Chapter One

General Introduction

1.1 Introduction

Breast cancer is second only to lung cancer as a cause of cancer deaths in American women Breast cancer is among the most common causes of cancer deaths today, coming fifth after lung, stomach, and liver and colon cancers. It is the most common cause of cancer death in women, (Steven Halls, 2015).

Excluding cancers of the skin, breast cancer is the most common type of cancer in women in the United States, accounting for 1 of every 3 cancers diagnosed. A woman's chance of developing invasive breast cancer at some time in her life is approximately 1 in 8 (12%). It is one of the leading causes of cancer mortality among women in the United States,(W Brueninget al,2012).

Because of early detection, intervention, and postoperative treatment, breast cancer mortality has been decreasing. Mammography is the preferred screening examination for breast cancer. It is widely available, well-tolerated and inexpensive. Randomized controlled trials have demonstrated a mortality benefit for women from 40 to 74 years old. Some studies have shown that mammography may be particularly beneficial for women who are 80 years of age and older, (Schonberg MA et al,2006).

One out of every seven women will be diagnosed with breast cancer in 2007

Fortunately, radical mastectomy (surgical removal) is rarely needed today with better treatment options, the breast is biologically a gland that secretes sweat, it is a defining structure in mammals and its main function is to feed offspring. In humans, breasts have an added sexual component: female human breasts, in

opposition to female primate breasts, maintain a considerable volume throughout puberty, which can increase by one third duringlactancy.(Ganesan S.et al2006).

The mammary gland originates in the breast. Female breasts do not begin growing until puberty, moment in which breast skin also stretches to adapt to new shapes and sizes. Inside the breast, changes take place that prepare the mammary gland for lactancyacinar cells, clustered in the lobules and which communicate to the outside through the galactophorous canals, suffer hypertrophy and activate, producing a typical secretion, which is milk. Hormone stimulation during menstruation, pregnancy and lactancy, as well as, hormone treatments and obesity, lead to breast size increase, (W Brueninget al,2012).

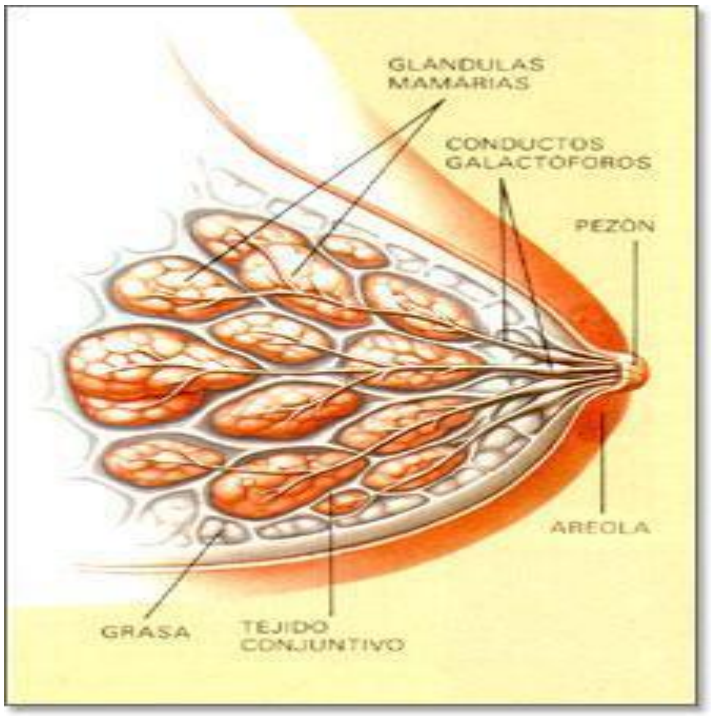

Figure (1.1) adopted from Schonberg MA, Ramanan RA, McCarthy EP, Marcantonio ER.

The breast is formed early in fetal life from an invagination of the ectoderm (superficial layer) of the embryo's ventral region. During this stage, some mammals develop two parallel rows (dogs, cats…), others such as humans, horses and bovine mammals only have two functioning mammary glands, the rest suffer atrophy. Nonetheless, some women present vestiges of these atrophied structures and more or less complete breasts are visible going from axilla to groin (supernumerary breasts or nipples). Other possible anomalies are: complete absence of one or both breasts, important asymmetries (certain level of asymmetry is normal), alterations in nipple-areola complex (inverted nipples, hypertrophy, etc.), or breast growth in males (gynecomasty) (Tofler GH et al2002.).

The aforementioned alternatives are mainly of morphological character, we will not cover hispathological alterations, since they are not of special interest to our subject, but we can superficially highlight the most common pathologies: swelling (mastitis, abscesses and fat necrosis), hormones (benign mammary dysplasia, cysts and adenosis) and benign (fibroadenoma) or malign (carcinoma) tumors. Due to the frequency of alterations, an early diagnosis is vital. This implies periodic medical examinations and a well-informed patient, including breast self-examination and a periodic gynecological control. (Schonberg MAet al2003.).

1.2 Problem of the study

Mammogram helps in detecting small breast tumors somehow differentiating benign from malignant lesions in the breast.

1.3 Objective

1.3.1 General Objective

The general objective of this study is to identify mammographic criteria for benignancy and malignant tumors.

1.3.2 Specific Objective

To compare the masses seen on mammogram if (malignant or benign)

To evaluate clinical breast symptoms such as palpable masses, focal pain and suspicious nipple discharge

To correlate between ages, shape, margin, presence of calcification and appearance of lymph nodes enlargements detecting malignant tumors.

1.4 Important of Study

The mammogram characterization of breast lump instead ofothers unnecessary investigations to detect early stages of breast tumors.

1.5 Over view of Study

This study includes five chapters; the introduction in chapter one while chapter two includesliterature review, materials and method explain in chapter Three, chapter four deals with result, finally discussion, conclusion and recommendation in chapter Five.

Chapter Two

Literature review

2.1. Theoretical Background

2.1.1 Anatomy of the breast.

The breasts of an adult woman are milk-producing glands on the front of the chest wall. They rest on the pectoralis major and are supported by and attached to the front of the chest wall on either side of the sternum by ligaments. Each breast contains 15-20 lobes arranged in a circular fashion. The fat that covers the lobes gives the breast its size and shape. Each lobe comprises many lobules, at the endof which were glands that produce milk in response to hormones.

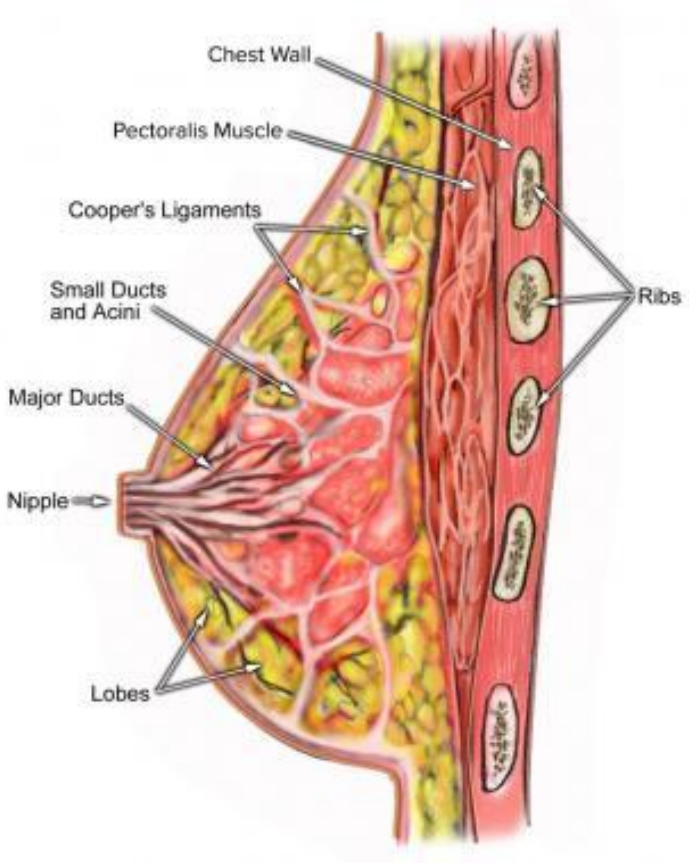

Figure (2.1) Anatomy of the breast adopted fromKohler BA,2001)

2.1.2 Pathophysiology

The current understanding of breast cancer etiopathogenesis is that invasive cancers arise through a series of molecular alterations at the cell level. These alterations result in breast epithelial cells with immortal features and uncontrolled growth.

Genomic profiling has demonstrated the presence of discrete breast tumor subtypes with distinct natural histories and clinical behavior. The exact number of disease subtypes and molecular alterations from which these subtypes arise remains to be fully elucidated, but these generally align with the presence or absence of estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor 2 (HER2).

This view of breast cancer--not as a set of stochastic molecular events, but as a limited set of separable diseases of distinct molecular and cellular origins--has altered thinking about breast cancer etiology, type-specific risk factors, and prevention and has had a substantial impact on treatment strategies and breast cancer research.

Evidence from The Cancer Genome Atlas Network (TCGA) confirms the following 4 main breast tumor subtypes, with distinct genetic and epigenetic aberrations(Badgwell BD, Giordano SH, Duan ZZ, Fang S, Bedrosian I, Kuerer HM, et al.) (Luminal A - Luminal B - Basal-like - HER2-positive).

It is noteworthy that the basal-like breast tumor subgroup shares a number of molecular characteristics common to serous ovarian tumors, including the types and frequencies of genomic mutations. These data support the evidence that some breast cancers share etiologic factors with ovarian cancer. Most compelling are the data showing that patients with basal-type breast cancers show treatment

responsiveness similar to that of ovarian cancer patients, (ACS. Breast Cancer Facts & Figures 2013-2014).

The various types of breast cancers are: infiltrating ductal carcinoma is the most commonly diagnosed breast tumor and has a tendency to metastasize via lymphatics; this lesion accounts for 75% of breast cancers while over the past 25 years, the incidence of lobular carcinoma in situ (LCIS) has doubled, reaching a current level of 2.8 per 100,000 women; the peak incidence is in women aged 40-50 years; infiltrating lobular carcinoma accounts for fewer than 15% of invasive breast cancers ,the medullary carcinoma accounts for about 5% of cases and generally occurs in younger women ,mucinous (colloid) carcinoma is seen in fewer than 5% of invasive breast cancer cases ,tubular carcinoma of the breast accounts for 1-2% of all breast cancers ,papillary carcinoma is usually seen in women older than 60 years and accounts for approximately 1-2% of all breast cancers ,metaplastic breast cancer accounts for fewer than 1% of breast cancer cases, tends to occur in older women (average age of onset in the sixth decade), and has a higher incidence in blacks and mammary Paget disease accounts for 1-4% of all breast cancers and has a peak incidence in the sixth decade of life (mean age, 57 years) (Evans DG,2002).

