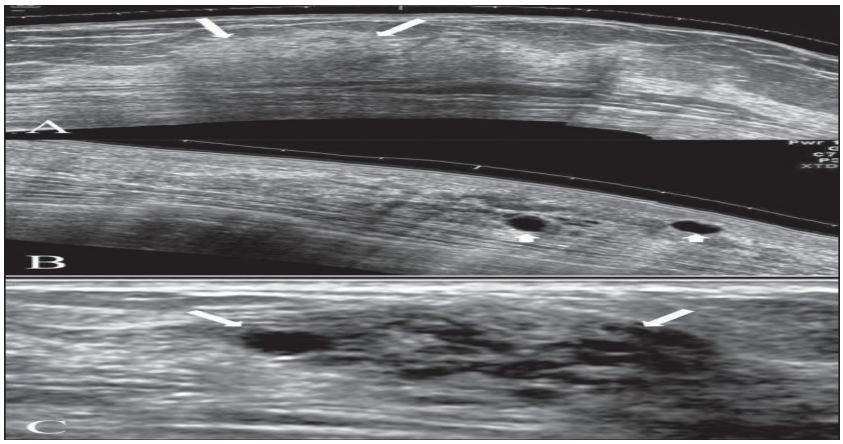

***Figure 2.11** Fibrocystic change. Extended view images (A, B) show a focal area of thickening of the breast parenchyma (A) with patchy increase in echogenicity (arrows) and scattered, discrete, thin-walled cysts (arrowheads in B).*

2.14.4 Ductectasia:

This lesion has a variable appearance. Typically, duct ectasia may appear as a single tubular structure filled with fluid or sometimes may show multiple such structures as well. Old cellular debris may appear as echogenic content. If the debris fills the lumen, it can be sometimes mistaken for a solid mass, unless the tubular shape is picked up chronic duct ectasia. Longitudinal image (A) shows a dilated duct containing inspissated debris (arrow) is seen. In crosssection (B), the intraductal debris may appear as a focal lesion (arrowheads). (Figure 2.12). (Gokhale, S. 2009).

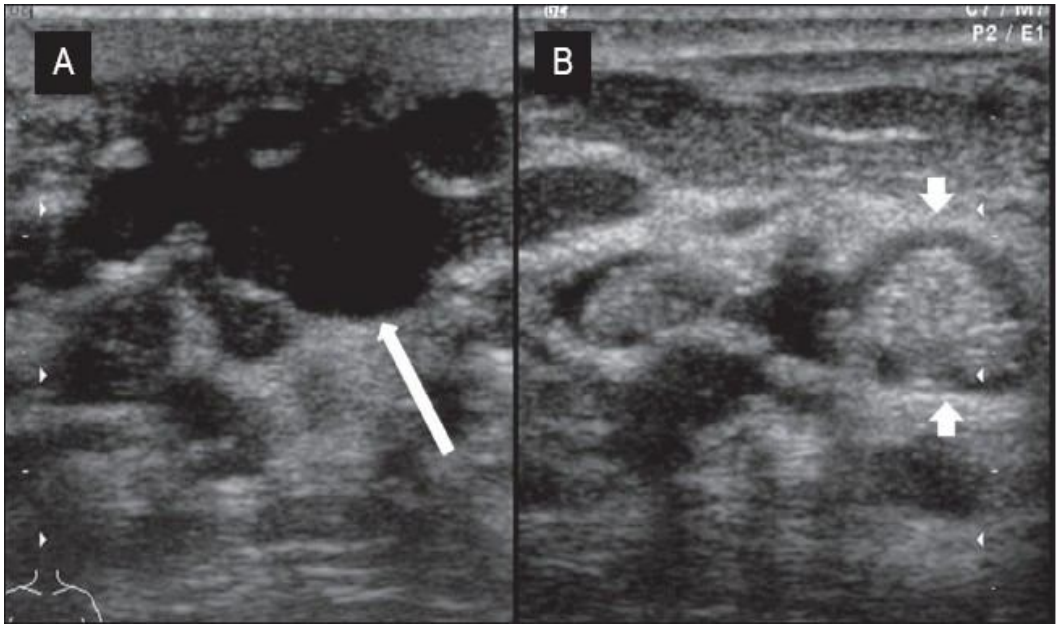

Figure 2.12 chronic duct ectasia. Longitudinal image (A) shows a dilated duct containing inspissated debris (arrow) is seen. In crosssection (B), the intraductal debris may appear as a focal lesion (arrowheads)

2.14.5 Fibroadenoma:

Fibroadenoma is an estrogen-induced tumor that forms in adolescence. It is the third

most common breast lesion after fibrocystic disease and carcinoma. It usually presents as a firm, smooth, oval-shaped, freely movable mass. It is rarely tender or painful. The size is usually under 5 cm, though larger fibroadenomas are known. Fibroadenomas are multiple and calcifications may occur. On USG, it appears as a well-defined lesion (figure 24). A capsule can usually be identified. The echotexture is usually homogenous and hypoechoic as compared to the breast parenchyma, and there may be low-level internal echoes. Typically, the transverse diameter is greater than the anteroposterior diameter(Figure 2.13). In a small number of patients, the mass may appear complex, hyperechoic or isoechoic. A similar USG appearance may be seen with medullary, mucinous or papillary carcinoma. (Gokhale, S. 2009).

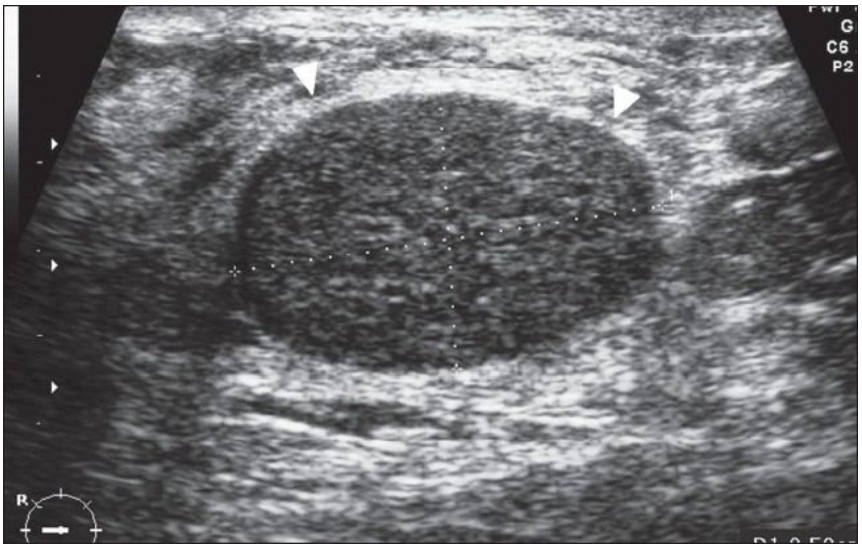

Figure 2.13 Fibroadenoma

2.14.6 Cystosarcoma phyllodes

This is a large lesion that presents in older women. The mass may involve the whole of the breast. It usually reveals well-defined margins and an inhomogeneous echo

structure, sometimes with variable cystic areas The incidence of malignant change is low. (Figure 2.14). Transverse scan reveals a large well-defined mass. There is inhomogeneous echotexture, with small areas of cystic degeneration.(Gokhale, S. 2009).