2.1.3 Breast tumors diagnosis

The earliest sign of breast cancer can be an abnormality depicted on a mammogram, before it can be felt by the woman or her physician. When breast cancer has grown to the point where physical signs and symptoms appear, the patient feels a breast lump (usually painless).

Screening mammography accounts for the greatest contribution to early detection and decrease in breast cancer mortality, although its use has resulted in a minor increase in the number of in situ cancers detected. According to the American Cancer society the death rate from breast cancer was increasing until 1990 when

the advent of widespread screening began to have an effect on the population. The death rate from breast cancer has decreased by 34% between 1990 and 2010 in the United States, (American Cancer Society. Breast Cancer Facts & Figures 2013-2014).

2.1.4 Breast density

Breast density is strictly a mammographic finding. Density has no relationship to the physical exam. It represents the ratio of glandular tissue (white on a mammogram) to fat (dark on a mammogram). The radiologist evaluates the density and categorizes it into one of 4 categories according to the BI-RADS atlas: A, B, C or D. Category A represents a breast that is composed almost entirely of fat, and category D represents a breast that is composed almost entirely of glandular tissue.

Breast density also impacts interpretation of mammograms and the risk of developing breast cancer. Data show that the sensitivity for breast cancer detection is inversely related to density. It is as high as 98% in fatty breasts (category A) and 50-65% in dense breasts (category D). In addition, the risk of developing breast cancer increases with breast density. The relative risk of developing breast cancer in women with very dense category D breasts is 4 times greater than in women with fatty category A breasts. In the United States, 50% of women have breast density category C or D. (Cherel P2005).

In the United States, there has been a political effort to make women aware of their individual breast density. Beginning in 2009 with Connecticut, 20 states now have passed legislation requiring some type of notification of patients of breast density.

2.1.5 Summary of BI-RADS assessment categories

BI-RADS assessment categories can be summarized as follows: firstly category 0 - Need additional imaging evaluation, secondly category 1 – Negative,thirdly category 2 - Benign finding, noncancerous, fourthly category 3 - Probably benign

finding, short-interval follow-up suggested, fifthly category 4 - Suspicious abnormality, biopsy considered,sixthly category 5 - Highly suggestive of malignancy, appropriate action needed and finally category 6 - Known cancer, appropriate action should be taken.

Category 0 is a temporary category that means additional imaging is needed before assigning a permanent BI-RADS assessment category. Most category 0 findings are shown to be benign after additional imaging is completed. This category is most often used when the radio9logist discovers something on a screening mammogram and wants to apply diagnostic views to make a decision. (Philpotts LE2013).

2.1.6 Treatment by BIRADS category

Each BI-RADS level has an appropriate management or follow-up plan associated with it. For example, if a referring doctor sees a mammogram report with a category 3 assigned to it, he or she knows the recommendation is for the woman to undergo follow-up mammography in 6 months.

If used correctly and consistently, each BI-RADS category has the risks of malignancy and the associated plan of management or follow-up.

2.1.7. Characteristic Benign Masses

Many masses that are demonstrated on mammograms require biopsy to determine whether they are benign. Taylor et al reported that the use of US in conjunction with mammography increased specificity from 51% to 66% in a population with a malignancy prevalence of 31%.This improvement could significantly reduce the biopsy rate of benign lesions. Breast US often reveals unexpected benign lesions.

Many benign breast conditions have a nonspecific appearance on US. However, some masses, such as simple cysts, sebaceous cysts, and intramammary lymph

nodes, have a characteristic appearance that suggests a specific diagnosis. Almost all highly echogenic masses are benign.

If color Doppler imaging demonstrates blood flow within the contents of a complex cyst or dilated duct, then these contents consist of solid tissue rather then just debris, blood clot, or echogenic fluid. However, we have seen solid tumors that lack demonstrable blood flow on color Doppler imaging. Several investigators reviewed the ability of color Doppler US or contrast-enhanced Doppler US to distinguish benign from malignant lesions. The results were variable; Doppler US is not generally used to distinguish benign from malignant solid breast masse

2.1.7.1 Joint statement from the American College of Radiology and Society of Breast Imaging

In response to the USPSTF new recommendations, the American College of Radiology and the Society of Breast Imaging issued a joint statement that included the following benefits and concerns of annual screening mammography starting at age 40:

It is well known that mammography has reduced the breast cancer death rate in the United States by 30 percent since 1990 ─ hardly a small benefit.

Based on data on the performance of screening mammography as it is currently practiced in the United States, one invasive cancer is found for every 556 mammograms performed in women in their 40s.

Mammography only every other year in women 50-74 would miss 19 to 33 percent of cancers that could be detected by annual screening.

Starting at age 50 would sacrifice 33 years of life per 1,000 women screened that could have been saved had screening started at age 40.

Eighty-five percent of all abnormal mammograms require only additional images to clarify whether cancer may be present (or not). Only 2 percent of women who

receive screening mammograms eventually require biopsy. The USPSTF data showed that the rate of biopsy is actually lower among younger women.

2.1.7.2 Diagnostic X-ray mammography

Diagnostic mammography is performed in symptomatic women, such as when a breast lump or nipple discharge is found during self-examination or when an abnormality is found during screening mammography. Diagnostic mammography uses specialized views to determine exact size and location of breast abnormalities and to image the surrounding tissue and lymph nodes. Typically, several additional views of the breast are acquired and interpreted during diagnostic mammography. Thus, diagnostic mammography is slightly more expensive than screening mammography. In most cases, however, diagnostic mammography confirms that potential abnormalities found at screening mammography or physical exam are benign.

A diagnostic mammogram consists of supplemental views tailored to the specific problem. These supplemental views can include latero-medial (LM) and medio-lateral (ML), exaggerated CC, magnification, spot compression, and others. Special skin markers are sometimes used to identify certain lesions, skin abnormalities, the nipple, and other areas.

The American College of Radiology (ACR) has established the Breast Imaging Reporting and Data System (BI-RADS) to guide the breast cancer screening and diagnostic routine. BI-RADS is the product of a collaborative effort between members of various committees of the ACR with cooperation from the National Cancer Institute, the Centers for Disease Control and Prevention, the FDA, the American Medical Association, the American College of Surgeons, and the American College of Pathologists, (Birdwell RL et al .2008).

The BI-RADS atlas provides a standardized system for performing breast imaging examinations, interpreting the findings, reporting the results, communicating

recommendation to patients and providers, and auditing statistical performance. There are separate guidance chapters for mammography, ultrasound, and magnetic resonance imaging (MRI). According to the ACR, the BI-RADS system is intended to guide radiologists and referring physicians in the breast cancer decision-making process that facilitates patient care.

BI-RADS categories or levels are used to standardize interpretation of mammograms among radiologists. They are useful for statistical analysis of mammography practice, and BI-RADS results are compiled in the National Mammography Database in the United States to help refine mammographic procedures everywhere.

2.1.7.3 Interpretation of mammograms

The quality of the mammograms should be assessed, and if not optimal, repeat examinations may be ordered. Mammograms of the right and left breasts are displayed on a high resolution monitor with previous comparable projections. Lighting should be homogeneous, and adequate viewing conditions should be maintained. The mammograms are inspected carefully. The search is done systematically through similar areas in both breasts. The goal of the radiologist is to determine whether the findings are normal, benign, or suspicious enough to warrant tissue sampling.

First, breast symmetry, size, general density, and glandular distribution are observed. Next, a search for masses, densities, calcifications, architectural distortions, and associated findings is performed. For masses, the shape, margins, and density are analyzed. The features of benign and malignant masses can be similar. Benign masses are often round or oval with circumscribed margins. Malignant lesions tend to have irregular, indistinct, or spiculated margins. Malignancies tend to have density greater than that of the normal breast tissue. The

presence of very low density fat in a lesion often indicates benign findings such as oil cysts, lipomas, galactoceles, and hamartomas.

Calcifications can also be the first sign of cancer or a harmless process in the breast. Benign calcifications are usually larger than calcifications associated with malignancy. They are usually coarser, often round with smooth margins, and more easily seen. Benign calcifications tend to have specific shapes: eggshell calcifications in cyst walls, tramlike in arterial walls, popcorn type in fibroadenomas, large and rodlike with possible branching in ectatic ducts, and small calcifications with a lucent center in the skin.

Calcifications associated with malignancy are usually small (< 0.5 mm) and often require high-resolution magnification imaging with digital zooming for accurate assessment. They tend to have a pleomorphic or heterogeneous shape or a fine granular, fine linear, or branching (casting) shape.

The distribution of the calcification can provide clues to the underlying process and should be specified as grouped, clustered, linear, segmental, regional, or diffuse.

Special findings may be encountered, such as a linear density that might represent a duct filled with secretions or a reniform-shaped mass with a radiolucent center that is typical of an intramammary lymph node.

Associated findings are then taken into account. These include skin or nipple retraction, skin thickening (which may be focal or diffuse), trabecular thickening, skin lesions, axillary adenopathy, and architectural distortion.

Diagnostic views are used to determine where each lesion is in the breast. These may be described as central, retroareolar, in a quadrant, or, more precisely, at a clock position. The breast is viewed as the face of a clock with the patient facing the observer. The depth of the lesion is assigned to the anterior, middle, or posterior third of the breast.

If previous examination results are available, their comparison is useful in assessing disease progress.

All of these findings are considered together, a final impression is formed, and a BI-RADS category is assigned.

2.1.7.4 Modern Imaging in Breast Cancer

Some women who have an abnormal mammogram or a lump in the breast may need to get a breast biopsy, where a doctor removes a small piece of breast tissue for testing. Here we explain what a breast biopsy is, how it's done, and what it might find For Women Facing a Breast Biopsy Mary's doctor calls to give her the results of her mammogram. The doctor says, "It's not normal, and I think we need to biopsy the area in question." Mary's first thought is, "Could this be breast cancer?" When she asks, the doctor explains that a biopsy (taking out and testing tissue from the suspicious area of the breast) is the only way to find out.

Another woman, Peg, just found a lump in her breast. She knows that the lump wasn't there last month. Her first thought: "I probably should see the doctor about this, but I'm pretty sure it's nothing to worry about."

Women react in different ways when they find out that something may be wrong with their breasts. Whatever their feelings and thoughts, at some point most women want to know more about what's happening.

Women who have had breast lumps, suspicious mammograms, and breast biopsies helped write this. They have gone through something much like what you may be going through now.