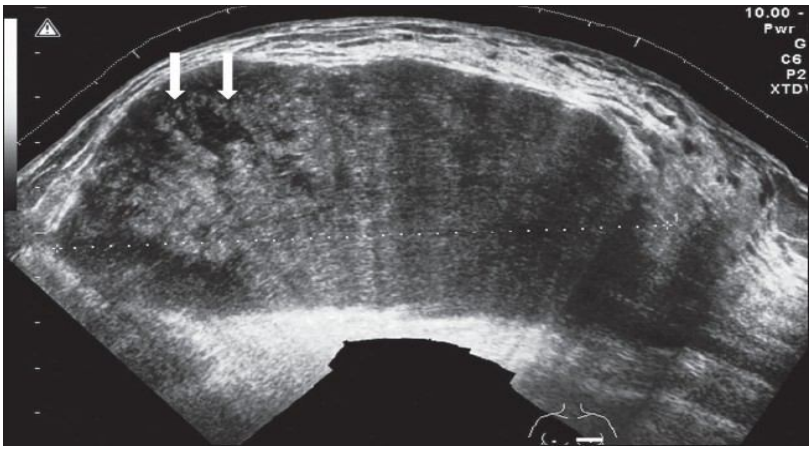

Figure 2.14 Cystosarcoma phyllodes

2.14.7 Lipoma:

Lipoma is a slow-growing, well-defined tumor. It may be a chance finding or the patient may present with complaints of increase in the size of the involved breast, though no discretely palpable mass can be made out. The tumor is soft and can be deformed by compression with the transducer.

A thin capsule can usually be identified and the tumor often reveals an echogenic structure, with a stippled or lamellar appearance. (Figure 2.15). (Gokhale, S. 2009).

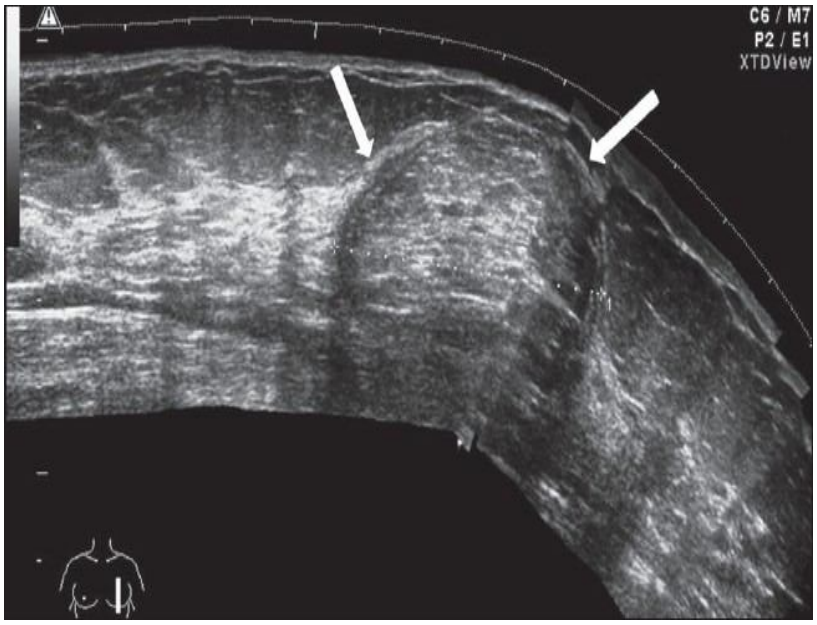

Figure 2.15 ***Sagittal extended view reveals a subtle echogenic mass with a reticular pattern and a well-defined, thin capsule.***

2.15 Final Assessment Categories

In 2003, recognizing the widespread use of ultrasonography (US) in breast imaging, the American College of Radiology (ACR) established the first edition of the Breast Imaging Reporting and Data System (BI-RADS) lexicon for US in an attempt to standardize image .Interpretation and reporting and to improve communication among radiologists, referring physicians, and surgeons. However, the BI-RADS US lexicon, which is still in its first edition, is not supported by large-scale statistically robust data on outcomes and is thus less widely validated than is the BI-RADS lexicon for mammography.BI-RADS assessments for US (Table 2.1) are based on an analysis of descriptors from several feature categories (Table 2.2), with the most

suspicious feature dictating the US assessment and recommendation. Whenever possible, the US lexicon uses terms similar to those used in the mammography lexicon, with the primary overlap related to the shape and margins of a mass. Some of the lesion features are unique to US, such as orientation, internal echo pattern, and posterior acoustic features. US descriptors should be selected only after evaluation in at least two perpendicular views confirms that the finding represents a true lesion. (Raza et al. 2010).

Table 2.1 BI-RADS assessment for US

BI-RADS US Category	Assessment and Management
0	Incomplete: additional imaging evaluation needed
1	Negative
2	Benign
3	Probably benign: short-interval follow-up recommended
4	Suspicious: biopsy
4A	Low suspicion
4B	Intermediate suspicion
4C	Moderate suspicion
5	Highly suggestive of malignancy: biopsy
6	Known malignancy: treatment ongoing

Table 1.2 Descriptor of several feature categories

US Descriptor	Features Favoring Benign	Features Favoring Malignant	Indeterminate Features
Shape of mass	Oval	Irregular, round	...
Orientation of mass	Parallel to skin	Not parallel to skin	...
Margin of mass	Circumscribed	Microlobulated, indistinct, angular, spiculated	...
Lesion boundary	Abrupt interface	Echogenic halo	...
Echo pattern	Anechoic, hyperechoic	Complex	Isoechoic, hypoechoic
Posterior acoustic features	...	Shadowing, combined pattern	Enhancement, no posterior acoustic features

The ultrasound lexicon has many similarities to the mammography lexicon, but there are some descriptors that are specific for ultrasound. Table 2.3 shows a summary of the mammography and ultrasound lexicon. (Zonderland. H, Smithuis. R, 2013).

Mammography Lexicon				Ultrasound Lexicon		
Breast composition	A. entirely fatty B. scattered areas of fibroglandular density C. heterogeneously dense, which may obscure masses D. extremely dense, which lowers sensitivity			**Breast composition**	a. homogeneous - fat b. homogeneous - fibroglandular c. heterogeneous	
Mass	**shape**	oval - round - irregular		**Mass**	**shape**	oval - round - irregular
	margin	circumscribed - obscured - microlobulated - indistinct - spiculated			**margin**	Circumscribed **or** Not-circumscribed: indistinct, angular, microlobulated, spiculated
	density	fat - low - equal - high			**orientation**	parallel - not parallel
Asymmetry	asymmetry - global - focal - developing				**echo pattern**	anechoic - hyperechoic - complex cystic/solid hypoechoic - isoechoic - heterogeneous
Architectural distortion	distorted parenchyma with no visible mass				**posterior features**	no features - enhancement - shadowing - combined pattern
Calcifications	**morphology**	typically benign		**Calcifications**	in mass - outside mass - intraductal	
		suspicious	1. amorphous 2. coarse heterogeneous 3. fine pleiomorphic 4. fine linear or fine linear branching	**Associated features**	architectural distortion - duct changes - skin thickening - skin retraction - edema - vascularity (absent, internal, rim) - elasticity	
	distribution	diffuse - regional - grouped - linear - segmental		**Special cases** *(cases with a unique diagnosis)*	simple cyst - clustered microcysts - complicated cyst - mass in or on skin - foreign body (including implants) - intramammary lymph node - AVM - Mondor disease - postsurgical fluid collection - fat necrosis	
Associated features	skin retraction - nipple retraction - skin thickening - trabecular thickening - axillary adenopathy - architectural distortion - calcifications					

Table 2.3 Mammography Lexicon and US Lexicon

2.15.1 BI-RADS 0 (Incomplete)

Although BI-RADS category 0 is used frequently at screening mammography, it is

less relevant for US, a modality that commonly completes the diagnostic work-up. However, in some instances, additional imaging, such as MR imaging, may be necessary before a final assessment is rendered. For example, as suggested in the ACR BI-RADS atlas, the differentiation between scarring and cancer recurrence at a lumpectomy site may require MR imaging evaluation in addition to mammography and US. Practice patterns differ as to the use of a category "0" attached to the recommendation for MR imaging after a diagnostic mammographic and/or US evaluation. At this time, clear radiologist-to-clinician communication of the recommended additional imaging follow-up is the responsibility of the radiologist (figure 2.16). (Raza et al, 2010).

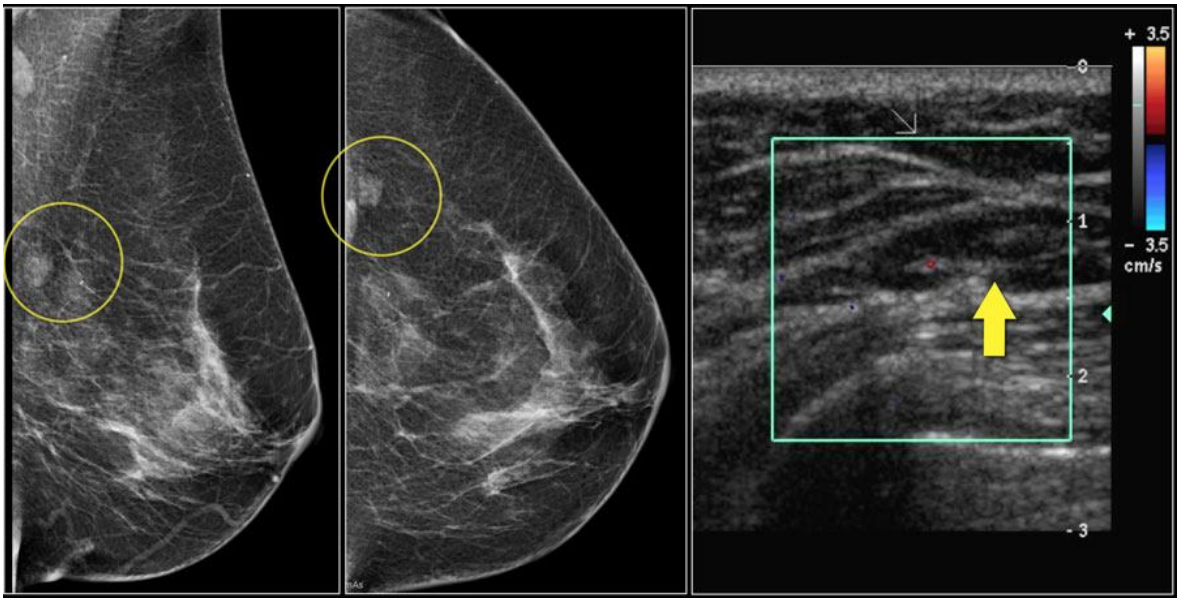

Figure 2.16 A mass on the mammogram which was assigned as BI-RADS 0. (Zonderland. H, Smithuis. R, 2013)

2.15.2 BI-RADS 1 (Negative)

If an abnormality is not seen at US, BI-RADS category 1 can be assigned, assuming that no suspicious findings are seen with mammography. Negative findings at US do not exclude breast cancer in the setting of a suspicious mammographic finding; and ultimately, BI-RADS categorization should be based on mammographic and US findings. If the patient is being evaluated for a palpable abnormality and the findings with both US and mammography are negative, the report should stress the importance of clinical assessment and further management based on the clinical level of concern. (Raza et al,2010).

2.15.3 BI-RADS 2 (Benign)

Category 2 is used when findings have been documented but the results of the evaluation are negative for malignancy. In the ACR BI-RADS atlas, the suggestion is to use this category for simple cysts, breast implants, stable postsurgical changes, and probable fibroadenomas noted to be unchanged at successive US studies. Normal intramammary lymph nodes can be categorized as BI-RADS 1 or 2. (Figure 2.17) (Raza et al,2010).

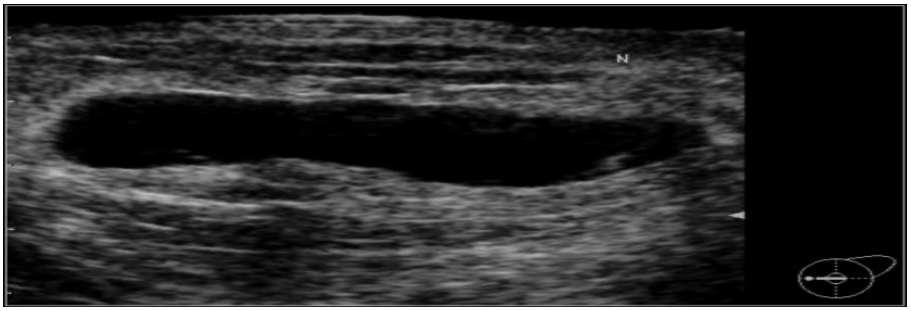

Figure 2.17 Normal intramammary lymph nodes can be categorized as BI-RADS 1 or 2(Zonderland. H, Smithuis. R, 2013)

2.15.4 BI-RADS 3 (Probably Benign)

As stated in the BI-RADS US lexicon, a solid mass with circumscribed margins, an oval shape, and parallel orientation can be classified as category 3. This mass should have a risk of malignancy of less than 2%. (Raza et al,2010).

2.15.5 BI-RADS 4 (Suspicious Abnormality)

The BI-RADS 4 category is assigned to suspicious lesions for which biopsy is recommended. This category is largely indeterminate and highly variable in outcome, with lesions having a probability of malignancy of approximately 3%–94%. Therefore, in the ACR BI-RADS atlas, the suggestion now is to subdivide category 4 into three subgroups (4A, 4B, and 4C) to better inform the referring clinicians and pathologist of the degree of concern. These subcategories also serve to accomplish a more informative internal audit, improve radiologic-pathologic

correlation, and improve image-directed research. Category 4A designates lesions with a low suspicion for malignancy. For this group, a benign pathologic diagnosis is expected and would be considered concordant. Radiologists may include solid masses with benign features (eg, fibroadenomas) in this category if the lesion is clinically palpable. Complicated cysts and some complex cystic and solid masses (eg, clinically apparent abscesses) are also included in this group. Category 4B is appropriate for lesions considered to have an intermediate suspicion for malignancy. Follow-up and correlation of pathologic results are of the greatest importance within this subgroup because the range of lesion types may be fairly evenly distributed between benign and malignant. Category 4C is used for lesions with moderate suspicion for, but not classic findings of, malignancy. Malignant results are expected at biopsy, with a benign result seen as being discordant.(Raza et al,2010).

2.15.6 BI-RADS 5 (Highly Suggestive of Malignancy)

BI-RADS 5 is reserved for findings that almost invariably represent breast cancer, with a likelihood of malignancy of more than 95%. The current rationale for using category 5 is that if the percutaneous tissue diagnosis is nonmalignant, this automatically should be considered as discordant (Figure 2.18). (Zonderland. H, Smithuis. R, 2013)

- Spiculated, irregular highdensity mass
- Segmental or linear arrangement of fine linear calcifications.
- Irregular spiculated mass with associated pleomorphic calcifications.