Here we will explain the basics of benign (non-cancer) breast conditions, diagnostic tests (such as different types of biopsies), and breast cancer. You'll also learn more about coping with your concerns and fears, and where to find emotional

support. The information here should not take the place of talking to your doctor or nurse.

2.1.7.5 Breast Cancer Staging

To stage cancer, the American Joint Committee on Cancer first places the cancer in a letter category using the tumor, nodes, metastasis (TNM) classification system. The stage of a breast cancer describes its size and the extent to which it has spread. The staging system ranges from stage 0 to stage IV according to tumor size, lymph nodes involved, and distant metastasis.

T indicates tumor size. The letter T is followed by a number from 0 to 4, which describes the size of the tumor and whether it has spread to the skin or chest wall under the breast. Higher T numbers indicate a larger tumor and/or more extensive spread to tissues surrounding the breast. TX: The tumor cannot be assessed. T0: No evidence of a tumor is present,This: The cancer may be LCIS, DCIS, or Paget disease, T1: The tumor is 2 cm or smaller in diameter,T2: The tumor is 2-5 cm in diameter. T3: The tumor is more than 5 cm in diameter.T4: The tumor is any size, and it has attached itself to the chest wall and spread to the pectoral (chest) lymph nodes.

N indicates palpable nodes. The letter N is followed by a number from 0 to 3, which indicates whether the cancer has spread to lymph nodes near the breast and, if so, whether the affected nodes are fixed to other structures under the arm.

NX: Lymph nodes cannot be assessed (eg, lymph nodes were previously removed). N0: Cancer has not spread to lymph nodes. N1: Cancer has spread to the movable ipsilateral axillary lymph nodes (underarm lymph nodes on the same side as the breast cancer). N2: Cancer has spread to ipsilateral lymph nodes (on the same side of the body as the breast cancer), fixed to one another or to other structures under the arm. N3: Cancer has spread to the ipsilateral mammary lymph nodes or the

ipsilateral supraclavicular lymph nodes (on the same side of the body as the breast cancer).

M indicates metastasis. The letter M is followed by a 0 or 1, which indicates whether the cancer has metastasized (spread) to distant organs (eg, lungs or bones) or to lymph nodes that are not next to the breast, such as those above the collarbone.MX: Metastasis cannot be assessed .M0: No distant metastasis to other organs is present .M1: Distant metastasis to other organs has occurred

The reduction in breast cancer mortality is attributed to early detection and shift from late stage to early stage disease at the time of diagnosis.

2.1.7.6 X-ray Mammography

Mammography is a special type of x-ray imaging used to create detailed images of the breast. It is estimated that 48 million mammograms are performed each year in the US. Mammography uses low dose x-rays, achieved by using targets made of low atomic weight alloys (eg, molybdenum and rhodium). Filters made of aluminum, molybdenum, beryllium, rhodium, or palladium is used to eliminate photons that do not contribute to the image, thereby minimizing the radiation dose to the patient.

Breast compression is necessary to flatten the breast so that the maximum amount of tissue can be imaged and examined. It also allows for a lower x-ray dose and immobilization of the breast to reduce motion blur. Compression also reduces x-ray scatter, which may degrade the image. Breast compression may cause some discomfort, but it should not cause any significant pain.

Randomized controlled trials in the 1970s and 80s used high-contrast, high-resolution (with single-sided emulsion) film to demonstrate findings smaller than 100 μm, such as micro calcifications. Nearly all film-based units in the United States have since been replaced with digital mammography systems.

In 2005, the American College of Radiology Imaging Network (ACRIN) published results of a multicenter trial comparing the diagnostic performance of film-screen to digital mammography.The results indicated equivalent overall performance for the 2 modalities. However, in subgroup analysis, digital mammography performed better for women with dense breasts, premenopausal women, and women younger than 50 years. Since then, there has been a gradual national and international shift away from film-screen to digital mammography.

Mammography plays a major role in the early detection of breast cancers, detecting about 75% of cancers at least a year before they can be felt. Mammography uses low-dose ionizing radiation. Patients receive less radiation from a mammogram than from background environmental sources each year. The significant reduction in breast cancer mortality far outweighs the risks and inconvenience of the test.

2.1.7.8 Screening x-ray mammography

There are 2 types of mammography examinations: screening and diagnostic. Screening mammography is done in asymptomatic women. Early detection of small breast cancers by screening mammography greatly improves a woman's chances for successful treatment. A screening examination consists of 2 images of each breast in the cranial-caudal (CC) and medio-lateral-oblique (MLO) projections that are viewed together. For screening mammography.

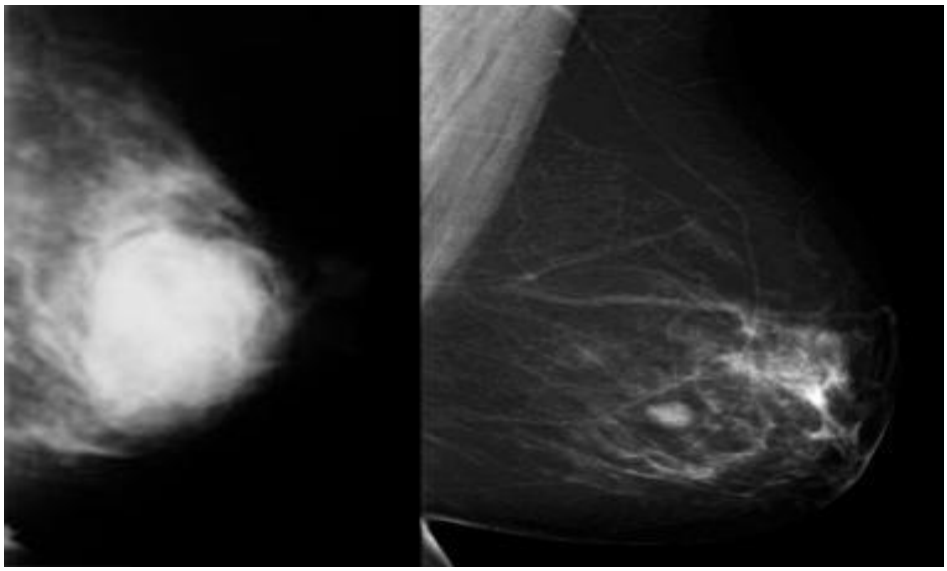

Figure (2.2)Image from a mammogram shows a benign mass: a fibroadenoma with well-defined edges and a halo sign.

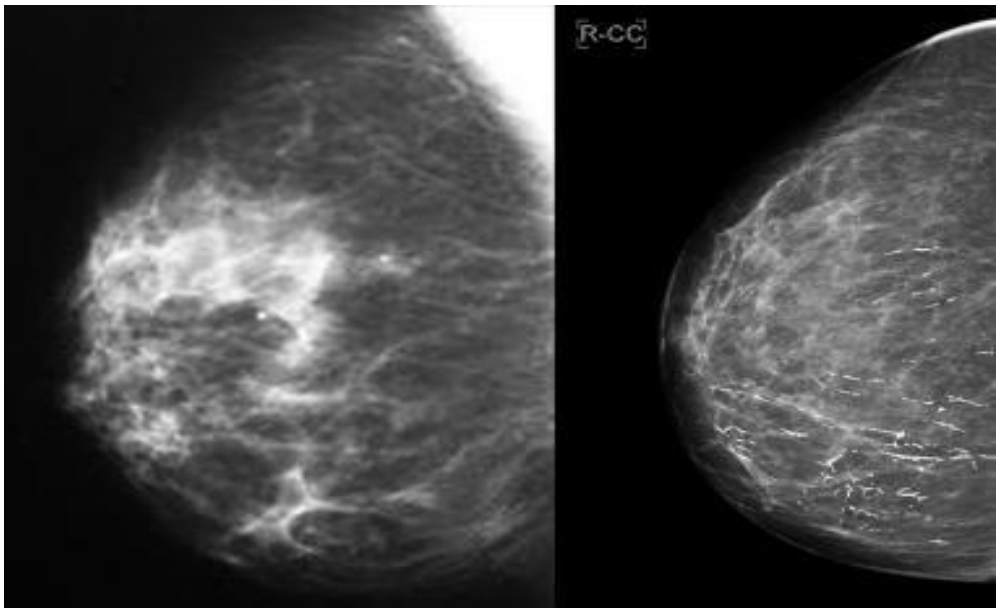

Figure (2.3)Benignmicrocalcifications: secretory change**.**

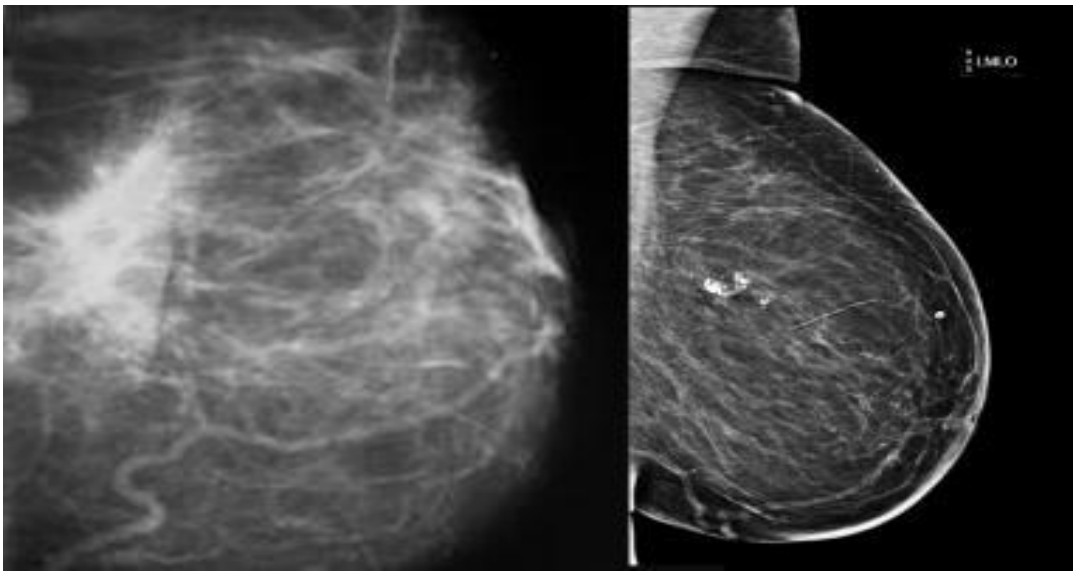

Figure (2.4) .

Mammogram shows traumatic fat necrosis following removal of a lesion. The stellate lesion has a halo center.

Screening mammography is recommended every year for women beginning at 40 years of age by the American Cancer Society, the American College of Radiology, the American College of Surgeons, and the American Congress of Obstetrics and Gynecology. Screening mammography may be performed as early as 25 years old in patients with a very high lifetime risk of cancer (>20%). These include patients With Known mutation of the BRCA1 or BRCA2 gene, Known mutation of PTEN or TP53 (Li-Fraumeni, Cowden, Bannayan-Riler-Ruvalcaba), Untested first-degree relative of patient with one of the known gene mutations, History of mantle radiation to the chest between the ages of 10 and 30 years and Lifetime risk of breast cancer >20% based on models (Gail, Tyrer-Cuzick etc.)

Research has shown that regular mammograms may decrease the risk of late-stage breast cancer in women 80 years of age and older, (Rechtman LR, Lenihan MJ, Lieberman JH, Teal CB, Torrente J, Rapelyea JA, et al.2014).

Some studies suggest that mammography screening should not just be based on age and family history of breast cancer but also on breast density, history of breast

biopsy, and beliefs about the benefits and risks of the screening, (Berg WA, Madsen KS, Schilling K, Tartar M, Pisano ED, Larsen LH, et al.2011). However, only 10-25% of all breast cancers occur in the high-risk population. Delayed or less frequent screening of the 75-90% of the United States population at average risk of developing breast cancer would result in late detection and many unnecessary deaths.

2.1.7.9 Benign breast conditions

Not all lumps are cancer if you find changes or something unusual in one of your breasts, it's important to see a doctor or nurse as soon as possible. But keep in mind that most breast changes are not cancer. Just because your doctor wants you to have a biopsy do not mean you have breast cancer. (A biopsy (by-op-see) is when a piece of tissue is taken out and looked at under a microscope.) In fact, most biopsy results are not cancer. But the only way to know for sure is to take out and test tissue from the suspicious area of the breast.

Non-cancerous breast conditions are very common, and they are never life threatening. The 2 main types are fibrosis and/or cysts and other non-cancerous or benign (be-nine) breast tumors.

2.1.7.10 Postoperative mammograms

Women who had previous surgery for breast cancer may still require breast cancer screening with mammography. If a woman had a total mastectomy, then continued annual screening of the other breast is recommended because the patient is at higher risk of developing cancer in the remaining breast. If she had subcutaneous or nipple-sparing mastectomy or partial mastectomy or lumpectomy, then annual screening is recommended for the treated breast. The first mammogram of the treated breast is often performed 6 months postoperatively to provide a baseline for

the new postoperative and radiation changes. Thereafter, the mammogram may be performed every 6-12 months for screening and follow-up.

Women with breasts augmented by implants may be a special challenge. Four special screening views are added to the 4 standard views. The implant must be pulled aside so the underlying breast tissue can be imaged. MRI may be useful for assessing silicone implant integrity in this group of patients. MRI is not recommended for screening of average-risk patients with implants. Rupture of saline implants can be determined with standard mammograms.

2.1.7.11 False-positive and false-negative results

False-positive results may arise when benign microcalcifications are regarded as malignant. Tissue summation shadows may appear as local parenchymal distortion; this may be erroneously called suspicious tissue. A benign circumscribed lesion may show signs suggestive of malignancy, along with other findings, such as an irregular border and no halo sign.

According to data from the Breast Cancer Detection Demonstration Project, the false-negative rate of mammography is approximately 8-10%. Approximately 1-3% of women with a clinically suspicious abnormality, a negative mammogram, and a negative sonogram may still have breast cancer.

Possible causes for missed breast cancers include dense parenchyma obscuring a lesion, poor positioning or technique, perception error, incorrect interpretation of a suspect finding, subtle features of malignancy, and slow growth of a lesion.

Birdwell et al performed a multicenter study and found that, on prior mammograms with missed cancers, 30% of the lesions were calcifications, with 17 of 49 clustered or pleomorphic. Approximately 70% were mass lesions, with 40% spiculated or irregular. For calcifications and masses, the most frequently suggested reasons for possible miss were dense breasts (34%) and distracting lesions (44%), (Canto MT, Anderson WF, Brawley O.2001).

Some cancers (eg, mucinous carcinomas) may have well-defined borders and mammographic features suggestive of benignancy.

The false-positive rate of recommendation for biopsy is 4.3-6.7/1000, and 64-84/1000 need additional imaging after screening. Using an annual screening regimen, 61% of patients will receive a recall from screening after 10 years, and 7% will have a recommendation for biopsy, (Cherel P, Becette V, Hagay C.2005).

DCIS has increased from 2.4/100,000 to 27.7/100,000 since screening. Fifty percent of all recurrences after DCIS are invasive. Long-term follow-up of low-grade DCIS treated only by biopsy without definitive excision or radiation therapy is associated, at 30 years, with a 30-60% incidence of invasive cancer, (Dang CM, Zaghiyan K, Karlan SR, Phillips EH.2009).

2.1.7.12 Digital breast tomosynthesis

Digital breast tomosynthesis (DBT), also known as 3D mammography, uses the same compression and views as 2D mammography and adds a 3D volume acquisition. The examination requires only a few additional seconds for each view, and most women will not be able to tell the difference between having a 2D or 3D exam. A traditional 2D exam displays the entire volume of the breast on a single 2D image. When viewed in this manner, the normal dense parenchyma can cause some normal tissue to look like possible cancer and can also hide cancers. DBT addresses some of these challenges of 2D mammography.

The 3D volume of the entire DBT acquisition can be displayed on a monitor and viewed as slices as thin as 1 mm. This ability theoretically allows the radiologist to see cancers that might be obscured, improving sensitivity. It should also allow the radiologist to separate normal tissue and avoid an unnecessary recall, improving specificity. The research has confirmed the improved performance of this test. In a multicenter reader study published in 2013, the sensitivity and specificity for breast

cancer was found to be significantly better with DBT than with 2D digital mammography, (De Koning HJ.2000).

In a reader study with an enriched population, 2-view tomosynthesis outperformed standard 2D mammography in terms of accuracy, as measured by the area under the ROC curve, for both masses and microcalcifications, (Elmore JG, Armstrong K, Lehman CD, Fletcher SW.2005).

Skaane and colleagues concluded that the combination of tomosynthesis and digital mammography resulted in a significantly higher cancer detection rate (27%, P =.001) and reduction in false-positive findings (15%, P< .001), as compared with digital mammography alone (N = 12,621), (Skaane P, Bandos AI, Gullien R, Eben EB, Ekseth U, Haakenaasen U, et al.2013).

In one study, the addition of 2-view tomosynthesis to conventional digital mammography during screening examinations resulted in a 29.7% decrease in recall rates (P< .01; N = 13,158). The greatest reduction in recall rates occurred in patients with dense breasts and in those younger than 50 years, (Feng SS, Sechopoulos I.2012).

Feng and colleagues demonstrated that DBT, on average, delivers twice the radiation dose to the breast than 2D digital mammography. This isn't surprising, since the DBT examination begins with the 4 standard views of 2D screening mammography, followed by 4 tomosynthesis views. However, the dose remains below the limit set by the FDA for screening mammography. In addition, Hologic has developed a software-based reconstruction algorithm that transforms the DBT images into a 2D image. If approved and instituted, the dose for a DBT exam would be the same as that for a 2D exam, with higher sensitivity and specificity.

DBT was approved by the FDA in 2011. Many centers across the United States and Europe are replacing their 2D mammography machines with DBT because of the increased sensitivity and specificity, although there are no data regarding a

mortality benefit. Regarding DBT, the ACR has stated that "breast tomosynthesis has shown to be an advance over digital mammography, with higher cancer detection rates and fewer patient recalls for additional testing."(Jong RA, Yaffe MJ, Skarpathiotakis M, Shumak RS, Danjoux NM, Gunesekara A, et al.2003).

2.1.8 Digital subtraction and contrast-enhanced digital mammography

Contrast enhanced digital mammography (CEDM) was invented to address the decreased sensitivity of mammography in dense breasts and the high cost of MRI. It was approved by the FDA in 2011. It is not being used for screening but is being used sparsely for cancer staging or neoadjuvant follow-up in places where MRI may not be available. Contrast resolution of CEDM is lower than that of CT or MRI. Subtraction can be performed by temporal or dual-energy techniques, (Lewin JM, Niklason L.2007).

Temporal subtraction requires immobilization and compression for both pre- and post-contrast images taken minutes apart. Compression can prevent blood flow and contrast enhancement. For these reasons, temporal subtraction has largely been abandoned. Dual-energy acquires 2 identical images after contrast injection in full compression a few seconds apart. Dual-energy takes advantage of the difference in the atomic density of tissue, as compared to the contrast, (Jochelson MS, Dershaw DD, Sung JS, Heerdt AS, Thornton C, Moskowitz CS, et al.2013).

Two images are acquired, and the low-density breast tissue is subtracted; however, the high energy of contrast persists, allowing any enhancing abnormality to be more visible. In a recent study comparing CEDM to MRI, the results indicated very high sensitivity for the index lesion with both modalities, but MRI detected more satellite tumors and CEDM had fewer false positives, (Zonderland HM, Coerkamp EG, Hermans J, et al.1999).

2.1.9 Other uses of radiography in breast cancer

A ductogram, or galactogram, is used to acquire images of the lumen of an individual duct and can help determine the cause of nipple discharge. In this procedure, a fine plastic tube (30-gauge) is placed into the opening of the suspected duct in the nipple. A small amount (0.1 to 0.3 cc) of iodinated contrast medium is injected, which outlines the shape of the duct on a mammogram and shows whether a mass is present inside the duct.

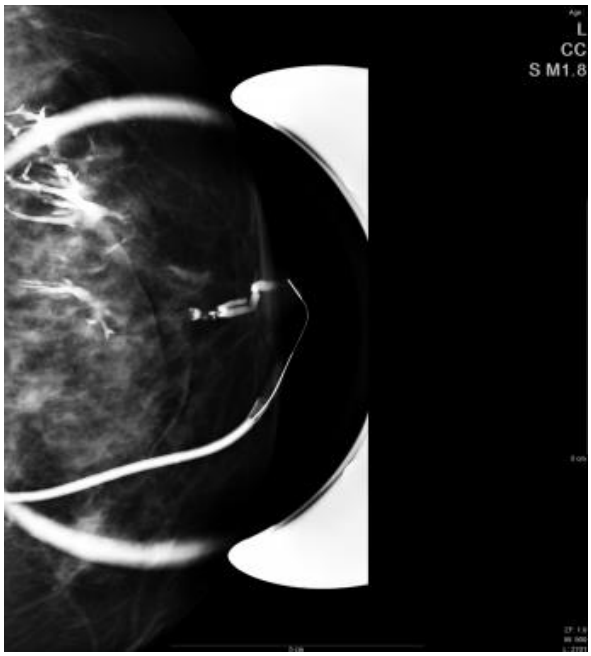

Figure (2.5)Mammographic spot image during a ductogram shows contrast (white) within the catheter and branching ductal system.