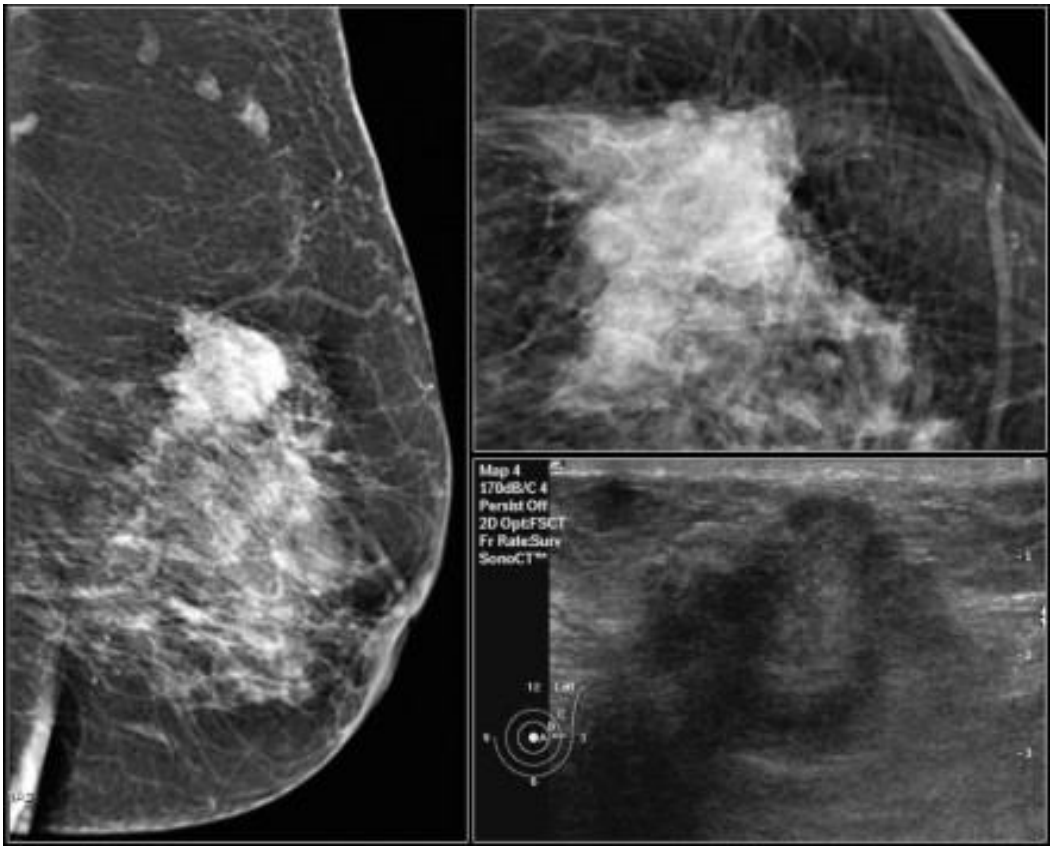

Figure 2.18 BI-RADS 5 (Highly Suggestive of Malignancy)

2.15.7 BI-RADS 6 (Known Cancer)

For biopsy-proved malignancy, BI-RADS 6 can be assigned before surgery or neoadjuvant therapy. (Figure 2.19). (Raza et al, 2010).

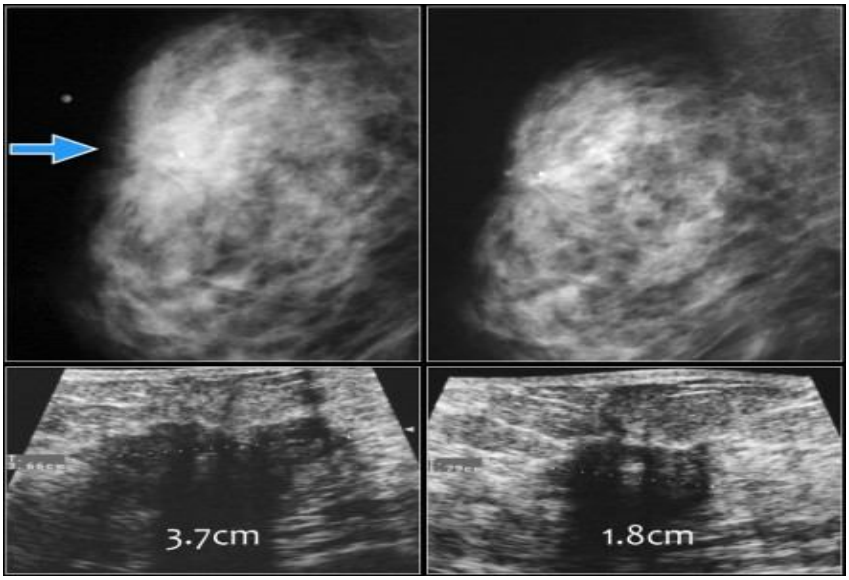

Figure 2.19 on the left BI-RADS 5 lesion. On the right after neo-adjuvant chemotherapy BI-RADS 6. (Zonderland. H, Smithuis. R, 2013)

CHAPTER THREE

METHODOLOGY

3.1 Area of the study

This study was conducted in the Preventive Medicine Department- Mother and Childhood Center, The national Breast cancer screening program - Dubai, United Arab Emirates. Documented images were printed .All patients were investigated and requested by authorized person.

3.2 Study Population

Data were collected for Female aged between 30 and 80 years old, different nationalities

3.3 Duration

This study was carried out from June 2013 to February 2015.

3.4 Sample volume

It was requested by my supervisor to be 50 cases and above. This study were conducted among 60 cases

3.5 Inclusion Criteria

- Female aged between 30 years old to 80 years old
- Menopausal or menstrual female.
- Female with or without family history of breast cancer.
- Female with or without symptoms.

3.6 Exclusion Criteria

Women younger than 30 years old or above 80 years old should be excluded in this study. Since screening program in UAE is recommended for women above 40 years and below 40 years if there is a family history of breast cancer.

3.7 Data Collection

Data was collected from patients who were referred to National Breast Screening in Preventive Medicine Department by all primary health centers in UAE considering their age, family history of breast cancer, did mammogram and was recommended to do ultrasound as further investigation for breast mass.

3.8 Equipment selection and Technique

This study was conducted by the GE Voluson E8 Expert Ultrasound System, 2007 includes Transducer options 7-10MHz 2D Wide Band Linear Probe. A lower frequency transducer may be required for the larger attenuative breasts,

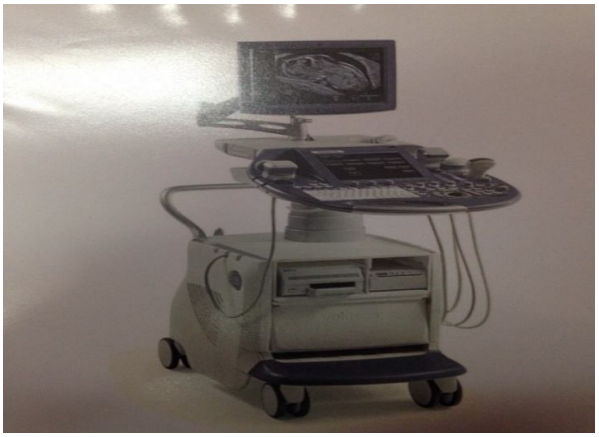

Figure 3.1 GE Voluson E8 Expert Ultrasound System,2007

inflammatory masses and the axilla. The use of a standoff may be required for nipple, superficial/or skin lesions. Low PRF color and spectral Doppler capabilities for assessing vascularity of lesions (Figur30112).