2.1.10Ultrasound

The role of ultrasonograph y in breast imaging is a subject of ongoing discussion. Sonography is widely accepted as the method of choice for the diagnostic differentiation of cysts from solid masses and for guidance in interventional procedures. Indeed, ultrasound can confidently diagnose a harmless cyst as the cause of a palpable lump or mammographic mass, thereby obviating the need for biopsy. The combination of a normal mammogram and a normal sonogram has a

negative predictive value greater than 98%. However, if there is a concerning physical exam finding, palpation-guided biopsy may still be indicated. The use of sonography as an adjuvant to mammography may increase accuracy by up to 7.4%.(Kolb TM, Lichy J, Newhouse JH.2002).

On sonograms, solid lesions with smooth or gently lobulated margins that are sharply defined, with homogeneous hypoechoic contents and an orientation parallel to the chest wall, are usually benign. Solid hypoechoic lesions with irregular margins, an orientation perpendicular to the chest wall, acoustic shadowing are suspicious, and biopsy is indicated to rule in or rule out malignancy. Solid hypoechoic lesions with irregular and poorly defined margins and with shadowing and vertical orientation are considered to be probably malignant. The lesions may show infiltration into the surrounding fatty tissue or other features associated with malignancy. (Kolb TM, Lichy J, Newhouse JH.2002) Some cancers can mimic benign tumors and appear well defined.

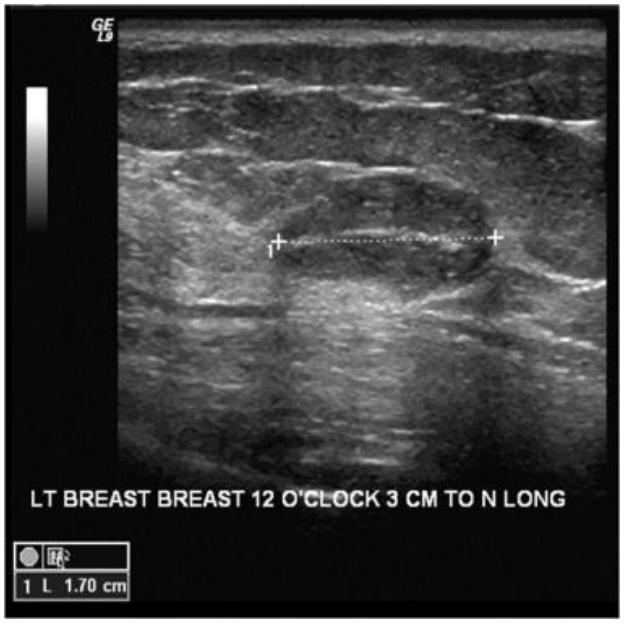

Figure (2.6)An ultrasound of a benign breast mass with circumscribed margins and oval shape; in this case, the mass is a fibroadenoma.

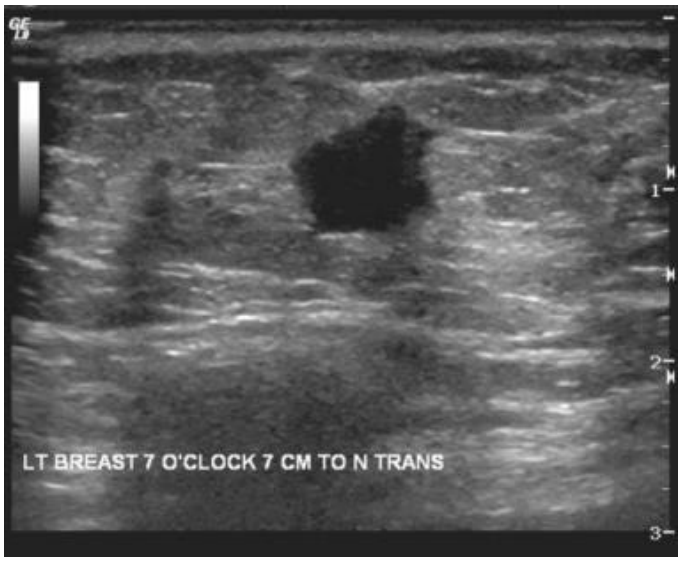

Figure (2.7) Ultrasound shows a suspicious hypoechoic mass with angular margins; in this case, the mass is an invasive ductal carcinoma.

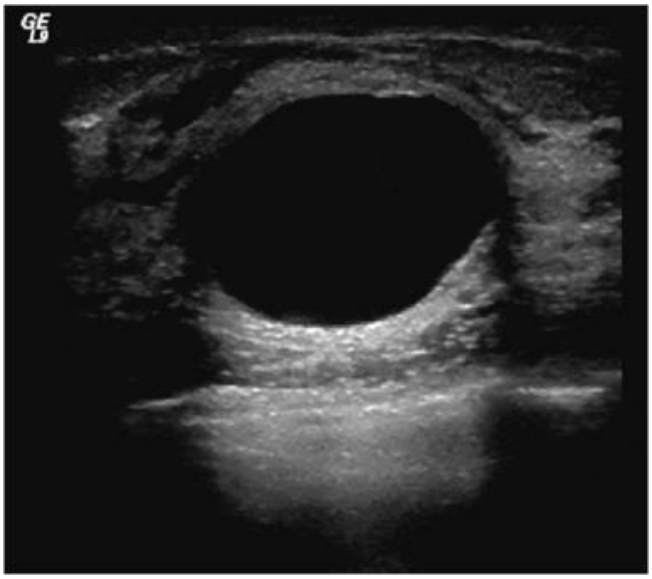

Figure (2.8) Ultrasound shows an anechoic cyst with smooth margins and enhanced through transmission. This is benign and does not need any imaging follow-up.

According to a multicenter trial conducted by the American College of Radiology Imaging Network, screening breast ultrasound detects 4.2 additional cancers per 1000 women with normal mammograms. (Bae MS, Moon WK, Chang JM, Koo HR, Kim WH, Cho N, et al.2014)The advantage of ultrasound includes the low

compression and lack of radiation. The major disadvantage is the high callback rate and a low positive predictive value of 10%.

A study from Korea that included over 100,000 patients reported a cancer detection rate of 3.4/1000. (U.S. Food and Drug Administration (FDA).

There is no randomized control trial showing a long-term mortality benefit associated with screening breast ultrasound. Screening breast ultrasound adds to health care costs, as a test that is performed in addition to mammography. The average callback rate from ultrasound is significantly higher than that of mammography, which also results in additional costs of diagnostic testing, time away from work, patient anxiety, and, in some cases, biopsy.

In September 2012, the U.S. Food and Drug Administration approved the first ultrasound system, the somo-v Automated Breast Ultrasound System (ABUS), for breast cancer screening in combination with standard mammography specifically for women with dense breast tissue. (Nakahara H, Namba K, Wakamatsu H, Watanabe R, Furusawa H, Shirouzu M, et al.2002).

Current practice and recommendations from the American College of Radiology suggest that mammography is always the first choice for screening of all women. In addition, screening breast ultrasound should be considered in high-risk patients who cannot tolerate MRI or in intermediate-risk patients with category C or D breast density.

2.1.11MRI and CT

Magnetic resonance imaging (MRI) and computed tomography (CI) may have adjuvant roles in the diagnosis of breast cancer. MRI may prove useful in screening younger women with dense breasts who are at a special high risk of developing breast cancer (eg, strong family history). CT may be used as an adjuvant for monitoring spread. Although CT imaging involves some exposure to radiation, it should be considered in patients in whom MRI is contraindicated.

2.1.11.1Magnetic resonance imaging

High-resolution dynamic contrast-enhanced (DCE) MRI of the breast has recently emerged as the most sensitive (95-100%) instrument for the detection of breast cancer. The sensitivity of MRI makes it an excellent tool in specific clinical situations, such as the screening of patients at high risk for breast cancer, evaluation of the extent of disease in patients with a new diagnosis, axillary carcinoma of unknown primary, assessing treatment response during neoadjuvant chemotherapy, and detection of local recurrence in patients who have received breast-conservation therapy. (Berg WA, Gutierrez L, NessAiver MS, Carter WB, Bhargavan M, Lewis RS, et al.2004).

MRI, however, has a significant false-positive rate, it is not readily available in all areas, and it is more expensive than mammography and sonography. Other limitations include the requirement of an intravenous gadolinium-based contrast agent, problems with claustrophobia, and longer imaging times. It also remains unclear if alterations in management plans based on MRI findings actually benefit patients.

Breast cancer almost always enhances on T1-weighted images after gadolinium enhancement. Multiple sequences, acquired before and after the administration of contrast, are compared to assess the rate enhancement and washout. The lesions are best imaged with fat-suppression techniques to eliminate the high signal intensity from fat on T1-weighted sequences. Two-dimensional (2D) or 3D techniques with gradient-echo sequences are time efficient and now largely used.

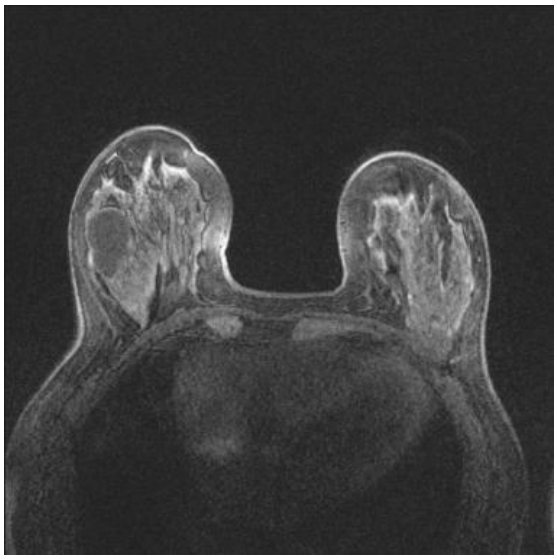

Figure (2.9) There is a large cyst in the right breast. The cancer in the left breast is isointense to normal tissue and very difficult to see.