3.8.1 Machine Setup

When establishing a breast preset for the ultrasound system, the following issues should be considered:

- In order to display the maximum level of grays you need to use a wide (high) dynamic range.
- The selected compression curve (post processing function) should display a wide range of grays. This combination will allow the Sonographer to demonstrate a lesion that might at lower levels of dynamic range appear isoechoic with the surrounding breast tissue. i.e. the mass will be shown on the image at the same shade of gray as the surrounding tissue. When a wide dynamic range is set, the lesion can then be differentiated from the surrounding tissue, as it will be displayed as a different shade of gray.

- Focal zones: Use as many focal zones as the equipment will allow for a reasonable frame rate.
- Field of View: The field of view needs to be sufficient to see the back of the pectoral muscle.
- Power Levels: Most machines require about 10% of maximum power output for breast imaging. Maximum power results in flaring on high impedance mismatch interfaces (such as ribs or the back of cysts). If Sonographer lowers the gain to prevent the flaring vital information is then lost. However, by lowering the power levels Sonographer can have uniform levels of grayscale i.e. no flaring and display low levels of gray in the image that would not have otherwise been demonstrated. Set the focal zones superficial to the ribs. By using 10% power and keeping the focal zones in front of the ribs any problems of heating in the tissue are minimized. Temperature changes in the tissue tend to mostly occur where there is high impedance mismatch e.g. at the breast/rib interface.

3.9 Patient Care

Patients having breast examinations require special care and attention. Patients are often well informed on breast lesion detection, management and outcomes, and can be anxious and demanding. Sonographer should take care to explain to the patient the examination procedure and the process by which the patient will receive the results before starting the examination. This will hopefully avoid difficult questions from the patient at the end of the examination.

3.10 Patient Positioning

The side to be examined is raised with the patient's hand behind their head (figure 3.2). The breast needs to be spread evenly across the chest wall to allow for a uniform depth of field and to reduce breast thickness. The reduced thickness allows optimization of focusing. The degree of obliquity required varies with the size and position of the breast on the chest wall. Placing the ipsilateral hand behind the head will assist in spreading the breast further. This also allows access to the axilla. (Griffiths, T. 2000).

3.11 Sonographer Positioning

Position the patient close to the edge of the ultrasound couch. Move the machine in close so that you do not have to stretch to reach the control panel. This will assist in reducing fatigue of the upper arm/neck ...etc, by decreasing the amount it is necessary to abduct the scanning arm. You will have to 'invade the patient's personal space' to be sufficiently close for this to be effective. The arm can be supported with a 45-degree sponge wedge. The sponge can carry the weight of the arm rather than having to hold the arm in constant abduction (Figure3.2). It is a position that can be adopted for all scanning and can reduce some of the physical stresses of scanning. Adjustment of the height of the patient couch and the scanning chair to suit each scanning situation is also important. (Griffiths, T. 2000).

Figure 3.2 Patient and Sonographer position

3.12 Scanning Technique

The most common scanning technique is to initially scan using the grid scanning pattern, followed by a radial (clock face) technique for the hard copy imaging.

3.12.1 Grid scanning pattern:

- Scan up and down the breast in rows, making sure you overlap each row slightly to ensure no breast tissue is overlooked (figure 3.3 &3.4).

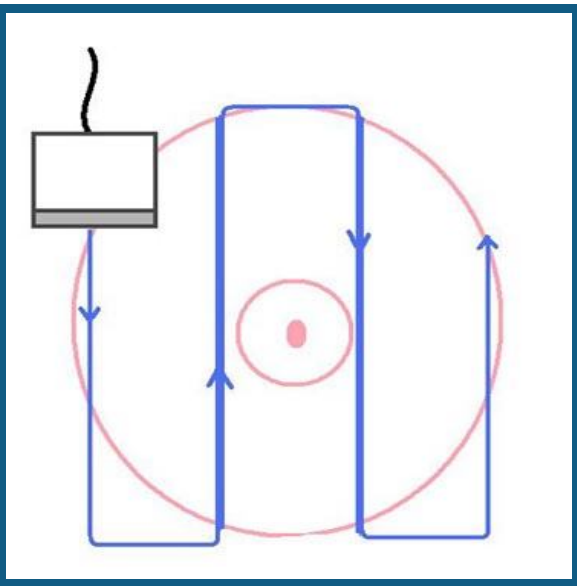

Figure 3.3

Grid scanning pattern: phase 1.

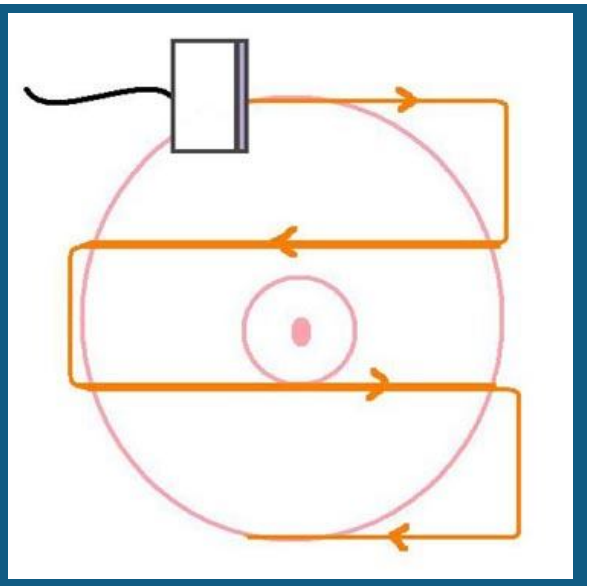

Figure 3.4

Grid scanning pattern: phase 2.

1. Begin in the upper outer quadrant, scanning in transverse. Slide inferiorly from top to bottom.
2. Move across and repeat the sweep inferior to superior.

3. Repeat this across the breast.
4. Rotate into a Sagittal plane and repeat the pattern.

A variation, particularly in larger or mobile breasts, is to apply the grid pattern quadrant by quadrant.

3.12.2 Radial scanning pattern (Clock-face)

- The breast is scanned and described as a clock-face.
- Begin at 12 o'clock in a Sagittal plane with the toe of the probe at the nipple.
- Scan by rotating the probe around the nipple (Figure 3.5).
- Depending on breast size, a second pass further from the nipple may be required.
- If pathology is identified, rotate the probe 90degrees in the 'anti-radial' plane (Figure 3.6).

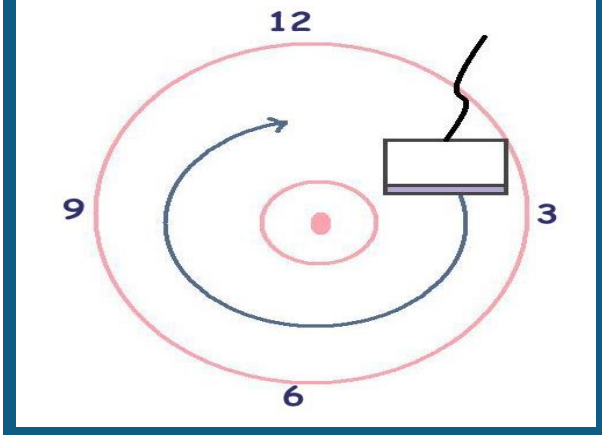

Figure 3.5

The scan direction for Radial breast scanning.

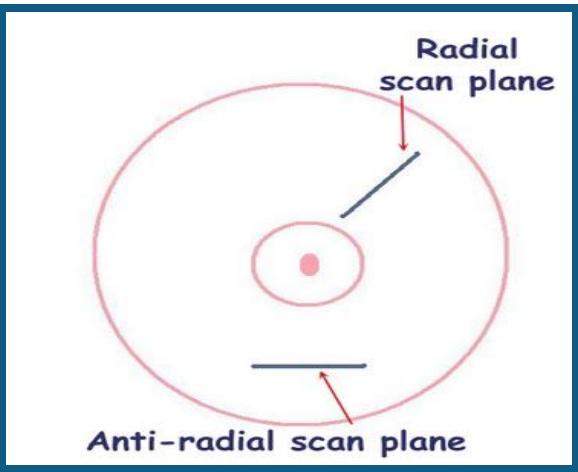

Figure 3.6

Hard copy imaging of regions of interest should be taken in 2 planes.

3.12.3 Implant imaging

- Should be scanned with the patient positioned as above.
- Treat the scan as a 2-fold examination:

1. The breast tissue.
2. The deeper implant. This may require lower frequency or a curved probe to investigate.

The implant should be anechoic with well-defined margins. Folds are commonly seen in the implant surface. Also, small traces of simple fluid will be seen overlying the implant but is contained by the overlying fibrous capsule that contains the

implant (Figure 3.8). This fluid is routinely seen within the implant folds .Most saline implants will have a small valve visible (Figure3.9). (www.ultrasoundpaedia.com/normal-breast/)

Figure 3.7 Folds are commonly seen in the implant surface

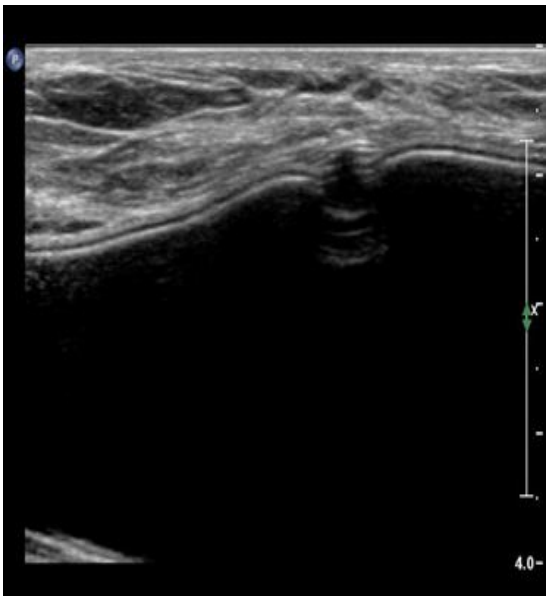

Figure 3.8 Most saline implants will have a small valve visible

CHAPTER FOUR

4.1 Data Analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS) version 21.All patients were grouped into age intervals 30-40,41-50,51-60,61-70 ,71-80 and according to ultrasound diagnose all patients were grouped to Norma/Benign, Probably Benign, Indeterminate, Probably Malignant and Malignant. The percentage of each diagnose was calculated from the total number of patients.

4.2 Results

All masses were evaluated according to their Appearance, the mass is benign if the shape is regular, the orientation is parallel to the skin, it's margin is circumscribed and has less than 4 lobulations, homogeneous, isoechoic or hyper echoic or anechoic, also masses are benign if they have posterior wall enhancement, if they are mobile, not infiltrated and it's vascularity is on periphery. The percentage of all benign masses recorded 27 (45 %) of the sample. Were the malignant masses had the appearance of taller than wider, they had indistinct or ill defined or angular or speculated margins, inhomogeneous and hypoechoic, masses will have posterior acoustic shadowing and masses will be fixed (not mobile), also masses will have

infiltrated architecture of surrounding tissues with inside (central) vascularity.

If the mass has a probability of malignancy findings by only 2% it will be classified as probably benign, if it has 49% or less of malignant findings it will be classified as indeterminate and the mass will be malignant if it has 50% or more of malignant findings.

All cases that undergo biopsy (histology tests), their results were compared with the ultrasound findings to determine the sensitivity and specificity of ultrasound in detecting malignant breast masses.

4.2.1 Malignancy VS Age

Family history and age were objectives in this study therefore the sample (60 participants) were divided into five groups, first one was between 30 to 40 and the second one was between 41-50, third one was between 51-60, fourth one was between 61-70, and the last one was between 71-80. In these participants 4 (6.66%) diagnosed as malignant masses, the majority of the malignant cases were found in the fifth group (age between 71-80) with a percentage of 50% (equal to 2 cases out of 4 malignant cases). Based on these results we found that malignancy rate increase with age, on the other hand this thesis need more participants and longer time to follow up in order prove it

4.2.2 Ultrasound Findings

Sixty subjects aged between 35 to 80 years old had ultrasound as further investigation for breast masses, there were 27 (45%) subjects diagnosed by ultrasound as Normal/benign, 19 (31.66%) subjects as probably benign, 8 (13.33%) subjects as indeterminate, 2 (3.33%) subjects as probably malignant, and 4 (6.66%) subjects as malignant. (Table 4.1) and (diagram 4.1).

Ultrasound finding	**Number of patient**	**Percentage (%)**
Normal / benign	**27**	**45%**
Probably benign	**19**	**31.66%**
Indeterminate	**8**	**13.33%**
Probably malignant	**2**	**3.33%**
Malignant	**4**	**6.66%**
Total	**60**	**100%**

Table 2.1 Ultrasound Findings

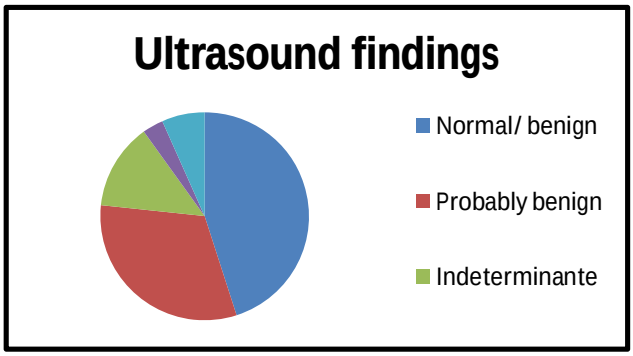

Diagram 4.1 Ultrasound Findings

4.2.3 Histopathology Test Results

All patients diagnosed as Probably benign, Indeterminate, Probably Malignant and Malignant were send to do histopathology test as further investigation. Table (4.2) shows a comparison between histopathology test results VS ultrasound findings. There were 19 (31.66%) classified as Probably Benign on ultrasound, 19 (100%) were confirmed benign by histopathology test. There were 8 (13.33) classified as

Indeterminate on ultrasound, only 3 had a result of malignant by histopathology. 2 (3.33%) were classified as Probably malignant on ultrasound, 2 (100%) were approved by histopathology as malignant mass.

Table 4.2 shows the results of ultrasound VS histopathology results

Ultrasound Findings	Histopathology Results	
	Benign	Malignant
Probably Benign 19(31.66%)	19 (100%)	0
Indeterminate 8(13.33%)	5 (62.5%)	3(37.5%)
Probably Malignant 2 (3.33%)	0	2 (100%)
Malignant 4 (6.66%)	0	4 (100%)

Since the aim of this study was to prove that ultrasound has a high sensitivity, and based on the comparison which done between ultrasound and histopathology tests it is obvious now that ultrasound has 100% sensitivity to detect malignant breast masses.