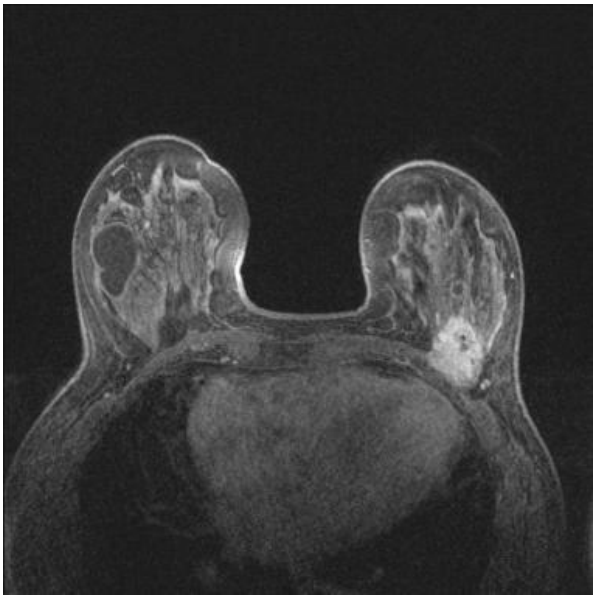

Figure (2.10) Same patient as in previous image: T1-weighted image with fat suppression after contrast clearly shows the posterior cancer invading the pectoralis major on the left.

The moderate specificity of MRI results in the detection of some lesions that may represent cancer and can only been seen with MRI. Special techniques have been developed to biopsy such lesions, using MRI for guidance.

The generally accepted indications for breast MRI include Screening women with a lifetime risk of breast cancer >20%, Search for primary malignancy in the breast in patients who have adenocarcinoma in an axillary lymph node but have a normal mammogram and clinical breast exam, and evaluation of the extent of disease in the ipsilateral breast and possible synchronous cancer in the contralateral breast in women with a new diagnosis of cancer.

Follow-up of known cancer to assess response to neoadjuvant chemotherapy.

Berg et al showed that MRI was more accurate than mammography or ultrasound at depicting the full extent of disease for DCIS, invasive ductal carcinoma, and invasive lobular carcinoma. (Kuhl CK, Schrading S, Bieling HB, Wardelmann E, Leutner CC, Koenig R, et al.2007) Kuhl et al demonstrated that MRI is much more sensitive for the detection of DCIS than mammography (94% vs 54% respectively), (Lehman CD, Smith RA.2009).

Gadolinium-based contrast agents have been linked to the rare development of nephrogenic systemic fibrosis (NSF) or nephrogenicfibrosingdermopathy (NFD). The disease has occurred in patients with end-stage renal disease after being given a gadolinium-based contrast agent to enhance MRI or MRA scans. NSF/NFD is a debilitating and sometimes fatal disease. Characteristics include red or dark patches on the skin; burning, itching, swelling, hardening, and tightening of the skin; yellow spots on the whites of the eyes; joint stiffness with trouble moving or straightening the arms, hands, legs, or feet; pain deep in the hip bones or ribs; and muscle weakness.

The 2009 National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology for Breast Cancer Screening and Diagnosis include using

breast MRI for screening as an adjunct to annual mammography and clinical breast examination in the following situations (Yau EJ, Gutierrez RL, DeMartini WB, Eby PR,2011).

In women who have a BRCA1 or BRCA2 mutation or who have a first-degree relative who has a BRCA1 or BRCA2 mutation but who have not undergone genetic testing themselves, then In those who are determined to have a lifetime risk greater than 20% based on models that are highly dependent on family history.

Then In those with a history of lobular carcinoma in situ, In patients who underwent radiation treatment to the chest between 10 and 30 years of age. Then In women who carry or have a first-degree relative who carries a genetic mutation in the TP53 or PTEN genes (Li-Fraumeni, Cowden, and Bannahyan-Riley-Ruvalcaba syndromes).

According to the NCCN, MRI is specifically not recommended for screening women at average risk for breast cancer. MRI is also not generally recommended as a problem-solving tool when mammographic, sonographic, or physical examination findings are equivocal. As stated, the addition of MRI may result in additional false-positive findings and does not obviate the need for biopsy. Tissue sampling is preferred for these situations, because it will directly answer the question in a relatively rapid and inexpensive manner.(Yau EJ, Gutierrez RL, DeMartini WB, Eby PR,2001).

2.1.11.2Computed tomography

Dedicated breast CT scanners have been developed and tested in the research setting but are not yet in widespread clinical use. Its advantages are the speed of the method, comfort for the patient, and absence of movement artifacts, easy standardization, and wide applicability. Dynamic contrast-enhanced CT of the breast has been found to be effective for the detection of intraductal extension of breast carcinoma and is thought to be useful in the preoperative assessment of the

extent of disease prior to breast-conserving surgery. The lesions appear attenuating compared with fatty background, and they show early enhancement on arterial phase contrast-enhanced CT.(Taillefer R.1999).

Three-dimensional (3D) helical CT can provide good information about the spread of breast cancer and could be an alternative to 3D MRI for preoperative examination of breast cancer. In vitro high-resolution helical CT can depict the internal structure of small nodes. Morphologic changes detected on helical CT help distinguish benign from malignant nodes. Tumors appear as dense lesions on CT and usually show early contrast enhancement similar to that seen with dynamic MRI. CT is less sensitive than mammography for detecting microcalcification when it is the sole manifestation of early cancer.

In one study, 3D CT depicted nearly all of the tumors and defined the correct tumor extent in most patients. Its sensitivity, specificity, and accuracy in diagnosing muscular invasion of breast cancer were 100%, 99%, and 99%, respectively. Its sensitivity, specificity, and accuracy in diagnosing skin invasion of breast cancer were 84%, 93%, and 91%, respectively. The sensitivity, specificity, and accuracy in detecting intraductal spread or DCIS were 71.9%, 83.3%, and 76.0%, respectively, for 3D CT and 87.5%, 61.1%, and 78.0%, respectively, for 3D MRI. The sensitivity rate for microcalcifications was about 59%.(Taillefer R.1999)

2.1.13 Nuclear Medicine and Other Screening Modalities

Currently, there are 2 types of nuclear-based imaging for the breast that are FDA approved and used in clinical practice: breast-specific gamma imaging (BSGI) and positron emission mammography (PEM).

Technetium-99m (^{99m}Tc)-sestamibi was the first radiopharmaceutical to be approved by the FDA for use in scintimammography and is used in BSGI.A BSGI exam consists of 4 views that are identical in positioning to a screening

mammogram. Each view requires 10 minutes, and the patients must stay still. The total imaging time is 40 minutes.Sestamibi must be injected intravenously, and it delivers a radiation dose to the entire body as it circulates. There is ongoing research into a reduced-dose protocol.

In a retrospective study, the overall sensitivity of ^{99m}Tc-sestamibi BSGI in the detection of breast cancer was 95%. BSGI single and dual head devices are available.(Berg WA, Madsen KS, Schilling K, Tartar M, Pisano ED, Larsen LH, et al.2011)

18F-Fluorodeoxyglucose (18F-FDG) FDG is used for PEM. PEM produces data that can be displayed as a 12-slice reconstruction. A clinical study reported a sensitivity of 93% and a specificity of 89% in patients with known cancer,

(Hendrick RE. 2010) There are no data on screening with PEM.

Although not indicated as a screening procedure for the detection of breast cancer for average-risk patients, BSGI and PEM may play a useful role in various specific clinical indications, as in the screening of high-risk patients who cannot undergo an MRI or in evaluating tumor response to chemotherapy.

The disadvantages of BSGI and PEM include the radiation dose that extends to the whole body, the false-positive findings, and the lack of technique and equipment for BSGI-guided tissue sampling. The recommended injection for BSGI is 740–1100 MBq (20–30 mCi) of ^{99m}Tc-sestamibi, resulting in an estimated effective whole-body dose of 8.9 to 9.4 mSv.(Canto MT, Anderson WF, Brawley O.2001) For PEM, 370 MBq of 18F-FDG results in an estimated effective whole-body dose of 6.2 to 7.1 mSV. These are both much higher than the average effective dose to the breast from a mammogram, which is 0.44 mSV to 0.56 mSV. The dose from natural background radiation is 3 mSV per year.

2.1.13.1 Electrical impedance imaging (T-scan)

Electrical impedance imaging scans the breast for electrical conductivity, based on the idea that breast cancer cells conduct electricity better. It involves passing a very small electrical current through the body and detecting it on the skin of the breast with a small probe (similar to an ultrasound probe). The test does not use radiation and does not require breast compression.

2.1.13.2 Thermography

Thermography (thermal imaging) and computerized thermal imaging depend on mapping heat radiating from the breast, with the assumption that cancerous tissue produces more heat than normal breast tissue. It is not approved as a screening tool for breast cancer. It has not been shown to provide any decrease in breast cancer mortality. It is not recommended as a screening tool.

2.1.13 .3CT laser mammography

Computed tomography laser mammography is an experimental test that uses a laser to produce a 3-dimensional view of the breast. It has not yet been approved for clinical use.

2.1.13 .4 Ductal lavage

During ductal lavage, breast cells are removed from a milk duct through a small flexible tube inserted into one of the ducts in the nipple. The sample is examined under a microscope to determine whether abnormal cells are present in the duct. It may be useful for screening in conjunction with mammography for women at high risk of developing breast cancer.

2.1.14 Mammography

Mammography performed in Symptomatic patients for Women >35 years of age with usage x-radiation were Invented in 1960s, modern type of machine 1969.

2.1.14.1 Mammography problems

The mammography problem include X-radiation and cant display results for Dense breasts in Young female not accurate for males and for females with Implants

2.1.14.2 Field Digital Mammography

Digital mammography is Better on all counts including Dense breast and Younger women with Less radiation.

The large number of biopsies performed for benign breast abnormalities has long been recognized as a serious problem. Excessive biopsies for benign lesions have adverse effects on society and on the women who undergo them by increasing the costs of screening projects, causing morbidity, and adding to the barriers that keep women from using a potentially life-saving procedure. Attempts have been made to increase the positive predictive value for biopsy (biopsy yield of cancer) by performing a complete diagnostic work-up that often includes ultrasonography (US).

In the 1970s, use of US decreased the number of biopsies for benign masses 25%–35% by enabling reliable identification of simple cysts. In the 1980s, investigators reported US features that occurred more frequently in benign solid breast masses and other features that occurred more frequently in malignant masses. However, in subsequent studies, US results were not yet reliable enough to determine whether biopsy should be performed on a solid mass. Nonetheless, investigators continued to pursue US features that would be typical of either benign or malignant lesions.

Improvements in US equipment have prompted more recent studies with findings that describe reliable signs for differentiating benign from malignant masses. However, it is important to determine if these results are reproducible when applied to practices with different US equipment, operator experience, interpreting

physicians, and patient populations. It is also important to establish the interobserver variability in the assessment of these features, since to our knowledge this has not been reported.