CHAPTER FIVE

5.1 DISCUSSION

In this study data was collected from 60 patients who were referred to National Breast Screening in Preventive Medicine Department by all primary health centers in UAE considering their age, family history of breast cancer, did mammogram and was recommended to do ultrasound as further investigation for breast masses.

Breast cancer is the most common malignancy among women universally. In the absence of known avoidable causes of breast cancer, the single most important factor in reducing death from breast cancer and in the extent of treatment required is early detection through screening. As a primary method for screening, mammography has been established and shown to reduce mortality from breast cancer about 30-50%. But still, in screening with mammography the sensitivity to non-palpable cancer in women with dense breasts is as low as 30-48%. In this study, I assessed the usefulness of ultrasonography as a complement to mammography in screening in detecting mass appearance in breast in order to reach the correct diagnosis, as well as the sensitivity of ultrasound in detecting of malignant breast masses.

Mammography is currently the sole acceptable technique for mass screening for breast cancer. Despite the reported decline in mortality rates from breast cancer, the dispute concerning the effectiveness of screening mammography continues. The sensitivity of mammography in the diagnosis of breast cancer is variable and influenced by age, breast density, family history, and other factors.

This is in against with some recent studies. Leong et al, (2012). revealed the relevant of supplementary US screening in identifying early stage clinically and mammographically occult breast cancers in dense breast women. Also, Shen et al, (2012). And Parris et al,(2013). Showed that US is more sensitive than mammography for early detecting of breast cancer. They concluded that formal screening breast US as an adjunct to mammography increases cancer detection rate.

Supplemental screening ultrasound has the potential of depicting small, node-negative breast cancers not seen on mammography, and its performance is improved in dense parenchyma. It is natural to expect that methods that improve the detection of small, node-negative cancers would further reduce mortality when performed in addition to screening mammography. However, direct evidence of a mortality reduction due to screening can only be generated in a large prospective randomized screening trial with mortality as an end point. Such trials are costly, require extensive infrastructure and resources, and are not practical under all contexts. Surrogate aims and end points, such as the diagnostic performance for the screening

modality or the size and stage of breast cancers depicted, have been correlated with mortality outcomes, and can be used to project the mortality reduction if the screening modality were implemented. Concerns remain, however, over the generalizability of such favorable results with screening ultrasound. In particular, there is concern for the operator dependence of freehand screening breast ultrasound because an abnormality must be perceived while scanning for it to be documented. Importantly, recent reports have shown that consistent breast ultrasound examination performance and interpretation is possible with minimal training. Other limitations to implementing widespread screening ultrasound include a shortage of qualified personnel to perform and interpret the examination and lack of standardized scanning protocols. These concerns have hampered use of screening ultrasound; 35% of surveyed facilities specializing in breast imaging offered it in 2005, even though most facilities offering screening ultrasound will do so only on a limited basis. (Berg et al. 2008).

Ultrasound is a valuable diagnostic tool in assessing the following indications:

•Investigating a palpable lump

•Mammography abnormality

•Follow up of known lesion

•Mastalgia

•Nipple discharge

•Infection or mastitis

•Guidance for biopsy or hookwire localization

Ultrasound increasingly enlisted as part of a comprehensive screening program alongside mammography. (Griffiths, T.2000).

Ultrasound has characteristics to distinguish between benign and malignant breast masses such as:

- Shape: regular, or irregular
- Orientation: parallel to skin, or taller than wider.
- Margin: circumscribed, indistinct.ill defined, angular, speculated or lobulated
- Echogenicity: homogeneous, non homogeneous, isoechoic, hypoechoic, hyperechoic or anechoic.
- Acousting transmission: posterior wall enhancement or acoustic shadowing.
- Mobility: mobile or fixed.
- Architecture of surrounding tissue: infiltrated or not infiltrated
- Vascularity: peripheral or centeral.

Sixty subjects aged between 35 to 80 years old had ultrasound as further investigation for breast masses, there were 27 (45%) subjects diagnosed by ultrasound as Normal/benign, 19 (31.66%) subjects as probably benign, 8 (13.33%) subjects as indeterminate, 2 (3.33%) subjects as probably malignant, and 4 (6.66%)

subjects as malignant. All patients diagnosed as Probably benign, Indeterminate, Probably Malignant and Malignant were send to do histopathology test as further investigation, There were 19 (31.66%) classified as Probably Benign on ultrasound, 19 (100%) were confirmed benign by histopathology test. There were 8 (13.33) classified as Indeterminate on ultrasound, only 3 had a result of malignant by histopathology. 2 (3.33%) were classified as Probably malignant on ultrasound, 2 (100%) were approved by histopathology as malignant mass.These tests results showed that ultrasound has 100% sensitivity in detecting malignant breast masses.

5.2 CONCLUSION

Every woman will pass through many stages in her life; therefor she has to be ready for everything. Every woman should be aware of any changes, with her breasts because Breast cancer is the most common causes of cancer deaths today. The most recent estimate indicated that more than 1.6 million new cases of breast cancer occurred among women worldwide, that's why early detection is the most important strategy to eliminate the majority of breast cancers. Many studies approved that ultrasonography has higher sensitivity than mammography. Ultrasonography is cheaper and safer than mammography; on the other hand ultrasonography can eliminate breast cancer mortality.This study showed that ultrasound is sensitive by 100% in detecting malignant breast masses. All masses have ultrasounographic appearance which has criteria that help to diagnose masses as benign or malignant. Bengin masses are well defined, regular margins, parallel to skin, circumscribed, mobile and have peripheral vascularity on Doppler. While malignant masses are ill-defined, irregular margins, taller than wider, angular and speculated, non-homogenous, fixed, and have central vascularity on Doppler.

In conclusion, Ultrasound is valuable modality that can detect breast malignant masses, it has 100% sensitivity in masses detection, all this will help to avoid unnecessary biopsies and increase the rate of early detection of malignant breast masses. Ultrasound is the modality of today and tomorrow because it can differentiate between benign, suspicious and malignant breast masses.

5.3 RECOMMENDATION

Concerns remain, however, over the generalizability of such favorable results with screening ultrasound. In particular, there is concern for the operator dependence of freehand screening breast ultrasound because an abnormality must be perceived while scanning for it to be documented. Importantly, recent reports have shown that consistent breast ultrasound examination performance and interpretation is possible with minimal training. Other limitations to implementing widespread screening ultrasound include a shortage of qualified personnel to perform and interpret the examination and lack of standardized scanning protocols.Ultrasound BIRADS categories should be applied for each patient in order to reach the correct diagnosis, avoiding unnecessary biopsies, based on that all patients should be followed up.

In my opinion patients follow up will make big difference in detection any changes correctly , and further studies should be applied with bigger sample size followed up for longer time.