Furthermore, the additional contribution of US needs to be determined for women in whom mammography has been performed. To investigate the general applicability and interobserver variability of US features to distinguish benign from malignant solid masses in other practices, we conducted a retrospective analysis of 162 consecutive cases in which patients underwent breast US followed by tissue diagnosis at two institutions. We also evaluated the additional contribution of US for those women with available mammograms.

2.2 Previous study

jama. In 1990 Carried out in his study Results of the NCI Breast Cancer Screening Consortium and National Health Interview Survey Studies Data from seven studies sponsored by the National Cancer Institute (NCI) were used to determine current rates of breast cancer screening and to identify the characteristics of and reasons for women not being screened. All seven studies were population-based surveys of women aged 50 to 74 years without breast cancer. While over 90% of non-Hispanic white respondents had regular sources of medical care, 46% to 76% had had a clinical breast examination within the previous year, and only 25% to 41% had had a mammogram. Less educated and poorer women had had fewer mammograms. The two most common reasons women gave for never having had a mammogram were that they did not know they needed it and that their physician had not recommended it. Many physicians may have overlooked the opportunity to recommend mammography for older women when performing a clinical breast examination and to educate their patients about the benefit of screening

mammography.(*JAMA.*1990;264(1):54-58. doi:jama.1990.) Results of the NCI Breast Cancer Screening Consortium and National Health Interview Survey Studies.

K. Kuhl, MD, Department of Radiology, University of Bonn, Sigmund-Freud-Str 25, D-53105 Bonn, Germany. In his study Mammography, Breast Ultrasound, and Magnetic Resonance Imaging for Surveillance of Women at High Familial Risk for Breast Cancer K. Kuhl, MD, Department of Radiology, University of Bonn, Sigmund-Freud-Str 25, D-53105 Bonn, Germany; Purpose To compare the effectiveness of mammography, breast ultrasound, and magnetic resonance imaging (MRI) for surveillance of women at increased familial risk for breast cancer (lifetime risk of 20% or more).

Nelson HD in his study screening for Breast Cancer: Systematic Evidence Review Update for the US Preventive Services Task Force [Internet].

Excerpt

To determine the effectiveness of mammography screening in decreasing breast cancer mortality among average-risk women age 40–49 years and 70 years and older; the effectiveness of clinical breast examination (CBE) and breast self examination (BSE) in decreasing breast cancer mortality among women of any age; and harms of screening with mammography, CBE, and BSE.

The Cochrane Central Register of Controlled Trials and Cochrane Database of Systematic Reviews (through the fourth quarter of 2008), MEDLINE® searches (January 2001 to December 2008), reference lists, and Web of Science® searches for published studies and Breast Cancer Surveillance Consortium for screening mammography data.

Randomized, controlled trials with breast cancer mortality outcomes for screening effectiveness, and studies of various designs and multiple data sources for harms. Relevant data were abstracted, and study quality was rated by using established criteria.

Mammography screening reduces breast cancer mortality by 15% for women age 39–49 (relative risk [RR] 0.85; 95% credible interval [CrI], 0.75–0.96; 8 trials). Results are similar to those for women age 50–59 years (RR 0.86; 95% CrI, 0.75–0.99; 6 trials), but effects are less than for women age 60–69 years (RR 0.68; 95% CrI, 0.54–0.87; 2 trials). Data are lacking for women age 70 years and older. Radiation exposure from mammography is low. Patient adverse experiences are common and transient and do not affect screening practices. Estimates of overdiagnosis vary from 1–10%. Younger women have more false-positive mammography results and additional imaging but fewer biopsies than older women. Trials of CBE are ongoing; trials of BSE showed no reductions in mortality but increases in benign biopsy results.

Studies of older women, digital mammography, and magnetic resonance imaging are lacking.

Mammography screening reduces breast cancer mortality for women age 39–69 years; data are insufficient for women age 70 years and older. False-positive mammography results and additional imaging are common. No benefit has been shown for CBE or BSE.

Patients and Methods We conducted a surveillance cohort study of 529 asymptomatic women who, based on their family history and/or mutational analysis, were suspected or proven to carry a breast cancer susceptibility gene (*BRCA*). A total of 1,542 annual surveillance rounds were completed with a mean

follow-up of 5.3 years. Diagnostic accuracies of the three imaging modalities used alone or in different combinations were compared.

Results Forty-three breast cancers were identified in the total cohort (34 invasive, nine ductal carcinoma-in-situ). Overall sensitivity of diagnostic imaging was 93% (40 of 43 breast cancers); overall node-positive rate was 16%, and one interval cancer occurred (one of 43 cancers, or 2%). In the analysis by modality, sensitivity was low for mammography (33%) and ultrasound (40%) or the combination of both (49%). MRI offered a significantly higher sensitivity (91%). The sensitivity of mammography in the higher risk groups was 25%, compared with 100% for MRI. Specificity of MRI (97.2%) was equivalent to that of mammography (96.8%).

Conclusion Mammography alone, and also mammography combined with breast ultrasound, seems insufficient for early diagnosis of breast cancer in women who are at increased familial risk with or without documented *BRCA* mutation. If MRI is used for surveillance, diagnosis of intraductal and invasive familial or hereditary cancer is achieved with a significantly higher sensitivity and at a more favorable stage.

J ClinOncol.2005 Nov in his study Mammography, breast ultrasound, and magnetic resonance imaging for surveillance of women at high familial risk for breast cancer.

To compare the effectiveness of mammography, breast ultrasound, and magnetic resonance imaging (MRI) for surveillance of women at increased familial risk for breast cancer (lifetime risk of 20% or more).

We conducted a surveillance cohort study of 529 asymptomatic women who, based on their family history and/or mutational analysis, were suspected or proven to carry a breast cancer susceptibility gene (BRCA). A total of 1,542 annual surveillance rounds were completed with a mean follow-up of 5.3 years.

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Static ultrasound elastography, which has been available for many years, provides a colour map of tissue elasticity superimposed on the real-time greyscale image. Invasive breast cancers are stiff compared with normal and benign tissues (Fleury*et al*, 2009) and often show areas of stiffness which are larger than the greyscale abnormality (Itoh*et al*, 2006; Schaefer *et al*, 2011). To overcome the lack of quantitative data generated by static elastography, scoring systems comparing the size and distribution of areas of elasticity within the greyscale ultrasound abnormality have been developed (Itoh*et al*, 2006; Fleury*et al*, 2009). Static elastography has been shown to have similar diagnostic performance to conventional greyscale ultrasound imaging but poor interobserver variability has prevented its widespread use (Regner*et al*, 2006; Burnside *et al*, 2007).

Shear wave elastography allows acquisition of objective measurements of lesion stiffness in kilopascals, unlike static elastography which does not give quantitative results (Athanasiou*et al,* 2010). Shear wave elastography has been shown to yield accurate information with regard to benign/malignant differentiation of solid breast masses in two previous small studies (Athanasiou*et al,* 2010; Evans *et al,* 2010). The small amount of data available suggests good shear wave reproducibility with an intraclass correlation coefficient of 0.80. This contrasts with the poor reproduciblity seen with static elastography (Regner*et al*, 2006; Burnside *et al*, 2007; Evans *et al,* 2010).

There has been only two large published study assessing the diagnostic performance of shear wave elastography combined with greyscale ultrasound to differentiate between benign and malignant solid breast masses (Chang *et al,* 2011; Berg *et al*, 2012), and no previous studies have assessed the reproducibility of shear wave elastography when four images rather than two are analysed. The BE1 study addressed the reproducibility of the interpretation of shear wave images but not the reproducibility of shear wave images of the same lesion taken by different operators (Cosgrove *et al*, 2011). Most shear wave studies have used the mean stiffness findings most useful, however, the BE1 study found the maximum stiffness value most helpful in distinguishing benign from malignant breast masses.

The aim of the study was to assess the performance of shear wave elastography combined with BI-RADS classification of greyscale images for benign/malignant differentiation in a large group of patients.

Sonographic features of the most common benign breast lesions

The classification of benign breast lesions on the basis of histological origin

Cysts are cause by over-distension of the terminal duct lobular units (TDLU) due to progressive filling with liquid, fibrosclerosis of the loose connective

intralobulartissue and coalescence of single dilated ductules in a polylobated mass up to a single tensive cyst.

Chapter three

Materials and method

3.1 Materials

The researcher used a mammographic machine hologic (selenia) which is holo-

gic Mammography.

Changing the paradigm in breast cancer screening hologic has always been at the forefront of breast cancer screening, so it's not surprising that we were the first to offer true mammography.

3.1.1 Designs of the study

This an analytical, case controlled study, which consisted of female clinical breast symptoms and abnormal mammogram cases

3.1.2 Population of the study

Adult Female patient evaluate clinical breast symptoms such as palpable masses, focal pain and suspicious nipple discharge As well as those female patients findings abnormal mammogram examination and refer to ultrasound to distinguish cyst or fibroadenoma… etc.

3.1.3 Sample and type of the study

The sample of this study consisted of 64 with female patient.

3.1.4 Duration and place of the study

The study will be conducted on the period from June 2014 to December 2014 in UAE in Khalifa A Center.

3.2 Method

3.2.1 Technique of data collection

This research will be implemented by a mammographic machine hologic (selenia)

3.2.2 Patient position

Patient is erect

The four basic views for screening mammogram should be taken

3.2.3 Study variables

The variable of the study will be consisted of: age, gender, weight, height, BMI, patient family history and mammographic features for benign and malignant solid masses.