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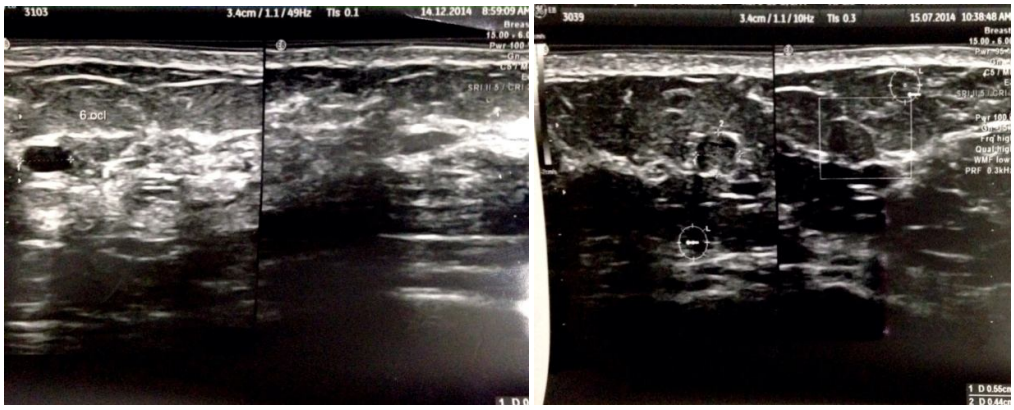
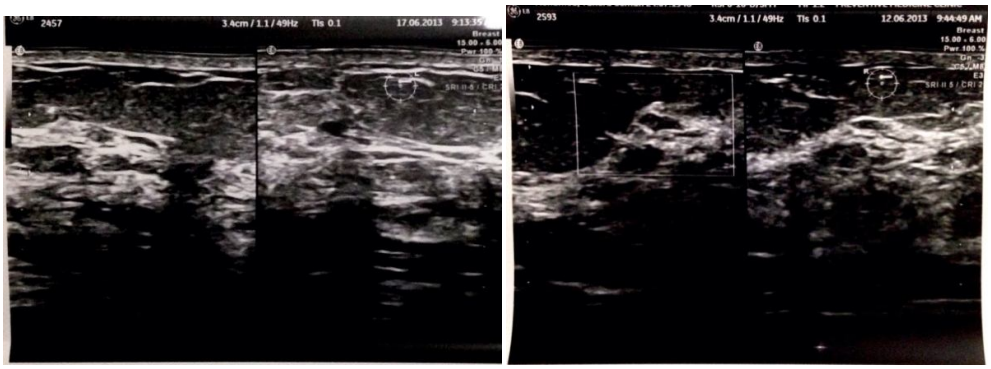
APPENDECIES

Benign Breast Masses(Personal Collection)





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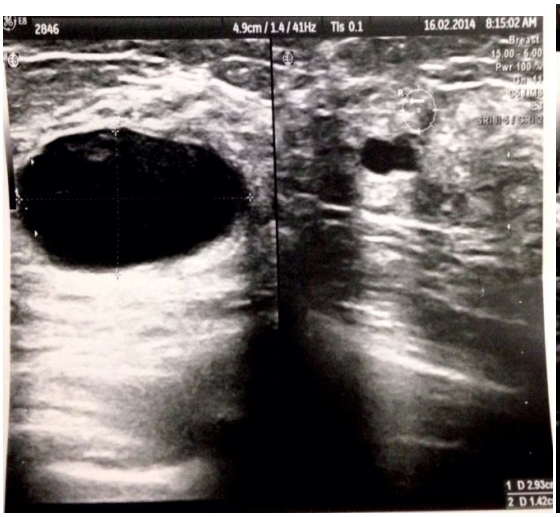

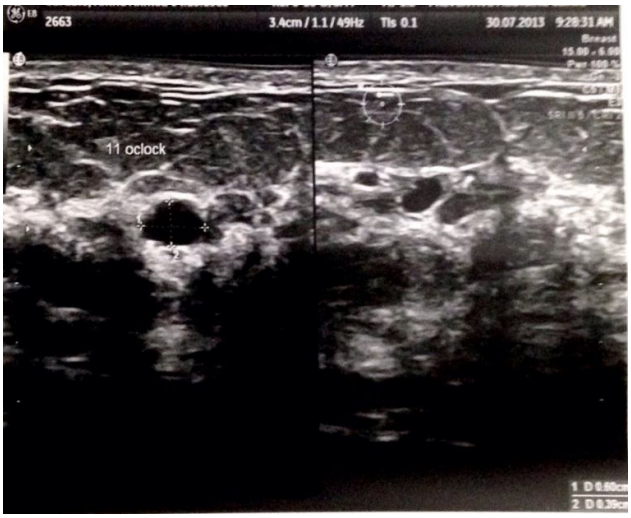

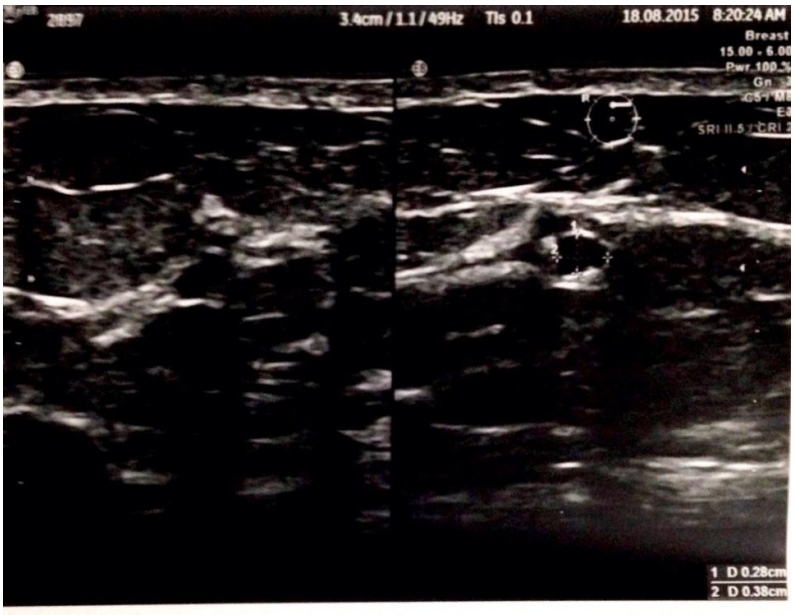

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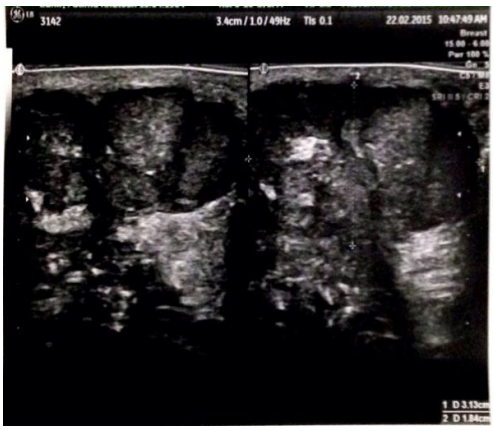

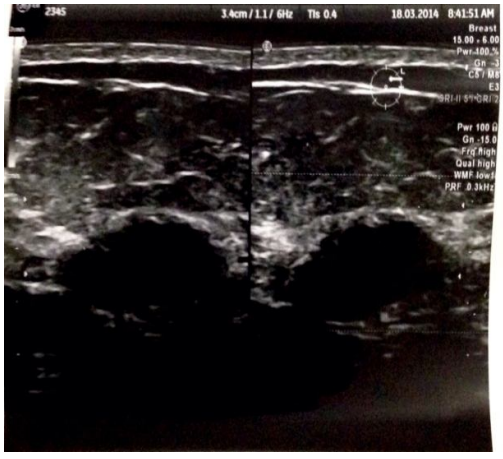

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