3.2.4 Method of data analysis

The data will be analyzed using Excel high-frequency technology

Chapter four

Results

1. Table (1) Shows Age Groups and Frequency:

Age	Frequency	Percent
11 – 30	2	3.1
31-50	43	67.2
51 – 70	17	26.6
71 and above	2	3.1
Total	**64**	**100.0**

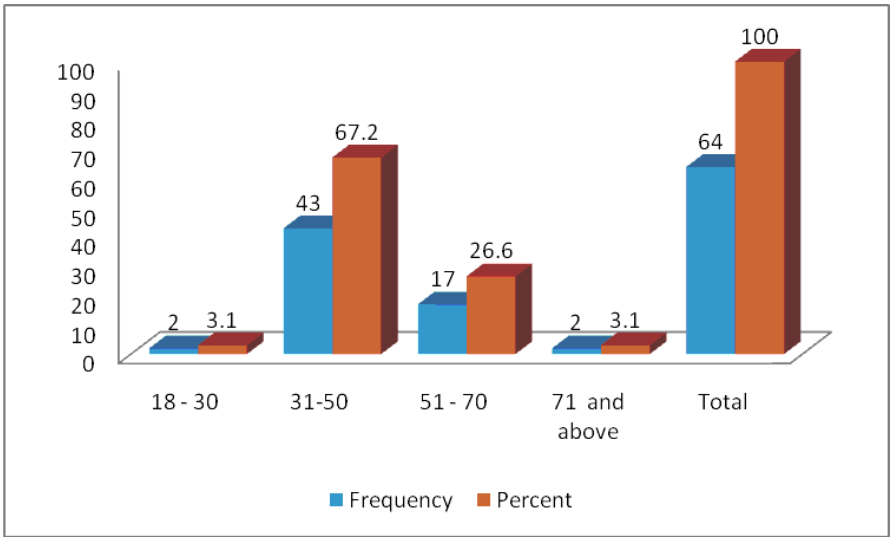

Figure (4.1) Age, Frequency and Percentage

2. Table (2) Shows the Shape, Frequency and Percentage:

Shape	Frequency	Percent
Around	4	6.2
around and oval	2	3.1
ill defined	24	37.5
Macrolobulated	2	3.1
Oval	17	26.6
Speculated	2	3.1
Tubal	2	3.1
well defined	11	17.2
Total	**64**	**100.0**

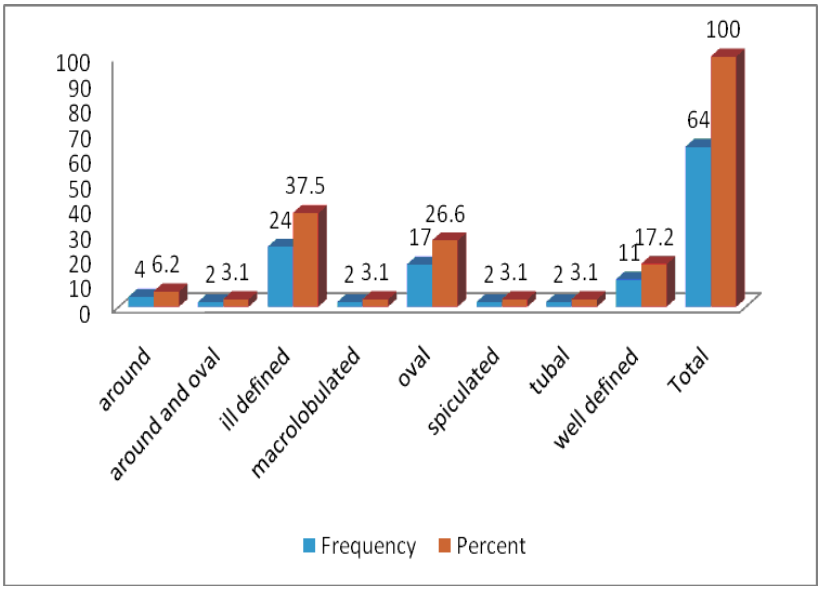

Figure (4.2) illustrate the Shape relations with frequency and the percentage (around,around and oval ,ill defined,oval, speculated,tubal,welldefined,total).

3. Table (3) Shows the Margin:

Margin	Frequency	Percent
Around	3	4.7
ill defined	1	1.6
Irregular	2	3.1
irregular with speculated & angulations	2	3.1
irregular, microlobulated&angulation	1	1.6
not well circumscribed	3	4.7
Lobulated	6	9.4
lobulated &angulation	2	3.1

Loculated	1	1.6
Macrolobulated	3	4.7
microlobulated &angulation	1	1.6
Multiloculated	1	1.6
obscured margin	1	1.6
Oval	1	1.6
retoareolar dilated ducts , no intraductal solid component ,	1	1.6
Speculated	5	7.8
Speculated &angulation tall more than width	1	1.6
spiculated & angulation	13	20.3
well defined	16	25.0
Total	**64**	**100.0**

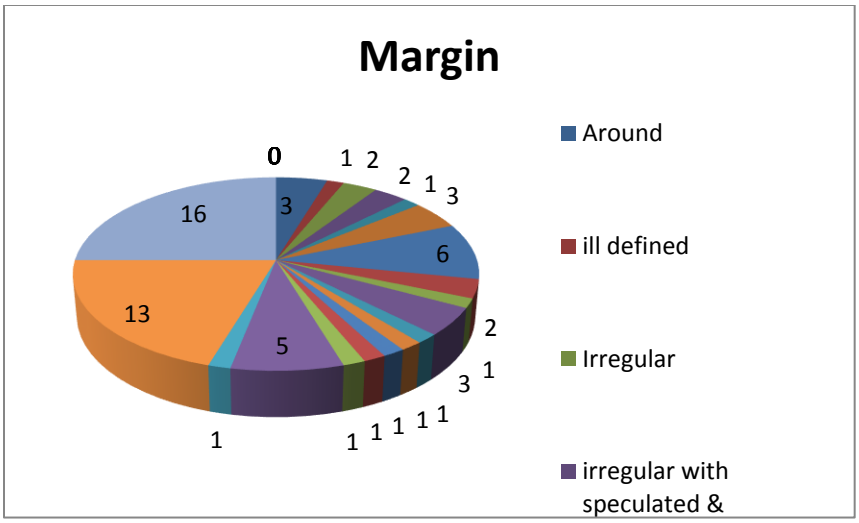

Figure (4.3) show margin with frequency and percentage data

4. Table (4) Shows the Calcification

calcification	Frequency	Percent
Yes	23	35.9
No	41	64.1
Total	**64**	**100.0**

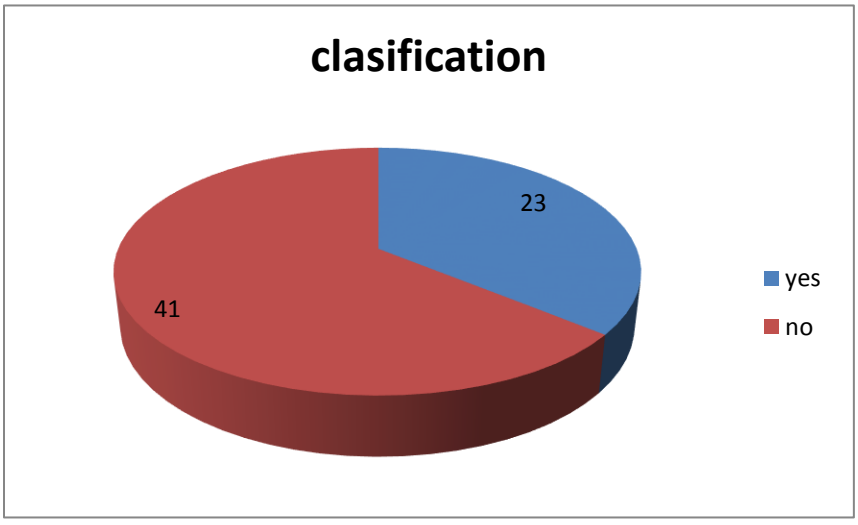

Figure (4.4) illustrate the frequency and valid result which is taken in to the values.

5. Table (5) Appearance of the Lymph:

Lymph	Frequency	Valid Percent
Yes	20	31.2
No	41	64.1
1	2	3.1
multiple	1	1.6
Total	**64**	**100.0**

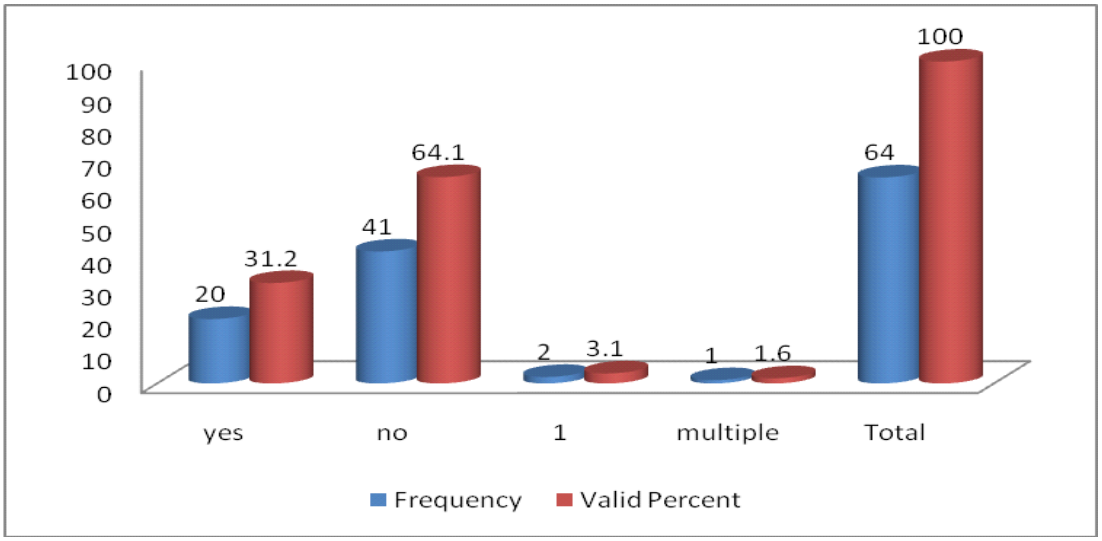

Figure (4.5) illustrate the Appearance of the Lymph enlargement according to the frequency and valid percent.

Discussions

After more covering study within 64 patients, is to identify sonographic criteria for benignancy and malignant masses. Table (1) shows the age of group and frequency that were in four group, the majority of patients were in (31-50) with 43 frequency and 67.2%

Table 2 shows the shape, the study found that most patient were ill defined with frequency 24 and 37.5 % , then Oval in frequency 17 and 26.6 %, and well defined were 11 with 17.2% , Around were 4 with 6.2% . And all of around and oval, Macro lobulated, Speculated and Tubal were all in 2 with 3.1%.

Table 3 shows the margin and the study find that well defined were 16 with 25% and speculated angulation were 13 with 20.3%.

Table 4 shows the classification the majority were no with 41 freq1uancy and 64.1 and the others yes with 23 frequency and 35.9% in all 64 patient.

Table 5 shows the appearance Lymph the study found that the majority were no in 41 frequency with 64.1 % and yes in 20 frequencies with 31.2 % and multiple were 1with 1.6%.

Conclusion

This work was facilitated by evolving technical improvements in mammography distinguish cysts from solid masses we demonstrate that mammography allow detecting early breast cancer mammography Equipment that provided better resolution and images. Rather than that demonstrated from US and maybe used to accurately classify some solid lesions as benign, allowing follow-up with imaging rather than biopsy.

Recommendation

- I recommend that screening mammography recommended annually for all women older than 40 years. Of all of the screening mammograms performed annually, show abnormalities that require further diagnostic testing, which typically includes the acquisition of spot compression or magnification mammography.
- Some women who have an abnormal mammogram or a lump in the breast are recommend to get a breast biopsy, where a doctor removes a small piece of breast tissue for testing.

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